

Lilian Yamamoto  
Miguel Esteban

# Atoll Island States and International Law

Climate Change Displacement  
and Sovereignty

 Springer

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# List of Abbreviations

Art.	Article
AOSIS	Alliance of Small Island States
BIOT	British Indian Ocean Territory
CBD	Convention on Biological Diversity
CCS	Carbon capture and storage
CCD	Climate Change Development Programme (email based Community)
CDM	Clean Development Mechanism
CLCS	UN Commission on the Limits of the Continental Shelf
CFC	Chlorofluorocarbon
CO <sub>2</sub>	Carbon dioxide
CaCO <sub>3</sub>	Calcium carbonate
COP	Conference of the Parties
CRIF	Catastrophe Risk Insurance Facility
DUD	Darrit-Uliga-Delap (The name of an islet in the Marshall Islands)
EEZ	Exclusive Economic Zone
EU	European Union
ENSO	El Niño-Southern Oscillation
GEF	Global Environmental Facility
GHG	Green House Gases
GNI	Gross National Income
GNP	Gross National Product
GDP	Gross Domestic Product
$H_s$	Significant wave height
$H_b$	Limiting breaker height
$h$	Water depth
IACHR	Inter-American Commission on Human Rights
IACtHR	Inter-American Court of Human Rights
ICCPR	International Covenant on Civil and Political Rights

ICRC	International Committee of the Red Cross
ICESCR	International Covenant on Economic, Social and Cultural Rights
IDP	Internally displaced persons
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPCC 4AR	Intergovernmental Panel on Climate Change 4th Assessment Report
ICJ	International Court of Justice
IOM	International Organisation for Migration
JICA	Japan International Cooperation Agency
KAP	Kiribati Adaptation Program
LOSC	Law of the Sea Convention
msl	Mean sea level
NAP	Normal Amsterdam Water Level
NGO	Non-Governmental Organisation
OAS	Organisation of American States
OAU	Organisation of African Unity
OHCHR	Office of the United Nations High Commissioner for Human Rights
ODA	Overseas Development Aid
OE	Ocean energy
OTEC	Ocean Thermal Energy Conversion
para.	Paragraph
PPT	Purchasing Power Parity
SAM	Southern Annular Mode
SMOM	Sovereign Military Order of St John of Jerusalem, of Rhodes and of Malta
SIDS	Small Island Developing States
SOPAC	Pacific Islands Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
SST	Sea surface temperature
ppm	Particles per million (related to concentration of CO <sub>2</sub> gasses in the atmosphere)
TPS	Temporary protected status
UN	United Nations
UNCED	UN Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNHCR	United Nations High Commissioner for Refugees
UNFCCC	United Nations Framework Convention on Climate Change
US or USA	United States of America
USACE	U.S. Army Corps of Engineering
VCLT	Vienna Convention on the Law of Treaties
V	Wind velocity
WMO	World Meteorological Organization

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# Chapter 1

## Introduction

Climate change is now recognised by the scientific community as one of the main challenges of the twenty-first century, and the threat that it poses to our civilization has only recently started to be understood. In particular, climate change will probably have a disproportionate effect on coastal regions, as due to the forecasted increase in sea levels caused by rising greenhouse gas concentrations in the atmosphere some low-lying areas could be submerged during the course of the century. Also, the potential for increased levels of tropical cyclone activity could devastate coastal areas due to the combined effect of storm surges and high waves. A number of these threats have already been recognised by the 4th United Nations Intergovernmental Panel on Climate Change (IPCC 4AR).<sup>1</sup>

This book focuses on the threat that climate change poses to the long-term survival of Atoll Island States, which we will define as States composed solely or almost exclusively of atolls. Prominent in this group of countries are Kiribati, Tuvalu, Nauru, the Marshall Islands, and the Maldives.<sup>2</sup> All of these could become submerged in the future by a combination of increased coral mortality, sea-level rise and coastal erosion resulting from higher levels of tropical cyclone activity. This would represent a significant event in the history of mankind, as although many countries have come and gone, in modern times no State has ever ceased to exist due to submergence by the sea.

It is necessary to examine carefully what is the scientific reasoning behind the assumption that Atoll Island States can actually lose their territory. What role will climate change exactly play? How will it physically and socially affect Atoll Island States? We will attempt to answer these two questions in Chaps. 2 and 3 of this book.

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<sup>1</sup> Contribution of Working Group II to the 4th Assessment Report of the IPCC (2007).

<sup>2</sup> Rayfuse (2009) p. 2. It is important to note that other countries, such as Palau for example, are likely to suffer greatly from the consequences of climate change highlighted in this book, though their existence will not be threatened to the same extent as those in the list above. In this sense many Archipelagic States in the Pacific Ocean have at least some non-atoll islands that have some higher mountains.

One of the main challenges posed by these questions is that our book can only outline some possible future scenarios. What is clear is that for each challenge brought about by climate change there is not always an appropriate law or treaty to address it, or that if there is a treaty it does not necessarily address the particular problem faced by Atoll Island States. An example of this problem is the present lack of an environmental displacement treaty which can deal with populations displaced by climate change intensified natural disasters.

Although not only Atoll Island States will be affected by sea level rise and many of what we will be explaining in this book is applicable to other areas in the planet<sup>3</sup> we decided to concentrate on these areas because they also face the challenge of preserving their status as sovereign States if they were to lose their territory and population. Interestingly the loss of these islands, and thus the threat to statehood, will arise from the death of corals, manifesting the very seldom noticed link between law and biodiversity. The death of colonies of animals, corals, will essentially put in peril not only the health and well-being of the inhabitants of atolls, but also their legal personality as citizens of a State that could cease to exist. This is a more onerous situation from an international legal perspective than that faced by larger countries, whose existence as a sovereign entity will not be threatened.

The concept of disappearing islands and lands, though present in the human mind due to mythological tales such as that of Atlantis, is not often given the full consideration it deserves. In fact, while the possibility of “disappearing” States has been recognised since the late 1980s, the issue has so far been addressed mainly as involving “climate” or “environmental refugees”. We will argue that this is an inaccurate concept, as people displaced as a consequence of climate change cannot be considered as refugees under the 1951 Convention Relating to the Status of Refugees.<sup>4</sup> We believe that the term “climate-change displaced people” is more accurate, and through the course of this book we will examine the challenges that such people could face in the future.

The possibility of Atoll Island States losing not just a few islands but their entire territory leads to the question on whether sovereignty is and has been always necessarily linked to territoriality and on the criteria that is set forth by 1933

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<sup>3</sup> In other areas, such as the densely populated Ganges, Mekong and Nile River deltas, a rise in sea level of 1 meter could affect 23.5 million people and reduce the land currently used for intensive agriculture by 1.5 million hectares. A sea level of around 2 m, which is already in the scenarios of some authors such as Vermeer and Rahmstorf (2009), could impact almost 25 m people in these deltas and render almost 2.5 million hectares of agricultural unproductive, according to Warmer et al. (2009), IV.

<sup>4</sup> According to this article a refugee is a person who must be outside their country of nationality or former residence; he or she has to have a fear persecution; and this fear of persecution must be for on grounds of race, nationality, religion, membership of a particular social group or political opinion; and the fear must be well-founded. Therefore, in international refugee law, environmental conditions might not be claimed as a basis for refugee protection. See also Renaud et al. (2007), p. 12; Conisbee and Simms (2003), pp. 17–19.

Montevideo Convention.<sup>5</sup> This is a question that is not normally asked since the majority of States hold some territory. This challenge led us to the research on specific entities which have been able to exercise the attributes of a sovereign power without holding any territory at the time, such as governments-in-exile or populations which moved out from a certain territory. But, who decides whether they can still be considered as a State in such situations? In order to reply to this question, we will analyse the various theories of statehood, in particular, the constitutive and declarative theories.

In this sense we will argue that the Montevideo criteria refers to the birth of States and the question regarding Atoll Island States is not whether they currently hold all the requirements to be a State (which they do), but rather if they can continue to be a State after losing one of these elements. Here, we will hold that the criteria for the birth of a State is actually based on a blend of legal and political judgements and therefore if such a combination is necessary for its birth, the same would be required for arguing that Atoll Island States can continue as sovereign entities.

The continuity of statehood is extremely important since it would not only determine their ability to continue utilising the resources which had previously been within their Exclusive Economic Zones (or EEZs, such as fisheries) but also from the point of view of preserving the cultural identity of their citizens. Inhabitants of Atoll Island States have a strong connection to their islands, and even as some appear resigned to the fact that they might have to leave the islands in the future, they are hoping to periodically return to them in order to have a connection to their heritage.<sup>6</sup>

The ideal solution from the perspective of preserving sovereignty would be investing in engineering protection systems to keep the islands above the water (Scenarios IV and VII discussed in Chap. 5). This would entirely avoid the discussion on whether statehood could be maintained without territory and population. However, many of the countries potentially affected are classed as developing, having relative high population densities and low level of available resources for adaptive measures.<sup>7</sup> This in turn makes their economies highly vulnerable, and on average they are also more food insecure than other Small Island States.<sup>8</sup> Thus, it is necessary to take into consideration that they will probably lack the funds and adaptive capacity to enable high cost engineering structures.

If the Atoll Island cannot protect at least one of its islands then there are a number of other possible solutions for Atoll Island States to attempt to preserve their sovereignty such as the cession of territory,<sup>9</sup> the construction of artificial

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<sup>5</sup> Montevideo Convention on the Rights and Duties of States in its Art. 1 states that elements of statehood are (a) a permanent population; (b) a defined territory; (c) government; and (d) capacity to enter into relations with the other states.

<sup>6</sup> Rakova (2009).

<sup>7</sup> Barnett and Adger (2003), p. 323.

<sup>8</sup> Barnett and Adger (2003), p. 326.

<sup>9</sup> Soons (1990), p. 230.

islands in other maritime areas and amend United Nations Convention on the Law of the Sea (UNCLOS) to accept artificial islands as a “defined territory”<sup>10</sup> (as outlined in Chap. 5), a merger with another State<sup>11</sup> or becoming De-territorialized States.<sup>12</sup> We will discuss these statehood questions by giving examples of sovereign entities which historically or at present have lacked certain elements of statehood, but still survived as such. This obviously poses some challenges since territoriality has long been emphasized as the almost exclusive way of exercising political power. However, it is undeniable that some of these entities, while not holding any territory (one of the traditionally perceived requirements of statehood), were or still are recognized as sovereign entities before international law.

Independently of whether the Atoll Island State can survive as a sovereign entity, their inhabitants could be forced to relocate to foreign lands. Historical accounts of forced displacement in the Pacific and Indian Oceans are numerous.<sup>13</sup> One example is how the mining of phosphate by the British colonial administration displaced the population of Banaba island in the 1940s. The entire population was relocated to Rabi island, which currently belongs to the Republic of Fiji.<sup>14</sup> Another example is that of the Chagossians (the inhabitants of Chagos Islands in the Indian Ocean, close to the Maldives) who were displaced by the UK government from Diego Garcia to the Mauritius and Seychelles due to military interests, but were not provided with land for the resettlement of the population.

If the populations of Atoll Island States are displaced because of the emissions of greenhouse gases, which allowed the economic development of industrialized nations, then ultimately these should create mechanisms to support and compensate for the relocations. In the past the reason for the forced population displacement was related to the appropriation of natural resources or to utilize the territories as military outposts, while in the future it will be due to the consequences of climate change (as highlighted in Chap. 3) that stem from greenhouse gas emissions by industries in the past and present. Simply put, in both cases the forced displacement will have its root in the geopolitical socio-economic advancement of industrialized countries. However, for the future displacement of inhabitants of Atoll Island States this issue will be masked by the problem that due to the lack of better economic opportunities many people in these countries (even nowadays) are migrating in search of a better life. Thus the reasons for the displacement will not only originate from a deteriorating local environment but will be interlinked with economic

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<sup>10</sup> Gagain (2012), p. 80.

<sup>11</sup> UN High Commissioner for Refugees (2011) p. 18, Soons (1990), p. 230 and Caron (1990), p. 650.

<sup>12</sup> Rayfuse (2010), p. 10, including application of the United Nations International Trusteeship system in order to create an *ex-situ* nation which would consist of a de-territorialized State, see Burkett (2011), p. 347.

<sup>13</sup> See the cause of relocation at Campbell et al. (2005), p. 21.

<sup>14</sup> Brookings Institute –project on international displacement (2011), p. 26.

issues, makes the creation of a Convention for the protection of climate displaced people (as proposed by many authors) a challenge. Moreover, the issue of sovereignty and whether Atoll Island States can continue to exist as sovereign entities is also central to try to establish what would be the status of the citizens of these countries if their islands ceased to exist. In this sense a variety of possibilities exist, depending on whether the Atoll Island State can continue to exist as a de-territorialized entity or not, and which would determine whether ultimately those displaced become stateless or not.

It could be argued that another alternative for the protection for climate-change displaced people would be to include them in the framework of complementary and temporary protection. However, this could be difficult since the concept of “serious harm”, which is required for example by EU Council Directive 2004/83/EC, does not include environmental displacement. Moreover, temporary protection applies to sudden rather than slow onset movements such as those that will probably be caused by climate change.

Temporary protection establishes minimum standards for protection of displaced persons which cannot temporarily return to their country of origin.<sup>15</sup> Complementary protection is granted by States on the basis of an international agreement or treaty outside the Convention Relating to the Status of Refugees framework. Such protection may be based on a human rights treaty, such as the International Covenant on Civil and Political Rights, the Convention against Torture, or the Convention on the Rights of the Child.<sup>16</sup> The difference between complementary protection and temporary protection is that the latter is related to short-term emergency response to a mass of people while the former does not constitute an emergency protection system. The application of either of them will be discussed in Chap. 7.

There is no controversy on whether climate change can affect human rights, but rather on whether it will cause a violation of these rights. Since the agents of climate change are diffuse it would be challenging to identify the violator of the affected human rights. Moreover, when would be the baseline for the greenhouse gas emissions that would be at the root of the violations? Would this baseline be set 10, 50, 100 or 200 years in the past? In this respect, questions related to the issue of time and law will be explored on Chap. 7. Often human rights and international criminal law focus on past events, on questions regarding exceptions to the retroactive application of laws or until when international tribunals should go in order to examine past crimes. On the other hand, environmental law emphasizes present

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<sup>15</sup> Art. 1, European Union: Council of the European Union, Council Directive 2001/55/EC of 20 July 2001 on Minimum Standards for Giving Temporary Protection in the Event of a Mass Influx of Displaced Persons and on Measures Promoting a Balance of Efforts Between Member States in Receiving such Persons and Bearing the Consequences Thereof, 7 August 2001, OJ L.212-223 7.8.2001, 2001/55/EC.

<sup>16</sup> McAdam (2007), pp. 2–3.

and future situations, instead of the past events which are the object of examination in international human rights bodies. One such example is that sustainable development relies upon the commitment to equity with future generations.<sup>17</sup>

In order to understand the problems that the inhabitants of Atoll Island States could face in the future it is essential to discuss the physical environment in which they exist and why climate change threatens the existence of atolls around the planet. Thus, it is not the scope of this book to provide details about each type of island that exists, as each one has particular characteristics. As the focus is on atolls, particular emphasis will be given to the geological processes that give birth to them, the living creatures which nowadays provide the sand that makes the islands, and the geomorphological processes that shape them. Chapter 2 will describe these characteristics and some of the socio-economic and geopolitical considerations of Atoll Island States. Many belong to developing country category, influencing the range of adaptation options available to them. They typically have a poorly developed infrastructure and limited natural, human and economic resources, and often their small populations are highly dependent on fishing to meet their protein needs.<sup>18</sup> Economically they are generally reliant on a limited resource base, and their adaptive capacity to climate change is generally considered to be low.<sup>19</sup>

To understand the threat that climate change poses to atolls Chap. 3 will analyse what levels of sea level rise can be expected during the course of the twenty-first century, why it is believed that tropical cyclones can be expected to increase in intensity and the potential influence of ocean acidification on coral mortality. Crucially, we will also discuss how it is not sea level rise in itself but the extinction of corals what would cause the disappearance of atolls. This is an important issue which has so far been largely neglected in the discourse regarding the potential problems facing Atoll Island States, and crucial while considering if the islands will disappear and why.

The physical world is intrinsically linked to relations between countries. The search for resources and their trade have been at the base of human interactions throughout history. In the modern world humankind has become aware that the planet has finite resources that need to be managed everybody is to profit from them. In Chap. 4 we will briefly examine the mechanisms which were created to deal with climate change and in what forums Atoll Island States have been engaging in order to raise their voice on the serious challenges they are facing on adaptation to sea level rise and climate change. Awareness of this problem is important in the discourse about “disappearing islands”. The governments and representatives of Atoll Island States have for some time been giving warnings about the potentially disastrous consequences that climate change (and particularly sea level rise) can have on them. Thus, Atoll Island States have genuine grievances that they are bringing to the table at international climate negotiations, often

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<sup>17</sup> Weiss (1992), p. 385.

<sup>18</sup> Mimura et al. (2007).

<sup>19</sup> Mimura et al. (2007).

through the Alliance of Small Island States (AOSIS) or the Small Island Developing States (SIDS). This alliance gives a platform for small States such as Tuvalu to have their voices heard within the wider international community, which is completely out of proportion to its size, and explains why an issue that could otherwise have gone unnoticed by the larger public has had such a big impact worldwide.

Still, this hides an important disparity between them, as differences between their economic and resource levels also represent unequal levels in their adaptive capacities. A “middle-income” country with a significant population, such as the Maldives, has a much greater ability to build infrastructure to protect its population. Significantly, as will be argued in Chap. 5, this can manifest itself in the ability to build artificial islands or protect the whole circumference of the capital, Malé, with concrete coastal defences. Such a country is likely to “engineer” its existing islands so that its territory will not disappear in the short to mid-term, even if the corals that make up the atolls die. We will argue that such a method of protecting existing islands is internationally accepted, and thus represents the clearest path for an Atoll Island State to preserve its maritime zones and sovereignty. Chapter 5 will not only discuss whether sea defences can be used to preserve baselines according to the United Nations Convention on the Law of the Sea (UNCLOS), but will also present other possible scenarios that could be envisaged for atolls in the future. Possible adaptation strategies against climate change will be discussed, together with the viability of these options from an economical and engineering point of view. In addition, the implications of the disappearance of some of these Atoll Island States with regards to the sovereignty over their current territories will be dealt with in this chapter. However, some of these scenarios that will be presented (such as the idea of creating floating islands or recreating an island after it has disappeared) appear to make little objective sense. Their inclusion does not mean that we consider all of them to be feasible, but rather it comes from an attempt to be as complete as possible when consider all options that could be thought of, and to highlight how some of the solutions sometimes proposed make little engineering or legal sense.

Our preferred solution would be for agreements to be reached so that future climate change could be kept to a minimum, ensuring the survival of coral reefs and thus the preservation of sovereignty of Atoll Island States as they currently are. This is the solution that makes most sense from a moral, economical, human, legal and engineering point of view. If this is not possible, the only engineering solution that would be legally proven to preserve baselines according to the UNCLOS as it now stands (and we believe it would be very difficult to alter or negotiate another treaty) would be to build coastal defences around the perimeter or existing islands and periodically elevate them to compensate for sea level rise. Although the economic and social consequences of the death of the corals on the atolls would be significant, protecting the islands by engineering means would assure their continued existence. In countries where tourism is an important revenue source, visitors could still stay at hotels in shallow water regions next to the islands, possibly on stilts. Food would be farmed in the existing islands, which would be periodically elevated using dredged materials. Given the timescales available, the population would have enough time



to adapt and gradually strengthen the coastal defence infrastructure. Nevertheless, the death of the atoll coral colonies would result in a decrease in food security, a reduced income from tourism and increased vulnerability to natural disasters, amongst many other problems highlighted in Chap. 3. It could also result in a loss of some maritime territory, depending on which islands are protected, as these are necessary to draw the baselines from which maritime zones are derived, as will be explained in Chap. 5. Much has been written about how to preserve these baselines, and various commentators<sup>20</sup> have proposed that The United Nations Convention on the Law of the Sea (UNCLOS) should be modified, or that at least there should be a movement to a progressive interpretation of some of its clauses. While we agree that such developments would be welcome, we will argue that raising the islands would be the most obvious and clear way of protecting the maritime zones that are derived from them. If the international community was to engage in a process of modifying UNCLOS (which would be very expensive, as these processes inevitably are<sup>21</sup>) to save the maritime zones of Atoll Island States, it would be arguably more cost-effective to use these resources to create an Atoll Island Defence Fund to elevate some key islands, allowing their population to stay in place (Fig. 1.1).

If such an Atoll Island Defence Fund was not created, poorer countries such as Tuvalu would probably lack the resources to attempt the engineering measures that would be required to survive the death of the coral reefs and trigger a sequence of events that would result in the disappearance of the islands (though a number of other scenarios are possible, as discussed in Chap. 5). In turn, the submergence of the islands would create a number of other legal problems regarding the status of the inhabitants of the country.

In this sense Chap. 6 will concern itself with outlining alternative solutions to preserve the sovereignty of the Atoll Island States and Chap. 7 will examine some of the possible legal effects of the re-location of the citizens of these countries. It will discuss the issue of climate displacement, which would determine the ability of the people of these islands to keep long-term control over their current natural resources. This chapter will deal with the concept “climate displaced people”, the alternative regimes under discussion and protection mechanisms. The issue of statelessness will also be discussed, for the case when Atoll Island States cease to be recognised by other States and they fail to acquire any new territory (as discussed in Chap. 6). This type of acquisition of territory has occurred in the past, and there is a (non too exact) precedent in the forced displacement Banabans during the twentieth century. The current situation of Atoll Island States has several similarities with the case of Banabans and can serve as an illustration to what could happen to the inhabitants of Small Atoll States if they were to relocate.

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<sup>20</sup> See Grote (2011).

<sup>21</sup> As they would involve numerous meetings, require expensive legal consultancy fees and travel costs for top diplomats and officials.



**Fig. 1.1** Atoll Island States are formed of low-lying sandy coral islands that are particularly threatened by rapid anthropogenic climate change

We believe this book is a fairly rare product of the collaboration between two people of fields that often do not attempt to publish together. One of us is a coastal engineer, who is engaged in the study of natural disasters, climate change and coastal structures, and the other is a researcher of international law. While writing, we have kept to the general principle that anybody from either discipline should be able to understand all concepts, and thus have tried to keep explanations simple and to start many discussions from first principles. Nevertheless, we think that as a product of this we are able to offer a good insight into what we believe are the two main aspects of the problems facing these islands as a consequence of climate change. On the one hand there are the direct physical problems associated with climate change, such as coastal erosion, inundation of islands, loss of crop productivity and degradation of the coral reefs. On the other hand, as a consequence of this there could be various legal challenges regarding whether Atoll Island States can maintain sovereignty over their current territories, the status of any displaced populations, and the possibility of acquiring new lands.

A reader who is already familiar with the physical and climate problems associated with these islands will find that Chaps. 2–4 are mainly a literature review of the existing knowledge on atolls, which deal with the physical aspects of these islands and the socio-economical situation of their inhabitants. These chapters offer a comprehensive view of the problems faced, and will allow somebody not familiar with the topic to understand the current state of the discussions. Many times we have found that there is often a great deal of confusion regarding atolls and how

they will respond to climate change, and hence in these three chapters we summarise what is the latest research on this subject. The following chapters introduce new ideas and concepts related to the potential legal problems faced by these countries. As such, in many occasions we do not arrive at any conclusions due to legal gaps in the current international law, and in these situations some of the solutions that we discuss are more related to policy-making.

## References

- Barnett J, Adger WN (2003) Climate dangers and atoll countries. *Clim Change* 61:321–227
- Brooking Institute –project on international displacement (2011) On the front line of climate change and displacement learning from and with Pacific Island countries. Available at [http://www.brookings.edu/~media/research/files/reports/2011/9/idp%20climate%20change/09\\_idp\\_climate\\_change](http://www.brookings.edu/~media/research/files/reports/2011/9/idp%20climate%20change/09_idp_climate_change). Accessed 15 Nov 2012
- Burkett M (2011) The nation ex-situ: on climate change, deterritorialized nationhood and the post-climate era. *Clim Law* 2:345–374
- Campbell J et al (2005) Community relocation as an option for adaptation to the effects of climate change and climate variability in Pacific Island countries (Asia Pacific Network for Global change research). Available at [http://www.sprep.org/att/irc/ecopies/pacific\\_region/643.pdf](http://www.sprep.org/att/irc/ecopies/pacific_region/643.pdf). Accessed 25 Oct 2010
- Caron D (1990) When law makes climate change worse: rethinking the law of baselines in light of a rising sea level. *Ecol Law Q* 17:321–653
- Conisbee M, Simms A (2003) Environmental refugees – the case for recognition. New Economics Foundation, London
- European Union: Council of the European Union, *Council Directive 2001/55/EC of 20 July 2001 on Minimum Standards for Giving Temporary Protection in the Event of a Mass Influx of Displaced Persons and on Measures Promoting a Balance of Efforts Between Member States in Receiving such Persons and Bearing the Consequences Thereof*, 7 August 2001, OJ L.212-223 7.8.2001, 2001/55/EC. Available at: <http://www.unhcr.org/refworld/docid/3ddcee2e4.html>. Accessed 27 Feb 2012
- Gagain M (2012) Climate change, sea level rise, and artificial islands: saving the Maldives’s statehood and maritime claims though the ‘constitution of the oceans’. *Colorado J Int Environ Law Policy* 23(1):77–120
- Grote J (2011) Implementing a new regime of stable maritime zones to ensure the (economic) survival of small island states threatened by sea-level rise. *Int J Mar Coastal Law* 26:263–311
- McAdam J (2007) *Complementary protection in International Refugee Law*. Oxford University Press, Oxford
- Mimura et al (2007) Small islands. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Parry et al. eds., Cambridge University Press, Cambridge, UK, 687–716
- Rakova U (2009) How-to guide for environmental refugees. Ourworld 2.0. <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>. Accessed 23 Aug 2009
- Rayfuse R (2009) W(h)ither Tuvalu? *International Law and Disappearing States*. University of New South Wales Faculty of Law Research Series, Paper 9. Berkeley Electronic Press
- Rayfuse R (2010) *International law and disappearing states: utilizing maritime entitlements to overcome the statehood dilemma*. University of New South Wales Faculty of Law Research Series, paper 52

- Renaud F et al (2007) Control, adapt or flee- how to face environmental migration, intersections, United Nations University, Institute for Environment and Human Security, No. 5/2007. Available at <http://www.ehs.unu.edu/file/get/3973>. Accessed 15 Jan 2011
- Soons HA (1990) The effects of a rising sea level on maritime limits and boundaries. *Netherlands Int Law Rev* 37(2):207–232
- UN High Commissioner for Refugees (2011) Climate change and the risk of statelessness: the situation of low-lying island states, May 2011, PPLA/2011/04. Available at <http://www.unhcr.org/refworld/docid/4e09a4ba2.html>. Accessed 18 Apr 2012
- Vermeer M, Rahmstorf S (2009) Global sea level linked to global temperature. *Proc Natl Acad Sci USA* 106:21527–21532
- Warmer et al (2009) In search of shelter: mapping the effects of climate change on human migration and displacement. Report for care. [http://www.care.org/getinvolved/advocacy/pdfs/Migration\\_Report.pdf](http://www.care.org/getinvolved/advocacy/pdfs/Migration_Report.pdf). Accessed 29 Dec 2011
- Weiss EB (1992) Intergenerational equity: a legal framework for global environmental change. In: Weiss EB (ed) *Environmental change and international law-new challenges and dimensions*. United Nations University Press, Tokyo

# Chapter 2

## Geography, Economy and Environment of Atoll Island States

### 2.1 Introduction

Before presenting the legal problems that climate change poses to Atoll Island States it is important to understand the physical and socio-economical environment in which they exist and why climate change threatens their existence. In the present chapter we will give the reader a general understanding of the physical processes that govern these islands, though we will not enter into detailed descriptions of the particular characteristics of each Atoll Island State. The focus of this book is on atolls, and hence particular emphasis will be given to the geological processes that give birth to them, the creatures which nowadays provide the sand that makes the islands, and the geomorphological processes shaping the coral islands that exist at their surfaces. Particularly, episodic events such as tropical cyclones can quickly alter the shape of these islands, eroding one side of them and depositing the materials elsewhere in the island. In fact, atolls are likely to suffer some of the worst effects of climate change, as highlighted in the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 4AR), which states how “it has long been recognised that islands on coral atolls are especially vulnerable to this combination of impacts, and the long-term viability of some atoll States has been questioned”. However, generally speaking most of the changes that take place in these islands nowadays are influenced by wave patterns or local alterations to the coastline (such as through the construction of jetties or dredging). We will thus showcase how some of the present geomorphological problems facing these islands have their root in past alterations of the coastline, while Chap. 3 will deal with possible future problems that could originate due to climate change.

However, it is also important to understand the socio-economic conditions of these islands and the challenge that climate change poses to their populations. Atoll Island States, which are islands constituted almost exclusively (or entirely) of atolls, are typically classified as developing countries, with small populations that are usually concentrated in a reduced number of highly urbanised islands. These problems influence the range of adaptation options available to them, something

that will become evident in later chapters in this book. Some of the solutions that could be pursued by a State which is set to lose all its territory would be to acquire new lands, build new islands or protect the existing ones with costly coastal infrastructure (as explained in Chap. 5), yet this would be difficult for countries with limited financial resources such as Tuvalu.

## 2.2 Types of Islands

Islands have different geological and geomorphological characteristics. Various processes are involved in their birth, affecting their geography, appearance and resources and thus shaping the conditions on which humans, plants and animals can inhabit them. Barnett and Campbell<sup>1</sup> classify Pacific region islands into several types, as shown in Table 2.1. While this classification is for the Pacific region, it generally encompasses the main types of islands found throughout the world, and can give the reader a general understanding of the main types of islands that surround atolls, the main target of this book. While many countries in the world possess atolls (such as Malaysia, Vietnam or the Philippines) there are only a limited number of countries made up exclusively of atolls (Kiribati,<sup>2</sup> Tuvalu, the Marshall Islands and the Maldives). They are located mainly in the Pacific, with the exception of the Maldives, which is in the Indian Ocean.

## 2.3 Atoll Islands

Atolls are islands made mainly from dead corals and foraminifera, enclosing a central lagoon and surrounded by an annular coral reef ecosystem. There are around 500 atolls in the world, with most of them being located in the Pacific Ocean, although they exist also in the Indian and Atlantic Oceans.<sup>3</sup> Reef-building corals only thrive in warm tropical and subtropical waters, and hence they are not generally found in the colder seas north and south of 30° latitude.

Charles Darwin originally explained the creation of coral atolls in the South Pacific, which originate as high volcanic islands and gradually transform into an atoll. His original explanation is still accepted as correct (with minor refinements), and is illustrated in Fig. 2.1. The origins of atoll islands can thus be traced back to an original volcano that emerged from the sea. Intra-plate islands, such as those found in the eastern or central Pacific Ocean, typically form on hotspots in the earth's mantle.<sup>4</sup> Corals then start to colonize the area around the volcano and slowly

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<sup>1</sup> Barnett and Campbell (2010), p. 25.

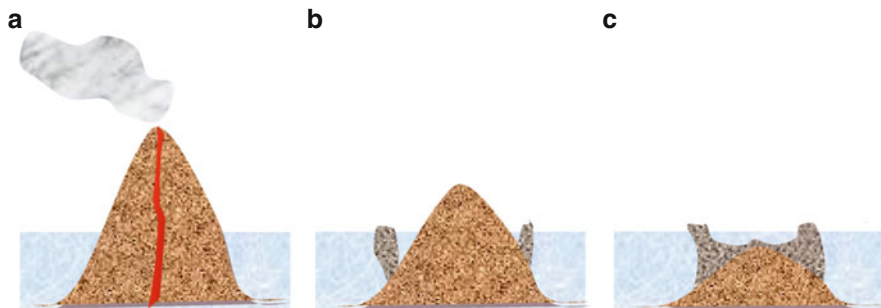
<sup>2</sup> Note that Kiribati also possesses Banaba, which is not an atoll.

<sup>3</sup> Sato and Yokoki (2010), p. 1.

<sup>4</sup> Barnett and Campbell (2010), p. 24.

**Table 2.1** Types of island in the Pacific region according to geographical characteristics and exposure to climate (adapted from Barnett and Campbell 2010, pp. 25–26)

Island type	Characteristics	Exposure to climate risks
Plate-boundary islands (e.g. Japan)	<ul style="list-style-type: none"> <li>• Large</li> <li>• High elevations</li> <li>• River flood plains</li> <li>• Orographic rainfall</li> <li>• Well developed soils</li> <li>• High biodiversity</li> </ul>	These types of islands in the western Pacific are exposed to droughts. Tropical cyclones can cause damage to coastal areas and catchments, and river flooding can also be a problem. Coral reefs are exposed to bleaching events
Raised limestone islands (e.g. Banaba)	<ul style="list-style-type: none"> <li>• Steep outer slopes</li> <li>• Concave inner basin</li> <li>• Sharp karst topography</li> <li>• Narrow coastal plains</li> <li>• No surface water</li> <li>• No or minimal soil</li> </ul>	Depending on the height they can be exposed to the consequences of tropical cyclones and storms (high waves and storm surge). Fresh water shortages and droughts can be a problem, which can lead to health problems. Flooding is extremely rare. Coral reefs are exposed to bleaching events
Intra-plate (Oceanic) islands Volcanic high islands (Hawaii, Guam)	<ul style="list-style-type: none"> <li>• Steep slopes</li> <li>• Different stages of erosion</li> <li>• Barrier or fringing reefs</li> <li>• Relatively small land area</li> <li>• Not fully developed river systems</li> <li>• Orographic rainfall</li> </ul>	Exposed to tropical cyclones, that can cause rivers and streams to be subjected to flash flooding. Islands are exposed to droughts. Barrier reefs may offer some protection against storm surge and tsunami, but they are exposed to bleaching events
Atolls (e.g. Tuvalu, Kiribati)	<ul style="list-style-type: none"> <li>• Very small area</li> <li>• Very low elevations</li> <li>• No or minimal soil</li> <li>• Small islets surround a lagoon</li> <li>• Shore platform on windward side</li> <li>• No surface (fresh) water</li> <li>• Freshwater lens</li> <li>• Conventional rainfall</li> </ul>	These islands are highly exposed to “King Tides” and high waves and the effects of tropical cyclones, which can lead to coastal flooding due to storm surges. Exposed to freshwater shortages and droughts, which can cause health problems. Coral reefs are exposed to bleaching events



**Fig. 2.1** Darwin's process of atoll formation. (a) In the beginning the island is formed by a volcano that emerges from the sea. (b) After the volcano dies, corals start to build a fringing reef, which typically has a shallow lagoon between the land and the reef. (c) Finally the island sinks below the sea level, and the barrier reef becomes an atoll surrounding a central lagoon

grow with time. The movement of oceanic plates would typically take these islands away from this hotspot, which leads to the formation of arcs of islands.<sup>5</sup> Once the volcano dies the island would start to subside, and the fringing coral reef surrounding the island starts to grow upwards. Eventually the fringing reef becomes a barrier reef as the outer part can maintain itself very near the sea level through natural growth in the coral reef, while due to erosion and subsidence the central part of the island continues to lose height. The inner part of the reef falls behind in this growth and becomes a lagoon, as the conditions for coral growth are less favourable in this area (see Fig. 2.1). Eventually the original volcanic part of the island will fall below the ocean surface, though the barrier reef continues to thrive, and the continuous supply of coral materials forms the small islets (referred to as reef, coral or coral-reef islands) that (if large enough) can sustain human population.

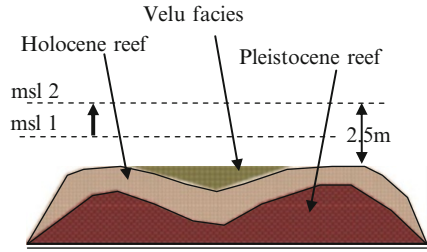
There are a number of theories describing the conditions that give rise to the formation of these reef islands. As previously explained, they tend to form after the volcano has disappeared beneath the sea surface, with the area around it (the barrier reef) slowly starting to accumulate sediments till the island emerges from the sea. Whether this happens during times of stable, rising or subsiding sea levels is still a matter of study. Kench et al.,<sup>6</sup> for example, studied the islands in the Maldives, an archipelago of 22 atolls and over 1,200 reefs islands in the Indian Ocean. In his model, for the case of the Maldives, vertical reef growth dominated island construction in the middle Holocene (approximately 6,000 years before now), as shown on Fig. 2.2. After this time, sedimentation became the dominant process, despite sea

<sup>5</sup> Barnett and Campbell (2010), p. 24.

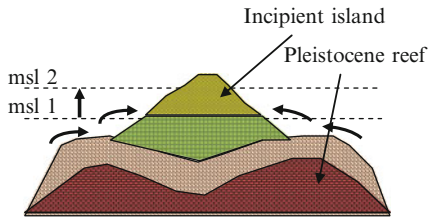
<sup>6</sup> Kench et al. (2005), p. 148.



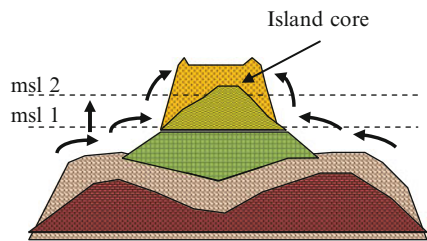
**Fig. 2.2** Six thousand years before present



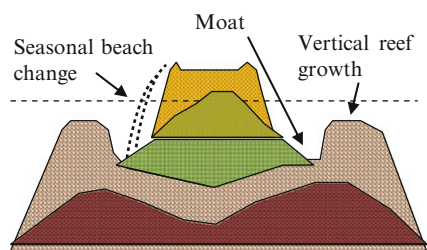
**Fig. 2.3** Five thousand years before present



**Fig. 2.4** Four thousand years before present



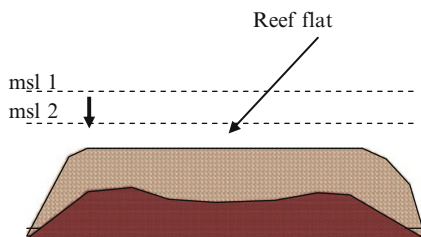
**Fig. 2.5** Present. Note: Figures 2.2–2.5 describe the model by Kench et al.,<sup>7</sup> where coral islands would have formed in times of raising sea levels.



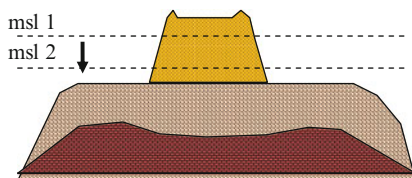
level increasing from mean sea level 1 (msl 1) to msl 2 (as shown on the figures) and created the beginning of an island, which at first would have just been a sand bank devoid of vegetation (Fig. 2.3). Gradually more and more sediments accumulate

<sup>7</sup> Kench et al. (2005), p. 147.

**Fig. 2.6** Six thousand years before present



**Fig. 2.7** Three thousand and five hundred years before present. Note: Figures 2.6 and 2.7 illustrate the conventional Indo-Pacific model, which meant the islands would have originally formed at a time of falling sea levels



and the island grows in size, and vegetation appears (Fig. 2.4). In the last 4,000 years the islands have probably been fairly stable, though the outer reef surface has continued to grow, with seasonal fluctuations in the beach position explaining a coral-algal moat surface next to the island.

The model of Kench et al.<sup>8</sup> differs from the conventional Indo-Pacific model in that the island initiation would have occurred when the islands were 2.5–1.0 m below sea level and that the island development preceded the reef-flat formation rather than followed it. Kench et al.<sup>9</sup> note how in this conventional model the vertical reef growth is constrained by a period of stable sea level, and hence lateral reef accretion becomes the dominant growth mode, which first leads to the formation of broad reef flats (see Fig. 2.6). As sea levels fell in the late Holocene the reef flats would emerge, with further sediments originating from them creating the islands (see Fig. 2.7). There is evidence supporting both theories, depending on the area of the world and the authors (as outlined in Kench et al.<sup>10</sup>). Although the difference between these two theories might appear to be academic, they could have rather profound consequences for the geomorphological stability of the islands in rising seas, as they suggest that these islands could indeed keep up with a normal rate of sea level rise. In the present book, however, we do not intend to go too deep into any of these theories as this is not our main purpose, but it is important for the reader to keep in mind the complex nature of geomorphological processes and how although there is some degree of understanding about what has happened in the past, what will happen in the future is far from clear.

<sup>8</sup> Kench et al. (2005), p. 148.

<sup>9</sup> Kench et al. (2009), p. 146.

<sup>10</sup> Kench et al. (2009), p. 146.

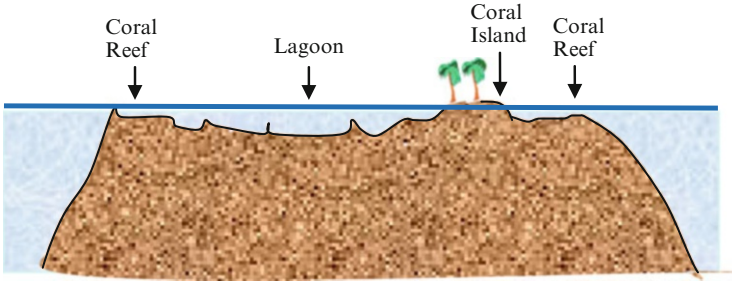


Fig. 2.8 Cross section through an atoll

### 2.3.1 Atolls and Coral-Reef Islands

Atolls, as explained previously, are elevated areas of the sea that have their origin on a volcano that has slowly disappeared, leaving behind a lagoon surrounded by a series of coral-reef islands. These coral-reef islands are essentially accumulations of the calcareous sands and gravels which are located at the surface of atolls and other reef platforms.<sup>11</sup> They typically have a low elevation and size, and are particularly reliant on the production of sand and gravel from corals and foraminifers for their geomorphological stability.

The lagoon at the centre of an atoll is relatively shallow in depth, especially compared with the depth of the outer ocean surrounding the island, which can be several thousand meters deep<sup>12</sup> (see Fig. 2.8). This lagoon is partially connected to the outer ocean by means of a number of passages, generally natural, though artificial ones also exist in some atolls.<sup>13</sup>

Fresh water originates from rainfall, and although due to their sandy/coral nature atolls are highly permeable, the fresh water table is slightly above sea water, which allows vegetation to flourish. The location of this water table, however, is critical for the survival of vegetation and can be easily contaminated by salt water and human and industrial waste<sup>14</sup> (see Fig. 2.9).

### 2.3.2 Raised Limestone Islands

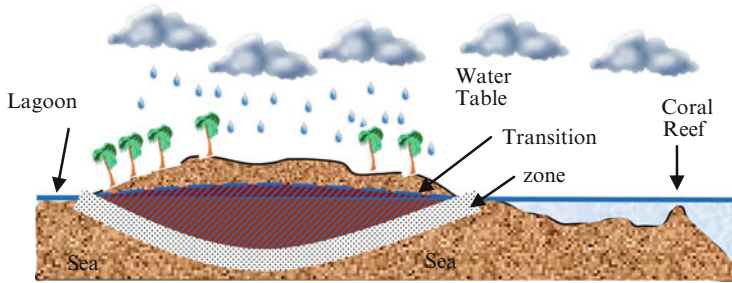
Limestone is a type of sedimentary rock composed of different forms of calcium carbonate, often the skeletal remnants of marine organisms like corals or

<sup>11</sup> Kench et al. (2005), p. 145.

<sup>12</sup> Sato and Yokoki (2010), p. 1.

<sup>13</sup> Sato and Yokoki (2010), p. 1.

<sup>14</sup> UNEP (1999).



**Fig. 2.9** Cross section through a typical coral island

foraminifera. Limestone islands (or raised atolls), such as Niue, Nauru or Banaba are atolls that have been “stranded above sea level” due to either geological (tectonic) processes or previous periods of sea-level change.<sup>15</sup> This means that they are much higher than typical atolls and have different geographical characteristics. Although they are not central to many of the arguments presented in this book, Chap. 7 will present some of the current challenges the former inhabitants of Banaba are facing due to the historical mismanagement of the resources of the island and the relocation of its population.

## 2.4 Coral Reefs and Foraminifers

Despite the fact that they may be small in size, islands (and coastal areas) often have very high levels of biodiversity, which interact with the physical environment in a variety of ways. Particularly for the case of small tropical islands and atolls two different types of creatures are of crucial importance to the long term physical and biological processes that take place in their coastline: corals and foraminifers. Coral reefs and reef sedimentary platforms are unique environments made up mainly of calcium carbonate ( $\text{CaCO}_3$ ) that are the result of ecological processes, where the skeletons of corals and other organism form the physical base of the coastal environment. The main environmental factors that control  $\text{CaCO}_3$  production are light penetration, surface temperature and the calcium carbonate saturation of seawater.<sup>16</sup>

<sup>15</sup> Barnett and Campbell (2010), p. 26.

<sup>16</sup> Kench et al. (2009), p. 183.

### 2.4.1 Coral Reefs

Coral reefs are underwater structures built by small colonial, anemone-like animals that house microscopic algae and secrete skeletal structures made up of calcium carbonate ( $\text{CaCO}_3$ ). These organisms are referred to as corals and due to the importance to atolls it is worth describing some basic aspects of their biology.

#### 2.4.1.1 Corals

Although people often think about corals as the reef-building type, in fact there are a number of different types (which are divided into two main groups, depending on the number of stinging cells<sup>17</sup> or “nematocysts”) that they possess, and only one type (scleractinians<sup>18</sup>) actually produce the reefs. These organisms form symbiotic relationship with algae, where the coral provides protection to the algae and the algae provides energy to the coral animals through photosynthesis. The algae also consume the  $\text{CO}_2$  and other waste produced by the corals and release oxygen. Together, they are the main contributors to reef accumulation, as the coral animals secrete the calcareous structures of the reef.<sup>19</sup> They are among the most biologically rich and productive ecosystems on earth, providing valuable ecosystem benefits to millions of people living in coastal areas.<sup>20</sup>

Corals can reproduce in two different ways. To extend the colony size, corals perform asexual reproduction (“budding”), with a small polyp gradually growing off an adult polyp. This form of reproduction explains why reefs can grow upwards to compensate for sea level rise, and why atolls can also expand laterally. However, corals can also reproduce sexually, where “gametes-eggs” and sperm are released by the polyps into the water to fuse and spread offspring (this is known as spawning, and takes place at certain special moments in the year). The resulting larvae float freely in the water column (hence they are categorised as planktonic animals) before they fix on a surface. Then they metamorphose into juvenile polyps with mouth and tentacles, incorporate the symbiotic algae and eventually start budding to create a new colony. This second type of reproduction is responsible for the colonization of new areas, and why corals currently appear to be migrating polewards to take advantage of higher sea surface temperatures, as we will explain in Chap. 3.

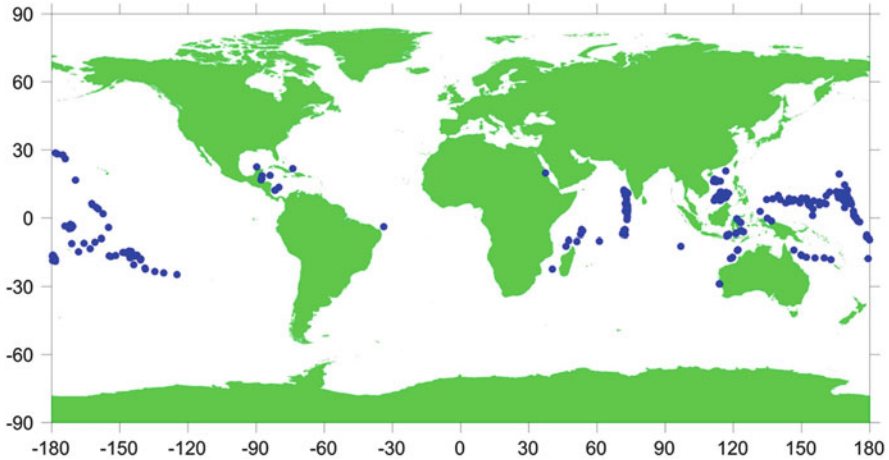
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<sup>17</sup> These nematocysts cells exist in corals and other cnidarians, and are used to capture prey and for defence.

<sup>18</sup> Scleractinians are stony corals with a hard calcium carbonate skeleton. They are often described as “reef building corals”, though not all scleractinians are reef building.

<sup>19</sup> Kleypas and Gattuso (2010).

<sup>20</sup> Burke et al. (2011), p. 5.



**Fig. 2.10** Location of coral reefs around the world. Figure courtesy of Hiroshi Takagi

#### 2.4.1.2 Location and Ideal Growing Conditions

Reefs grow best in the warm shallow waters of tropical and subtropical seas, and are found around many islands and coastal areas. Due to their preference for warm seas they are typically found between  $28^{\circ}$  North and South of the Equator, in areas where the water does not drop below  $17^{\circ}\text{C}$  or above  $33\text{--}34^{\circ}\text{C}$ ,<sup>21</sup> as shown on Fig. 2.10. Corals are reliant on photosynthetic energy, and hence reef-building corals are constrained to relatively clean shallow waters (the depth of water to which the sunlight can reach depends on the turbidity of the water, and hence this depth can range from around 90 m to less than 5 m in high turbid environments, according to Kench et al.<sup>22</sup>). Growth is constrained also by salinity concentrations, with corals being sensitive to either extreme (and thus are usually not present close to river mouths due to the sediment stress and low salinity of these areas). Corals also dislike waters with high nutrient conditions, and increases in these (such as due to water pollution from human activities such as agriculture) mean that hard coral systems can be replaced by macroalgae ecosystems.<sup>23</sup>

Globally they occupy less than 1 % of the oceans (an area of  $28,000\text{ km}^2$ , or around half the area of France, according to the UNEP-WCMC World Atlas of Coral Reefs<sup>24</sup>), though they host one quarter of all known marine fish species. Indonesia, followed by Australia, the Philippines and France are the countries with the biggest extension of reefs, representing over 50 % of the world's total between them. Individually the size of the reefs varies, going from less than  $1\text{ km}^2$  for the

<sup>21</sup> Kench et al. (2009), p. 183.

<sup>22</sup> Kench et al. (2009), p. 183.

<sup>23</sup> Kench et al. (2009), p. 183.

<sup>24</sup> Spalding et al. (2001), p. 10.

case of smaller reefs, to more than 100 km<sup>2</sup>, and networks of barrier reefs can be even larger (such as the Great Barrier Reef in Australia, which is the largest biological construction on Earth, visible even from space). Coral reefs are characterised by a high level of biodiversity and elaborate specialization of resident species, and provide many ecosystem services that economically support nearby human populations. They provide income and employment through export fisheries, marine recreation and tourism (they are one of the main sources of interest for tourist divers, who are attracted by the colourful nature of the reefs and the fish population they support). Also, they represent a fertile ground for the research and development of new drugs.<sup>25</sup> They also offer a considerable amount of protection from natural disasters such as high waves and tsunamis, as will be discussed later in Chap. 3.

### 2.4.1.3 Value and Threats

Based on analysis undertaken by the Economics of Ecosystems and Biodiversity (TEEB) project,<sup>26</sup> the value of coral reefs to humankind is between US\$130,000 and \$1.2 million/ha each year.<sup>27</sup> These calculations take into account the services provided by coral reefs in relation to food, raw materials, ornamental resources, climate regulation, moderation of extreme events, waste treatment, water purification, biological control, cultural services (including tourism), and maintenance of genetic diversity. Despite their benefits many of them have been seriously degraded by human activities such as over-fishing, coastal development, pollution or destructive fishing practices (such as fishing using explosives<sup>28</sup>). The reefs are also sensitive to elevated sea temperatures, which causes the corals to expel their symbiotic algae, resulting in what is known as coral bleaching. These coral bleaching episodes have increased markedly in the past decades,<sup>29</sup> and while corals might recover, high mortality is often reported as a result. The El Niño Event in 1998, for example, is believed to have caused the loss of 90 % of the corals in some parts of the Indian Ocean.<sup>30</sup> Also, corals are vulnerable to ocean acidification, which has been shown to decrease the rate at which the corals can form their calcium carbonate skeletons.<sup>31</sup> Figure 2.11 shows an example of dead coral lying under a healthy coral, highlighting also how they are also able to recover from

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<sup>25</sup> Spalding et al. (2001), p. 54.

<sup>26</sup> TEEB (2010).

<sup>27</sup> Which would represent a value of between US\$ 364 and 3,360 billion for all the coral reefs in the world. Note that the higher estimate represents a value higher than the GDP of Germany, according to the CIA (2012).

<sup>28</sup> Spalding et al. (2001), p. 48.

<sup>29</sup> Reaser et al. (2000), pp. 1500–1511.

<sup>30</sup> Spalding et al. (2001).

<sup>31</sup> Kleypas and Gattuso (2010).





**Fig. 2.11** Example of live coral on top of dead coral. Picture courtesy of Beatrice Lecroq

damage and in some circumstances return to a healthy state. The effects of climate change on coral reefs will be described in more detail in Chap. 3.

### **2.4.2 Foraminifers**

Foraminifers are single-cell amoeboid protists that typically produce a small shell made of calcium carbonate or agglutinated sediment particles. Usually they are less than 1 mm in size, though they can grow up to 20 cm long (Fig. 2.12). They move and catch their food with a network of thin extensions of the cytoplasm. Their food consists on a variety of other creatures such as diatoms, algae or other foraminifera, and some shallow water species have symbiotic algae to perform photosynthesis. They are very important as in many atolls they can be one of the major producers of coastal sediments (such as in the case of Majuro Atoll<sup>32</sup>). Generally speaking the distribution of foraminifera is controlled by a similar set of environmental variables as those that influence coral growth, as explained previously.<sup>33</sup>

## **2.5 Dynamic Coastal Environments**

One of the common characteristics of coastal environments around the world is their dynamic nature. Sand and other sediments are constantly being transported around the coast through a process known as littoral or longshore drift, where the sand on one side of the beach is transported further down due to the oblique nature

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<sup>32</sup> Sato and Yokoki (2010), p. 1.

<sup>33</sup> Kench et al. (2009), pp. 180–213.





**Fig. 2.12** Sand originating from dead foraminifera

of wave attack. Coastal cliffs are eroded by the effect of waves, and the resulting sand and gravel is also transported to calmer areas where it accumulates. Coral colonies progressively form bigger reefs, which supply sand to the beaches behind them. Coastal dunes move, till they are anchored by vegetation, which will grow thinner or denser according to rainfall or the action of animals or humans. These areas are thus in a state of constant change, irrespective of whether the climate is changing or not.

In fact, coastal erosion problems are nothing new, as industrialized nations have been suffering from them for decades.<sup>34</sup> Traditionally coastal engineers<sup>35</sup> attribute coastal erosion to local human activity, and more specifically to the process of industrialization and modernization of society.<sup>36</sup> This problem is summarized in Fig. 2.13, which shows how economic growth leads to changes in the usage of coastal and fluvial areas, which in turn interferes with how sediments would have naturally moved around the system, leading to coastal erosion.

Reef islands are also dynamic landforms that are able to re-organise the sediments that form them in response to changing conditions.<sup>37</sup> However, these changes rarely represent a “tipping point” that dramatically alters the social practices of a certain island, and hence environmental change is a feature of island life, to which the inhabitants have learnt to adapt.<sup>38</sup>

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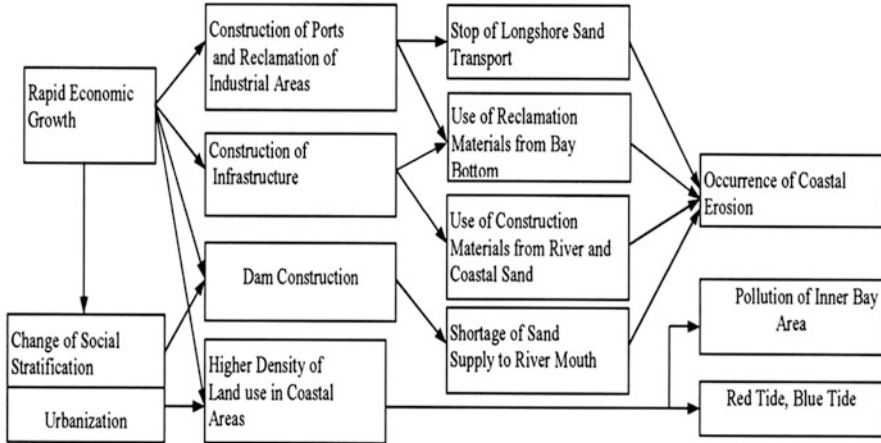
<sup>34</sup> Shibayama (2009).

<sup>35</sup> Despite the fact that nowadays the general media attributes many coastal problems to issues of climate change and rising sea levels.

<sup>36</sup> Shibayama (2009).

<sup>37</sup> Kench et al. (2009), pp. 180–213.

<sup>38</sup> Barnett and Campbell (2010), p. 26.



**Fig. 2.13** Industrialization process and coastal problems—Japan model (reproduced from Shibayama 2009, p. 178)

### 2.5.1 Atoll Systems

For the case of coral islands the main sources of sediments are dead corals, foraminifers and other organisms that produce shells, as these islands have no rivers that can supply materials from the upstream regions.<sup>39</sup> To understand atoll systems it is important to study the cycling of the calcium carbonate ( $\text{CaCO}_3$ ) within the system, as these processes can lead to an overall increase or decrease in the amount of sediments within it. A carbonate budget could thus be described as the sum of all the  $\text{CaCO}_3$  produced by the system (by primary producers such as corals or secondary encrusters) minus what is lost through physical or biological erosion, dissolution or sediment export.<sup>40</sup> The production part of this equation does not only relate to the presence of coral, for example, but also to destructive processes within them. For the production of sediments to take place it is important also that a small fraction of the mass of the corals dies and thus processes such as bioerosion (such as those produced by sponges as they eat corals, or by fish) are important to degrade some of the corals, as this makes them susceptible to physical and chemical erosion, producing large amounts of sediments.<sup>41</sup> Other episodic events such as tropical cyclones or tsunamis also play a role in the evolution of coral reefs, as they generate much coral rubble, which is also important in the coral building processes.<sup>42</sup> The coastal sediments that result from these processes come in a wide variety of sizes (see Fig. 2.14), as they can originate from larger pieces of

<sup>39</sup> Sato and Yokoki (2010), p. 1.

<sup>40</sup> Kench et al. (2009), pp. 180–213.

<sup>41</sup> Kench et al. (2009), pp. 180–213.

<sup>42</sup> Blanchon et al. (1997), pp. 1–16.



**Fig. 2.14** Typical sediments originating from coral reef systems (i.e. coral gravel and sand)

corals that gradually reduce in size over time due to the effects of abrasion. This coral rubble is redistributed around the island by different waves systems and contributes to the morphological development of the island. New areas of accumulation are rapidly colonised by vegetation, which tends to stabilize them.<sup>43</sup>

Based on the state of this carbonate budget Kench et al.<sup>44</sup> summarise how there are a variety of types of reefs, such as

- Production dominated, where  $\text{CaCO}_3$  production rates exceed those of carbon degradation, a common state of many reefs through the Holocene
- Import dominated, where there is a high proportion of materials that come from outside the reefs, and thus creates also a positive  $\text{CaCO}_3$  balance
- Export dominated, where a significant proportion of the materials of the reefs is removed, leading to low net accumulation rates
- Bioerosion dominated, where the biological degradation or sediment conversion of the reef exceeds the production of  $\text{CaCO}_3$ , which leads to high negative budget balances. This is increasingly typical in the late Holocene as a result of environmental disturbance or reduced rates of primary carbonate production.

<sup>43</sup> Magnan et al. (2011).

<sup>44</sup> Kench et al. (2009), pp. 180–213.

### 2.5.2 Coastal Erosion in Atolls

Coastal erosion is typically a significant problem in atolls as they are generally small and narrow in shape.<sup>45</sup> These islands are generally believed to be highly vulnerable to environmental changes, extreme events and particularly sea level rise, which will be extensively discussed in Chap. 3.

Nevertheless, it is important to remember that the morphological changes seen in this environment will often not be caused by climate change, but by some other natural or artificial factors.<sup>46</sup> Natural factors include mainly waves and currents, which can transport the sediments from one location to another.<sup>47</sup> Extreme events, such as tropical cyclones, are particularly able to cause large morphological changes,<sup>48</sup> as the high waves and currents associated with these events can cause great amounts of materials to be rapidly transported. However, these events tend to be rare, and the transportation of sand in the coast of the lagoon is often the main factor related to morphological change.<sup>49</sup> Table 2.2 presents some simple assumptions on the major natural factors affecting morphological changes in atolls, which was adapted from Sato and Yokoki.<sup>50</sup> Morphological changes can be divided into two conditions according to the difference in external forces, transported materials, the areas affected and the frequency of the events. In this table for the sake of completeness we have also included the potential effects of tsunamis, as these events can have profound impacts on the shoreline of islands. It is important to note that coastal vegetation counteracts many of these processes, anchoring the sediments and thus reducing the effects of erosion.<sup>51</sup>

Artificial factors relate to the influence of humans on the environment, and can occur in a variety of ways, some of which will only be felt years or even decades after certain actions took place. Dredging, over-fishing, dynamite fishing, the construction of ports, changes in littoral ecosystems, loss of coastal forests, changes in catchment usage, increase use of fertilisers, reef mining, tourism impact, channel construction or the construction of groynes and dikes are some of the causes of anthropogenic stress on the reefs.<sup>52</sup>

The most easily observed anthropogenic impacts can be felt not on the ecology of the reefs themselves, but on the shorelines of nearby islands.<sup>53</sup> In a study carried out in Funafuti Atoll in Tuvalu a digital comparison of photos from 1941, 1943, 1984 and 2003 found no evidence that erosion on the lagoon side of the island of

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<sup>45</sup> Sato and Yokoki (2010), p. 1.

<sup>46</sup> Sato and Yokoki (2010), 5.

<sup>47</sup> Kench et al. (2009), pp. 180–213.

<sup>48</sup> See for example Sato and Yokoki (2010) and Kench et al. (2009), pp. 180–213.

<sup>49</sup> Sato and Yokoki (2010), p. 5.

<sup>50</sup> Sato and Yokoki (2010), p. 5.

<sup>51</sup> Kench et al. (2009), pp. 180–213.

<sup>52</sup> Kench et al. (2009), pp. 180–213.

<sup>53</sup> Kench et al. (2009), pp. 180–213.

**Table 2.2** Factors affecting morphological changes in Atolls (adapted from Sato and Yokoki 2010, p. 5)

	Normal conditions	Extreme conditions
External forces	<ul style="list-style-type: none"> <li>• Swells</li> <li>• Wind waves</li> <li>• Tidal flows</li> </ul>	<ul style="list-style-type: none"> <li>• High waves due to Tropical Cyclone</li> <li>• Tsunami</li> </ul>
Transported materials	<ul style="list-style-type: none"> <li>• Sands (from corals, foraminifers)</li> </ul>	<ul style="list-style-type: none"> <li>• Sands (from corals, foraminifers)</li> <li>• Coral gravels</li> </ul>
Main area concerned	<ul style="list-style-type: none"> <li>• Lagoon side coastal (partly also on ocean-side coast)</li> </ul>	<ul style="list-style-type: none"> <li>• Ocean side coast</li> <li>• Lagoon side coast</li> </ul>
Frequency	<ul style="list-style-type: none"> <li>• Every day</li> <li>• Seasonal</li> </ul>	<ul style="list-style-type: none"> <li>• Once in a decade or longer</li> </ul>

Fongafale was more pronounced between 1984 and 2004.<sup>54</sup> The study found changes in the shapes of the island in the atoll, but concluded that it was likely that much of the present lagoon shoreline instability was the effect of profound changes due to dredging by the US military during the 1940s. Essentially it appears that any dredging of the lagoon basin can disturb coastal processes and accelerate coastal erosion.<sup>55</sup> In another small island, that of Anjouan in the Comores, the extraction of sand in certain beaches for use as a construction material significantly increased the rates of erosion.<sup>56</sup> In spite of this, local politicians (with financial aid from the international community) are increasingly building sea defences, which are presented as a counter-measure to fight climate change.<sup>57</sup> It is thus important to remain objective about the real reasons behind coastal erosion in littoral areas, as this is a well documented phenomenon typically linked to human activities rather than to climate change.

In fact, in one of the largest studies on the morphological changes on reefs islands that we are aware of, Webb and Kench<sup>58</sup> surveyed 27 atoll islands in the central Pacific over a 19–61 year period and found that 86 % of the islands had remained stable or increased in area, with only 14 % of those studied exhibiting a reduction in their dimensions. Thus, despite the constant talk in the media about the effects of sea levels during the twentieth century, there is evidence that the islands have been able to dynamically adapt, even increasing in area.<sup>59</sup> Nevertheless, it is interesting to note that erosion of the shorelines facing the ocean reef was detected in 50 % of the islands examined by Webb and Kench,<sup>60</sup> and that accretion<sup>61</sup> of the

<sup>54</sup> Webb (2005).

<sup>55</sup> Webb (2005).

<sup>56</sup> Sinane et al. (2010).

<sup>57</sup> Sinane et al. (2010).

<sup>58</sup> Webb and Kench (2010), pp. 234–246.

<sup>59</sup> Webb and Kench (2010), pp. 234–246.

<sup>60</sup> Webb and Kench (2010), pp. 234–246.

<sup>61</sup> Accretion means the accumulation of sediments in a certain area, i.e. the opposite of erosion.

lagoon shorelines was detected in 70 % of the islands. Accretion only occurred in 30 % of the islands they examined, often in the leeward (non-exposed margins of the atoll). Webb and Kench<sup>62</sup> note how in 65 % of the island studied there was a migration of the reef islands towards the lagoon, which is most evident on the windward margins of the atolls. This could possibly be signalling a change in conditions of corals in the islands, and could be a warning of the future problems that these islands could be facing, as detailed in Chap. 3.

## 2.6 Atoll Island States

Worldwide, more than 275 million people live within 10 km of a coast where a reef is located, and this increases to around 850 million if a radius of 100 km is considered.<sup>63</sup> Ninety-four countries and territories benefit from reef tourism, which contributes over 15 % of GDP in 23 of these.<sup>64</sup> However, this book deals with the subject of Atoll Island States, which we have defined as countries which are formed almost or uniquely of one or more atoll islands (i.e. an atoll archipelago). They are considered to be highly vulnerable to climate change, as the highest point in these islands is often only a few metres above sea level and hence their inhabitants cannot relocate to higher ground within the islands and would probably have to move to foreign countries as a consequence of sea-level rise and other consequences of climate change. They typically have a high ratio of coastline to land area, relative high population densities and low level of available resources for adaptive measures.<sup>65</sup> This in turn makes their economies highly vulnerable, and on average they are also more food insecure than other Small Island States.<sup>66</sup> The soils in these islands are generally of poor quality, and thus rather limited for agricultural production, meaning that typically fishing is an important aspect of both food production and exports.<sup>67</sup> By the very nature of atolls all settlements are located

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<sup>62</sup> Webb and Kench (2010), pp. 234–246.

<sup>63</sup> Burke et al. (2011).

<sup>64</sup> Burke et al. (2011).

<sup>65</sup> Barnett and Adger (2003), p. 327.

<sup>66</sup> Barnett and Adger (2003), p. 327.

<sup>67</sup> For example most people in Kiribati are engaged in subsistence activities, including fishing, the growing of bananas and copra (dried coconut), according to Loughry and McAdam (2008), p. 51. See also Maas and Carius (2012), pp. 1–17. In terms of the commercial exploitation of fisheries, tuna is very important to these islands, and 8 countries in the Pacific (Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Palau, Papua New Guinea, Solomon Islands and Tuvalu) have signed the Nauru Agreement, a subregional agreement on terms and conditions for tuna purse seine fishing licences in the region. This contributes US\$31 million to the GDP of the Marshall Islands (almost 20 % of GDP), employing 1,229 people. It also employs 321 people in Tuvalu and 656 in Kiribati, according to the Tuna Economic Indicators Update published by the [Pacific Islands Forum Fisheries Agency](#).

**Table 2.3** Atoll Island State statistics<sup>a</sup>

Country statistics	Tuvalu	Kiribati	Maldives	Tokelau <sup>b</sup>	Marshall Islands
Population	10,619	101,998	394,451	1,368	68,480
GDP (PPP)	\$36 m	\$612 m	\$2.754 bm	\$1.5 m <sup>c</sup>	\$33.5 m
GDP per capita	\$3,400	\$6,200	\$8,400	\$1,000	\$2,500
Land area (km <sup>2</sup> )	26	811	298	12	181
Highest elevation (m)	5	81	2.4	5	10

<sup>a</sup>CIA “The World Factbook”

<sup>b</sup>This is a territory of New Zealand, despite two referenda in 2006 and 2007 to change the status to one of free association (which were not approved)

<sup>c</sup>GDP data is a 1993 estimate

in the vicinity of the coast, with the main city typically hosting the major port, airport and government institutions.<sup>68</sup> Tourism can also be an important source of revenue,<sup>69</sup> as is fishing within the Exclusive Economic Zones (EEZs)<sup>70</sup> and overseas aid. Prominent in this group are Tuvalu, the Maldives, Kiribati, the Marshall Islands and Tokelau. Some basic statistics for these countries and territories are given in Table 2.3. However, many other countries have atolls in their territory, and although the legal problems described throughout the book might be less severe than for Atoll Island States (formed uniquely of atolls), the physical dangers described in Chap. 3 will still affect these islands. In fact, many other Archipelagic Island States are usually composed of more than one type of island.<sup>71</sup> Although the sovereignty discussions in this report will be centred on atolls, some of the discussions on the legal implications will be at least partially valid for other types of low-lying islands environments, such as sand cays or low-lying volcanic islands with fringe reefs (such as Fiji or Samoa, for example).

### 2.6.1 *Urbanisation, Development Challenges and Vulnerability*

Atolls which are highly urbanised (typically those which serve as capitals of Atoll Island States) have been experienced rapid population growth and urbanisation in the past decades. This has brought with it a number of benefits, such as an increase in labour and institutional capacity, but has also placed extra pressure on the natural and economic systems of the islands, and affected the human and physical mechanisms that ensure their resilience.<sup>72</sup> Many of the houses in these islands

<sup>68</sup> Mimura et al. (2007) (a chapter within the IPCC 4AR).

<sup>69</sup> Representing more than one-fifth of the GDP of Kiribati and 28 % of that of the Maldives, according to the CIA “The World Factbook”.

<sup>70</sup> Maas and Carius (2012), pp. 1–17.

<sup>71</sup> Barnett and Campbell (2010), pp. 21–50.

<sup>72</sup> Magnan et al. (2011).



lack modern sanitation systems, and even where sewage systems exist they are often not constructed to discharge the effluence beyond the reef.<sup>73</sup> This can result in the sewage returning to the shores the high tide, affecting the quality of water<sup>74</sup> and the corals, as explained earlier in this chapter.

Higher levels of urbanisation also increase the pressure to protect the buildings and infrastructure on which these human systems are based. This has a complex effect on the overall resilience of the islands, which paradoxically become more vulnerable as a result. The small dispersed populations that inhabit the more sparsely populated atolls are in a certain way quite vulnerable, but can also easily relocate if morphological changes take place in the islands. Highly urbanised dense populations require infrastructure (water supply, hospitals, etc.) to sustain them, and the failure of these systems can have very severe consequences for all its inhabitants. More rural atolls might, on the other hand, have a greater margin of manoeuvre, which could actually influence the adaptation strategies of atoll islands.<sup>75</sup>

Thus, increased development and population might enable a country greater access to financial and human capital, while posing a greater stress on natural resources and infrastructure, both of which are important to the survival of its population. This complex interaction and how to adequately resolve it is one of the major challenges facing Atoll Island States.

## 2.7 Conclusions

Atoll Island States consist exclusively or almost exclusively of coral islands that originate from the skeletons of dead corals and foraminifera around the atoll. Atolls are very particular and fragile ecosystems, which are made of a wide diversity of organisms surviving around coral colonies. Corals colonies naturally expand and grow both horizontally and upwards, a characteristic that can explain why atolls around the planet have survived past changes in sea levels. Thus, it cannot be concluded that sea level rise alone will lead to the future submergence of atolls, and as long as corals remain healthy (something which is not clear, as increases in sea temperatures and acidification could increase future coral mortality) coral islands can “grow upwards” to compensate.

Coral islands are complex active geomorphological features whose shape is influenced by local wave conditions and episodic events such as tropical cyclones. Nowadays, coastal erosion is unlikely to be related with climate change or sea level rise, but rather caused by human interference with coastal processes (such as

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<sup>73</sup> Loughry and McAdam (2008), p. 51.

<sup>74</sup> Loughry and McAdam (2008), p. 51.

<sup>75</sup> Magnan et al. (2011).



longshore drift). The construction of jetties or dredging traps sediments, leads to erosion elsewhere in the coastline, a well known problem in coastal engineering.

Socio-economically speaking, Atoll Island States tend to be medium to low income countries, with their economy dependent on agriculture, fishing, tourism, the revenue originating from their Exclusive Economic Zones (EEZ) and overseas aid. They typically have high population densities, often concentrated on the island where the capital is located, where most of the important infrastructure and government institutions are also situated. Their relative poverty especially influences the range of adaptation options available to each of them, as extensive coastal engineering defence works are unlikely to be financially viable for most countries. Furthermore, the possible death of coral reefs could cause further impoverishment through the loss of fishing and tourism, highlighting the precarious balance in which their populations coexist with the environment of the atolls.

## References

- Barnett J, Adger WN (2003) Climate dangers and atoll countries. *Clim Change* 61:321–327
- Barnett J, Campbell J (2010) *Climate change and Small Island States*. Earthscan Ltd, London
- Blanchon P et al (1997) Anatomy of a fringing reef around Grand Cayman: storm rubble not coral framework. *J Sediment Res* 67:1–16
- Burke L, Reytar K, Spalding M, Perry A (2011) Reefs at risk revisited. World Resources Institute. <http://www.wri.org/>. Accessed 18 Aug 2011
- CIA (2012) *The World Factbook*. <https://www.cia.gov/library/publications/the-world-factbook/index.html>. Accessed 28 May 2012
- Kench PS, McLean RF, Nichol SL (2005) New model of reef-island evolution: Maldives, Indian Ocean. *Geology* 33(2):145–148
- Kench PS, Perry CT, Spencer T (2009) Coral reefs. Chapter 7. In: Slaymaker O, Spencer T, Embleton-Hamann C (eds) *Geomorphology and global environmental change*. Cambridge University Press, Cambridge, pp 180–213
- Kleypas J, Gattuso JP (2010) Coral reef. In: Cleveland CJ (ed) *Encyclopedia of earth. Environmental Information Coalition, National Council for Science and the Environment*, Washington (First published in the *Encyclopedia of Earth* October 18, 2006; Last revised March 28, 2010.)
- Loughry M, McAdam J (2008) Kiribati – relocation and adaptation. *Forced migration review*. <http://www.fmreview.org/FMRpdfs/FMR31/FMR31.pdf>. Accessed 27 Mar 2012
- Maas A, Carius A (2012) Territorial integrity and sovereignty: climate change and security in the Pacific and beyond. In: Scheffran J et al (eds) *Climate change, human security and violent conflict, hexagon series on human and environmental security and peace*, vol 8. Springer, Heidelberg, 651–665
- Magnan A, Duvat V, Pirazzoli P, Woppelmann G (2011) In light of climate change, can coral archipelagos be defined as vulnerable “resource systems”? In: 4th Congress of the Asia & Pacific Network, Paris, 14–16 Sept 2011 (in French)
- Mimura et al (2007) *Small islands. Climate Change 2007. Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Parry et al. eds., Cambridge University Press, Cambridge, UK, 687–716
- Pacific Islands Forum Fisheries Agency (2012) *Nauru Agreement Concerning Cooperation in the Management of Fisheries of Common Interest* [http://www.ffa.int/nauru\\_agreement](http://www.ffa.int/nauru_agreement). Accessed 28 May 2012

- Reaser JK, Pomerance R, Thomas PO (2000) Coral bleaching and global climate change: scientific findings and policy recommendations. *Conserv Biol* 14:1500–1511
- Sato D, Yokoki H (2010) Numerical calculation on Shoreline Conservation in Majuro Atoll, The Marshall Islands. In: Proceedings of the international conference on coastal engineering, No. 32(2010), Shanghai. Retrieved from <http://journals.tdl.org/ICCE/>. doi:10.9753/icce.v32.sediment.94
- Shibayama T (2009) Coastal processes, concepts in coastal engineering and their application to multifarious environments. World Scientific, Singapore
- Sinane K, David G, Pennober G, Troadec R (2010) Fragilisation et modification des formations littorales meubles sur l'île d'Anjouan (Comores): Quand l'érosion d'origine anthropique se conjugue au changement climatique. *Vertigo* 10(3). doi:10.4000/vertigo.10528
- Spalding MD, Ravilious C, Green EP (2001) World atlas of coral reefs. University of California Press, Berkeley, [http://www.unep-wcmc.org/world-atlas-of-coral-reefs\\_524.html](http://www.unep-wcmc.org/world-atlas-of-coral-reefs_524.html)
- TEEB (2010) The economics of ecosystems and biodiversity: mainstreaming the economics of nature: a synthesis of the approach, conclusions and recommendations of TEEB. <http://www.teebweb.org/>. Accessed 28 May 2012
- UNEP (United Nations Environment Programme) (1999) Pacific Islands environment outlook. UNEP, Apia
- Webb A (2005) Tuvalu technical report- coastal change analysis using multi-temporal image comparisons-Funafuti Atoll. EU EDF 8/9 SOPCA Project Report 54
- Webb AP, Kench PS (2010) The dynamic response of reef islands to sea-level rise: evidence from multi-decadal analysis of island change in the Central Pacific. *Global Planet Change* 72:234–246. doi:10.1016/j.gloplacha.2010.05.003

# Chapter 3

## Climate Change and Its Effects on Atoll Island States

### 3.1 Introduction

The Earth's climate is a complex system that depends on the energy received from the Sun and how this energy is distributed throughout the different layers of materials (i.e. the various levels in the atmosphere, oceans, crust) that make up the system. Part of the energy that is received from the Sun is actually reflected back into space, but much of the energy is retained through a multitude of so-called greenhouse gases, which keep the planet much warmer than what it would be without them. The IPCC 4AR stresses the role that these gases have on the temperature of the planet, and increases in their concentrations can lead to anthropogenic changes in the climate. In actual fact, humans have been exerting an influence on the local environment for a long time, as the progressive population increase throughout the ages led to the cutting of trees and cultivation of the areas previously occupied by forests. However, it is generally agreed that the rate of CO<sub>2</sub> emissions greatly increased since the beginning of the industrial era, which has led to an acceleration in the pace of climate change. Indeed, according to the IPCC 4AR 11 of the 12 years between 1995 and 2006 were the warmest on record, and since then new records have been reached. As a consequence of this a number of effects have been predicted, such as an increase in the pace of sea level rise due to melting of glaciers and ice caps, increases in the intensity of tropical cyclones or changes to the frequency of extreme drought and precipitation events. The present chapter will detail the impacts that scientists think these changes will have on atolls, particularly those related to sea-level rise, ocean acidification, coral mortality and increases in tropical cyclone intensity.

Particularly, this warming and increased acidification of the sea could bring about great increases in coral mortality, probably the most important long-term problem affecting the survival of Atolls Island States. Although we tend to consider these coral islands as land areas, a more accurate description would be to think of them as living creatures, one gigantic colony of inter-related species, with humans living on their back. Corals are constantly providing the building materials that

compose the coral islands on top of the atolls, and that has allowed them to keep up with sea level changes throughout time. For that to continue to happen corals must be healthy, though it is not expected that they will be able to survive the multiple stresses that will be placed on them due to climate change.<sup>1</sup> Thus, their death would in the long-term also force those living on their “backs” to relocate, as the islands would no longer be able to keep pace with sea level rise and “drown”. Despite this, in the middle-term even if all the corals were to die, the islands would probably survive, as there is a certain amount of geomorphological resilience in the system. Nevertheless, the survival of the islands does not mean that the infrastructure and houses built on them would remain intact, as tropical cyclones and other high intensity events (such as tsunamis) can rapidly alter the coastline of an already degraded environment. As atolls are small, profound alterations of their coastline can result in large extents of their infrastructure being destroyed and greatly affect the economy and society of its inhabitants.

Finally, it is important to note that although the situation of Atoll Island States is generally ignored due to their isolation and relatively low demographic and economic importance in the world’s economy, the peril of these islands will highlight many of the problems that coastal communities will face in the future.<sup>2</sup>

## 3.2 Climate Change and Its Implications for Atoll Island States

The link between human activities and the increase in global temperatures is an issue that very few people question these days, and has been enshrined in a wide body of scientific literature that was last summarised in the IPCC 4AR. This report highlights how the concentration of greenhouse gas emissions in the atmosphere [measured in parts per million (ppm) of CO<sub>2</sub> concentration] is nearly double that present at pre-industrial levels and is still rising. The IPCC 4AR sets out a number of climate change scenarios for different future levels of CO<sub>2</sub> concentrations, and estimates that if these can be kept below around 450 ppm there is a 50 % chance that the global temperature will not exceed 2–2.4 °C. However, given the current political climate and the lack of success in recent climate change negotiations (as explained in more details in Chap. 4) it seems unlikely that this can be achieved, which would mean not only that the effects of climate change will slowly be felt by countries around the globe, but that the speed at which these effects take place could increase (i.e. the pace of sea level rise could accelerate in the future).

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<sup>1</sup> It should be noted that opinions on the subject sometimes differ, but as we will show in this chapter it appears unlikely that they will be able to adapt in the short term. For some views on this see Hoegh-Guldberg et al. (2011), pp. 1494–1495.

<sup>2</sup> Magnan et al. (2011).

Climate change poses a severe challenge to the long-term survival of Atoll Island States. The IPCC 4AR discusses different global warming scenarios for various parts of the world and states how “the probability of extreme warm seasons is 100% in all cases for the small islands and the scenarios of warming are all very significant by the end of the century”. The IPCC also states with very high confidence that “there is strong evidence that under most climate change scenarios, water resources in small islands are likely to be seriously compromised”, as they tend to be especially vulnerable to future changes and distribution of rainfall.<sup>3</sup> For the case of Tarawa Atoll in Kiribati it has been estimated that a 10 % reduction in average rainfall could lead to a 20 % decrease in the size of the freshwater lens, and this problem could be further compounded by sea level rise.<sup>4</sup> Surface sea temperatures are expected to rise as a result of this global warming, and it is believed that this could lead to stronger tropical cyclones, resulting in increased damage and coastal erosion. Crucially also for Atoll Island States, the warming of the sea could lead to increased coral mortality, which together with ocean acidification might decrease the ability of these creatures to keep pace with sea level rise. The combinations of all these factors could render many atoll islands uninhabitable during the course of the next century, as will be discussed in more detail throughout the rest of this chapter.

It is important to also remember that whether atolls become uninhabitable or disappear will probably depend on a number of ecological thresholds being breached or not. These thresholds represent points at which abrupt changes in the ecosystem take place, which are completely out of proportion with the stresses that occurred prior to it. This might happen after a period of gradual worsening of the conditions in the ecosystem, though after the threshold is reached the ecosystem would significantly change in nature. An example of this will be given later regarding how coral reefs can experience a phase shift to areas dominated by macroalgae. From the human perspective, if these thresholds are exceeded, the resources, service and functions provided by that ecosystem might rapidly change to a state from which they cannot easily be brought back.<sup>5</sup> This can have grave consequences for the inhabitants of the islands, as certain parts of their environment might deteriorate quite rapidly, which would restrict the time available for them to adapt.

### 3.2.1 *Sea Level Rise*

Raising global temperatures causes seawater to also become warmer, which makes it expand and increases the volume of oceans globally (this is known as “thermal expansion” or “steric” sea level rise). Increasing temperatures also lead to the melting

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<sup>3</sup> Mimura et al. (2007) (A chapter within the IPCC 4AR).

<sup>4</sup> Mimura et al. (2007) (A chapter within the IPCC 4AR).

<sup>5</sup> Lyytimaki and Hilden (2011), pp. 598–612.

of the polar ice and glaciers, further contributing to sea level rise. The IPCC 4AR<sup>6</sup> noted there is strong evidence that global sea level has gradually risen in the twentieth century. In itself, this is not a phenomenon that the planet has not experienced before, as sea levels have naturally increased and decreased in the past following ice age cycles. However, what has been different this time is that according to the IPCC 4AR<sup>7</sup> “it is *very likely* that the response to anthropogenic forcing contributed to sea level rise during the latter half of the 20th century”. It appears that prior to the nineteenth century sea levels had not significantly changed for a few thousand years, whereas it is estimated that during the twentieth century global average sea level rose at a rate of approximately 1.7 mm/year. The rate of increase is not always the same for different regions, and for the case of the Pacific Ocean there appears to be significant regional differences in sea-level behaviour over the last century, though the scarce data available generally agrees with large-scale global trends.<sup>8</sup>

Better information is available since the early 1990s as satellites have been able to provide more accurate data. Since this time sea level rise is estimated to have been risen by around 3 mm/year, which is significantly higher than during the previous half a century. As at present CO<sub>2</sub> emissions continue to increase, it appears that a significant amount of sea rise is inevitable, unless drastic action is taken to reduce emissions. Furthermore, the IPCC 4AR<sup>9</sup> notes that “atmospheric CO<sub>2</sub> will continue to increase in the long term even if its emission is substantially reduced from present levels” as these particles are not so easily eliminated once they are in the atmosphere. Future patterns of sea level rise are highly uncertain due to a lack of understanding of the precise working of global climate and its interaction with the physical environment. Much of this is down to uncertainty in the response of the big ice sheets of Greenland and Antarctica.<sup>10</sup> In fact, it is currently believed that sea level is likely to rise much more by 2100 than the range of 0.18–0.59 m given in the IPCC 4AR. In this report, the coupled models used for the twenty-first century sea level projections did not include representations of dynamic ice sheets, and hence only considered simple mass balance estimates of the contributions from Greenland and the Arctic ice sheets. In fact the IPCC 4AR assumed that ice was accumulating over the Antarctic ice sheet, though currently it appears to be losing mass as a consequence of dynamic processes.<sup>11</sup> Recent analysis such as that by Vermeer and Rahmstorf argue that for the future global temperature scenarios given in the IPCC 4AR the projected sea level rise for the period 1990–2100 could be in the 0.75–1.9 m range.<sup>12</sup>

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<sup>6</sup> Bindoff et al. (2007) (A chapter within the IPCC 4AR).

<sup>7</sup> Solomon et al. (2007) (A chapter within the IPCC 4AR).

<sup>8</sup> Webb and Kench (2010), pp. 234–246.

<sup>9</sup> Solomon et al. (2007) (A chapter within the IPCC 4AR).

<sup>10</sup> Allison et al. (2009), pp. 1–64.

<sup>11</sup> Allison et al. (2009), pp. 1–64.

<sup>12</sup> This research was done by linking sea-level variations on time scales of decades to centuries to the global temperature, which could explain around 98 % of the variance in the data. See Vermeer and Rahmstorf (2009).

Due to ocean density and circulation changes the distribution of sea level rise is unlikely to be uniform. Although the interest of the IPCC 4AR was centred around parameters that indicate average global water levels, from an economic, engineering and social point of view the most important thing is what will be the regional sea levels, which could differ significantly from the global average.<sup>13</sup> In fact, from an engineering point of view the U.S. Army Corps of Engineering (USACE) now requires that “impacts to coastal and estuarine zones caused by sea-level change must be considered in all phases of Civil Works programs” in which the USACE is involved.<sup>14</sup> These impacts are to be considered from the point of view of three sea-level rise scenarios:

- “low” scenario, this should be the minimum that should be taken into account by all projects, based on the historical rise of sea level at a certain location, which should be obtained from the extrapolation of historical tide gauge rates.
- “medium” scenario, which should be somewhere in between the low and high scenarios, with the design team having the possibility of setting a variety of these medium scenarios.
- “high” scenario, exceeding the upper bounds of the IPCC estimates from both 2001 and 2007 to take into account high levels of ice melting from Greenland and Antarctica, in line of recent peer-reviewed articles.<sup>15</sup> At present this report notes how no authors currently proposed a twenty-first century mean sea level rise of more than 2 m.

The performance of the projects should be evaluated in terms of human health and safety, economic costs and benefits, environmental impacts and other social effects.<sup>16</sup>

The impact of sea-level rise could have serious consequences in certain areas of the world, flooding millions of people living in the low lying areas of South, South-East and East Asia.<sup>17</sup> Even under a conservative scenario of only 40 cm increase in sea level by the end of the twenty-first century the projected number of people flooded in coastal zones would increase from 13 to 94 m.<sup>18</sup> Bangladesh would lose a vast extension of coastal areas,<sup>19</sup> and it is estimated that by 2050 millions of people would be affected by sea-level rise in each of the Ganges-Brahmaputra-Meghna,

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<sup>13</sup> Magnan et al. (2011).

<sup>14</sup> USACE (2011).

<sup>15</sup> Though the report does not specify which peer-reviewed articles, thus meaning that the latest research on the subject should be used. An extreme case could be for example the scenarios outlined by Vermeer and Rahmstorf (2009).

<sup>16</sup> USACE (2011).

<sup>17</sup> Stern (2006).

<sup>18</sup> Wassmann et al. (2004), pp. 89–107.

<sup>19</sup> Caron (1990), pp. 621–653.

Mekong and Nile deltas.<sup>20</sup> For the case of many small islands it could lead to a massive loss of mangroves,<sup>21</sup> which in turn would result in increased rates of coastal erosion and flooding. Not only would certain coastal areas be permanently flooded, but areas further inland would also become less productive due to the increased salinity levels brought about by inundation during tropical cyclone storm surges.

The consequences of sea level rise would thus be felt by most nations on Earth. However it is possible for the inhabitants of most countries to move inland to higher grounds or to attempt costly sea defences, which would result in significant economic losses but not threaten the existence of the countries themselves. Where no coastal defences are attempted, either because of their unfeasibility or cost, massive displacement of people from low-lying areas to higher grounds will inevitably take place.

For the case of Atoll Island States, where the entire islands are only a few metres above sea level, neither of these strategies can guarantee the long-term survival of the country itself, as will be discussed later. For the Maldives it has been suggested, for example, that a rise in sea level of approximately 50 cm by the end of the twenty-first century is possible,<sup>22</sup> and this could lead to the flooding of many coastal areas (assuming that coral reefs cannot keep pace with the rate of sea level rise, as will be discussed later in this chapter). A number of authors have expressed the fear that this could lead to an increase in the number of land disputes and negatively affect the social peace of small Island States,<sup>23</sup> though States composed entirely of atolls such as Tuvalu or Kiribati have so far been socially quite stable. Nevertheless, it is theoretically possible that even in these places the inundation of lands can contribute to violence by increasing environmental pressures, though these additional factors “do not in themselves justify predictions of violence”.<sup>24</sup> Ultimately many of the inhabitants could be displaced, and the international community will have to somehow cope with such a situation. The legal questions regarding the status of these “climate-change displaced persons” have been widely discussed in recent times,<sup>25</sup> and will be addressed in more detail in Chap. 7.

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<sup>20</sup> See Ericson et al. (2006), pp. 63–82. For the case of the Bay of Bengal see Tasnim (2010) citing Warrick et al. (1996) or Shibayama et al. (2009).

<sup>21</sup> Mimura et al. (2007) (A chapter within the IPCC 4AR).

<sup>22</sup> See Woodworth (2005), pp. 1–19, although this clearly does not agree well with more recent work such as that of Vermeer and Rahmstorf (2009).

<sup>23</sup> Though the literature on this tends to refer to islands that have already seen violent conflicts for the last decades anyway, such as Solomon Islands and places in Papua New Guinea, see Maas and Carius (2012), pp. 1–17.

<sup>24</sup> Barnett (2004), pp. 191–215.

<sup>25</sup> See, for example Okamatsu (2005) or Conisbee and Simms (2003).



### 3.2.2 *El Niño and La Niña*

The influence of this type of natural periodic climate oscillation on the weather conditions of the Pacific area and even other parts of the world has gathered increasing attention in the past decades.

First of all it should be noted how this oscillation is entirely natural, and its inclusion in this section is only to highlight that some of the situations which it currently creates could become the norm in the future. This oscillation creates variations in surface sea temperature (SST) that can have important influences on natural cycles of coral mortality and island flooding. Thus it deserves a more detailed explanation, in order to clarify how some of the changes in the environment currently seen are often linked to these events, though future climate change could exacerbate the effects of these cycles.

This phenomenon was poorly understood in the past, and even at present many of its causes and associated effects have not been entirely elucidated. The words originally come from the Spanish language, meaning “The Boy” (El Niño) and “the Girl” (La Niña), and the cyclical oscillation associated with them is referred to as the El Niño-Southern Oscillation, or ENSO. Essentially this phenomenon represents two naturally opposite extremes in the sea surface temperatures across the central and east-central equatorial Pacific.<sup>26</sup> During el Niño events there is an eastward shift in the warm area of the Pacific, whereas in the la Niña events this area is colder and the western part of the Pacific is warmer. The cycle typically lasts 3–5 years (although historically they can go anywhere from 2 to 7 years), with El Niño part of the oscillation typically lasting 9–12 months and La Niña 1–3 years, though more prolonged episode have also existed.<sup>27</sup> These events result in changing rainfall patterns across the world, and can have a great influence on small islands, as they can often result in draughts or flooding, depending on the location of the island within the cycle. This oscillation is also responsible for temporary changes to the base sea level, which can exacerbate the effect of tides and lead to the flooding of low-lying coastal areas. One such example happened during La Niña in 2011, where areas of Majuro atoll in the Marshall islands were flooded by high tides which were combined with a sea level around 15 cm higher than normal due to La Niña.<sup>28</sup> Although 15 cm might not sound like much, for atoll islands the combination of this with high tides and waves can make the difference between certain areas being inundated or not, and future sea-level rises could add to this problem.

There is currently much debate about the role that climate change will play on the ENSO oscillation, and how this will affect atolls. The higher surface sea

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<sup>26</sup> Climate Prediction Centre (2005).

<sup>27</sup> Climate Prediction Centre (2005).

<sup>28</sup> Johnson (2011).

temperatures associated with El Niño events can lead to increased coral mortality,<sup>29</sup> which can highlight the dangers that an increase in sea temperatures can bring about, as explained in more detail in the next section.

### 3.2.3 *Loss of Coral Reefs*

It is not the sea-level rise in itself that poses the greatest long-term risk to the existence of atolls, but the ability of coral reefs to keep up with this sea level rise.<sup>30</sup> Although sea level has gradually risen in the past coral reefs have been able to keep pace with it and the islands on them grew upwards through the supply of sand created by the corals. The “Reefs at Risk” report<sup>31</sup> estimates that more than 60 % of the world’s reefs are under immediate and direct threat from one or more local sources of stress (such as coastal development, marine or watershed based pollution and destructive fishing practices). When these are combined with the effects of climate change, it is believed that 75 % of reefs are considered to be threatened.<sup>32</sup> Generally reefs in the Pacific region (where many atolls are located) are less endangered due to lower pressures on coastal resources, with almost 50 % of the reefs in this area currently considered threatened, and 20 % rated as high or very high.<sup>33</sup> Particularly places like French Polynesia, Hawaii, the Marshall Islands and the Federated States of Micronesia have some of the lower overall threat ratings.<sup>34</sup>

Although reefs are being threatened world-wide by local pollution and the effect of high water temperatures, it is important to note that there is evidence also for a rapid poleward expansion of tropical reef corals in response to rising sea water temperatures.<sup>35</sup> According to Yamano et al.<sup>36</sup> there is large scale evidence (based on 80 years of national record of temperature and corals in Japan) that several major coral species have shown poleward expansions since the 1930s. The speed of this expansion may have reached up to 14 km/year, indicating how global warming is definitively having an effect on the distribution of these species. Although this might provide some hope that corals as a species could survive in the future, it does not offer much hope for the survival of current reefs and the atolls which depend on them.

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<sup>29</sup> Kench et al. (2009), pp. 180–213.

<sup>30</sup> Reaser et al. (2000), pp. 1500–1511.

<sup>31</sup> Burke et al. (2011).

<sup>32</sup> Burke et al. (2011).

<sup>33</sup> Burke et al. (2011).

<sup>34</sup> Burke et al. (2011).

<sup>35</sup> Yamano et al. (2011).

<sup>36</sup> Yamano et al. (2011).

### 3.2.3.1 Coral Bleaching

Coral reefs are vulnerable to changes in their environment, particularly the quality (quantity of nutrients, salinity, etc.) and temperature of the water around them. When conditions are not ideal for corals, episodes of what is referred to as “coral bleaching” take place, where the corals lose their colourful appearance and turn white. This whitening is the visible sign of a loss of cells containing the symbiotic algae (*zooxanthellae*) responsible for the corals’ bright colour, which play a vital role in their metabolism.<sup>37</sup> Essentially, when they are under stress corals will release the symbiotic algae, as it increases its short-term chances of survival, and the coral is able to regain the algae from the sea water at a later time. However, if the stressful conditions persist, the coral dies. Hence, although coral reefs can recover from infrequent and mild bleaching, intense and frequent events can cause irreversible damage.<sup>38</sup>

Coral bleaching is associated with events where the water temperature is above normal, and recently episodes of mass coral reef mortality have been experienced around the world.<sup>39</sup> The temperature of the sea water plays a major part in this, and variations of over +3 or 4 °C can result in “mass bleaching” events such as those that took place in 1982–1983, 1987–1988, 1994–1995 and 1998.<sup>40</sup> It is important to note, however, that the various species of corals respond in different ways to increased temperatures and how there are other factors at play, such as local cold and warm water flows (due to upwelling from cold deep waters and the effects of tides), variations in water turbidity and the resilience of each reef.<sup>41</sup> Also, corals in each area show different tolerance to water temperatures, suggesting how a number of adaptation and evolutionary mechanisms might be at play,<sup>42</sup> and it is conceivable that given time and assuming no other stressors corals would be able to successfully adapt to slight increases in water temperatures.

Coral mortality can lead to a shift in reef ecological status, such as what happened in Uva Island in the Pacific Coast of Panama in 1982–1983.<sup>43</sup> Here warm surface temperatures related to an El Niño event and associated coral bleaching led to a reduction in approximately 50 % of coral cover, and resulted in a negative CaCO<sub>3</sub> reef budget. This resulted in a shift in the reef’s ecological state, which was made worse by low tide exposure, cold water stress after the El Niño had passed and increases in corallivore erosion (due to increases in echinoid densities). It is of course important to note how coral reefs can recover from many of these events, that some reefs can return to periods of positive CaCO<sub>3</sub> budgets after

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<sup>37</sup> Kench et al. (2009), pp. 180–213.

<sup>38</sup> Burke et al. (2011).

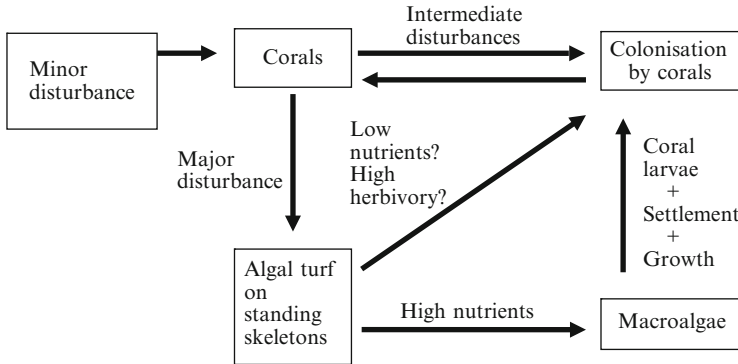
<sup>39</sup> Reaser et al. (2000), pp. 1500–1511.

<sup>40</sup> Kench et al. (2009), pp. 180–213.

<sup>41</sup> Kench et al. (2009), pp. 180–213.

<sup>42</sup> Kench et al. (2009), pp. 180–213.

<sup>43</sup> Kench et al. (2009), pp. 180–213.



**Fig. 3.1** Ecological phase shifts on coral reefs (after Kench et al. 2009, pp. 180–213, who adapted it from Done 1992, pp. 121–132)

periods of degradation and that natural cycles might be the norm in these kind of environment, as shown in Fig. 3.1.<sup>44</sup> There is considerable evidence that this concept of phase shift<sup>45</sup> indeed takes place (Kench et al.<sup>46</sup> summarise how in Jamaica coral cover declined from around 55 % in the 1950s to around 3 %, while macroalgal cover increased from 4 to 92 %, though they also note that some limited recovery might be taking place in some areas). Indeed Kench et al.<sup>47</sup> note how natural cycles of geomorphic change might be the norm, with periods of higher sea temperatures resulting in greater coral mortality then being followed by periods of recovery. However it remains unclear what would happen if the frequency of the periods of higher sea temperatures was to increase, as predicted under current climate change models.

In order to reverse this phase shift some strategies have been tried, such as the establishment of reserves around certain areas. However, although the establishment of reserves to replenish fish stocks is relatively well documented, the evidence that they can have positive effects on corals and the fish species associated with them is inconclusive.<sup>48</sup> In theory, the establishment of reserves around areas where a shift in ecological state had taken place (such as in the Glover’s Reef in Belize) would encourage the proliferation of herbivorous fish who would eat the macroalgal cover, and help in re-establishing coral colonies, though this is not always the case.<sup>49</sup> In practice, it appears that much is still not understood about these processes, and that reserve performance can vary considerable reflecting local differences in reef community composition, reserve placement and the enforcement

<sup>44</sup> Kench et al. (2009), pp. 180–213.

<sup>45</sup> Done (1992), pp. 121–132.

<sup>46</sup> Kench et al. (2009), pp. 180–213.

<sup>47</sup> Kench et al. (2009), pp. 180–213.

<sup>48</sup> See Huntington et al. (2011), pp. 1077–1085 and International Society for Reef Studies (2008).

<sup>49</sup> Huntington et al. (2011), pp. 1077–1085 and International Society for Reef Studies (2008).

of fishing bans.<sup>50</sup> Also, it is important to note that marine reserves cannot deal with all detrimental impacts (generally they only regulate fishing, but not pollution, sedimentation from the coast or other issues), and thus by themselves are not enough. Better management practices would be needed across the broader marine and coastal environment to deal with all impacts and threats.

According to projections by the “Reefs at Risk” report,<sup>51</sup> and assuming greenhouse gas emissions continue in the present trajectories, during the 2030s around half of the reefs in the planet will experience thermal stress sufficient to induce severe bleaching in most years. This is expected to increase to around 95 % of the reefs by the 2050s.

### 3.2.3.2 Ocean Acidification

Corals are also vulnerable to ocean acidification, which can decrease the rate at which corals form their calcium carbonate skeletons,<sup>52</sup> and increased concentrations of CO<sub>2</sub> in the oceans could also retard the capacity of coral reefs to keep up with sea-level rise.<sup>53</sup> Ocean acidification occurs as a consequence of the enhanced uptake of CO<sub>2</sub> by the oceans, which effectively act like a sink of part of the CO<sub>2</sub> released into the atmosphere by human activities. This capacity of the oceans to absorb CO<sub>2</sub> has been responsible for CO<sub>2</sub> concentrations raising less rapidly than what they would have otherwise done, though at the cost of increasing the acidity of the water. It appears that the pH of tropical surface water declined from 8.2 in the pre-industrial period to 8.1 nowadays.<sup>54</sup> This essentially means that the acidity has increased significantly, by 30 %.<sup>55</sup>

Ocean acidification reduces the saturation level or aragonite in the water, a compound that corals need to build their skeletons.<sup>56</sup> Calcification rates are predicted to decrease by between 12 and 48 % by the time that CO<sub>2</sub> concentrations reach twice the preindustrial era in the next 30–50 years, which can lead to reduced skeletal growth.<sup>57</sup> By 2030 it is estimated that only half the planet’s reefs will be located in areas where aragonite levels are ideal for coral growth, and this will decrease to 15 % by 2050.<sup>58</sup> It is predicted that by 2050 ocean acidification could increase by 150 %, a faster rate of change than what has been experienced in the

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<sup>50</sup> Huntington et al. (2011), pp. 1077–1085 and International Society for Reef Studies (2008).

<sup>51</sup> Burke et al. (2011).

<sup>52</sup> Kleypas and Gattuso (2010).

<sup>53</sup> Kleypas et al. (1999), pp. 118–120.

<sup>54</sup> Kench et al. (2009), pp. 180–213.

<sup>55</sup> Secretariat of the Convention on Biological Diversity (2009), pp. 1–61.

<sup>56</sup> Burke et al. (2011).

<sup>57</sup> International Society for Reef Studies (2008).

<sup>58</sup> Burke et al. (2011).

marine environment in the last 20 million years.<sup>59</sup> The IPCC 4AR projects that by 2100 CO<sub>2</sub> concentrations might have risen so much that the pH could be lowered to 7.8. Also, increased acidification will lead to higher dissolution rates of carbonate in the water, which will compound the effect of slower coral growth, negatively affect reef building<sup>60</sup> and shift some reef carbonate budgets towards a state of net erosion. According to a report by the Convention on Biological Diversity (CBD), tropical waters around the year 2100 will “experience rapid declines in carbonate ions, reducing rates of net warm water coral reef accretion and leaving biologically diverse reefs outpaced by bioerosion and sea-level rise”.<sup>61</sup>

These effects can already be observed in areas that have naturally occurring vents that release CO<sub>2</sub> into the water, which can effectively serve as “natural labs” that allow scientists to observe the effects that CO<sub>2</sub> has on coral populations. In one such area in Papua New Guinea, the water progressively increases in acidity in the proximity of the vents, and these areas are characterised by having fewer species of corals, and particularly none of the structurally complex ones that can provide cover for fish.<sup>62</sup> At pH levels of 7.8 (in line with what could be expected if CO<sub>2</sub> concentrations increased from the present levels of around 390–750 ppm, as per some of the scenarios found in the IPCC 4AR) coral reef cover is typically maintained, though coral diversity is severely reduced and *Porite* corals establishes dominance over the coral reefs, though at low rates of calcification. At pH levels of 7.7 reef development ceases, and leads to an environment dominated by seagrasses, but devoid of the hard-shelled snails that normally live there.<sup>63</sup> Avoiding high levels of CO<sub>2</sub> in the atmosphere thus appears to be crucial to ensure the survival of coral reefs as we presently know them.

It could be possible that coral reefs would practically disappear within a generation<sup>64</sup> with Veron et al.,<sup>65</sup> predicting that

at today’s atmospheric CO<sub>2</sub> levels (~387 ppm), coral reefs are committed to an irreversible decline. Mass bleaching will in future become annual, departing from the 4 to 7 years return-time of El Niño events. Bleaching will be exacerbated by the effects of degraded water-quality and increased severe weather events. In addition, the progressive onset of ocean acidification will cause reduction of coral growth and retardation of the growth of high magnesium calcite-secreting coralline algae. If CO<sub>2</sub> levels are allowed to reach 450 ppm (due to occur by 2030–2040 at the current rates), reefs will be in rapid and terminal decline world-wide from multiple synergies arising from mass bleaching, ocean acidification, and other environmental impacts. Should CO<sub>2</sub> levels reach 600 ppm reefs will be eroding geological structures with populations of surviving biota restricted to refuges. Domino effects will follow, affecting many other marine ecosystems. This is likely to have been the path of great mass extinctions of the past, adding to the case that anthropogenic CO<sub>2</sub> emissions could trigger the Earth’s sixth mass extinction.

<sup>59</sup> Secretariat of the Convention on Biological Diversity (2009), pp. 1–61.

<sup>60</sup> See Kench et al. (2009), pp. 180–213 and International Society for Reef Studies (2008).

<sup>61</sup> Secretariat of the Convention on Biological Diversity (2009), pp. 1–61.

<sup>62</sup> Fabricius et al. (2011), pp. 165–169.

<sup>63</sup> Fabricius et al. (2011), pp. 165–169.

<sup>64</sup> Rogers and Laffoley (2011), pp. 1–18.

<sup>65</sup> Veron et al. (2009), pp. 1428–1436.



**Fig. 3.2** Land-based pollution can affect coral reef growth (photo from Tuvalu). Picture courtesy of Hiroshi Takagi

### 3.2.3.3 Effects on Atolls

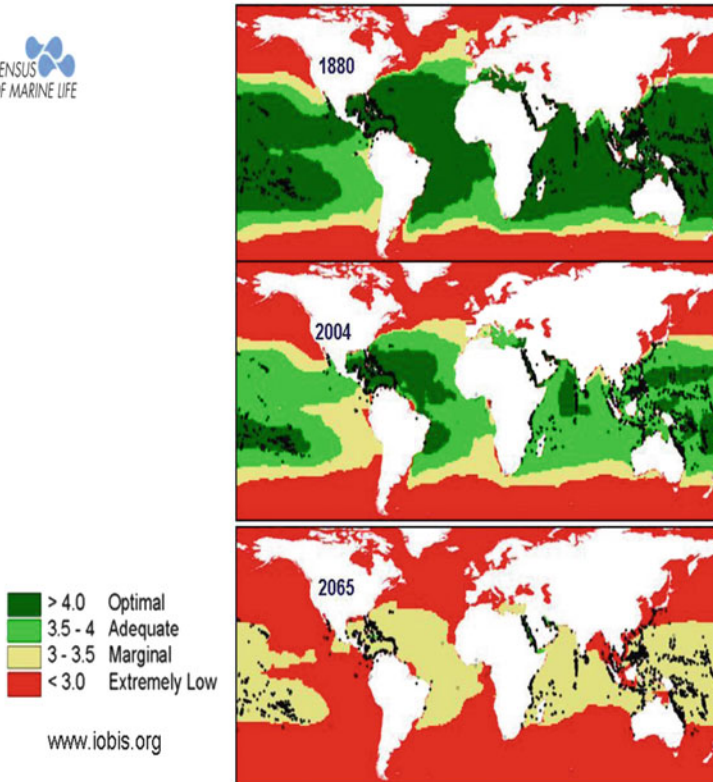
The combination of an increase in sea surface temperatures and ocean acidification, together with the detrimental effects of land-based sources of pollution (see Fig. 3.2) and other anthropogenic stressors (unsustainable fishing practices, coastal development, etc.) make it unlikely that the coral reefs will be able to keep up with the pace of sea level rise.<sup>66</sup> Indeed, atoll islands suffer from severe waste treatment problems, and a survey on rubbish collection on Kaupule in 2000 in Tuvalu found that the community produces approximately 258 tonnes of solid waste per year,<sup>67</sup> much of which finds its way into the ground and then the sea due to the relatively under-developed toilet systems used in the island.<sup>68</sup> This in turn affects the water quality, which can have a detrimental effect on the corals. In terms of house-hold waste, it has been estimated that Funafati produces over 6,000 m<sup>3</sup> of waste each year, a considerable challenge to dispose of using existing land-fill sites (see Fig. 3.2). Again, pollution from these land-fills can find its way into the water,

<sup>66</sup> Westmacott et al. (2000).

<sup>67</sup> According to JICA (2011).

<sup>68</sup> Similar problems exist in other atolls such as Kiribati, according to Loughry and McAdam (2008).





**Fig. 3.3** Effects of ocean warming and acidification on the future of coral reefs (figures are reproduced from the Census of Marine life, with the permission of John Guinotte, from the original research that lead to this figure, in Guinotte et al. 2003, pp. 551–558)

and could eventually pose an even bigger problem due to the limited available land in the island. Notwithstanding these land-based sources of pollution by 2030 the combined impact of ocean warming and acidification could mean that 90 % of the reefs move to threatened status, and by 2050 nearly all of them will be classified as such, assuming there is no change in the local pressure on reefs.<sup>69</sup>

The Census of Marine Life summarised quite well these effects in Fig. 3.3, showing what the effects of ocean warming and acidification might mean for the future of coral reefs. Optimal temperature and pH conditions for coral reef calcification have declined from 1880, and conditions are projected to become marginal for most tropical areas by 2065.

As it is unlikely that coral growth will be able to overcome the stressors to which it is currently subjected<sup>70</sup> this will mean that there will be less sand supplied to the

<sup>69</sup> Burke et al. (2011).

<sup>70</sup> See Westmacott et al. (2000) and Kench et al. (2009), pp. 180–213.



islands, and progressively their height relative to the surface of the sea will decrease. This will lead to a higher risk of flooding, coastal erosion, a decreasing ability of the islands to sustain human populations<sup>71</sup> and eventually places like Kiribati, Tuvalu, the Marshall Islands and the Maldives could potentially become entirely submerged.<sup>72</sup> It is important to remember, though, that the timescales involved in this are likely to be greater than sometimes claimed. Reef structures have considerable resilience, and even if the ecosystem that supports them degrades considerably there is a delayed response for that to propagate through the geomorphic system.<sup>73</sup> Paradoxically, episodes of bleaching and other natural or human impacts might have a short-term positive impact on the supply of sediments, and hence the reality of how these changes might come about is far more complex than what is often thought.

There is evidence that a number of reef systems failed during the Holocene, and there are examples of these failed islands around the world,<sup>74</sup> which are typically located in depths of 30–70 m. The failure of these reefs has been attributed to sea surface temperature fluctuations, declining water quality and rapid increases in sea levels.<sup>75</sup> One particular episode, referred to as the meltwater pulse 1A (MWP-1A) was responsible for a sea level rise of 15 m over a period of 500 years, and probably resulted in several reefs around the Great Barrier Reef (Australia) and the Comores Islands (Western Indian Ocean) failing.<sup>76</sup> It is interesting to note how in the Indo-Pacific region reefs generally survived this period far better.<sup>77</sup> Such an extreme rate of sea level rise would be higher than that forecasted by the IPCC 4AR or even the more extreme scenarios currently proposed (such as that by Vermeer and Rahmstorf,<sup>78</sup> as described previously in this chapter). It is also interesting to note how the rates of vertical accretion of reef margins for different regions around the world range from 8 to 30 mm/year, according to Kench et al.,<sup>79</sup> with a rate of around 10 mm/year for the Indo-Pacific atolls. This would be more than enough to keep pace with the sea level rise outlined in the various scenarios on the IPCC 4AR (where the most severe emission scenarios project a 5.9 mm/year rise in sea levels), though many coral systems would not be able to cope with the sea level rise predicted in Vermeer and Rahmstorf,<sup>80</sup> which would represent 19 mm/year. Nevertheless, even when it appears that coral reefs have the potential to keep pace with the sea level rise scenarios given in the IPCC 4AR, this would depend to a large

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<sup>71</sup> Barnett and Adger (2003), p. 325.

<sup>72</sup> Caron (1990), pp. 621–653.

<sup>73</sup> Kench et al. (2009), pp. 180–213.

<sup>74</sup> Kench et al. (2009), pp. 180–213.

<sup>75</sup> Kench et al. (2009), pp. 180–213.

<sup>76</sup> Kench et al. (2009), pp. 180–213.

<sup>77</sup> Kench et al. (2009), pp. 180–213.

<sup>78</sup> Vermeer and Rahmstorf (2009).

<sup>79</sup> Kench et al. (2009), pp. 180–213.

<sup>80</sup> Vermeer and Rahmstorf (2009).

extent on the health of these systems and how well they could adapt to the changing environmental conditions.

In terms of the long-term survivability (centuries to millennia) of corals as a species, mass bleaching alone is unlikely to cause widespread extinctions as the complexities of reef topographies could provide a refuge from which re-seeding could take place,<sup>81</sup> and there is some evidence that corals are currently moving to higher latitudes.<sup>82</sup> Ocean acidification, on the other hand, could pose a greater problem for their long-term survival and be potentially more devastating than the bleaching caused by increases in surface sea temperatures.

### **3.2.3.4 Mass Extinction of Marine Species Caused by the Death of Corals**

Oceans cover the vast majority of the Earth's surface, and their health is of paramount importance to the survival of countless species. Atoll Island States, being completely surrounded by the sea, are dependent on the overall health of these oceans to maintain the local ecosystems on which they depend. It appears that currently the world is experiencing a severe decline in the numbers of many marine species, many of which are being driven to the point of commercial extinction.<sup>83</sup> Assuming current rates of CO<sub>2</sub> emissions remain the same, coral reefs as we know them will be in severe danger by the 2030s,<sup>84</sup> and many species of fish that find their home around them will probably collapse as a result. This in turn is likely to have a knock-on effect on the population of other sea species in the vicinity of the coral reefs themselves, which will severely impact the ability of the population of Atoll Island States to obtain fish from these areas. The effects, however, will not just be limited to Atoll Island States. Veron et al.<sup>85</sup> point how anthropogenic CO<sub>2</sub> emissions could trigger the Earth's sixth mass extinction, the consequences of which would be far-fetched and affect fisheries around the planet in ways difficult to foresee. This would have not only severe socio-economic implications for fishermen world-wide, but also for the food security of many States.

### **3.2.4 King Tides (Spring Tides)**

The term King Tides is often employed in Small Island States (especially in the Pacific) to refer to the phenomenon of spring tides, which occur when the Sun,

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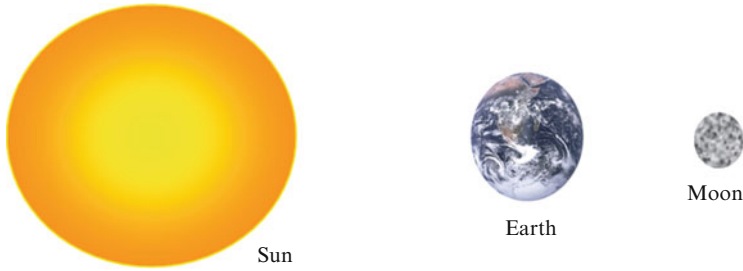
<sup>81</sup> Veron et al. (2009), pp. 1428–1436.

<sup>82</sup> Yamano et al. (2011).

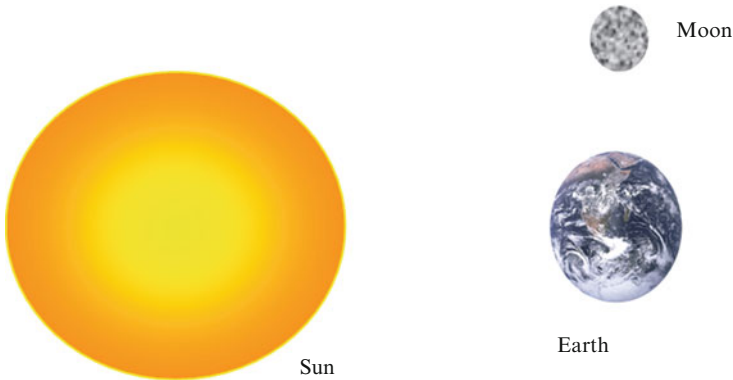
<sup>83</sup> Rogers and Laffoley (2011), pp. 1–18.

<sup>84</sup> Veron et al. (2009), pp. 1428–1436.

<sup>85</sup> Veron et al. (2009), pp. 1428–1436.



**Fig. 3.4** Diagram showing a representative alignment of the Earth–Moon–Sun system at spring or “King” tides (note spring tide also occurs when Moon is between the Sun and the Earth)



**Fig. 3.5** Diagram showing a representative alignment of the Earth–Moon–Sun system at neap tide

Earth and Moon are aligned (see Fig. 3.4 for the case of kind tides and Fig. 3.5 for neap tides, which represent the opposite effect i.e. when tides are at their lowest). During these periods the tidal force due to the Sun reinforces that of the Moon, and results in tidal ranges much greater than under other circumstances. It is important to note that the distance from the Sun to the Earth<sup>86</sup> and other factors also play a part in the tidal range, explaining how the height of these tides varies throughout the year.

The periods when “king tides” occur can be particularly dangerous to coastal areas in all countries, as they can result in stronger currents and coastal inundation. However, for the case of Atoll Island States this phenomenon can be even more dangerous, as sometimes entire sections of low-lying atolls can be submerged by the high waters.<sup>87</sup> For the case of Tuvalu, for example, the highest water level during a kind tide was +3.41 m in February, 2006, compared to a mean sea level of

<sup>86</sup> The Earth’s orbit around the Sun is elliptical, and thus the effect of the Sun on the tidal range will vary throughout the year.

<sup>87</sup> Rakova (2009).

+2.0 m from chart datum level (JICA report).<sup>88</sup> Due to this reason King tides could potentially play a very significant part in the depopulation of many small lying islands, as the flooding of the islands causes an increase in salinity in soils that can make them unsuitable to support agriculture. Seawater intrusion is actually already a problem in many islands, which has already caused the loss of many crops and the decrease in productivity of fields.<sup>89</sup> Increases in sea level rise will accentuate this problem, as the frequency of tides flooding any given island could rise, leading to the loss of more vegetation and crops. One example of a place where this could already be happening is that of the Carteret Islands.

### 3.2.4.1 King Tides and Its Effect on the Carteret Islands

In the Carteret Islands in Papua New Guinea the effect of these King tides has led to the contamination of fresh water supplies and “turned vegetable plots into swampy breeding grounds for malaria-carrying mosquitoes”.<sup>90</sup> The inhabitants of these islands have started to attempt to relocate to the main island of Bougainville, in what has been called “one of the first organised resettlements movements of climate change displaced persons”.<sup>91</sup>

These islands are located 86 km north-east of the island of Bougainville, one of the main islands (though not the biggest) of the many that form part of Papua New Guinea.<sup>92</sup> The atoll is made up of number of islands stretching around 30 km in the north–south direction, with a total land area of 0.6 km<sup>2</sup> and a maximum elevation of 1.5 m above sea level.<sup>93</sup> The main settlement is at Weteili on the main islet (Han islet), and the total population of the islands is around 3,300 people.<sup>94</sup> Originally there were six islets, but Huene was split in half by the sea and at present there are seven, and there has been severe erosion to others such as Piul. The Han islet itself has suffered from complete inundation at times during king tides.<sup>95</sup>

As a consequence of the increasing frequency of these inundation events the islands are becoming progressively uninhabitable, as increases in salinity and contamination of fresh water supplies are rendering many areas unsuitable for cultivation, with the islanders having to rely on outside food to cover part of their needs (the government sends in supplies by ship several times a year).<sup>96</sup> Indeed

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<sup>88</sup> According to JICA (2011).

<sup>89</sup> Maclellan (2009).

<sup>90</sup> Rakova (2009).

<sup>91</sup> Displacement Solutions (2009), p. 18.

<sup>92</sup> Rakova (2009).

<sup>93</sup> Rakova (2009).

<sup>94</sup> Rakova (2009).

<sup>95</sup> Rakova (2009).

<sup>96</sup> Rakova (2009).

Taro,<sup>97</sup> the local staple food, no longer grows on the atoll, and there has been an increase in the number of mosquitoes, with the associated health risks they pose in the transmission of vector diseases.<sup>98</sup> The natural tree cover of the island is also suffering from the inclusion of salt water on the fresh water table.<sup>99</sup>

Although there has been some debate over the cause of these increases in flooding (including plate tectonic movement, destruction of the coral reefs by ammonium nitrate bombs for stun fish harvesting or depletions of the aquifer in the islands<sup>100</sup>), it has been claimed that sea level rise has had a big part to play in the problems experienced by the islands.<sup>101</sup>

In response to these problems, the islanders have tried to build sea walls or plant mangroves, though both of these measures have proven to be ineffective.<sup>102</sup> The government has generally recognised the problem, and in 1984 they resettled ten families from the Carterets to Bougainville, though these returned to the islands after civil war broke out there Bougainville in 1989.<sup>103</sup> Five men from the island attempted once again to move to Bougainville in 2009 in 300 acres of land mostly donated by the Catholic Church,<sup>104</sup> with the plan to build houses, plant crops and eventually allow another 1,700 islanders to move to the main land.<sup>105</sup> The final plan is for all inhabitants to voluntarily relocate to Bougainville over the next 10 years, though considerable help will probably be needed for this to happen (the estimated 300 families would need 1,500 ha of land<sup>106</sup>). Ninety-six percent of the land mass in Bougainville is governed by customary land ownership, and less than 3 % is held by the government.<sup>107</sup> The Carteret islanders do not have the necessary financial resources to buy private land, and so far the local government has lacked the political will to purchase or expropriate the land, despite some budget funds allegedly been allocated to this project.<sup>108</sup>

The difficulties in this relocation have been the subject of the documentary “Sun Come Up”,<sup>109</sup> explaining the challenges that islanders are having in finding lands,

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<sup>97</sup> This is a type of tropical plant that is grown as a root vegetable and as a leaf vegetable. It can be grown in paddy fields or upland areas.

<sup>98</sup> Rakova (2009).

<sup>99</sup> Rakova (2009).

<sup>100</sup> South Capitol Street 2011.

<sup>101</sup> Rakova (2009).

<sup>102</sup> Rakova (2009).

<sup>103</sup> Rakova (2009).

<sup>104</sup> Displacement Solutions (2009), p. 18.

<sup>105</sup> Rakova (2009).

<sup>106</sup> Displacement Solutions (2009), p. 19.

<sup>107</sup> Displacement Solutions (2009), p. 18.

<sup>108</sup> Displacement Solutions (2009), p. 18.

<sup>109</sup> Redfearn 2011 USA, Papua New Guinea. The documentary was nominated for an Oscar at the 83<sup>rd</sup> Annual Academy Awards in 2011.

especially given the difficulties of attempting to relocate to a place that was ravaged by civil war. Essentially, Bougainville has several communities that are culturally, politically and socially different, and hence newcomers are not immediately welcomed.

The inhabitants of the islands, however, expect that in the future they will keep returning to the reefs to manage them as fishing grounds and to have a connection to their heritage.<sup>110</sup> To do so, they will attempt to set up a Conservation and Marine Management Area, which would allow them to make sustainable use of their ancestral marine resources.<sup>111</sup> This would involve developing an equitable sea transport service for freight and passengers. In doing so, the islanders are hoping to maintain their cultural identity in the future.<sup>112</sup>

This case study raises a number of important lessons for the inhabitants of other islands who think about the possibility of relocating, such as the need to identify potential land which is not claimed by other people, the need for adequate financial resources, and the potential problems that can be caused by political authorities which are not committed to the process or who have other problems to deal with. These and other problems will be the subject of Chaps. 6 and 7.

### 3.3 Natural Disasters

Natural disasters such as tropical cyclones and tsunamis are likely to play a key role in the damage that climate change can cause to atolls and other small islands. Although normally the natural environment of these islands contributes to their protection, the cutting of mangroves around the coastline and the death of coral reefs can dramatically increase their vulnerability, increasing inundation levels, coastal erosion and the damage associated with them. Thus, strong episodic events might cause far more damage on a coastal zone that is degraded (from an environmental point of view) than on a healthy coastline. While the effects of climate change might not be felt for some time, the degradation of coastal environments in atolls is already taking place nowadays, and this can make them even more susceptible to future changes in the environment and natural disasters.

A key concept in how islands are affected by natural disasters is that of vulnerability. This can be defined as a product of the physical exposure to a natural hazard, and the “human capacity to prepare for or mitigate and to recover from (cope with) any negative impacts of disaster”.<sup>113</sup> Essentially, it measures how well a community is prepared for a natural disaster and what will be the effects if a

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<sup>110</sup> Rakova (2009).

<sup>111</sup> Rakova (2009).

<sup>112</sup> Rakova (2009).

<sup>113</sup> Adapted from a table detailing the vulnerability of Small Island States, in Pelling and Uitto (2001).

**Table 3.1** Vulnerability of Atoll Island States (Pelling and Uitto 2001)***Developing countries***

Colonial history, reliance on primary exports, extremes of poverty and inequality, limited physical and social infrastructure, inappropriate land use, weaknesses in governance and public administration

***Small size***

Limited natural resource base, high competition between land use, intensity of land-use, immediacy of interdependence in human-environment systems, spatial concentration of productive assets

***Insularity and remoteness***

High external transport costs, time delays and high costs in accessing external goods, delays and reduced quality in information flows, geopolitically weakened

***Environmental factors***

Small exposed interiors, large coastal zones

***Disaster mitigation capability***

Limited hazard forecasting ability, complacency, little insurance cover

***Demographic factors***

Limited human resource base, small population, rapid population changes, single urban centre, population concentrated on coastal zone, lack of economies of scale leading to high per capita costs for infrastructure and services

***Economic factors***

Small economies, dependence on external finance, small internal market, dependence on natural resources, highly specialised production

particular disaster strikes them. Another concept often used is that of resilience, which could be considered the reciprocal of vulnerability, and which can be defined as a quality that enables a community to quickly recover from a disaster shock.<sup>114</sup> This concept emphasizes coping with disasters rather than trying to avoid or control the physical causes of them.<sup>115</sup> Atoll Island States are typically very vulnerable to natural disasters, and the main problems that affect most of them are highlighted in Table 3.1.

### 3.3.1 Tropical Cyclones

Tropical cyclones can play a key role in dramatically changing life in coastal communities, due to the devastating effects they have on low-lying coastal areas. Coral islands are only a few metres above sea level, and thus these events bring with them a number of different sources of possible damage, namely:

- High winds
- High precipitation

<sup>114</sup> Pelling and Uitto (2001).

<sup>115</sup> Pelling and Uitto (2001).

- High waves that are generated as a consequence of the high winds
- Storm surges (as explained in more detail later in this chapter)

Damage to coastal communities varies greatly depending on factors such as the local coastal geometry, the atmospheric storm intensity or the location of human settlements. They can especially cause devastation in poor countries such as Bangladesh.<sup>116</sup> In this country, a cyclone in 1970 killed between 300,000 and 500,000 people.<sup>117</sup> Another cyclone in 1991 produced a storm surge of 6 m and led to another 140,000 deaths.<sup>118</sup> More recently Cyclone Sidr was one of the strongest cyclones ever recorded in the Bay of Bengal, causing huge damage when making landfall in Bangladesh on November 15, 2007. Sidr slammed the highly vulnerable low lying densely populated coastal areas with heavy rain, winds of up to 215 km/h, and a significant storm surge.<sup>119</sup> Although the casualty figure was rather limited (with just over 4,000 people killed<sup>120</sup> due to an extensive network of storm surge shelters built after previous disasters) the effect on homes, crops and livelihoods was extensive<sup>121</sup> (affecting 8.9 million people and causing an estimated US\$3.1 billion of economic losses<sup>122</sup>). In some areas of the country coastal dikes were built before cyclone Sidr struck, and even though these were reinforced in areas with sandbags many could not resist the force of the waves.<sup>123</sup> Nevertheless, Shibayama et al.<sup>124</sup> report how they could significantly reduce the damage to areas behind them. Many of the embankments that protected the land from the sea water were then breached again by cyclone Aila in May 2009.<sup>125</sup> In the Caribbean, Hurricane Ivan devastated Grenada in 2004, damaging or destroying over 90 % of hotel guest rooms, 80 % of the island's nutmeg trees (both the island's main foreign exchange earners) and causing massive damage to the country's socio-economic infrastructure,<sup>126</sup> estimated at around 200 % of GDP.<sup>127</sup> However, tropical cyclones occur most frequently in the western north Pacific Area, which accounts for approximately one-third of all typhoons in the

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<sup>116</sup> This country currently faces many challenges, such as overcrowding, land scarcity and poor urban conditions. Particularly important is the threat posed by sea level rise, as a large amount of the country is situated in the low-lying Ganges-Brahmaputra River Delta. The area is thus at high risk from the effects of storm surges which can lead to the inundation of coastal lands where millions of people live. It has been estimated that half of Bangladesh's population lives in areas less than 5 m below sea level. See Tasnim (2010).

<sup>117</sup> Landsea et al. (2006).

<sup>118</sup> See Shibayama et al. (2009) and Tasnim (2010).

<sup>119</sup> Shibayama et al. (2009).

<sup>120</sup> Tasnim (2010).

<sup>121</sup> Shibayama et al. (2009).

<sup>122</sup> According to the Disaster Management Centre, as reported by Tasnim (2010).

<sup>123</sup> Shibayama et al. (2009).

<sup>124</sup> Shibayama et al. (2009).

<sup>125</sup> Ahmed (2011).

<sup>126</sup> Mimura et al. (2007) (A chapter within the IPCC 4AR).

<sup>127</sup> Warner et al. (2009).



world.<sup>128</sup> In 2006, typhoon Dorian left 800 people dead in the Philippines alone.<sup>129</sup> Cyclone Val hit Samoa in December 1991, the worst storm to hit the islands in over 100 years, destroying over half the coconut palms. The total economic impact of this cyclone, together with cyclone Ofa in 1990 has been estimated to have caused damage greater than the country's annual average GDP.<sup>130</sup> Samoa was again devastated by a tropical cyclone in 1998. The island State of Niue was hit by cyclone Heta in 2004, causing great social and economic disruption to its 1,500 inhabitants, estimated at over three times the value of its annual GDP.<sup>131</sup>

However, serious damage from typhoons is not limited to less developed countries. In August 2009, Typhoon Morakot struck Taiwan, leaving hundreds dead, and many were buried alive or trapped by mudslides and floods.<sup>132</sup> In 1959 Typhoon Isewan in Japan triggered a massive storm surge that took around 5,000 lives on the coastline of Ise Bay.<sup>133</sup> Following this disaster the Japanese government embarked on a large scale coastal defence construction program, yet typhoon Bart in 1999 and Chaba in 2004 brought storm surges that caused significant damage to the Japanese coastline.<sup>134</sup>

Atoll Island States can greatly suffer from tropical cyclones. In October 1972, cyclone "Bebe" hit Tuvalu, killing several people destroying millions of dollars worth of property.<sup>135</sup> The capital atoll of Funafati was engulfed by waves from both the ocean and lagoon side, with a huge 19 km long, 30–40 m wide and 4 m high embankment (called a "storm ridge") being formed as a consequence of the waves moving huge quantities of sediments.<sup>136</sup> The storm damaged houses, infrastructure, boats, coconut trees, the reef flats and caused extensive scouring of the islets in the atoll.<sup>137</sup> This scouring is of particular importance in the context of this book and the effects that future climate change can have on these islands, and thus in this section we will describe in more detail how these phenomena can affect coastal regions.

### 3.3.1.1 What Are Tropical Cyclones?

A tropical cyclone is a storm system characterised by a large low-pressure centre surrounded by numerous thunderstorms, which result in strong winds and heavy rain. The driving mechanism behind them is the heat released when moist air rises,

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<sup>128</sup> Imamura and Van To (1997), pp. 71–87.

<sup>129</sup> See Munich Re (2009).

<sup>130</sup> Maclellan (2009).

<sup>131</sup> Maclellan (2009).

<sup>132</sup> BBC (2009).

<sup>133</sup> Kawai et al. (2008).

<sup>134</sup> Kawai et al. (2008).

<sup>135</sup> Fitchett (1987), pp. 1–7.

<sup>136</sup> Fitchett (1987), pp. 1–7.

<sup>137</sup> Fitchett (1987), pp. 1–7.

resulting in condensation of the water vapour contained in this moist air. The heat mechanism that drives a tropical cyclone differentiates these storms from other types of cyclonic windstorms, such as European windstorms, as they originate in the vicinity of the equator, though not too close to it (from around 10° north or south of it). The reason for this is that they require a certain amount of Coriolis force (which is an acceleration effect caused by the Earth's rotation), which does not exist at the equator. This explains, for example, how some Island States such as the Federated States of Micronesia (FSM) and Tuvalu are affected by tropical cyclones, while Kiribati (which is located close to the equator) has no record of a direct cyclone impact.<sup>138</sup> Equally, as they feed on warm moist air, they cannot form in the colder northern latitudes.

Tropical cyclones, as their name implies, are cyclonic in nature, with counter clockwise rotation in the Northern Hemisphere and clockwise rotation in the Southern Hemisphere. Depending on its location, a tropical cyclone is referred to by a variety of names such as hurricane (e.g. America), typhoon (Asia Pacific), or cyclone (Indian Ocean).

### 3.3.1.2 Influence of Climate Change on Tropical Cyclones

One of the fears of global warming is that it might result in an increase in the frequency and intensity of tropical cyclones due to the increases in surface sea temperatures.<sup>139</sup> Tropical cyclones need high surface sea temperatures to develop (and it is well known that these must be over 26 °C for them to start forming), and “feed” on this heat to maintain or increase their strength. Once they move over land or into colder areas their power starts to wane, and hence it appears logical that future increases in global temperatures will increase the intensity of these events. Actually, over recent years a number of scholars have even voiced concerns about the possibility that global warming could have already been causing an increase in tropical cyclone intensity, and it is claimed that a 30-year analysis of satellite record of tropical cyclones confirms this.<sup>140</sup> An analysis of the trends in the upper quintiles of cyclone maximum wind speeds also found a significant upward trend for wind speed quintiles above the 70th percentile.<sup>141</sup> However, some authors have disputed the accuracy of satellite-based pattern recognition.<sup>142</sup> Also, it is believed that there is a certain cyclical variability in the natural patterns of tropical cyclones, which could be due to short-scale decadal cycles such as the El Niño-Southern Oscillation (ENSO).<sup>143</sup>

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<sup>138</sup> Webb and Kench (2010), pp. 234–246.

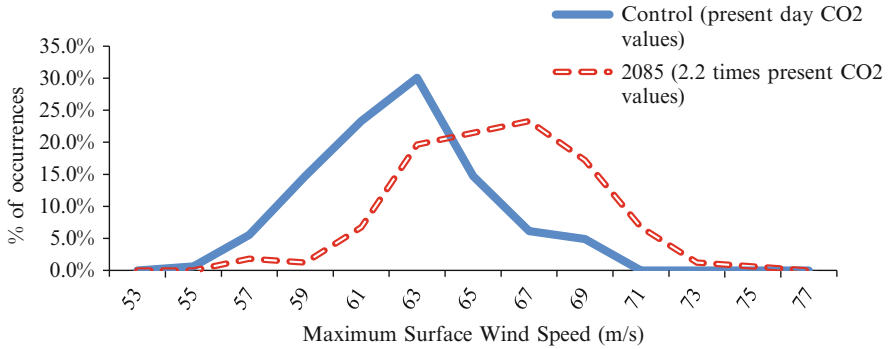
<sup>139</sup> Nordhaus (2006).

<sup>140</sup> Webster et al. (2005), pp. 1844–1846.

<sup>141</sup> Elsner et al. (2008), pp. 92–94.

<sup>142</sup> See of example Landsea et al. (2006), pp. 452–454.

<sup>143</sup> Mousavi et al. (2011), pp. 575–597.



**Fig. 3.6** Typical resolved inner-grid convection hurricane intensity simulation showing possible current and future probability distribution functions of tropical cyclone intensity, adapted from Knutson and Tuleya (2004), pp. 3477–3495

To try to understand how tropical cyclones are likely to be affected by an increase in global temperatures a number of climate models using powerful supercomputers have been carried out, as highlighted in the IPCC 4AR. One example of such research is the work of Knutson and Tuleya<sup>144</sup> who carried out simulations for a Surface Sea Temperature (SST) change of between +0.8 and +2.4 °C (assuming a linear +1 % compounded yearly increase in CO<sub>2</sub> over a period of eighty years up to the year 2085). This +1 % yearly increase means that CO<sub>2</sub> levels would reach 2.2 times the control value (that of 2004) by the year 2085. Knutson and Tuleya computed and presented histograms for the maximum surface wind speed for four different types of hurricane simulation, as shown in Fig. 3.6. The histograms depict an increase in both storm intensity and near-storm precipitation rates related to the increase in surface sea temperature. These authors acknowledge how other forcing agents besides greenhouse gases may have important effects on the global climate, but quantification of their past and possible future forcing remains even more unclear than for greenhouse gases. However surface sea temperature is not the only factor that affects the intensity of tropical cyclones. Other factors such as vertical wind shear can also play a crucial role, although how to correctly apply this is still under discussion.<sup>145</sup>

The IPCC 4AR reports that although there is general agreement that tropical cyclones are likely to increase in intensity there is no consensus yet on the future frequency of these events. Pielke also highlights the uncertainties regarding future changes in tropical cyclone intensity, and reports how nine of the leading scholars on tropical cyclones and climate change give estimates ranging from a 0 to 36 % increase in tropical cyclone intensity by the year 2100.<sup>146</sup> More recently Knutson

<sup>144</sup> Knutson and Tuleya (2004), pp. 2458–2468.

<sup>145</sup> See Emanuel et al. (2008), pp. 347–367, Chan (2006), p. 1713, and Vecchi et al. (2008).

<sup>146</sup> Pielke (2007) and Pielke and Landsea (1998), pp. 621–631.

et al.<sup>147</sup> summarised all the most important work on tropical cyclone simulations, including recent research that was done using higher resolution models than those used in the work that led to the IPCC 4AR. Their review suggests that the intensity of tropical cyclones in the future could increase by between 2 and 11 % by 2100. It is important to emphasize how Knutson et al.<sup>148</sup> find that the higher resolution models predict higher increases in tropical cyclone intensity than lower resolution ones, and hence it is possible that current models might be underestimating the potential problem.

### 3.3.1.3 Storm Surges

Storm surges are increases in mean sea level that originate as a consequence of the low atmospheric pressure at the centre of tropical cyclones and the wind and wave forcing of the sea water. Essentially, tropical cyclones are low pressure systems and as they move over the ocean the water level increases due to the reduced atmospheric pressure at a certain point. Roughly speaking, for each 1 hPa drop in atmospheric pressure a 1cm increase in sea level can be expected. Strong tropical cyclones can be 60 hPa or more below normal atmospheric pressure and thus this effect alone can cause significant flooding in coastal areas, especially if combined with spring tides.

However, tropical cyclones also bring strong winds, and these have the effect of “pushing” the general mass of the sea water towards the land, further increasing the flooding effect caused by the decrease in atmospheric pressure. These two effects (the increase in sea levels caused by the drop in atmospheric pressure and the wind and wave forcing of the sea water) are superimposed with the high waves that are caused by the strong winds, and this can help explain the devastation that can be caused in coastal areas by a strong tropical cyclone. Although completely unrelated to tsunami events strong storm surges can cause similar inundation, especially to areas where the coastal defences are non-existent or inadequate (such as in the case of New Orleans during the passage of Hurricane Katrina). Atolls rely on their coral reefs for much of the protection against the waves caused by tropical cyclones and are quite vulnerable against storm surges. If these events increase in magnitude in the future, and this is compounded by a decrease in the protection offered by coral reefs, the results could be devastating.

## Climate Change, Sea Level Rise and Storm Surge Considerations

The magnitude of the storm surge generated depends on a variety of factors, such as the tropical cyclone track, central pressure, radius and the forward speed.<sup>149</sup>

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<sup>147</sup> Knutson et al. (2010), pp. 157–163.

<sup>148</sup> Knutson et al. (2010), pp. 157–163.

<sup>149</sup> Kawai et al. (2008).

A simplification of the momentum balance for storm surge generation shows that, for a constant wind  $V$  acting over a water body of constant depth ( $h$ ) the wind generated surge ( $\zeta$ ) is given by<sup>150</sup>:

$$\zeta \propto \frac{V^2}{h}$$

This indicates how any increase in water depth, such as for example due to sea level rise, is expected to decrease the surge generation potential, while any increase in wind speed (due to stronger tropical cyclones) will increase the surge generating potential. This increase in sea level rise can attenuate the effects for some shallow areas, and for the case of a shallow bay with a mean depth of 4 m a 0.5 m increase in sea levels represents more than 10 % change in depth. However, in the open deep coastlines with water depths over 20 or 30 m any increase in water depth is unlikely to impact the magnitude of the storm surge.<sup>151</sup>

Despite the fact that this increase in depth will not significantly affect storm surge generation, sea levels in the future will be higher, and unless land is raised, coastal defences are built or people move their houses inland (this last option being unavailable altogether to the inhabitants of atolls, who have no inland areas to move to), a smaller storm surge would be needed to flood the same coastal area.

#### 3.3.1.4 Tropical Cyclone Damage

Tropical cyclones present a number of problems and challenges for human settlements. They can cause not only direct damage to human habitation and infrastructure, what could be described as the direct economic damage, but also disrupt the surrounding environment and ecosystems. The economic damage caused by these events is generally believed to be exponential,<sup>152</sup> where for example in the East Coast of the U.S.A. a 10 % increase in intensity can cause a 54 % increase in the mean normalized economic losses.<sup>153</sup> Climate change is expected to significantly increase the damage that these events cause throughout the world.<sup>154</sup> For the case of the Asia-Pacific region it has been estimated that the shift in tropical cyclone distribution shown in Fig. 3.6 could cause an increase in housing damage in the Philippines of between 37 and 58 % by 2085, depending on

<sup>150</sup> Mousavi et al. (2011), pp. 575–597.

<sup>151</sup> Mousavi et al. (2011), pp. 575–597.

<sup>152</sup> Pielke (2007) and Pielke and Landsea (1998), pp. 621–631.

<sup>153</sup> Hallegatte (2007), pp. 1956–1966. For a more detailed review of the potential losses to the US see Schmidt (2010).

<sup>154</sup> Mendelsohn et al. (2012).



**Fig. 3.7** Houses in atolls are often located next to the shore (picture from Tuvalu, courtesy of Hiroshi Takagi)

the adaptive capacity of the region considered.<sup>155</sup> The damage caused by these events to agriculture can also be substantial, as high wind speeds can easily destroy even the more resilient crops.<sup>156</sup>

For the case of atolls most of the infrastructure and houses tend to be located close to the sea, making these types of islands extremely vulnerable to tropical cyclone damage (see Fig. 3.7). Furthermore, the tourist installations from which many of these islands extract a large part of the revenues are also located near the coastline and hence are vulnerable to coastal erosion. As outlined in the previous chapter and in the IPCC 4AR, tourism is a major contributor to GDP and employment in many atolls, and the effects of climate change are likely to be largely negative.<sup>157</sup>

The damage that tropical cyclones can cause to ecosystems and land is more difficult to quantify, as the erosion of coastal areas sometimes appears to have no direct economic consequence but over a long period of time it can affect the inhabitability of an island. These events have also been known to damage coral reefs, which are vital to the long term sustainable development of atolls. Conversely, they can also have somewhat beneficial effects, such as opening up senescent reefs and promote opportunistic growth by fast growing corals,<sup>158</sup> plus

<sup>155</sup> Esteban et al. (2013).

<sup>156</sup> Stromberg et al. (2011), pp. 1079–1090.

<sup>157</sup> Mimura et al. (2007) (A chapter within the IPCC 4AR).

<sup>158</sup> Kench et al. (2009), pp. 180–213.

the damage they cause to reefs can be the source of sediments for the reef islands. As long as these events are not too destructive, the reef can recover fairly quickly. However, the problem lies in the fact that tropical cyclones can actually devastate a reef completely, and the damage that these events cause increases exponentially with wind speed. Kench et al.<sup>159</sup> note how for wind speeds of 120–150 km/h there is a patchwork of impacted and non-impacted areas, though for more severe storms in excess of 200 km/h the whole structure of the reef can be damaged, reducing it to an unstable rubble plan which is “unconducive to coral re-establishment”. An increase in tropical cyclone intensity can thus have not only catastrophic effects on reefs, but the increase in size of the storms would gradually extend the damage to wider portions of the archipelagos.

This increase in intensity could exacerbate all of these effects in the future, resulting in increased erosion of coastal areas and an additional loss in soil productivity due to higher frequencies of coastal flooding (due to storm-surges). The combined effect of both sea level rise, coral mortality and the potential increase in tropical cyclone intensity would thus place such a great level of stress on atolls that they could eventually destroy the ecosystem of the island, rendering it uninhabitable or completely submerging it.

### 3.3.2 *The Role of Tsunamis*

Something that is often forgotten in the discussions about the vulnerability and future inhabitability of Atoll Island States is the role that tsunamis can have on the geomorphology of these islands. Although tsunamis are natural hazards that are not related to climate or future changes to it, they can cause great destruction, and could become the “tipping point” that cause an environmentally degraded atoll already heavily affected by sea level rise to disappear or become uninhabitable.

Tsunamis are naturally occurring events where a number of long period waves strike a coastal area, often resulting in massive destruction when the waves are of sufficient height. These events are unrelated to climate change, as they are caused mainly by earthquakes under the sea.<sup>160</sup> Although many people around the globe were unaware of the existence of these events prior to 2004, they have gained increasing media attention following the Indian Ocean tsunami of 2004, the *Great Eastern Japan Earthquake and Tsunami of 2011*<sup>161</sup> and other smaller events in past years.<sup>162</sup> These events have occurred throughout history at (geologically speaking) fairly regular intervals, though the fact that little was known by the general public

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<sup>159</sup> Kench et al. (2009), pp. 180–213.

<sup>160</sup> Though other events such as volcanic eruptions or landslides also generate them.

<sup>161</sup> Mikami et al. (2012), pp. 1–26.

<sup>162</sup> For example the Mentawai tsunami in Indonesia, see Shibayama et al. (2012). Also the 2010 Chilean tsunami Mikami et al. (2012), pp. 529–534.

about them is related to their relative infrequency related to human life spans, though modern media has certainly increased awareness.

Tsunamis can cause catastrophic damage to coastal areas, and often result in the erosion of dozens of metres of coastline, providing that the waves carry sufficient energy. Generally speaking, developing countries have very few resources to deal with natural disasters, and it has been said that Pacific Island countries have “serious problems with disaster planning, response and risk management, including too few resources and staff, no systematic collection of data on disasters and little integration of disaster risk management into national planning”.<sup>163</sup> This highlights the potentially devastating effects that these events can have on the local population. The Banda Aceh tsunami of 2004, for example, severely affected the Maldives despite the 2,500 km that separated it from the epicentre of the magnitude 9.0 earthquake.<sup>164</sup> Waves of up to 4 m reached the islands, which resulted in many being completely inundated,<sup>165</sup> caused 82 dead, 26 missing and 12,000 people being made homeless.<sup>166</sup> The tourism sector, which is the country’s largest source of foreign income, was also severely affected, with 19 resorts so damaged they had to close down, and another 14 suffering major damage (out of a total of 87 existing resorts before the tsunami, according to Fritz et al.<sup>167</sup>). Malé, the capital, was one of the few islands in the country that was not completely overwashed by the tsunami, as some degree of protection was offered by detached concrete protections and the runway at Malé International Airport on Hulhule Island, west of Malé.<sup>168</sup> The tsunami also resulted in severe coastal erosion in some of the islands and destruction of coastal structures, such as in Kandholhudhoo Island, where part of the island had been reclaimed from the sea by building an encircling seawall which partially collapsed due to tsunami erosion.<sup>169</sup>

Coral reefs can play an important role in dissipating tsunami energy, protecting coastal areas and alerting residents of the dangers of the incoming waves.<sup>170</sup> For example the Samoan Islands, and especially Upole Island, have a wide coral reef (which can be as wide as 2 km). During the 2009 Samoan tsunami the wave broke over the edge of the coral reefs and become a bore-type wave, and the turbulence associated with this helped dissipate much of the incoming energy of the wave, which would then be felt as a “rising-tide”.<sup>171</sup> These “rising-tide” types carry much less energy than other types of tsunami events, and result in far less coastal erosion and destruction of structures and houses, highlighting the importance of reefs as

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<sup>163</sup> Maclellan (2009).

<sup>164</sup> Fritz et al. (2006), pp. 137–154.

<sup>165</sup> An estimated 40 % of the lands in the Maldives were inundated, see Lamb (2005).

<sup>166</sup> Fritz et al. (2006), pp. 137–154.

<sup>167</sup> Fritz et al. (2006), pp. 137–154.

<sup>168</sup> Fritz et al. (2006), pp. 137–154 and Lamb (2005).

<sup>169</sup> Fritz et al. (2006), pp. 137–154.

<sup>170</sup> Mikami et al. (2011a, b).

<sup>171</sup> Mikami et al. (2011a, b).





**Fig. 3.8** Destroyed village in the Mentawai Islands (Indonesia) in 2010

natural barriers. Not only did the coral reefs dissipate the energy of the incoming wave, but also many people saw the wave breaking on top of it and quickly became aware of the approaching tsunami.<sup>172</sup> This role of coral reefs in dissipating the energy of incoming tsunamis has been validated by computer simulations.<sup>173</sup> However, the destruction of coral reef ecosystems (as outlined previously in this chapter) can increase the damage caused to coral islands by a tsunami, as the energy of the waves will not be dissipated by the reef and lead to greater coastal erosion. Nevertheless, it is important to understand that even when the reefs are present these are still extremely powerful and dangerous events and despite the presence of coral reefs entire coastal villages can be wiped from the map, such as those in Mentawai Islands, Indonesia, in 2010 (see Fig. 3.8).

Tsunamis, though comparatively rare events in many places in the world, could actually act as a catalyst and greatly exacerbate other climate change problems. Thus, extremely vulnerable islands facing a variety of other problems could be easily brought to a tipping point of irreversible collapse due to the tremendous coastal erosion and destruction that these events can cause. For the case of a degraded atoll, suffering already from the effects of sea level rise and where the coral reef had been severely damaged, it is easy to envisage how the tsunami could overwash the island and result in the erosion of great portions of it. An example of this kind of scenario could be seen during the *Great Eastern Japan Earthquake and Tsunami of 2011* in the town of Rikuzentakata in the northern Tohoku region. Here,

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<sup>172</sup> Mikami et al. (2011a, b).

<sup>173</sup> Kunkel et al. (2006).



**Fig. 3.9** Only one tree survived in the coastal forest of Rikuzentakata. Note that the water areas around the tree were previously a coastal forest, and that there was also coastal defences (to the left of the picture) protecting part of the area

a coastal forest in the seaside of the town was removed by the tsunami, with the area behind it also suffering a great amount of coastal erosion (see Fig. 3.9).<sup>174</sup> An even more dramatic example of coastal erosion was observed at Motoyoshicho Nakajima, where around 300 m of coastal erosion was recorded. This area was made of low-lying ground around the mouth of Tsuya River, and hence easily inundated by the tsunami wave, which was measured to be between 9.23 and 10.88 m in height<sup>175</sup> (see Fig. 3.10). As coral islands are typically not so wide, such an event in an atoll that was not protected by either vegetation or coastal defences could cause it to completely disappear. Of course if the island was not completely wiped out it could recover in time if it had an ample supply of sediments, though for the cases of a degraded coral reef this does not seem likely, and what was left of the island would probably slowly erode further due to wind waves. It is also important to note that, aside from coastal erosion and damage to infrastructure and housing, tsunami events can also result in increases in the salinity of the flooded areas, which can cause the death of trees and other plants.

<sup>174</sup> Although there is a general belief that coastal forests can help to protect against a tsunami, it is not always clear whether they actually offer much protection. Moreover, as observed, the forests can often suffer much damage themselves. Indeed, for the stronger events, such as in this case, the tsunami can rip trees and carry them inland, increasing thus the damage to infrastructure. This process can result in greater damage to human settlements, with the trees becoming floating debris that can then hit both structures and individuals.

<sup>175</sup> Mikami et al. (2012).



**Fig. 3.10** Around 300 m of coastal erosion were measured at Motoyoshicho Nakajima

### 3.4 Wave Climate

The increases in wind speeds associated with potential increases in tropical cyclone intensity and other mid-latitude storms could have an important effect on wave climate, which together with sea level rise and storm surges could exacerbate the vulnerability of coastal regions.<sup>176</sup> Research at Kyoto University in Japan estimated future ocean wave changes based on the projections of high-resolution atmospheric general circulation and global wave models and found that there will be changes in the distribution of wave heights around the planet.<sup>177</sup> Broadly speaking, according to this research mean waves will increase at both middle latitudes and in the Antarctic, and decrease around the equator.<sup>178</sup> The patterns are actually slightly more complicated, though it is also important to understand that although mean wave heights might decrease in some locations this does not mean that the maximum wave heights will also decrease. Essentially, the average wave climate conditions depend on the global scale atmospheric circulation change, while the maximum wave heights is often the consequence of high intensity wind events such as tropical cyclones. The potential increases in tropical cyclone intensity (as outlined previously in this chapter) mean that while average wave heights might decrease in some areas (such as around Japan), the extreme waves caused

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<sup>176</sup> Mori et al. (2010), pp. 15–19.

<sup>177</sup> Mori et al. (2010), pp. 15–19.

<sup>178</sup> Mori et al. (2010), pp. 15–19.

by tropical cyclones will increase,<sup>179</sup> and this will still create complex problems for coastal areas.

Evidence that there are trends in patterns of wave climate are already clear, and for the Southern Hemisphere these tend to be associated with the Southern Annular Mode (SAM, also referred to as the high-latitude mode and the Antarctic Oscillation) and El Niño events.<sup>180</sup> Future changes to El Niño/La Niña events could thus change the dominant directions of sand movement, and alter existing patterns of sediment transport, that could confuse efforts to protect atoll islands.

### 3.5 Coastal Erosion

The IPCC 4AR highlights how sea level rise could create significant problems for atolls in terms of coastal erosion. Normally reef islands are highly dynamic environments where the sediments that form the island reorganise themselves to adapt to changes in the environment.<sup>181</sup> However, the changes to which these islands are normally subjected to occur at timescales that are at least an order of magnitude greater (centennial to millennial) than the timescales which they will face in the future.<sup>182</sup> It is not clear how the fluid flows and sediment dynamics on exposed fringing reefs might change in response to rapid sea-level rise.<sup>183</sup> Recent computer models suggest that an increase in water depth of the order of 0.5–1 m on 1–2 m deep exposed fringing reefs could result in larger wave heights and setup, which would result in much higher waves in the area between the fringing reef and the beach<sup>184</sup> (an area referred to as the “reef flat”). It has been suggested that these changes will mean that sea-level rise could outstrip potential new reef flat accretion and result in an increase in water depth over exposed fringing reefs flats of around 0.4–1.5 by 2100<sup>185</sup>. This would result in the reopening of the “energy window” that would allow geomorphic processes to gather pace.<sup>186</sup> However this increase in the depth of the area between the fringing reef and the beach also assumes that corals will not be able to supply enough materials to compensate for sea level rise, which is not clear as much is still unknown about how corals will fare in the future, as explained previously.

An indication of what could happen is reported by Sheppard et al.<sup>187</sup> for the case of the Seychelles. According to these authors in 1998 large numbers of the corals in

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<sup>179</sup> Mori et al. (2010), pp. 15–19.

<sup>180</sup> Hemer et al. (2010), pp. 475–491.

<sup>181</sup> Kench et al. (2009), pp. 180–213.

<sup>182</sup> Kench et al. (2009), pp. 180–213.

<sup>183</sup> Storlazzi et al. (2011).

<sup>184</sup> Storlazzi et al. (2011).

<sup>185</sup> Storlazzi et al. (2011).

<sup>186</sup> Kench et al. (2009), pp. 180–213.

<sup>187</sup> Sheppard et al. (2005), pp. 223–234.

this country (as in the rest of the India Ocean) died as a result of high water temperatures. The reef flat was covered by stagshorn and other boulder coral forms. When the corals died the depth of the water in the reef flat increased by approximately the same amount as the height of the previously existing corals, creating a “pseudo-sea level rise” on the reef flats (i.e. the depth of the water in the area increased). This also resulted in a lowering of friction in the area, as the three-dimensional original structure of the corals presented more friction to waves than the smoother section of the coral rubble that slowly developed after the corals died.<sup>188</sup> Typically, the longer offshore waves usually decompose after breaking up over the coral reef and transform into secondary waves which travel shoreward across the reef flat, gradually reducing the energy in them.<sup>189</sup> An increase in depth, together with a decrease in the energy dissipation due to the corals results in bigger waves reaching the shoreline, which explained the observed erosion in some sites in the Seychelles. Sheppard et al.<sup>190</sup> believe also that the rise in energy reaching the shores will now accelerate more rapidly.

Increasing sea levels might also have an effect on the morphology of the lagoons. In most reefs waves break on the fore-front of the reef, producing an increase in elevation of the water surface at the front of the reef flat (a phenomenon technically known as wave setup). Essentially this increase in elevation creates a wave-driven current that flushes the lagoon via the gaps in the reef. The strength of this current depends on the wave setup (i.e. the strength of the waves) and the water depth.<sup>191</sup> A change in water depth over the reef could change the hydrodynamics of the system,<sup>192</sup> such as for example increasing the wave-driven current, which could increase erosion in the lagoon.

Kench and Cowell<sup>193</sup> simulated morphological changes in Kiribati, Fiji and the Maldives for a sea level rise of 0.5 m and highlighted how if the amount of sediment supply remains constant the islands could move by between 3 and 15 m, with overwashing events promoting migration of the islands along the reef platforms. In fact it appears that the amount of sediment supply and whether this is in balance or not might be more important than sea level rise itself and that reef sedimentary landforms might be more resilient than commonly thought, according to Kench et al.<sup>194</sup>

These effects would result in the shifting of sediments by the action of waves and currents, and there is already some evidence that there has been some shore

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<sup>188</sup> Sheppard et al. (2005), p. 224.

<sup>189</sup> Sheppard et al. (2005), p. 226.

<sup>190</sup> Sheppard et al. (2005), p. 223.

<sup>191</sup> Also on the friction of the sediment particles, for more details see Hearn (1999), pp. 30007–30019.

<sup>192</sup> Hearn (1999), pp. 30007–30019.

<sup>193</sup> Kench and Cowell (2002), pp. 645–656.

<sup>194</sup> Kench et al. (2009), p. 201.

readjustment to recent past sea level increases. 50 % of the islands in a study of atolls by Webb and Kench<sup>195</sup> exhibited ocean shoreline erosion, which generally did not result in a reduction in the size of the island but a migration of it towards the lagoon. At present, it is thus not clear that increases in sea-level alone will result in the disappearance of reef islands as these structures have shown a degree of morphological resilience over the twentieth century.<sup>196</sup> Nevertheless, increases in sea temperatures during El Niño events have led in the past to shift in ecological states (as highlighted earlier in this chapter) from one of coral to another of algal dominance. This is what happened in Uva Island (Panama) during the 1982–1983 El Niño, which led to marked increased in the rates of erosion of the seaward reef areas.<sup>197</sup> Hence future increases in sea level temperatures could limit the supply of sediments originating from coral reefs, which in turn would result in higher levels of coastal erosion.

Actually, much is still not known about how atolls will behave to future increases in sea-levels, as this will depend on the pace of the rise and the ability of corals to keep up with it. The fact that reef islands have been able to withstand past changes is not surprising given that during much of the twentieth century corals have been far healthier than what they could be during the course of the twenty-first century, and that sea level rise has probably not been that much higher than what could be expected without human interference in the climate. These two conditions might not be true in the future, which could lead to more significant erosion of these islands, especially for those areas where there is significant human interference in the local environment and where the coral reef could fail to adapt to climate change. Kench et al.<sup>198</sup> suggest how in this situation some of the smaller islands could disappear towards the end of the twenty-first century. This, however, assumes that no significant engineering works are undertaken to protect the islands. While it would probably be very difficult for the poorer Atoll Island States to construct them, those with more financial capacity (such as the Maldives) could probably protect many of their islands, as will be discussed in Chap. 5.

In order to understand how vulnerable and sensitive these islands are to coastal erosion, we will consider the current and future problems of two different atolls where the capitals of the Marshall Islands and Tuvalu are located. Both of these examples are indicative of the problems faced by other atolls throughout the world, which are likely to be aggravated by climate change.

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<sup>195</sup> Webb and Kench (2010), pp. 234–246.

<sup>196</sup> Webb and Kench (2010), pp. 234–246.

<sup>197</sup> Kench et al. (2009), p. 186.

<sup>198</sup> Kench et al. (2009), p. 207.

### 3.5.1 *Majuro Atoll, Marshall Islands*

Majuro Atoll is located in the Pacific Ocean and serves as the capital of the Republic of the Marshall Islands. It is approximately 40 km in width from east to west and around 20 km from north to south. The main two islets consist of the Darrit-Uliga-Delap (DUD), where the capital facilities are located, and the larger Laura islet, which are connected by a narrow island called the “Long Island” area. The northern part of the atolls consists of many islets with or without human settlements and vegetation, and in the centre of this area a large artificial passage has been constructed for cargo ships and fishing boats.<sup>199</sup> Laura islet has sandy beaches on its lagoon side, but the ocean side is made of larger coral gravel. The DUD area, on the other hand, has an artificial seawall on its lagoon side. The sea state in the lagoon and ocean side of the atoll are quite different, with the larger wave heights typically occurring between the months of December and March.

The northern tip area of the Laura islet has suffered severe erosion in the past 10 years, with the lagoon side coast undergoing both erosion and accretion,<sup>200</sup> which could be caused by the sediment production volume by foraminifers being much smaller than the volume of the longshore sediment transport.<sup>201</sup>

#### 3.5.1.1 *Climate Change and Beach Nourishment*<sup>202</sup>

Sato and Yokoki<sup>203</sup> computed the long-term morphological changes to Majuro Atoll using an erosion and accretion model that took account of the likely levels in production of sediments and longshore processes, together with the worst case sea level rise scenarios outlined in the IPCC AR4 (a sea rise of 0.59 m by 2100). The model they used to do this was able to predict the morphological changes in the beach profiles that took place between 1997 and 2007 [based on their own field surveys and those carried out by the Pacific Islands Applied Geoscience Commission (SOPAC)]. Considering that more than 80 % of the island’s sediments are fine foraminifer sand, the sand movement in the lagoon coast is the most important for understanding and estimating the islands’ morphological changes. The transportation of coral gravels is mainly caused by tropical cyclones and although an important process, it is also quite rare in Majuro Atoll.<sup>204</sup>

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<sup>199</sup> Sato and Yokoki (2010), p. 2.

<sup>200</sup> Accretion means the accumulation of sediments in a certain area, i.e. the opposite of erosion.

<sup>201</sup> Sato and Yokoki (2010), p. 4.

<sup>202</sup> Beach nourishment describes an engineering process by which some sand which is lost (typically due to the longshore transport process, where the waves move the sand along the shore from one place to the next) is replaced with sand which is sourced from a different area. In this way, the shoreline’s profile can be maintained at a certain location.

<sup>203</sup> Sato and Yokoki (2010), pp. 1–2.

<sup>204</sup> Sato and Yokoki (2010), p. 5.



The computer simulation that these authors carried out increased the sea level gradually over a period of 100 years, and considered the volume of sediments supply available from foraminifers.<sup>205</sup> The results of Sato and Yokoki<sup>206</sup> show how some areas of the atoll, such as the northern tip of the Laura islet or Long Island, will suffer continuous erosion and accretion in the northern part will lead to the connection of small islands. Generally the rates of erosion dominate the process, with much of the sediments being transported into the centre of the atoll and infilling the lagoon. Sato and Yokoki<sup>207</sup> thus suggest that a beach nourishment scenario, where sand is taken from the lagoon and placed back on the beach could create an equilibrium in the island, where the natural morphological processes would be counter-acted by artificial human intervention.

### 3.5.1.2 Extreme Climate Change

It appears possible that in the scenarios outlined (which are restricted to those outlined in the IPCC 4AR) the atoll would be able to keep pace with an increase in sea levels. However, recent work such as that of Vermeer and Rahmstorf<sup>208</sup> put sea level rise for the period 1990–2100 in the 0.75–1.9 m range, which would mean that the supply of sediments would not be able to keep pace with the increase in the level of the water. In their work, Sato and Yokoki<sup>209</sup> also consider the extent of the reef as being constant, and it is not clear that corals will be able to keep up with this pace of sea level rise. Thus the wave climate considered by these authors might be an underestimate of what could be experienced in the future, especially considering the potential for increases in tropical cyclone intensity. An increase in water depth in the area between the fringing reef and the adjacent reef flat would result in larger waves in the area, as explained previously in this chapter.<sup>210</sup> In turn, larger waves in the area behind the fringing reefs would mean that the quantity and size of the sediment which is transported by the waves would increase,<sup>211</sup> leading to higher levels of coastal erosion. Greater wave and wind-driven currents would hence increase the rate at which sediments are transported from the inner reef flat to the outer reef flat and fore reef where coral growth is typically highest.<sup>212</sup> This increased amount of sediments in the water around the fore reef would result in

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<sup>205</sup> As calculated by Fujita et al. (2009), pp. 29–45.

<sup>206</sup> Sato and Yokoki (2010), p. 9.

<sup>207</sup> Sato and Yokoki (2010), p. 11.

<sup>208</sup> Vermeer and Rahmstorf (2009).

<sup>209</sup> Sato and Yokoki (2010), pp. 1–15.

<sup>210</sup> The height of waves is generally dependant on depth of the water, with deeper water meaning that higher waves are possible in a given area.

<sup>211</sup> Storlazzi et al. (2011), p. 94.

<sup>212</sup> Storlazzi et al. (2011), p. 83.



decreased light availability for photosynthesis and increase sediment-induced stress on the reefs, which could be detrimental to the whole ecosystem.<sup>213</sup>

### 3.5.2 *Funafati Atoll, Tuvalu*

Another country that has a number of coastal erosion problem is Tuvalu, a Polynesian Atoll Island State situated in the Pacific Ocean, close to Kiribati and Fiji. It consists entirely of reef islands on atolls and table reefs and has a land area of 26 km<sup>2</sup>, making it the fourth smallest country in the world (after the Vatican, Monaco and Nauru). The population has been estimated at over 10,619 people and has an annual population growth rate of 0.7%,<sup>214</sup> resulting in a rapid population increase in recent years. Around half the population live in the capital atoll of Funafati, despite only having a total islet aggregate area of 2.4 km<sup>2</sup> (with a population density of 1,420 people per square kilometre<sup>215</sup>). The atoll has an irregular oval shape with a maximum length of 25 km and width of 20 km.<sup>216</sup> The central lagoon has a depth of 55 m, though oceanic depths of over 1,000 m are reached within 2.3 km of the shore of the atoll.<sup>217</sup> Many islets exist on the atoll rim, with the largest one called Fongafale, which concentrates government buildings and other infrastructure such as hospitals, schools and the airport. Due to the scarcity of domestic resources, the population relies heavily on the import of food and other daily necessities, resulting in a huge trade deficit.<sup>218</sup>

#### 3.5.2.1 Long-Term Morphological Change in Fongafale Islet<sup>219</sup>

Fongafale Islet, arguably the most important location in Tuvalu due to its high population density and concentration of important infrastructure, has suffered a number of morphological changes during the course of the last 70 years.<sup>220</sup> Coastal erosion has been widely reported and has threatened the houses and lives of the inhabitants of the atoll.<sup>221</sup> The reason for these changes appears to be a combination

<sup>213</sup> Storlazzi et al. (2011), p. 83.

<sup>214</sup> According to the CIA (2012).

<sup>215</sup> According to the Japan International Cooperation Agency JICA (2011).

<sup>216</sup> Fitchett (1987), p. 1.

<sup>217</sup> Fitchett (1987), p. 1.

<sup>218</sup> According to JICA (2011), p. 4.

<sup>219</sup> Islets, or “coral islands” are the inhabitable part of atolls. It is formed from the dead skeleton of corals and foraminifera, and are the only part of the atoll which are above the sea surface. An atoll typically has several islets or “coral islands” on its surface, as seen in Fig. 2.8. Thus, Fongafale Islet is located within the capital atoll of Funafati.

<sup>220</sup> Webb (2005), pp. 1–17.

<sup>221</sup> JICA (2011), p. 4.

of both anthropogenic and natural phenomena, due to “environmental load by population growth (sand supply decrease due to deterioration of water quality, and constructing barriers for accretion of sand) and sprawl of residential area (inhabitation in flood prone areas, and extracting earth and sand from coastal areas) rather than precipitation change or sea level rise due to global warming”.<sup>222</sup>

However, the causes of coastal erosion are not only related to recent events. Aerial photographs taken during World War II show how the American military carried out extensive works on the island, which have effected its development ever since. Also, in 1972 tropical cyclone “Bebe” hit the country killing six people (which might not seem to be a great number, but considering that in 1973 the population of the island was 5,887 it represented 0.1 % of the people in the country, which is proportionally high) and devastating the island. Fongafale was engulfed by waves from both the ocean and lagoon side, and the storm carried a great quantity of sediments onto the eastern reef flat of the atoll.<sup>223</sup> This formed a huge rubble embankment (or “storm ridge”, 18 km long, with a mean height and width of 3.5 and 37 m, respectively).

A study by Webb<sup>224</sup> that compared photos from 1941, 1943, 1984 and 2003 found little evidence that erosion on the lagoon side of the island of Fongafale was more pronounced between 1984 and 2004.<sup>225</sup> The study did find changes in the shapes of the island in the atoll, but the shoreline instability was likely caused by the effect of the profound changes due to dredging carried out by the US military during the 1940s. Figures 3.11 and 3.12 show the net surface land area change for each of the islets in the Funafuti atoll over a period of 19 years.<sup>226</sup> According to these the overall surface of all the islets increased by almost 3 %, showing how in recent times these islets have been actually increasing in size. The same is generally also true for other atolls in Tuvalu, with Fig. 3.13 showing how various other islets are either relatively stable or increasing in size.

Nevertheless, there have been important changes to the geometries of the various islets, and it appears that any dredging of the lagoon basin can disturb coastal processes and accelerate coastal erosion.<sup>227</sup> Other reasons that are thought to contribute to coastal erosion include:

- Blocking of sand transportation due to the placement of structures. The placement of small wharfs along the lagoon side can block long-shore sand transport, trapping sand on one side of the structure and creating erosion on the other side.

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<sup>222</sup> JICA (2011), p. 1.

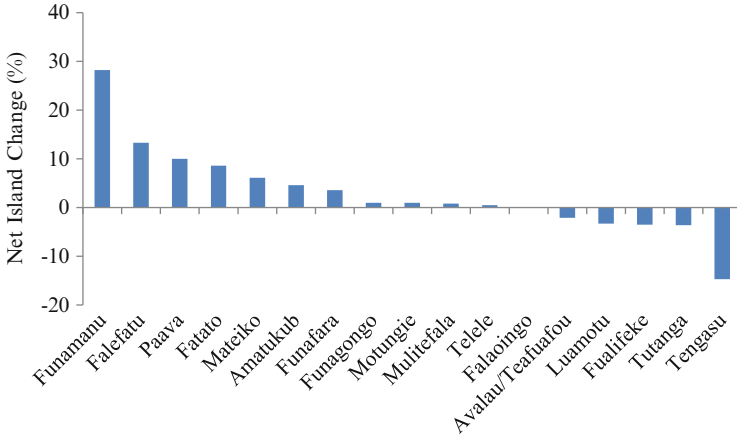
<sup>223</sup> Maragos et al. (1973).

<sup>224</sup> Webb (2005), pp. 1–17.

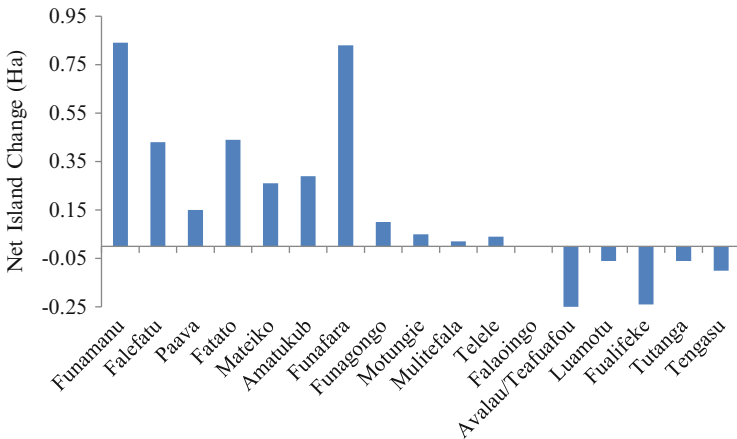
<sup>225</sup> Webb (2005), pp. 1–17.

<sup>226</sup> Webb and Kench (2010).

<sup>227</sup> Webb (2005), pp. 1–17.

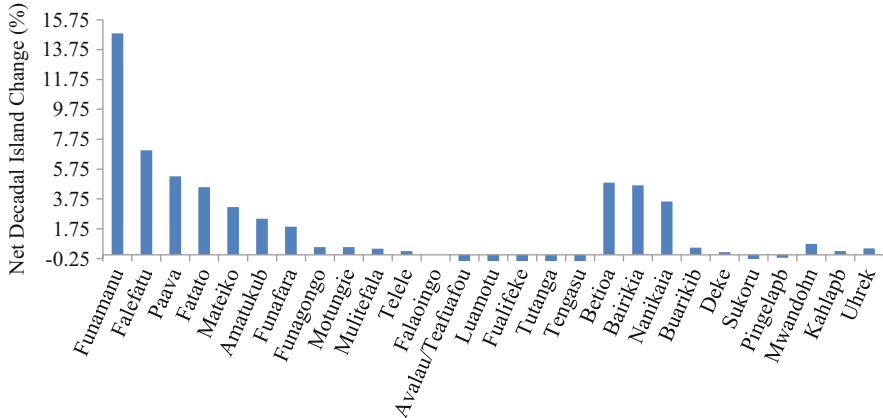


**Fig. 3.11** Net Island Change (%) over a period of 19 years for the islets that make up the Funafati Atoll (after Webb and Kench 2010, p. 239)



**Fig. 3.12** Net Island Change (Ha) over a period of 19 years for the islets that make up the Funafati Atoll (after Webb and Kench 2010, p. 239)

- Dredged areas in the lagoon can also block long-shore sand, as any moving sand can fall into the excavated hole. While in the long-term this hole will be filled and long-shore transport will re-start, in the short term the trapping of sediments can result in coastal erosion in the area behind it. In Funafati there are several dredged holes that are contributing to this effect.
- Inappropriate placement of seawalls. Seawalls have been constructed at different locations along the coast, though these can accelerate erosion of the sandy beach in front of them due to the increased turbulence caused by wave reflection.



**Fig. 3.13** Net Decadal Island Change (%) over 19 years for the islets in Funafuti, Tarawa, Pingelap and Mokil Atolls (after Webb and Kench 2010)

### 3.5.2.2 Other Problems

The problems in Tuvalu are not limited to coastal erosion, however. Increasingly frequent saltwater flooding (which decreases agricultural output) caused by storm surges or “king tides” has also been cited as a problem.<sup>228</sup> The country also faces significant challenges related to the disposal of sewage due to poorly designed septic tank systems that are often released into the wider ecosystem, contaminating the groundwater and the lagoon.<sup>229</sup> The country also produces an increasing amount of waste which is typically disposed of in borrow pits, though these can damage the storm ridges and also have an impact on water quality and the coral ecosystem due to leakages from the landfill.<sup>230</sup>

### 3.5.2.3 Climate Change

As elsewhere in the planet, sea levels in Tuvalu are also rising, in this case at an average rate of 2.3 mm/year. This is within the average range of the IPCC AR4 estimation of  $3.1 \pm 0.7$  mm/year for the 1993–2003 period.<sup>231</sup> Because of sea level rise and due to its low elevation Tuvalu has been in the point of view of the world’s media,<sup>232</sup> often being cited as one of the first countries that could disappear because

<sup>228</sup> Warmer et al. (2009), p. 9.

<sup>229</sup> JICA (2011), p. 5.

<sup>230</sup> JICA (2011), p. 5.

<sup>231</sup> JICA (2011), p. 8.

<sup>232</sup> Tuvalu has been a very popular subject in the media in the last years. Many articles have been written about the subject, see for example Reuters (2007) or Horner and Le Gallic (2004).

of anthropogenic influences in climate. This could indeed be true, due to the different problems highlighted so far in this chapter, but it is not likely to happen in the immediate future. In fact, as explained in this section, the islands have so far been (marginally) growing, though the reasons for this are not entirely clear (and it is important to note how the death of corals can paradoxically result in an increase to the sand available to the islands in the short term). The survival of the country, as explained previously in this chapter, hinges on the ability of coral reefs and foraminifera to survive the multiple stresses placed on them, and if they cannot do so, then it is likely that the increase in sea level will indeed eventually submerge the islands.

### 3.6 Changes in Precipitation and its Effects on Water Supplies

Another of the major problems associated with climate change could be a change in the distribution and intensity of rainfall throughout the planet. Already droughts in several atoll islands can be linked to natural variations in the planet's weather, such as El Niño/La Niña oscillation.<sup>233</sup> For example, during the 1997–1998 El Niño event, 40 atolls in the Federated States of Micronesia ran out of potable water, with the government being forced to introduce water rationing.<sup>234</sup> It is feared that these variations could increase in the future and lead to more frequent and/or severe draughts in atolls. Much work has been done on these types of impacts, and it is important to understand that different models can give different (and sometimes contradictory) answers, depending on the level or resolution and the parameters employed. Due to the coarse nature of many current climate models, the small size of atolls, and uncertainty regarding future El Niño/La Niña effects it is difficult to really understand to what extent some island nations could receive more or less rainfall in the future. It is of course possible that during certain decades patterns of rainfall will intensify in some areas to later decrease in accordance with the warming of the planet and the regional climatic variations this will produce.

Decreases in precipitation will have disproportionately large effects on the water supply of atoll islands as they can lower the water lens, which can suffer from the intrusion of sea water to become more salty.<sup>235</sup> It has been estimated that a 10 % reduction in average rainfall by 2050 could lead to a 20 % reduction in the size of the freshwater lens on the Tarawa Atoll, Kiribati, and reduce the thickness of the freshwater lens on atolls by as much as 29 %.<sup>236</sup> This on certain islands could be counterbalanced by more frequent El Niño episodes.<sup>237</sup>

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<sup>233</sup> BBC (2011).

<sup>234</sup> Maclellan (2009), p. 17.

<sup>235</sup> Maas and Carius (2012), p. 655.

<sup>236</sup> UNFCCC (2007).

<sup>237</sup> Magnan et al. (2011), p. 3.

It is also important to consider that an increase in air temperatures could also increase evaporation,<sup>238</sup> which can also have an effect on the availability of freshwater,<sup>239</sup> though to which extent this would really affect atolls (situated in tropical areas where temperatures are high throughout the year) is unclear. This potential decrease in precipitation and the availability of water resources could have important consequences on agriculture and water consumption.<sup>240</sup> A long dry spell in the Solomon Islands of 2007 resulted in poor harvests and people being left dependant on imported food, leading to poorer levels of nutrition amongst the population.<sup>241</sup> These freshwater supplies can also be threatened by increases in the sizes of storm surges and sea level rise, as explained in previous sections in this chapter.

If the population of atolls continues to increase and the potential for farming and fishing is diminished (through a combination of a decrease in the availability of freshwater and degradation of the coral reefs, as also explained previously in this chapter) this could affect food security, and force the inhabitants to import increasing quantities of food.<sup>242</sup>

There are a number of ways in which atoll islands can adapt to these effects. One of them is the installation of desalination plants, which convert sea water into fresh water, partly or totally covering for the fresh water needs of islands. However these plants are expensive to maintain and operate, as they require a significant amount of electricity which is often expensive for the case of smaller nations that rely on imported fossil fuels. It is also possible to increase the water storage capacity, by building reservoirs over land or on top of the houses. However, these islands already have limited available space, so it would not be so easy to create large reservoirs (which would also restrict the amount of land available for other purposes). The storage of water on top of houses is of course possible, though the amount of water that can be stored in this way is limited, probably enough for basic human consumption but not for agriculture.

Paradoxically, some of these adaptation measures could increase the potential vulnerability of the island in the long term. The creation of desalination plants and reservoirs contribute even more to fixing the shorelines and ground levels of the island, as they represent relatively massive infrastructure elements that would be difficult to elevate in the future. Thus, while these islands in the past have responded to sea level rises by also growing upwards (as outlined previously in Chap. 2), the creation of such infrastructure would restrict this natural adaptation mechanism. The Atoll Island State would thus be committing itself to their defence in the face of

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<sup>238</sup> Magnan et al. (2011), p. 3.

<sup>239</sup> Maas and Carius (2012), p. 655.

<sup>240</sup> Magnan et al. (2011), p. 3.

<sup>241</sup> Maclellan (2009), p. 17.

<sup>242</sup> The case of Niue is an interesting one, where a typhoon in 2004 devastated the island and transformed the island into a net importer of food for some time, see Maas and Carius (2012), p. 655.

rising seas, as its loss could greatly increase the water resources vulnerability of the island. These measures could thus help alleviate short term problems, though their construction in the face of a rapidly changing climate could contribute to increasing the long-term vulnerability of the socio-economical system. Of course, many of these problems can be solved by a variety of engineering solutions, though it is not clear that these islands would be able to afford the progressively increasing cost of each new adaptation measure.

### 3.7 Adaptation Measures

The degree to which people are vulnerable to changes in the climate relates to a variety of factors, such as to what extent they are dependent on the environment for their livelihoods (with fisherman for example being very dependent), the extents to which the environment is sensitive to climate change (deserts are assumed to be less vulnerable than forests) and the capacity of people to adapt to these changes.<sup>243</sup> Adaptation measures seek to reduce the damages that will take place as a consequence of climate change by improving the resilience of local people to changes in the environment. The capacity to adapt is a function of many factors such as the access to economic resources, technologies, information and skills, risk perception or the quality of governance.<sup>244</sup> Although many of the climate negotiations focus on the issue of mitigation, adaptation measures can also offer advantages to various countries, as they increase innovation and as a result a country might choose to give greater weight to adaptation measures than mitigation.<sup>245</sup>

It is generally thought that low-income societies are more at risk from climate change than wealthier societies and people, and hence many Atoll Island States are potentially amongst those at higher risk.<sup>246</sup> As discussed in Chap. 2, atolls are not static but dynamic environments, and through time their inhabitants have learnt how to adapt to the slow and gradual process that take place in them. Of course, intense and dramatic changes, such as tropical cyclones, volcanic eruptions or tsunamis can bring about irreversible changes, to which it is difficult to adapt and which can result in dramatic socio-economic changes. For the case of Samoa, for example, the tsunami that occurred on the 29th of September 2009 brought about widespread damage to many villages. Though the coral reefs that are present in some locations offered some degree of protection and warning, nevertheless many villages decided to relocate to higher grounds.<sup>247</sup> Of course, relocating villages to

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<sup>243</sup> Barnett and Campbell (2010), p. 33.

<sup>244</sup> Barnett and Campbell (2010), pp. 15–17.

<sup>245</sup> Onuma and Arino (2011), pp. 639–656.

<sup>246</sup> Barnett and Campbell (2010), p. 9.

<sup>247</sup> It is important to stress the strong role that the chief of the villages (which are given the name of “Matai”) plays in a society that has strong social connections, and how such social conditions allow for a quick decision-making process on how to adapt to the results of natural disasters. See Mikami et al. (2011a, b).

higher grounds is not without its challenges, as these areas can have poorer access to water and make the villages more dependent on technology for their survival.<sup>248</sup> Unfortunately, this is not an option available to the inhabitants of Atoll Island States, which have no high areas to relocate to. It is also important to understand how although islanders might have a strong capacity to adapt to slow changes in their environment, this capacity might be stretched by the more frequent and intense changes that result as a consequence brought about by climate change.<sup>249</sup>

### 3.7.1 *Financing Adaptation*

At present only a limited number of mechanisms exist to finance adaptation measures in Atoll Island States. One of the problems regarding adaptation is that while developing countries are calling for financial and technical assistance to deal with climate change, developed countries are reluctant to provide this assistance, partly because of the uncertainty associated with adaptation and its cost and partly because they are less affected by climate change.<sup>250</sup> Current discussions on a loss and damage mechanism and other such issues will be dealt with in more detail in Chap. 4.

Despite calls for increased funding, some mechanisms already exist, such as the Global Environment Facility, the Adaptation Fund [financed with a share of the proceedings from the Clean Development Mechanism (CDM) project activities], the World Bank Catastrophe Risk Insurance Facility (CRIF)<sup>251</sup> or direct overseas development aid (ODA) such as that provided by the Japan International Cooperation Agency (JICA).<sup>252</sup> The Adaptation Fund, for example, was established to finance concrete adaptations projects in developing countries that are parties to the Kyoto Protocol.<sup>253</sup> The Global Environment Facility, funded in 1991,

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<sup>248</sup> A village for example might be located in an area where the water flows from gravity from the mountain, and relocating it to the top might remove this water supply and require finding a new one. This in turn raises the problems of watershed managing, the possibility of needing pumps (and the costs involved in operating them, etc.). This information came from the problems faced by a Samoan village trying to relocate after the tsunami, as described in an email response by Kevin Petrini of the United Nations Development Programme (UNDP) to the CCD (Climate Change and Development) Community to the “Providing Additionality in Adaptation Projects – Examples; Experiences” thread. Email in file with authors.

<sup>249</sup> Barnett and Campbell (2010), pp. 1–19.

<sup>250</sup> Morita (2008), p. 67.

<sup>251</sup> Warner et al. (2009), p. 3.

<sup>252</sup> Other sources providing adaptation funds or exploring how to do it would include the World Bank, the United Nations Development Programme (UNDP), the Organisation of American States (OAS), Regional Development Banks, or International Financial Institutions (including Swiss RE or Citigroup, for example), the Special Climate Change Fund, or the Least Developed Countries Fund as listed in Warner et al. (2009), pp. 34–35 and Morita (2008), p. 68.

<sup>253</sup> Morita (2008), p. 69.



established the Strategic Priority on Adaptation (SPA), which was allocated an initial US\$50 million, and other adaptation funds.<sup>254</sup>

It is important to remember that it is often difficult to separate and distinguish projects that will be used to adapt against climate change and other more general development projects.<sup>255</sup> This issue of “additionality” is quite an important one, and many developing countries have argued that climate change finance should be “new and additional” to existing development aid.<sup>256</sup> However, it is complicated to separate the reasons why certain changes occur, and for example raising salinity could be due to sea level rise,<sup>257</sup> the extraction of groundwater or a combination of these and other factors. Thus, often it is difficult to clearly establish that the objective of a project is restricted to only adapting to climate change, as for example the construction of a seawall can be classified as a climate change adaptation project or a remedial action to other alterations in the coastline (such as the construction of a port which interferes with shoreline processes).

It is also important to consider that despite the fact that Adaptation Funds exist, and that they provide critical help to Small Island States, they are neither at the scale or magnitude of the potential future challenges facing these islands, as the infrastructure requirements will be substantial (billions of dollars over the next 10 years alone).<sup>258</sup> Also, it is important to note that few global investors are interested in these islands given the small-scale nature, challenges and potential returns from adaptation projects in Atoll Island States.<sup>259</sup> It has been estimated that at least double the current level of adaptation funding would be required simply to address the most urgent adaptation needs (around US\$380–700 m<sup>260</sup>).

### 3.7.2 *Coral Reefs and Foraminifera*

In order to protect the shorelines of coral islands technical and policy measures have been used. Some of these measures relate to the preservation of coral reefs, mangrove areas and sandy beaches, with numerous reports such as the IPCC 4AR

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<sup>254</sup> A total of US\$230 million, according to Morita (2008), p. 70.

<sup>255</sup> As commented by Brian Dawson of the Secretariat of the Pacific Community (SPC) to the CCD (Climate Change and Development) Community to the “Providing Additionality in Adaptation Projects – Examples; Experiences” thread. Email in file with authors.

<sup>256</sup> As commented by Brian Dawson of the Secretariat of the Pacific Community (SPC) to the CCD (Climate Change and Development) Community to the “Providing Additionality in Adaptation Projects – Examples; Experiences” thread. Email in file with authors.

<sup>257</sup> As commented by Brian Dawson of the Secretariat of the Pacific Community (SPC) to the CCD (Climate Change and Development) Community to the “Providing Additionality in Adaptation Projects – Examples; Experiences” thread. Email in file with authors.

<sup>258</sup> Warner et al. (2009), p. 27.

<sup>259</sup> Warner et al. (2009), p. 28.

<sup>260</sup> Between AU \$365 and 668 m, according to Maclellan (2009), p. 9.

recognising that the preservation of these coastal barrier systems is essential to the survival of atolls. However, at present not enough is known about how coral reefs could adapt to the multiple stressors (increase in sea temperatures, ocean acidification, pollution) that are being placed on them. It is imperative not only that much more research is carried out on how these ecosystems will behave in the future, but also on the possibility of understanding which species of corals could be more resilient to climate change, so that they could be transplanted in areas where currently coral cover has disappeared. Coral transplantation has been shown to be successful in many areas around the world, though the long-term success of these schemes would depend on the general ability of the planted species to cope with changes in their environment. In Japan, for example, it has become popular for diving tours to transplant coral fragments onto deteriorated coral reefs.<sup>261</sup> However, these can create potential problems such as decreasing the fecundity of the donor colonies, contributing to low species diversity and having a negative effect on the surrounding environment of the exploited corals.<sup>262</sup> Okubo and Onuma<sup>263</sup> suggest that although more costly, a combination of seedlings (corals cultivated directly from the eggs) and fragments should produce the best environmental effects. Nevertheless, this is poorly understood at present, and should become an area of priority research in the future.

Adaptation measures can often provide new and interesting solutions to existing problems, and some of the solutions to the problem of dying coral reefs are very innovative. For example, the MUSA (Museo Subacuatico de Arte), off the coast of Cancun in Mexico, has hundreds of marine cement sculptures sunk in an area that was previously a “desert of sand underwater”. The sculptures are naturally and slowly colonized by corals and algae, attracting large numbers of fish and human divers.<sup>264</sup> Particularly this last species also brings important revenues to the area, and a way for Atoll Island States to adapt to climate could reside in their ability to attract and motivate the world’s diving community.

Foraminifera are at present also poorly understood. These creatures can greatly contribute to the supply of sediments, and a great deal of sand in the beaches of many atolls comes from their skeletons. Some efforts to better understand the role that they could play in ensuring the survival of atolls are currently underway. The Japanese government, for example, is currently involved in two Overseas Development Aid (ODA) projects in Tuvalu. The first of these projects relates to the short term reduction of disaster risks (J-PACE Project), whereas the second one is related to the long-term replenishment of sand through foraminifera (FORAM-SAND Project). In this work the ideal conditions for foraminifera sand creation are being investigated in experimental flumes. The project started in April of 2009 and will finish in March of 2014, which will hopefully shed some light on the ability of these

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<sup>261</sup> Okubo and Onuma (2010), pp. 69–80.

<sup>262</sup> Okubo and Onuma (2010), pp. 69–80.

<sup>263</sup> Okubo and Onuma (2010), pp. 69–80.

<sup>264</sup> Thomas Cook Travel Inflight Travel Magazine (2012), pp. 94–100.

creatures to act as an eco-technological adaptive mechanism. This FORAM-SAND project could form an important part of the islands long-term adaptation strategies, though it is possible that other short term projects can also contribute. The J-PASE project aims to do that by assessing the ecosystem and coastal erosion of damaged areas in Tuvalu. As part of the proposed solutions, gravel beaches will be created in some locations, as these have the ability to significantly reduce wave energy and are generally more stable than sandy beaches. The Tuvalu government has already accepted this proposal, and it is expected that in the future foraminifera sand can accumulate over the gravel beach.

### ***3.7.3 Freshwater and Farming***

Adaptive measures have been discussed through the National Communications to the United Nations Framework Convention on Climate Change (UNFCCC) from Small Island States, who have assessed their own vulnerability to climate change. The most common themes stated were the urgency for adaptation action and the need for financial resources to secure it. Freshwater was seen as a serious issue, and many Small Island States recognized the need for more integrated planning and management concerning coastal zones, human health and tourism, as highlighted in the IPCC 4AR. There is a growing realization that the supply of freshwater in the future might be impaired due to increasingly variable rainfall, with more intense drought events and higher salinity of the soils in the coastal margins. Already the freshwater table in coral islands is often contaminated due to a higher frequency of “king” tides, which results in sand being deposited over agricultural lands and a general increase in their salinity. Once an area is inundated several times in a short space of time, the lands quickly become unsuitable to grow crops.

One possible solution to this problem is the development of more salt tolerant varieties of plants, or opting for other types of food similar to local crops that are able to withstand current and upcoming climate changes.<sup>265</sup> Of course there is a limit to what can be done in these cases, as certain crops might withstand more salty environments, but the complete flooding of fields would certainly kill all vegetation (which would result from Scenarios II and III outlined in Chap. 5). The rising of islands would of course remove this problem (as per Scenario VII) though it could be too expensive to raise all islands in an archipelago, and outside the financial capacity of the poorer States. However, some of the submerged islands would in fact become shallow sea areas, which could be used for aquaculture or other such activities, though of course this might require finding suitable species and considerable investment in materials and training. It is important to emphasize also that all these “food” adaptation options could represent cultural shifts, as they would mean

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<sup>265</sup> In fact, there is anecdotal evidence how in places like Bangladesh already how farmers in coastal areas are shifting from crop cultivation to crab farming in areas that were once fields, as unless embankments are repaired water can sometimes enter during high tides, see Ahmed (2011).

altering current eating practices. Nevertheless, considering the challenges facing Atoll Island States changing food practices is unlikely to be one of the key problems.

### 3.7.4 *Insurance*

One of the great problems facing Atoll Island States is that the effects climate change will have on them are unlikely to be felt gradually, but rather episodic events (such as tsunamis and tropical cyclones) will probably cause catastrophic damage on their already deteriorated physical environments (as explained earlier in this chapter). During the time when the physical environment of the islands has not deteriorated too dramatically it might be possible for them to rebuild their infrastructure with the help of insurance. In this sense the World Bank is piloting a scheme for small States to buy insurance coverage against natural disaster risk (the Catastrophe Risk Insurance Facility, or CRIF).<sup>266</sup> This scheme, launched in 2007, is the first ever multi-country catastrophe insurance pool, where its members pay a premium each year into the fund and in turn receive immediate budget relief to overcome the liquidity gap that usually occurs in the first few months following a natural disaster.<sup>267</sup> This pooling of risk is estimated to save the participating countries around 40 % of what they would have otherwise paid in premiums.<sup>268</sup> The fund is not intended to cover all the reconstruction costs, for which the countries will depend on other sources of finance, including donor assistance.<sup>269</sup> Though schemes such as these could help Atoll Island States in the short to mid-term, they are unlikely to provide a lasting solution in the face of the severe environmental challenges facing them, as explained earlier in this chapter. Essentially, to recover from a natural catastrophe it would be necessary for an inhabitable part of an island to remain. For the case of a coral island it is possible that once the coral protection has been severely damaged and a significant sea level rise has taken place a natural disaster could cause widespread erosion, leaving it in a state where it would be uninhabitable.

### 3.7.5 *Migration*

Migration is a very important adaptive strategy,<sup>270</sup> and that of last resort for many Atoll Island States. Although it is often seen as a failure of adaptation strategies,<sup>271</sup> it has been used for thousands of years by humans to adapt to

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<sup>266</sup> Warner et al. (2009), p. 3.

<sup>267</sup> Warner et al. (2009), p. 33.

<sup>268</sup> Warner et al. (2009), p. 34.

<sup>269</sup> Warner et al. (2009), p. 33.

<sup>270</sup> As recognised by many authors, see for example Atapattu (2009), McAdam (2011), or Söderbergh (2011).

<sup>271</sup> IOM (2008), p. 38.

changing weather conditions around the planet and hence much experience has been accumulated on the subject.<sup>272</sup> Although the idea of migration is politically charged and rejected in many political circles, moving from the narrative of “climate refugees” and into thinking of those migrants as a positive asset can have welcome benefits both for the migrants and their host country. Also, seeing migration as an adaptation tool might also diffuse some of the more sensational approaches invoked at times.<sup>273</sup>

We will discuss migration in terms of its legal consequences in Chap. 7, and it is outside our scope to talk about the social and policy implications of how it should be done. Nevertheless, it is important to point out that, if done properly, migration can be a positive adaptation option.<sup>274</sup> A strong culture of migration is shared (it could be even claimed that has always existed) amongst many small Island States, where seafaring, oceanic and mobile cosmologies are profoundly important.<sup>275</sup> If it is done in a way that respects the dignity of the people as human beings, and investments are made in education, migrants can become assets for the country that receives them.

Resettlement is already something being considered within some Atoll Island States, and at the 60th session of the UN General Assembly in 2005 the President of Kiribati mentioned the need for countries to consider relocation as a form of adaptation against climate change.<sup>276</sup> The Kiribati government contemplates in its 2005 Integrated Land and Population Development Programme to relocate people from smaller to bigger islands within their territory.<sup>277</sup> This programme inscribes itself within a broader national Climate Change Adaptation Strategy, though it should be noted it is also meant to release stress in the capital atoll, which has a population density of 8,000 people per square kilometre (similar to Hong Kong, but without high-rise buildings).<sup>278</sup>

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<sup>272</sup> Of course it is also possible to think that migration is actually a failure to adapt to changing weather conditions, though it also has to be understood that humans are not always able to adapt to a changing environment and thus migration is part of the natural adaptation process. Primitive human societies in many areas of the world have been described as hunters-gatherers, constantly moving in a nomadic fashion from one area to the next. Thus, migration appears as a natural way in which humans adapted to changes in their environment.

<sup>273</sup> McAdam (2011), pp. 102–137.

<sup>274</sup> Philippe Bancour of the IOM on his keynote speak at the “Climate Change and Migration in the South Pacific Region: Policy Perspectives”, organised by the Institute of Policy Studies, Victoria University of Wellington, Wellington, New Zealand, 9–10<sup>th</sup> July, 2009.

<sup>275</sup> Farbotko and Lazrus (2011), p. 7.

<sup>276</sup> As mentioned in Loughry and McAdam (2008). The President of the Republic of the Marshall Islands, Jurelang Zedkaia, also mentions relocation as an “undeniable threat” in his keynote address to the “Threatened Island Nations Conference” at Columbia University on the 24 May 2011.

<sup>277</sup> Boege (2010), p. 19.

<sup>278</sup> Boege (2010), though these statistics should be viewed with caution, as different authors appear to come up with a variety of statistics depending on how these are derived. In fact population in Kiribati has already been moved to the atoll of South Tarawa, which has resulted in over half of the population of Kiribati living there and prompting the government in the 1990s to relocate some 5,000 to outlying atolls, according to Loughry and McAdam (2008).

Significant communities of Tuvaluan people already exist in countries such as New Zealand, where immigrants have maintained their community and cultural links.<sup>279</sup> It is important, however, that this migration is carried out in a sustainable way, and that attempts are made to settle the migrants into adequate locations that do not in turn threaten the environment of the States that receive them.<sup>280</sup> However, migration might result in a “brain drain”, as skilled workers find it easier to obtain jobs abroad, possibly leading to a decrease in adaptive capacity in the islands.<sup>281</sup> The International Migration Organization states how:

At irreversible stages of environmental change, permanent migration can be better managed and sustainable resettlement schemes carried out incrementally. Such initiatives should aim for a gradual rather than mass retrenchment of workers from affected industries and ensure that economic and labour market restructuring - including skills training - allow for their swift absorption in areas of resettlement. Where internal resettlement options are not feasible, it may be warranted to explore bilateral arrangements. In all cases, effective migrant integration policies and spatial planning arrangements are essential.<sup>282</sup>

It has been argued that Pacific Islanders who have emigrated to Australia, New Zealand and the United States have been able to carry and maintain their cultures in the places they have moved to,<sup>283</sup> and this can provide later movers with a feeling of community and identity. Nevertheless, a number of challenges and pitfalls have been identified, particularly based on the experience of the Carteret islanders: those derived from the connection between land and people (where those who move might feel the loss of the spiritual connection to their lands), the challenge of integrating host communities with those that emigrate (and the potential for conflict that derives from that) and issues relating to the provision of funding for an orderly migration and the adequate governance of this funding.<sup>284</sup> Thus, it appears important that any resettlement should be considered holistically, addressing not only technical, legal and economic aspects, but also cultural and spiritual values, focusing both on the communities that will resettle and those that will receive them.<sup>285</sup> In fact, the government of Kiribati’s long term strategy is to secure “merits-based migration” options to New Zealand and Australia, so that small communities can be established and to help a possible future mass migration of the entire population.<sup>286</sup> Tuvalu, while officially seeking to promote adaptation measures so that people can stay at home, are also trying to secure ways in which Tuvaluans can migrate in the future.<sup>287</sup> It is important to understand that this migration at first might be circular,

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<sup>279</sup> See Farbotko and Lazrus (2011), p. 7.

<sup>280</sup> IOM (2007), p. 6.

<sup>281</sup> IOM (2007), p. 6.

<sup>282</sup> IOM (2007), p. 6.

<sup>283</sup> Boege (2010), p. 21.

<sup>284</sup> As summarised in Boege (2010).

<sup>285</sup> As summarised in Boege (2010).

<sup>286</sup> McAdam (2011), pp. 102–137.

<sup>287</sup> McAdam (2011), pp. 102–137.

with some of the migrants returning home after a period of time,<sup>288</sup> but eventually would become less so, with more people permanently emigrating to communities already established in foreign lands.

### 3.7.6 Construction of Coastal Defences

Although the geomorphological processes of high and low-lying islands can be somewhat different, all coastal areas around the planet are potentially affected by the problem of erosion. To protect against this problem there are generally two types of methods available. The first type are often defined as the “hard” methods, which employ groynes, seawalls, revetments and other types of structures to prevent the transport of sediments or to protect the coastline against the action of waves. On the other hand, there are also the so-called “soft” methods, which involve the stabilization of sand dunes with vegetation or beach nourishment (where sand is dredged from outlying areas and placed on receding coastlines).

However, for the case of Small Island Developing States (SIDS) “hard” defence methods are preferred because of their high visibility, which makes them popular with politicians and those who finance them.<sup>289</sup> They are extremely costly, and one such project in the Maldives (under the name “Safer Island”) has lined the coastline with tetrapod concrete armour units at a cost US\$4,000 per meter, largely funded by the Japanese government.<sup>290</sup> Islands such as Malé (the capital of the Maldives) are encircled with hard engineering structures and artificial harbours<sup>291</sup> making it impossible for natural morphodynamic adjustments to take place, and meaning that in the future it will be necessary to reinforce these defences if the islands are to survive. Essentially, once hard structures are constructed it becomes increasingly difficult for the island to survive without them, as the natural processes that would otherwise allow the island to adapt to a changing environment are disrupted. It is interesting thus that such structures, far from protecting the land, could in some cases lead to increases in vulnerability in the medium to long term. Thus, it is quite important to attentively consider the impact that each of these structures can have on the environment and morphodynamic processes that take place around them.

Atolls depend on the health of coral reefs for their long-term survival. However, the construction of coastal structures can have detrimental effects on the local environment, sediment transport and water quality, all of which can cause stress to the corals. For example, the building of sea walls can increase wave reflection which in turn will change the wave climate in their vicinity and cause higher turbulence and sediment transport, leading to greater rates of coastal erosion and

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<sup>288</sup> McAdam (2011), pp. 102–137.

<sup>289</sup> Sinane et al. (2010), para. 3.

<sup>290</sup> AOSIS (2008).

<sup>291</sup> Kench et al. (2009), p. 204 and Fritz et al. (2006), p. 144.

turbidity. Gently sloping beaches are very effective at dissipating wave energy, and changing from these to inclined or vertical sea walls will mean that the energy stays within the vicinity of the coastline, creating reflection waves, currents and thus transforming the geomorphological processes in the vicinity of the island. In this respect, the planting of mangroves can also generally be more beneficial to the long-term stability of the coastline than building hard structures. Sadly, in many places these trees are still being cut,<sup>292</sup> though in recent times there has been an increased awareness about the problems associated with their removal. In many places there are now activists working with local communities to try to plant mangroves to protect the coastline,<sup>293</sup> though the effectiveness of these projects depend also on mangroves not being cut in other locations.

Not only generally little thought is given to the effects of human activities on corals (as explained in previous sections of this book) but sometimes the corals themselves are used for the construction of coastal walls. Although this can have a short-term positive effect on the prevention of coastal erosion these actions can adversely affect the long-term capacity of the islands to adapt. An inhabitant of Kiribati<sup>294</sup> explained to one of the authors that to protect their house from coastal erosion they built a seawall using coral stones. Their neighbours did not do so immediately and continued to lose ground to the sea till they eventually decided to build their own wall. Although, significantly, this person nowadays understands the problems involved in using the corals as stones, he also explained how at the time his family was ignorant about these issues. Although this does point to an increase in local awareness, it is also not clear how long does it take for the reef to recover from the environmental cost of building this seawall. Also, although people might understand the consequences of their actions, when faced with the prospect of their own lands being eroded as a consequence of morphological alterations of the islands it is not always clear that any individual might react in a different way. In a way, which one of us would not do something similar, if we faced the prospect of our own houses being washed away, and if the only available materials for building the seawall were the coral stones which were just in front of the house? The situation might be improving nowadays in this respect, as many NGO's and ODA's (such as the Japanese International Cooperation Agency, JICA) work on these countries, and they have the financial resources to build coastal structures in a way that essential components of the reef are not used.

Notwithstanding this problem of using coral stones, the construction of sea defences generally has a negative effect on the coastline, which is then dependent on these structures to maintain its profile (once the protective effect of the corals is lost). The transition from natural to man-made defences can be generally thought of as a one way process, in the sense that it is more difficult to then revert to a natural system of defence. Corals can of course colonize coastal defences (see Fig. 3.14,

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<sup>292</sup> Maclellan (2009), p. 27.

<sup>293</sup> Maclellan (2009), p. 23.

<sup>294</sup> During a private conversation at Waseda University in the June 2011, Tokyo, Japan.





**Fig. 3.14** Corals can start to colonize coastal defences. Picture courtesy of Beatrice Lacroq

showing how corals can start to cover concrete armour units), and it is possible to start to cultivate corals, though changes to the local environment in terms of increased turbidity can hinder these efforts. Essentially, the loss of the coral reefs can result in a vicious circle where higher water depths lead to bigger waves being able to reach coastal structures and these results in increased turbulence which removes more bottom materials.

Once coral islands start to rely on “hard” structures they can be considered as being fixed. In their natural state these islands are dynamic environments that slowly displace horizontally and vertically to adapt to changes in the climate and sea level. Sediments will migrate horizontally following the coastal processes that are dictated by sea waves. Raising sea levels result in greater space for coral growth, increasing sediment production and the island gradually “growing” upwards. The construction of “hard” structures stops both of these movements. Particularly important is the fact that islands cannot continue to grow in the vertical direction. For this to happen it would be necessary to gradually increase the size of the protective structures, though the low level of the areas behind them would result in the coastal defences gradually becoming higher than the land. These islands are highly porous, and would thus become waterlogged and eventually turn into a lagoon enclosed by the protective structure, unless more material could be piled on top of it. This material could be sourced from elsewhere (such as from other nearby failed atolls), though it would be costly and would require constant engineering works. Nothing is impossible in this respect, and the technology required is fairly standard, as can be seen from the construction of extravagant island groups off the coast of Dubai in the United Arab Emirates. However, though this can be

done by an oil rich State, it would be much more difficult for poor Atolls Island States to attempt similar levels of engineering works (though maybe not outside the reach of others such as the Maldives, as will be further explained in Chap. 5).

It is important to emphasize that coastal structures themselves will also be influenced by the effects of climate change. The foundations would be exposed to greater scour and the main structures would be subjected to bigger and more frequent wave forces.<sup>295</sup> Also, overtopping (the times when the waves go over the top of the structure and reach the area that it was supposed to protect) and run-up (the height to which the waves reach when they attack the structure) will be greater and more frequent<sup>296</sup> requiring these structures to be reinforced to withstand the larger forces they will be subjected to.

### 3.7.6.1 Engineering Considerations Regarding the Design of Protective Structures

Sea level rise and other effects of climate change, such as an increase in tropical cyclone intensity,<sup>297</sup> could alter future wave patterns<sup>298</sup> and lead to increased damage to coastal defences. However it is not necessarily clear to what degree these influences will impact on the stability of these structures and whether they should be strengthened accordingly.

Nowadays the effect of climate change is generally ignored when designing protective structures,<sup>299</sup> which could lead to them being under-designed towards the end of their life for the cases of rapid increases in sea levels. Traditionally these structures are designed by looking at historical records of wave conditions over an area, which are assumed not to change over time. Also, traditional design philosophy does not take into account sea level rise (despite the fact that sea levels have been increasing over the past century), and assumes that sea level will be the same throughout the life of the structure. It is important to note that these structures typically have a long design life, usually of 30 years, though many continue to serve their purpose for longer periods due to the great expense involved in their construction and the fact that if well built and maintained they might not deteriorate significantly.

Regarding atolls, the main criteria when designing coastal defences relates to the depth of the water at their front, as deeper waters will result in higher waves being able to reach the structures, and thus requiring them to be stronger. An acceleration in the pace of sea level rise will necessitate the alteration of current design methodologies and lead to substantial increases in the cost to build and maintain

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<sup>295</sup> Ewing (2010), pp. 261–286.

<sup>296</sup> Ewing (2010), pp. 261–286.

<sup>297</sup> See Knutson and Tuleya (2004), p. 2458 or Oouchi et al. (2006), p. 271.

<sup>298</sup> Mori et al. (2010), p. 17.

<sup>299</sup> Not necessarily always, but in general these effects appear to be ignored.

them. This acceleration in sea-level rise could be compounded by other effects such as increases in water depth due to the effects of higher reflection from coastal structures and other processes related to problems with the coral reefs, as outlined earlier in this chapter.

Currently protection structures are designed using historical patterns in wave climate, and coastal engineers typically use the significant wave height ( $H_s$ )<sup>300</sup> to estimate the size of the various elements of a given structure. However, for the case of atolls the “Limiting Breaker Height” ( $H_b$ ) parameter is more relevant for the design of structures. As waves approach the coast they are affected by the friction of the bottom floor and undergo a series of changes known as shoaling: the horizontal component of the fluid velocity associated with the wave motion of the crest of the wave steepens as the amplitude increases, till the wave eventually breaks. In other words, as the wave approaches the coastline it gradually increases in size till the movement at the top of becomes too extreme and the wave breaks, and where this happens depends on the water depth at a given location. The term “Limiting Breaker Height” is often used, as there is an upper limit to the waves physically possible at a certain water depth for a given wave period. For the case of atolls, this is the crucial parameter for the design of structures as the water inside the barrier reef (i.e. in the reef flat area) is relatively shallow, and hence the maximum height of the waves will be constrained by this effect. If in the future sea level continues to rise and the corals are unable (as explained previously in this chapter) to keep pace with it then the height of the waves that can reach the coral islands will increase, making it necessary to build stronger structures that what would be presently needed. This problem is illustrated in Fig. 3.15.

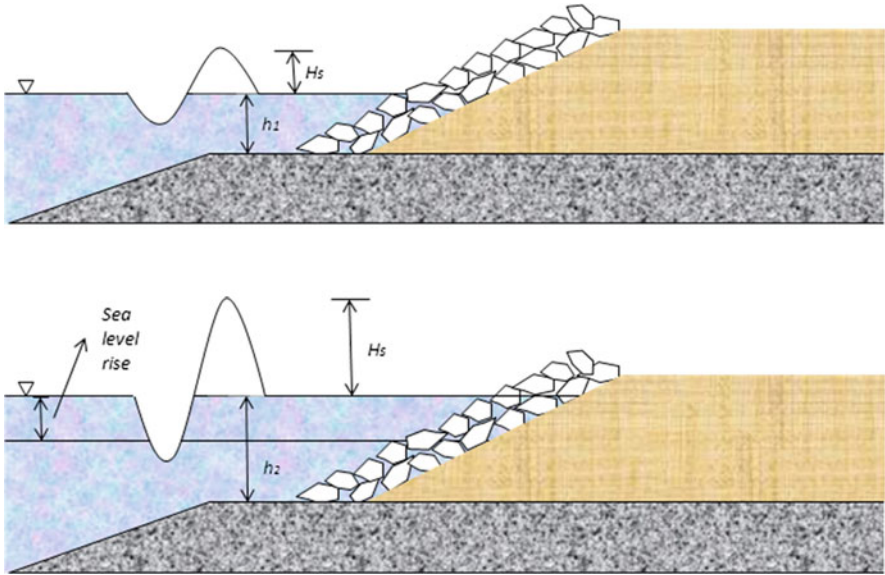
Different types of structures will be affected in slightly different ways. For the case of atolls islands the most important structures are typically coastal revetments (typically using rocks as armour) and rubble mound breakwaters, though it is also worth talking about the effect on other types of structures.

### 3.7.6.2 Coastal Armoured Mounds and Rubble Mound Breakwaters

Coastal revetments and rubble mound breakwaters typically consist of a mound with some porosity which is covered by a sloping armour layer consisting of large rock or concrete units (see Figs. 3.15 and 3.16). These armour units are the crucial part of the structure, as their task is to resist the force of the wave, and once they are removed the breakwater is considered to have failed as the underlayer can be quickly removed by the effect of wave action. Figure 3.16 shows a typical cross-section of a rubble mound breakwater. The weight of the armour units is generally proportional to the size of the waves (with higher waves requiring bigger armour).

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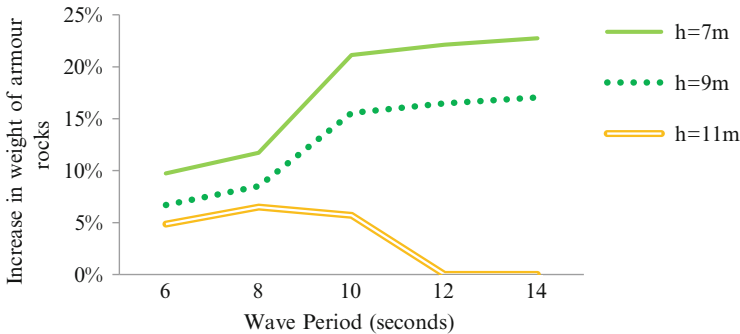
<sup>300</sup>This significant wave height is estimated as the average of the top one-third of the waves in a given storm.



**Fig. 3.15** Problem of coastal revetments under sea level rise. The *top figure* represents current conditions, and the *bottom figure* shows how when sea-level rises the water depth in front of the structure will increase (from  $h_1$  to  $h_2$ ) resulting in an increase in the significant wave height ( $H_s$ ) possible in front of the structure. This can amplify the damage caused by the waves and create other problems such as overtopping



**Fig. 3.16** Typical rubble mound breakwater section, using tetrapod armour



**Fig. 3.17** Increase in the required weight of armour rocks for Scenario 2, compared with no sea-level rise (Esteban et al. 2011). This is given for three different water depths (7, 9 and 11 m) and wave periods ( $T = 6\text{--}14$  s). Results are for a significant wave height of 9 m

Esteban et al.<sup>301</sup> calculated the effect that sea level rise would have on a variety of geometries, bathymetries and structure configurations of various types of rock armour. These were computed for four different sea level rise scenarios over a period of 50 years<sup>302</sup>, and compared to a control scenario where conditions remained the same as at present (i.e. no sea level rise):

- Scenario 1: 0.15 m increase, which would correspond to an annual increase of 3 mm, similar to that at the end of the twentieth century
- Scenario 2: 0.44 m increase, which would be similar to the increase suggested by the worst IPCC 4AR scenario in the period between 2050 and 210.
- Scenario 3: 0.9 m increase, which would be half-way between scenarios 2 and 4.
- Scenario 4: 1.3 m increase, similar to the increase suggested by Vermeer and Rahmstorf<sup>303</sup> in the period 2050–2100.

Figure 3.17 shows the required weight of armour rocks for Scenario 2, compared with a control scenario where there is no sea-level rise.<sup>304</sup> It shows how especially for the lower values of water depth (represented by the letter  $h$ ) the requirements in armour will increase substantially, as the Limiting Breaker Height  $H_b$  parameter will increase and hence higher waves will reach the breakwater. The effect is far more severe for Scenario 4, as shown on Fig. 3.17.

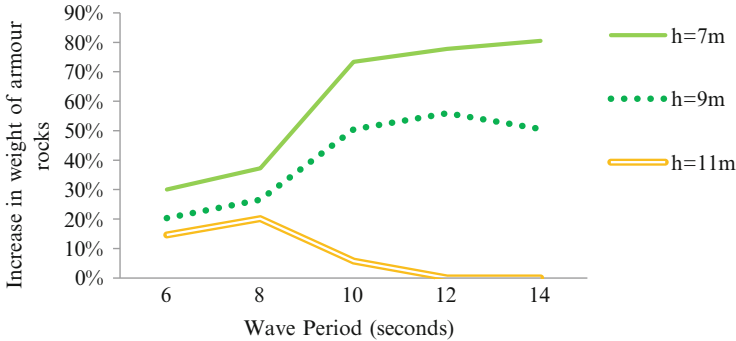
The effect of the increase in required armour is greater for the case of the sections with lower water depth, which is particularly relevant for the case of coastal revetments, typically located in shallow water. Thus, coastal protections

<sup>301</sup> Esteban et al. (2011).

<sup>302</sup> Fifty years was the assumed design life of rubble mound breakwaters, though it should be noted that typically they are designed with a life of 30 years.

<sup>303</sup> Vermeer and Rahmstorf (2009).

<sup>304</sup> The figure plots the effect that sea level has on different values of water depth ( $h$ ), for a beach slope  $\theta = 1:30$  and a significant wave height outside the barrier reef  $H_s = 9$  m.

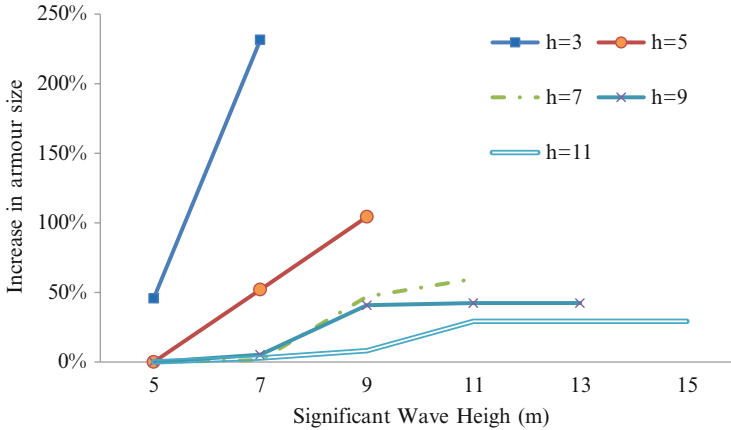


**Fig. 3.18** Increase in the required weight of armour rocks for Scenario 4, compared with no sea-level rise (Esteban et al. 2011). This is given for three different water depths (7, 9 and 11 m) and wave periods ( $T = 6\text{--}14$  s). Results are for a significant wave height of 9 m

around atolls can be expected to be gradually damaged unless bigger protective stones are used. Continuous increases in sea level that are not associated with an increase in the supply of sand (which would be the case if the corals in the vicinity of these structures died) would result in the water depth in front of these structures to gradually increase, with the increased depth in turn feeding a loop mechanism of allowing bigger waves to reach the coastline, in turn resulting in more erosion (as even if the coastline erosion is stopped by the use of structures the area in front of these structures can still be eroded). This would mean that the structures would have to be constantly reinforced, by the use of armour of increasing size. Although this increase in stone size might not be a great issue in other areas, atolls generally do not have large rocks around them (assuming that the reefs themselves are not used to construct the revetments) and hence this would require the import of materials from outside, which can be costly.

On the other hand, for structures located in deeper water (such as rubble mound breakwaters) the Limiting Breaker Height will be *relatively* less affected, and hence the armour requirements will not change substantially or at all, as shown in Figs. 3.17 and 3.18. Thus, for the deeper sections the most important effect is the increase in water depth, which will require the breakwaters to be increased in size in order to avoid overtopping. Figure 3.19 shows the increased requirement in armour for a variety of significant wave heights and depth. For the case of rubble mound breakwaters another important parameter to keep in mind is the height of the structure, which will depend on a parameter referred to as the run-up.<sup>305</sup> The crest of the structure must be high enough to prevent the waves from overtopping, but not high enough for it to be uneconomical or aesthetically displeasing. As wave heights increase due to a higher Limiting Breaker Height then the potential run-up on the breakwater will also increase and require them to be built with higher crests

<sup>305</sup> This run-up is defined as the vertical distance above still water which is reached by the waves as they rush up the seaside slope of the structure.



**Fig. 3.19** Increase in armour size for Scenario 4 for a variety of significant wave heights and water depths ( $h = 3\text{--}11\text{m}$ )

so that there is not significant overtopping. It appears that for the more extreme cases of sea level rise (Scenario 4 after Vermeer and Rahmstorf,<sup>306</sup> for a sea level rise of 1.3 m) a breakwater designed in 2050 would require between 8 % (for the deeper sections) and 66 % more materials (for the shallower sections) than one designed in the twentieth century not taking into account sea level rise.<sup>307</sup>

All this shows how the cost of adapting these structures to only this one aspect of climate change is not negligible, especially considering the considerable amount of materials involved in their construction. For the case of atolls the increased need for source materials could create great financial and environmental stresses, highlighting the vulnerability of this adaptation strategy.

### 3.7.6.3 Caisson Breakwaters

Caisson breakwaters are protection structures formed of box-like concrete caisson units which are placed in the sea, as shown in Fig. 3.20. Although they are not so typical in atolls it is still worth considering the effects that climate change could have on them. In this sense Okayasu and Sakai<sup>308</sup> found that the probability of sliding failure could increase by up to 50 % in the period ranging from 2000 to 2050 and that the adaptation cost could correspond to between 0.5 and 2.3 % of the sectional area of the caisson. Takagi et al.<sup>309</sup> showed how a 10 % potential increase

<sup>306</sup> Vermeer and Rahmstorf (2009).

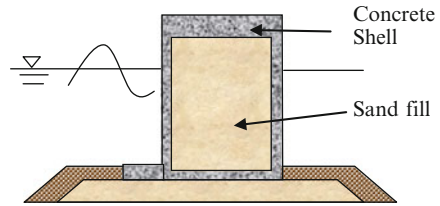
<sup>307</sup> Taking into account the requirement for increased armour and for the breakwater to be built to a higher level. See Esteban et al. (2011).

<sup>308</sup> Okayasu and Sakai (2006), pp. 4883–4893.

<sup>309</sup> Takagi et al. (2011), p. 37.



**Fig. 3.20** Caisson type breakwater



in the future wind speed of typhoons resulting from the warming of surface sea temperatures can lead to a 21 % increase in the significant wave height generated by these winds. This effect, together with the sea level rise detailed in the IPCC 4AR could make the expected sliding distances for the breakwaters he studied up to three times greater than at present. Hence, it is clear that no matter what coastal structures are employed as adaptation strategies all of them will also suffer the effects of the change in climate, requiring a higher standard of construction than at present.

#### 3.7.6.4 Further Considerations

It is worth noting that the effect of climate change on coastal structures is likely to be far more complex than what has been described in this section. The type of wave breaking also plays a big factor in the nature of damage, and structures designed in the surf zone<sup>310</sup> will suffer higher damage than those outside it. Thus, construction inside the surf zone is generally discouraged,<sup>311</sup> though if sea levels change rapidly a structure that is not designed for the surf zone could very well be inside it by the end of its life. Other possible effects such as wave setup,<sup>312</sup> which causes a quasi linear rise in the mean water level towards the shoreline, can also have an effect.<sup>313</sup> This can affect the depth of water in front of the breakwater and hence the damage. Increases in tropical cyclone intensity (as explained previously in this chapter) are also likely to result in increased levels of storm surge, and these can also have a negative effect on the stability of defence structures.

Relying on coastal structures to adapt against climate change thus appears to be an expensive and dangerous course of action for Atoll Island States. The considerable uncertainties regarding climate change, coupled with local geomorphological problems associated with higher levels of erosion, could make it difficult to adequately design these structures in the middle to long term. This would require

<sup>310</sup> The surf zone is the area near the coastline where the waves break. These breaking waves can exert very large forces on structures.

<sup>311</sup> Goda (2000), p. 443.

<sup>312</sup> Associated with the existence of stress acting on the water due to the presence of wave motion (called radiation stress).

<sup>313</sup> The magnitude of the radiation stress may change due to variations in the wave height as it propagates towards the coastline (due to shoaling and wave breaking), and hence this may cause changes in the inclination of the mean water level.



accepting greater risk levels or overdesigning these structures. Accepting a higher risk level on islands which entirely rely on these structures for their survival could be catastrophic, and the overdesign of the structures could place great financial stress on the local inhabitants. For the poorer countries, such as Tuvalu or Kiribati, attempting such a solution at an island level would probably be unrealistic, though a country with greater financial resources such as the Maldives already has the capital island of Malé encircled with defences.<sup>314</sup> Thus, although costly and probably outside the reach of smaller nations, these coastal structures could offer the only chance of preserving some islands in the face of the extinction of coral reefs, highlighting the dilemma that many of these countries might face in the future.

### 3.8 Conclusions

Anthropogenic climate change could have grave consequences for the survival of atolls around the planet. Corals are particularly vulnerable to increases in surface sea temperatures and ocean acidification, both of which could increase as a result of raising greenhouse gases in the atmosphere. Though atolls have survived past increases in sea levels around the planet through the upward growth of the coral reefs, future increases in coral mortality mean that there will be less materials available for the islands to compensate for rising waters. This in turn will result in higher levels of coastal erosion, which could eventually cause entire islands to disappear.

However, geomorphological change is unlikely to be linear, with most of the change occurring due to high intensity episodic events. It is also believed that future increases in sea surface temperatures could lead to stronger tropical cyclones, which could also magnify the pace of geomorphological change. Other episodic events such as tsunamis, while not being influenced by climate change, could devastate environmentally degraded islands and profoundly alter vulnerable sections of the coastline.

A number of adaptation options against climate change are available to Atoll Island States, ranging from migration (we will discuss the concept of “climate change displacement” in Chap. 7), to coral planting and the acquisition of insurance. However, ultimately the only definite way that coral islands can survive the death of corals is through the construction of coastal defences, which will become progressively more expensive as the depth of water in front of them continues to raise. Essentially the required strength of coastal defences will increase as the water in front of coastal revetment deepens and allows larger waves to affect the coastline. In a normal situation this depth would stay constant, with corals growing upwards to compensate for sea level raise.

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<sup>314</sup> See Kench et al. (2009), p. 204, and Fritz et al. (2006), p. 144.

Atoll Island States are thus intrinsically linked to the environment that surrounds them, on which they depend not only for the nourishment but also to keep them afloat against the rising seas. Although richer Atoll Island States might be able to elevate and reinforce some key islands, it is unlikely that the poorer States will have the financial resources required to do so, and could eventually be submerged following the death of the coral reefs.

## References

- Ahmed J (2011) Bangladesh farmers fatten crabs on polluted land. BBC News, 20 February 2011. <http://www.bbc.co.uk/news/world-south-asia-12046805>. Accessed 25 Feb 2011
- Allison I, Bindoff NL, Bindschadler RA, Cox PM, de Noblet N, England MH, Francis JE, Gruber N, Haywood AM, Karoly DJ, Kaser G, Le Quéré C, Lenton TM, Mann ME, McNeil BI, Pitman AJ, Rahmstorf S, Rignot E, Schellnhuber HJ, Schneider SH, Sherwood SC, Somerville RCJ, Steffen K, Steig EJ, Visbeck M, Weaver AJ (2009) “Copenhagen Diagnosis”. The Copenhagen Diagnosis, 2009: updating the world on the latest climate science. <http://www.copenhagendiagnosis.org/read/default.html>. Accessed 26 Jan 2010
- AOSIS (2008) Global climate change and small island developing states: financing adaptation. Green Paper. [http://www.un.int/wcm/webdav/site/suriname/shared/documents/papers/CLIMATECHANGEAOSIS\\_GreenPaper\\_Feb52008\\_.pdf](http://www.un.int/wcm/webdav/site/suriname/shared/documents/papers/CLIMATECHANGEAOSIS_GreenPaper_Feb52008_.pdf). Accessed 14 March 2013
- Atapattu S (2009) Climate change, human rights, and forced migration: implications for international law. *Wisconsin Int Law J* 27:607
- Barnett J (2004) Global warming and the security of atoll-countries. McMillan Brown Centre for Pacific Studies, University of Canterbury, Christchurch, pp 191–215. [http://www.upf.pf/IMG/pdf/12\\_Barnett.pdf](http://www.upf.pf/IMG/pdf/12_Barnett.pdf). Accessed 28 Mar 2012
- Barnett J, Adger WN (2003) Climate dangers and atoll countries. *Clim Chang* 61:321–337
- Barnett J, Campbell J (2010) Climate change and small island states: power, knowledge, and the South Pacific. Earthscan, London
- BBC (2009) Taiwan leader in typhoon apology. 15 August 2009. <http://news.bbc.co.uk/2/hi/asia-pacific/8202821.stm>. Accessed 18 Dec 2011
- BBC (2011) Tokelau plans an all-renewable future. Concerning islands that are pursuing an all-renewable future. <http://www.bbc.co.uk/news/science-environment-16109449>. Accessed 18 Dec 2011
- Bindoff et al (2007) Climate change the physical science basis. Contribution of Working Group I to the 4th Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge
- Boege V (2010) Challenges and pitfalls of resettlement measures: experiences in the Pacific Region. Paper presented at the ESF-UniBi-ZiF research conference on environmental change and migration: from vulnerabilities to capabilities, Bad Salzufen, 5–9 December 2010. COMCAD Working Papers, No. 12
- Burke L, Reyntar K, Spalding M, Perry A (2011) Reefs at risk revisited. World Resources Institute. <http://www.wri.org/>. Accessed 13 May 2012
- Caron D (1990) When law makes climate change worse: rethinking the law of baselines in light of a rising sea level. *Ecol Law Q* 17:621–653
- Chan JCL (2006) Comment on changes in tropical cyclone number, duration, and intensity in a warming environment. *Science* 311(5768):1713. doi:10.1126/science.112152
- CIA (2012) The World Factbook. <https://www.cia.gov/library/publications/the-world-factbook/index.html>. Accessed 28 May 2012

- Climate Prediction Centre (2005) Frequently asked questions about El Niño and La Niña. National Centers for Environmental Prediction. [http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/ensostuff/ensofaq.shtml#DIFFER](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensofaq.shtml#DIFFER). Accessed 28 Feb 2011
- Conisbee M, Simms A (2003) Environmental refugees – the case for recognition. Nef. [http://www.alofatuvalu.tv/FR/12\\_liens/12\\_articles\\_rapports/Refugees\\_A.Simms.pdf](http://www.alofatuvalu.tv/FR/12_liens/12_articles_rapports/Refugees_A.Simms.pdf). ISBN 1 899 407 70 7
- Displacement Solutions (2009) Climate change displaced persons and housing, land and property rights. Preliminary strategies for rights-based planning and programming to resolve climate-induced displacement. Report by displacement solutions. [http://displacementsolutions.org/files/documents/DS\\_Climate\\_change\\_strategies.pdf](http://displacementsolutions.org/files/documents/DS_Climate_change_strategies.pdf). Accessed 19 Dec 2011
- Done TJ (1992) Phase shifts in coral reef communities and their ecological significance. *Hydrobiologia* 247:121–132
- Elsner JB, Kossin JP, Jagger TH (2008) The increasing intensity of the strongest tropical cyclones. *Nature* 455:92–94
- Emanuel K, Sundararajan R, Williams J (2008) Hurricanes and global warming. Results from downscaling IPCC AR4 simulations. *Bull Am Meteorol Soc* 89(3):347–367. doi:10.1175/BAMS-89-3-347
- Ericson JP, Vorosmarty CJ, Dingman SL, Ward LG, Meybeck M (2006) Effective sea-level rise and deltas: causes of change and human dimension implications. *Global Planet Change* 50:63–82
- Esteban M, Takagi H, Shibayama T (2011) Sea level rise and the increase in rubble mound breakwater damage. In: Proceedings of international conference on coastal structures, Yokohama, 5–9 September 2011
- Esteban M, Stromberg P, Gasparatos A, Thomsom-Pomeroy D (2013) Global warming and tropical cyclone damage in the Philippines. *J Clim Res* 56:51–60
- Ewing L (2010) Sea level rise: major implications to coastal engineering and coastal management tsunami forces on structures, chapter 36, Handbook of coastal and ocean engineering. World Scientific, Singapore, pp 261–286
- Fabricius KE, Langdon C, Uthicke S, Humphrey C, Noonan S, De'ath G, Okazaki R, Muehlehner N, Glas MS, Lough JM (2011) Losers and winners in coral reefs acclimatized to elevated carbon dioxide concentrations. *Nat Clim Change* 1:165–169
- Farbotko C, Lazrus H (2011) The first climate refugees? Contesting global narratives of climate change in Tuvalu. *Glob Environ Change*. doi:10.1016/j.gloenvcha.2011.11.014
- Fitchett K (1987) Physical effects of hurricane Bebe upon Funafati atoll, Tuvalu. *Aust Geogr* 18(1):1–7
- Fritz H, Synolakis CE, McAdoo B (2006) Maldives Field Survey after the December 2004 Indian Ocean Tsunami. *Earthq Spectra* 22(S3):137–154
- Fujita K, Osawa Y, Kayanne H, Ide Y, Yamano H (2009) Distribution and sediment production of large benthic foraminifers on reef flats of the Majuro Atoll, Marshall Islands. *Coral Reefs* 28:29–45
- Goda Y (2000) Random seas and design of maritime structures. World Scientific, Singapore
- Guinotte JM, Buddemeier RW, Kleypas JA (2003) Future coral reef habitat marginality: temporal and spatial effects of climate change in the Pacific basin. *Coral Reefs* 22:551–558
- Hallegatte S (2007) The use of synthetic hurricane tracks in risk analysis and climate change damage assessment. *J Appl Meteorol Climatol* 46(11):1956–1966
- Hearn CJ (1999) Wave-breaking hydrodynamics within coral reef systems and the effect of changing relative sea level. *J Geophys Res* 104(C12):30007–30019
- Hemer MA, Church JA, Hunter JR (2010) Variability and trends in the directional wave climate of the Southern Hemisphere. *Int J Climatol* 30:475–491
- Hoegh-Guldberg O, Ortiz JC, Dove S (2011) The future of coral reef. *Science* 334:1494–1495
- Horner C, Le Gallic G (2004) The disappearing of Tuvalu: trouble in paradise, documentary. <http://www.der.org/films/the-disappearing-of-tuvalu.html>. Accessed 31 July 2012
- Huntington BE, Karnauskas M, Lirman D (2011) Corals fail to recover at a Caribbean marine reserve despite ten years of reserve designation. *Coral Reefs* 30:1077–1085

- Imamura F, Van To D (1997) Flood and Typhoon Disasters in Viet Nam in the half century since 1950. *J Nat Hazard* 15:71–87
- International Society for Reef Studies (2008) Coral reefs and ocean acidification, Briefing Paper 5. [http://www.fit.edu/isrs/documents/ISRS\\_BP\\_ocean\\_acid\\_final28jan2008.pdf](http://www.fit.edu/isrs/documents/ISRS_BP_ocean_acid_final28jan2008.pdf). Accessed 5 Apr 2011
- IOM (2007) Discussion note: migration and the environment. MC/INF/288, 1 November 2007. International Organization for Migration (IOM). [http://www.iom.int/jahia/webdav/shared/shared/mainsite/about\\_iom/en/council/94/MC\\_INF\\_288.pdf](http://www.iom.int/jahia/webdav/shared/shared/mainsite/about_iom/en/council/94/MC_INF_288.pdf). Accessed 15 Feb 2012
- IOM (2008) Migration and climate change. IOM migration research series no. 31. [http://publications.iom.int/bookstore/free/MRS-31\\_EN.pdf](http://publications.iom.int/bookstore/free/MRS-31_EN.pdf). Accessed 15 Dec 2012
- JICA (2011) Study for assessment of ecosystem, coastal erosion and protection/rehabilitation of damaged area in Tuvalu, Japan International Cooperation Agency, Final report, January 2011
- Johnson G (2011) High tides flood low-lying atolls in Marshalls. *Marianas Variety Newspaper*. <http://www.mvariety.com/2011022034428/local-news/high-tides-flood-low-lying-atolls-in-marshalls.php>. Accessed 28 Feb 2011
- Kawai H, Hashimoto N, Matsuura K (2008) Estimation of extreme storm water level in Japanese bays by using stochastic typhoon model and tide observation data. In: Proceedings of the international offshore and polar engineering conference, Vancouver, 6–11 July 2008
- Kench PS, Cowell PJ (2002) The morphological response of atoll islands to sea-level rise: part 2. Application of the modified shoreface translation model (STM). *Journal of Coastal Research* 34:645–656
- Kench PS, Perry CT, Spencer T (2009) Coral reefs. Chapter 7. In: Slaymaker O, Spencer T, Embleton-Hamann C (eds) *Geomorphology and global environmental change*. Cambridge University Press, Cambridge, pp 180–213
- Kleypas J, Gattuso JP (2010) Coral reef. In: Cleveland CJ (ed) *Encyclopedia of Earth*. Environmental Information Coalition, National Council for Science and the Environment, Washington (First published in the *Encyclopedia of Earth* October 18, 2006; Last revised March 28, 2010. [http://eoeearth.org/article/Coral\\_reef](http://eoeearth.org/article/Coral_reef). Accessed 27 May 2010)
- Kleypas J, Buddemeier R, Archer D, Gattuso J, Landon C, Opdyke B (1999) Geochemical consequences of increased carbon dioxide in coral reefs. *Science* 284:118–120
- Knutson TR, Tuleya RE (2004) Impact of CO<sub>2</sub>-induced warming on simulated Hurricane intensity and precipitation sensitivity to the choice of climate model and convective parameterization. *J Clim* 17(18):3477–3495
- Knutson T, McBride J, Chan J, Emanuel K, Holland G, Landsea C, Held I, Kossin J, Srivastava A, Sugi M (2010) Tropical cyclones and climate change. *Nat Geosci* 3(3):157–163. doi:10.1038/ngeo779
- Kunkel CM, Hallberg RW, Oppenheimer M (2006) Coral reefs reduce tsunami impact in model simulations. *Geophys Res Lett* 33(23), L23612. doi:10.1029/2006GL027892
- Lamb S (2005) Paradise (soon to be) Lost. *Spiegel Online*, February 15, 2005. <http://www.spiegel.de/international/0,1518,341669,00.html>. Accessed 26 Mar 2012
- Landsea CW, Harper BA et al (2006) Can we detect trends in extreme tropical cyclones? *Science* 313(5786):452–454
- Loughry M, McAdam J (2008) Kiribati – relocation and adaptation. Forced migration review. <http://www.fmreview.org/FMRpdfs/FMR31/FMR31.pdf>. Accessed 27 Mar 2012
- Lyytimäki J, Hilden M (2011) Coping with ecological thresholds in coastal areas: results from an international expert survey. *Coastal Manage* 39(6):598–612
- Maas A, Carius A (2012) Territorial integrity and sovereignty: climate change and security in the Pacific and beyond. In: Scheffran J et al (eds) *Climate change, human security and violent conflict*. Springer, Heidelberg, pp 651–665
- MacLellan N (2009) The future is here: climate change in the Pacific. Oxfam report. [www.oxfam.org.au/climate-change](http://www.oxfam.org.au/climate-change). Accessed 23 Dec 2011

- Magnan A, Duvat V, Pirazzoli P, Woppelmann G (2011) In light of climate change, can coral arhipelagos be defined as vulnerable “resource systems”? In: 4th congress of the Asia & Pacific network, Paris, 14–16 September 2011 (in French)
- Maragos JE, Baines GBK, Beveridge PJ (1973) Tropical Cyclone Bebe creates a new land formation on Funafuti Atoll. *Science* 181:1161–1164
- McAdam J (2011) Refusing refuge in the Pacific: (de)constructing climate-induced displacement in international law. In: Pigué E, Pécoud A, de Guchteneire P (eds) *Migration, environment and climate change*. UNESCO, Paris, pp 102–137
- Mendelsohn R, Emanuel K, Chonabayashi S, Bakkensen L (2012) The impact of climate change on global tropical cyclone damage. *Nat Clim Change* 2:205–209
- Mikami T, Shibayama T, Matsumaru R, Takagi H, Faainuseiamalie L, Chanmow I (2011a) Field survey and analysis of the Tsunami Disaster in the Samoan Islands, 2009. In: *Proceedings of coastal structures conference*, Yokohama, 2011
- Mikami T, Shibayama T, Takewaka S, Esteban M, Ohira K, Aranguiz R, Villagran M, Ayala A (2011b) Field survey of tsunami disaster in Chile 2010. *J Jpn Soc Civil Eng, Ser. B3 (Ocean Engineering)* 67(2):529–534 (in Japanese)
- Mikami T, Shibayama T, Esteban M, Matsumaru R (2012) Field survey of the 2011 Tohoku earthquake and tsunami in Miyagi and Fukushima Prefectures. *Coastal Eng J* 54(1):1250011/1-1250011/26
- Mimura et al (2007) Small islands. Climate change, impacts, adaptation and vulnerability. Contribution of Working Group II to the 4<sup>th</sup> Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge
- Mori N, Yasuda T, Mase H, Tom T, Oku Y (2010) Projection of extreme wave climate change under global warming. *Hydrol Res Lett* 4:15–19
- Morita K (2008) A study of financing system possibilities for adaptation to climate change –case study of a small island state. *J Int Dev* 7(2). doi:10.1088/1755-1307/6/1/412001
- Mousavi ME, Irish JL, Frey AE, Olivera F, Edge BL (2011) Global warming and hurricanes: the potential impact of hurricane intensification and sea level on coastal flooding. *Clim Change* 104:575–597
- Munich Re (2009) Natural disasters 1980–2008, 10 costliest typhoons ordered by insured losses. <http://www.munichre.com/>. Accessed 28 Apr 2009
- Nordhaus WD (2006) The economics of hurricanes in the United States. In: *Annual meetings of the American Economic Association*, Boston
- Okamatsu A (2005) Problems and prospects of international legal disputes on climate change. Available at [http://web.fu-berlin.de/ffu/akumwelt/bc2005/papers/okamatsu\\_bc2005.pdf](http://web.fu-berlin.de/ffu/akumwelt/bc2005/papers/okamatsu_bc2005.pdf). Accessed 15 Oct 2012
- Okayasu A, Sakai K (2006) Effect of sea level rise on sliding distance of a caisson breakwater – optimization with probabilistic design method. In: *Proceedings of 30th international conference on coastal engineering*, ASCE, pp 4883–4893
- Okubo N, Onuma A (2010) A mixture of fragments and seedlings is environmentally optimal for coral transplantation. *J Jpn Coral Reef Soc* 12:69–80 (in Japanese)
- Onuma A, Arino Y (2011) Greenhouse gas emission, mitigation and innovation of adaptation technology in a north–south economy. *Environ Dev Econ* 16:639–656
- Oouchi K, Yoshimura J, Yoshimura H, Mizuta R, Kusunoki S, Noda A (2006) Tropical cyclone climatology in a global warming climate as simulated in a 20km-mesh global atmospheric model. *J Meteorol Soc Jpn* 84(2):259–276
- Pelling M, Uitto JI (2001) Small island developing states: natural disaster vulnerability and global change. *Environ Hazards* 3:49–62
- Pielke RA Jr (2007) Future economic damage from tropical cyclones. Sensitivities to societal and climate changes. *Philos Trans R Soc*. doi:10.1098/rsta.2007.2086
- Pielke RA, Landsea CW (1998) Normalized Hurricane damages in the United States: 1925–95. *Weather Forecasting* 13:621–631

- Rakova U (2009) How-to guide for environmental refugees. OurWorld 2.0. <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>. Accessed 25 Feb 2011
- Reaser JK, Pomerance R, Thomas PO (2000) Coral bleaching and global climate change: scientific findings and policy recommendations. *Conserv Biol* 14:1500–1511
- Reuters (2007) Tuvalu about to disappear into the ocean, 13 Sept 2007. <http://uk.reuters.com/article/2007/09/13/environment-tuvalu-dc-idUKSEO11194920070913>. Accessed 31 July 2012
- Rogers AD, Laffoley D d'A (2011) International earth system expert workshop on ocean stresses and impacts. Summary report. IPSO, Oxford, pp 1–18
- Sato D, Yokoki H (2010) Numerical calculation on shoreline conservation in Majuro Atoll, The Marshall Islands. In: Proceedings of the international conference on coastal engineering, 32, Shanghai. <http://journals.tdl.org/ICCE/>
- Schmidt S (2010) Economic losses from tropical cyclones in the USA – as assessment of the impact of climate change and socio-economic effects. PhD Thesis at the Technical University of Berlin
- Secretariat of the Convention on Biological Diversity (2009) Scientific synthesis of the impacts of ocean acidification on marine biodiversity. Montreal, Technical Series No. 46, pp 1–61
- Sheppard C, Dixon DJ, Gourlay M, Sheppard A, Payet R (2005) Coral mortality increases wave energy reaching shores protected by reef flats: examples from the Seychelles. *Estuar Coastal Shelf Sci* 64:223–234
- Shibayama T, Tajima Y, Kakinuma T, Nobuoka H, Yasuda T, Hsan RA, Rahman M, Islam MS (2009) Field survey of Storm Surge Disaster due to cyclone Sidr in Bangladesh. In: Proceedings of coastal dynamics conference, Tokyo, 7–11 September 2009
- Shibayama T, Esteban M, Ohira K, Mikami T, Sasaki J, Suzuki T, Achiairi H, Widodo T (2012) Field survey of tsunami disaster on Sipora Island, Indonesia after Sumatra earthquake 2010. In: PIANC-COPEDEC 8th international conference on coastal and port engineering in developing countries, Chennai, 20–24 February 2012
- Sinane K, David G, Pennober G, Troadec R (2010) Fragilisation et modification des formations littorales meubles sur l'île d'Anjouan (Comores): Quand l'érosion d'origine anthropique se conjugue au changement climatique. *VertigO* 10(3) (in French)
- Söderbergh C (2011) Human rights in a warmer world: the case of climate change displacement, Working Paper. <http://lup.lub.lu.se/record/1774900>. Accessed 5 Jan 2012
- Solomon et al (2007) Climate change: the physical science basis. Contribution of Working Group I to the 4th Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge
- Stern N (2006) Stern review on the economics of climate change. Cambridge University Press, Cambridge
- Storlazzi CD, Elias E, Field ME, Presto MK (2011) Numerical modelling of the impact of sea-level rise on fringing coral reef hydrodynamics and sediment transport. *Coral Reefs*. doi:10.1007/s00338-011-0723-9
- Stromberg P, Esteban M, Gasparatos A (2011) Climate change effects on mitigation measures: the case of extreme wind events and Philippines' biofuel plan. *J Environ Sci Policy* 14 (8):1079–1090
- Takagi H, Kashihara H, Esteban M, Shibayama T (2011) Assessment of future stability of breakwaters under climate change. *Coastal Eng J* 53(1):21–39
- Tasnim KM (2010) Investigation of the physical characteristics of dynamic topography change due to cyclone Sidr around Kuakata Beach. Dept of Civil engineering Master Thesis, University of Tokyo, Tokyo
- Thomas Cook (2012) Travel Inflight Travel Magazine, Feb/Mar 2012 Issue, pp 94–100
- UNFCCC (2007) Climate change: impacts, vulnerabilities and adaptation in developing countries. <http://unfccc.int/resource/docs/publications/impacts.pdf>. Accessed 23 Mar 2012
- USACE (2011) Sea-level change considerations for civil work programs. Circular No. 1165-2-212. 1 October 2011. U.S. Army Corps of Engineering. Expires 30 September 2013

- Vecchi GA, Swanson KL, Soden BJ (2008) Whither Hurricane activity? *Science* 322:687. doi:[10.1126/science.1164396](https://doi.org/10.1126/science.1164396)
- Vermeer M, Rahmstorf SPNAS (2009) Projections of future sea level becoming more dire. *Proc Natl Acad Sci USA* 106(51):21461–21462. doi:[10.1073/pnas.0912878107](https://doi.org/10.1073/pnas.0912878107)
- Veron JEN, Hoegh-Guldberg O, Lenton TM, Lough JM, Obura DO, Pearce-Kelly P, Sheppard CRC, Spalding M, Stafford-Smit MG, Rogers AD (2009) The coral reef crisis: the critical importance of <350 ppm CO<sub>2</sub>. *Mar Pollut Bull* 58:1428–1436
- Warmer et al (2009) In search of shelter: mapping the effects of climate change on human migration and displacement. Report for care. [http://www.care.org/getinvolved/advocacy/pdfs/Migration\\_Report.pdf](http://www.care.org/getinvolved/advocacy/pdfs/Migration_Report.pdf). Accessed 29 Dec 2011
- Warner K et al (2009) Global climate change and small island developing states: financing adaptation. <http://www.careclimatechange.org>. Accessed 21 Dec 2011
- Warrick et al (1996) Sea level changes in the Bay of Bengal. In: Warrick RA, Ahmad QK (eds) *The implications of climate and sea level change for Bangladesh*. Kluwer, Dordrecht
- Wassmann R, Hien NX, Hoanh CT, Tuong TP (2004) Sea level rise affecting the Vietnamese Mekong Delta: water elevation in the flood season and implications for rice production. *Clim Change* 66:89–107
- Webb A (2005) Tuvalu Technical Report - coastal change analysis using multi-temporal image comparisons-Funafuti Atoll. EU EDF 8/9 SOPCA Project Report 54
- Webb AP, Kench PS (2010) The dynamic response of reef islands to sea-level rise: evidence from multi-decadal analysis of island change in the Central Pacific. *Glob Planet Change* 72:234–246. doi:[10.1016/j.gloplacha.2010.05.003](https://doi.org/10.1016/j.gloplacha.2010.05.003)
- Webster PJ, Holland GJ et al (2005) Changes in tropical cyclone number, duration, and intensity in a warming environment. *Science* 309(5742):1844–1846
- Westmacott S, Teleki K, Wells S, West JM (2000) Management of bleached and severely damaged coral reefs, International Union for the Conservation of Nature, Gland. <http://cmsdata.iucn.org/downloads/coralen.pdf>. Accessed 16 Jun 2011
- Woodworth PL (2005) Have there been large recent sea level changes in the Maldive Islands? *Glob Planet Change* 49:1–19
- Yamano H, Sugihara K, Nomura K (2011) Rapid poleward range expansion of tropical reef corals in response to rising sea surface temperatures. *Geophys Res Lett* 38(4). doi:[10.1029/2010GL046474](https://doi.org/10.1029/2010GL046474)



# Chapter 4

## Climate Change Negotiations and AOSIS

### 4.1 Introduction

Climate change has been the subject of increasing debate in the international arena for the last few decades. Originally the main focus of the international community was on the prevention of chlorofluorocarbon (CFC) gas emissions from industry, which are thought to have an effect on the destruction of the ozone layer, especially at high altitude.<sup>1</sup> Eventually, 29 industrialized countries and the European Commission signed the Montreal protocol in 1987, where everybody agreed to eliminate the use of CFCs.<sup>2</sup>

After this time the debate generally changed to the effects that greenhouse gases would have on global warming, which led to the establishment of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992.<sup>3</sup> The UNFCCC and the negotiations that surround it are critical to the survival of Atoll Island States, as they represent the best chance of limiting greenhouse gas concentrations in the atmosphere to a limit which will not affect coral reefs. This would ensure the survival of islands without any adaptation measures, such as expensive coastal defence works, and thus the success of the negotiations and ensuing mitigation actions is an important goal for Atoll Island States.

While few people believe the UNFCCC can achieve reductions in emissions to a level that could avert significant climate change,<sup>4</sup> slowing down the pace of change could give time for corals to adapt to changing climatic conditions. As explained in Chaps. 2 and 3, Atoll Island States are different from other islands in that they can dynamically adapt to sea level changes through vertical growth in the coral reefs, and thus the health of the reef is critical for the islands to survive. No other area of the planet is so dependent on its ecosystem for long-term survival, highlighting the

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<sup>1</sup> David (2010).

<sup>2</sup> David (2010).

<sup>3</sup> David (2010).

<sup>4</sup> Barnett and Campbell (2010), p. 86.



importance of limiting the rise in sea surface temperatures and ocean acidification. This vulnerability has been recognised for a long time, with Tuvalu emerging in the 1990s as “climate change *cause célèbre*”.<sup>5</sup> Media around the world started and continue to report on the story of a small and vulnerable group of islands in the Pacific, which could be flooded as a consequence of climate change.<sup>6</sup> In this way Atoll Island States have started to become identified as the first potential victims of large-scale climate change.

In this chapter we will briefly describe the history of climate change negotiations and the part that the Alliance of Small Island States (AOSIS) plays in this process. Particularly important for our discussions in Chap. 7 will be how AOSIS has been successful in introducing a “loss and damage proposal” into the negotiations.<sup>7</sup> Such a proposal draws on numerous principles of international law, including polluter pays, intergenerational equity, trans-boundary harm and responsibility of a State.<sup>8</sup> Its aim is to eventually create an international solidarity fund, possibly based on the responsibility of greenhouse gas emissions by major industrialised countries, that would compensate countries for economic and non-economic losses stemming from slow-onset climate impacts.<sup>9</sup> These damages could include the cost of relocation of the Atoll Island State inhabitants if islands become uninhabitable,<sup>10</sup> as we will discuss in Chap. 6, or the construction of coastal defences, as we will discuss in Chap. 5. The proposal appears to slowly be finding its way into negotiations, as one of the key outcomes of the COP18 in Doha was that a “pathway” was established to “provide vulnerable populations with better protection against loss and damage caused by slow onset events such as rising sea levels”.<sup>11</sup>

## 4.2 History of Climate Change Negotiations

The history of climate change negotiations will be summarised in the next few sections in order to provide the framework in which this book is inserted, and to help understand why the plight of such small States as Tuvalu has gathered news headlines around the world. We will start our discussions with the establishment of the IPCC in the late 1980s and then continue with the UNFCCC process and current state of negotiations. We have separated the role of AOSIS into a different section in order to clearly illustrate the actions that Atoll Island States are taking

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<sup>5</sup> Barnett and Campbell (2010), p. 87.

<sup>6</sup> Barnett and Campbell (2010), p. 87.

<sup>7</sup> Trust (2012).

<sup>8</sup> Trust (2012).

<sup>9</sup> Trust (2012).

<sup>10</sup> Trust (2012).

<sup>11</sup> UNFCCC (2012).

through this organisation, highlighting the importance these countries give to the success of negotiations.

### ***4.2.1 The Intergovernmental Panel on Climate Change (IPCC)***

The IPCC is a scientific intergovernmental body that was set up at the request of a number of governments for the assessment of climate change. It was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in order to provide a climate change scientific view in addition to its potential environmental and socio-economic impacts.<sup>12</sup> Up to now, four assessment reports have been written:

- IPCC First Assessment Report, in 1990
- IPCC Supplementary Report, 1992 (for the UNCED Conference in Rio)
- IPCC Second Assessment Report, in 1995
- IPCC Third Assessment Report, in 2001
- IPCC Fourth Assessment Report (or IPCC 4AR), in 2007

with work currently under way for a fifth report, which should be finalised in 2014.

From the very first IPCC report there has been a strong emphasis on the point that global warming is being heavily influenced by human activities (and so the word anthropogenic is often used in this respect), meaning that it is generally accepted that the release of green house gases (GHG) into the atmosphere is causing a significant part of the warming observed.

### ***4.2.2 The United Nations Framework Convention on Climate Change***

The perceived importance of climate change led the UN to convene the UN Conference on Environment and Development (UNCED), also known as the Earth Summit, which was held in Rio de Janeiro in 1992. As a result of this summit the United Nations Framework Convention on Climate Change (UNFCCC) was produced, which entered into force on the 21st of March 1994. The Convention, in its Art. 2 States how

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate

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<sup>12</sup> IPCC 4AR.

system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

The UNFCCC establishes a general framework for intergovernmental efforts to deal with the impacts that might occur due to climate change, and it has been adopted by 195 parties. The signatories committed themselves to voluntary “non-binding” reductions in their emissions of greenhouse gases to the atmosphere with the aim of preventing dangerous anthropogenic interference with the Earth’s climate. The parties of the Convention should also gather and share information on greenhouse gas emissions, national policies and best practices, start national strategies for addressing greenhouse gas emissions and attempt to adapt to the expected impacts of climate change. A key benchmark in these treaties is the emissions of greenhouse gases in the year 1990, with countries around the world often making various pledges with reference to this year. Convention member countries meet on an annual basis at the Conference of the Parties (COP), with the IPCC reports playing a major part in these meetings.

The main difference between the UNFCCC and the Montreal protocol is the voluntary nature of the cuts. The Montreal protocol established penalties for those countries that did not comply, while the UNFCCC is based on the countries “doing their best and sending reports to measure their efforts”.<sup>13</sup>

### ***4.2.3 The Kyoto Protocol***

The Kyoto Protocol is a legal instrument to the United Nations Framework Convention on Climate Change (UNFCCC) which is aimed at fighting global warming by reducing global emissions of greenhouse gases. While the Convention fosters the parties to stabilize greenhouse gas emissions, the Protocol commits them to doing that.

The Protocol was initially adopted in 1997 at the city of Kyoto, Japan, and entered into force in 2005. Despite the fact that it is yet to be ratified by some countries (most notably the USA), 186 countries had signed it by January 2009. Under the Protocol, 37 industrialized countries (referred to as Annex I countries) committed to a reduction of four greenhouse gases (CO<sub>2</sub>, methane, nitrous oxide, sulphur hexafluoride) and two groups of gases produced by them, and all member countries gave general commitments. Annex I countries in particular agreed to reduce their collective greenhouse gas emissions by 5.2 % from 1990 levels, which was far more significant than the framework of voluntary targets under the original UNFCCC.

At the COP13 in Bali in 2007 the Bali Roadmap on long-term issues was agreed, which established the “Bali Action Plan” and attempted to establish a shared vision

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<sup>13</sup> David (2010).

for long-term cooperation on issues of mitigation, adaptation, finance and technology.<sup>14</sup> Ultimately the aim of these and the rest of the negotiations conducted in the 2005–2009 period was for a successor treaty to this first Kyoto Protocol to be signed in 2009.

#### ***4.2.4 Recent Development in Climate Change Negotiations***

The original Kyoto Protocol expired in 2012 and currently international negotiations are underway to find a possible treaty that succeeds it, though at the time of writing it appears doubtful whether this will be possible given the current international political climate. The successor to the Kyoto Protocol was supposed to be signed during the UN Climate Change conference in Copenhagen, Denmark, in December 2009.<sup>15</sup> However, this high-profile event was marked by many disagreements, which ultimately only provided a non-binding political statement (The “Copenhagen Accord”), and highlighted how negotiations between the various parties appeared to be blocked. The COP 15 in Copenhagen “took note” of this Copenhagen Accord, and statements by the UNFCCC Executive Secretary confirmed that this does not have the same legal status as adopting the Accord.<sup>16</sup> This “taking note” would mean that the UNFCCC merely acknowledged that something existed, nothing more than that.<sup>17</sup> While the Copenhagen Accord included language that highlighted the need to keep any increase in temperature to below 2 °C and established a US\$30 billion fund, many observers felt that the Conference was a disappointment.<sup>18</sup>

Subsequently in 2010 at the UNFCCC COP-16 in Cancun the international community agreed to limit global warming to below 2 °C under the so called “Cancun Agreements”.<sup>19</sup> It was also agreed that this should be reviewed by 2015 with the view of possibly tightening this target to 1.5 °C due to the adverse effect that an increase in temperatures could have for some regions such as Small Island States. It also had some other practical outcomes, such as a US\$100 billion “Green Climate Fund” to assist developing countries defend against the consequences of climate change.<sup>20</sup> This fund was created as a new operating entity of the Convention’s financial mechanism, and governed by a 24-member board.<sup>21</sup> The Cancun Agreements actually include many elements of the Copenhagen Accord,

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<sup>14</sup> Earth Negotiations Bulletin (2012), p. 2.

<sup>15</sup> Earth Negotiations Bulletin (2012), p. 27.

<sup>16</sup> Hyvarinen (2011), p. 3.

<sup>17</sup> Hyvarinen (2011), p. 3.

<sup>18</sup> Söderbergh (2011), p. 2.

<sup>19</sup> Schewe et al. (2011), pp. 25–31.

<sup>20</sup> Söderbergh (2011), p. 3.

<sup>21</sup> Earth Negotiations Bulletin (2012), p. 2.

and in this sense it brings part of these into the UNFCCC framework.<sup>22</sup> However, it is not clear to what extent the national pledges that each country made under the Copenhagen accord have been legally incorporated into the UNFCCC through the Cancun agreements.<sup>23</sup>

The current mood of negotiations has also began to change, with Annex I parties (which includes developed countries, such as many members of the European Union) starting to insist that developing countries (and in particular China, with together with the U.S. are the biggest overall greenhouse gas emitters) enter into agreements on how to limit their emissions.<sup>24</sup>

In recent times there has also been a general politicization and fragmentation of the UNFCCC process,<sup>25</sup> manifested in an increasing number of issues placed in the climate change agenda, with more and more groups attempting to have their voices heard.<sup>26</sup> At times it appears as if the whole of the world's problems are to be solved at these negotiations, which has resulted in the issues discussed becoming increasingly more complex and inter-related. While there is no arguing that the problems facing the planet are indeed complex, it could also be unrealistic to attempt to solve them all under the UNFCCC framework.

The UNFCCC COP18 in Doha, which coincided with the last stages of writing of the present book, brought about some very interesting developments. First of all, the Kyoto Protocol was amended so that it will continue from 2013, with a second commitment period of 8 years.<sup>27</sup> A timetable has been approved so that a universal climate change agreement covering all countries could be agreed by 2015, with the view of entering into force in 2020 so that temperature rise can be kept below 2 °C. Also, developed countries reiterated their commitments to mobilizing US\$100 billion for adaptation and mitigation by 2020.<sup>28</sup> Crucially however, with respect to adaptation, the document states how “a pathway has been established towards concrete institutional arrangements to provide the most vulnerable populations with better protection against loss and damage cause by slow onset events such as rising sea levels”.<sup>29</sup>

However, although the Kyoto Protocol was extended, many countries appear to have shown a lack of ambition as under the new agreement they have only agreed to review their emission reduction commitments by 2014.<sup>30</sup> The deal covers mainly Europe and Australia, which are only responsible for around 15 % of global emissions.<sup>31</sup>

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<sup>22</sup> Hyvarinen (2011), p. 3.

<sup>23</sup> Hyvarinen (2011), p. 3.

<sup>24</sup> Hyvarinen (2011), p. 1.

<sup>25</sup> Betzold et al. (2011), p. 592.

<sup>26</sup> Betzold et al. (2011), p. 592.

<sup>27</sup> UNFCCC (2012).

<sup>28</sup> UNFCCC (2012).

<sup>29</sup> UNFCCC (2012).

<sup>30</sup> UNFCCC (2012).

<sup>31</sup> BBC (2012).

### 4.3 The Alliance of Small Island States

To understand the broader geopolitical reality in which Atoll Island States exist it is important to remember that despite their small size they form part of a larger alliance of countries, which shapes to some extent the way in which they interact with the larger international community. The Alliance of Small Island States (AOSIS) is a coalition of 43 States and observers that share the common characteristic of being constituted of small islands and low-lying communities. Its members all share a growing concern about the environment and the effects that climate change can have on the fragile ecosystems that often surround islands. The first political manifestation of this can be found in a conference held in Malé (the capital of the Maldives) between the 14th and 18th of November 1989, where the countries that attended quickly increased their awareness of their vulnerability to sea level rise.<sup>32</sup> As a result these countries called on the “world family of nations” to immediately limit their greenhouse gas emissions.<sup>33</sup> Eventually, AOSIS was created in 1990, 2 years after the IPCC commenced its work, and since then it has invested a great amount of energy into the ratification of the Kyoto Protocol, as the countries that form AOSIS all consider themselves to be the principal victims of climate change.<sup>34</sup> It is worth considering briefly the profile of this organisation and that of Small Island Developing States. Understanding what countries make them up can provide a clearer picture of the influence and weight of these organisations, and how through them Atoll Island States can wield an influence in international climate negotiations that is often disproportionate to their sizes and populations.

#### 4.3.1 *Structure of AOSIS and Socio-Economic Profile of its Members*

The group, despite lacking a formal charter or a secretariat, takes decisions at ambassadorial-level plenary sessions, and act as a negotiating body and lobby for the Small Island Developing States (SIDS). The organization is constituted of countries from all around the world, representing 28 % of developing countries, 20 % of the total UN’s membership though only around 5 % of the world’s total population.<sup>35</sup> Some of these islands, and specially atolls, can have very high population densities, with 8,300 people/km<sup>2</sup> on Fongafale in Tuvalu and 47,400 people/km<sup>2</sup> in Malé in the Maldives.<sup>36</sup>

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<sup>32</sup> David (2010).

<sup>33</sup> Grote (2011), p. 264.

<sup>34</sup> David (2010).

<sup>35</sup> AOSIS website (2012).

<sup>36</sup> Webb and Kench (2010), p. 234.

Within the group most of its members are island countries which are members of the UN, four are countries which are part of a continent (Guinea-Bissau, Guyana, Surinam and Belize), two are island countries in an association with New Zealand (and hence not part of the UN), and the last four are observers who belonging to another country but with a large degree of autonomy (American Samoa, Netherlands Antilles, Guam and the U.S. Virgin Islands). It is quite significant how even countries that are not islands have joined the group, mainly because of their feeling of vulnerability against sea level rise and its consequences on coastal mangrove trees.<sup>37</sup>

Many of the islands in the group have relatively underdeveloped economies, with Barnett and Campbell<sup>38</sup> noting how economic growth in islands in the Pacific has historically been low, and throughout the 1990s many economies in that region were either stagnant or contracted. GDP per capita again varies significantly amongst them, with Kiribati, Samoa, the Solomon Islands, Tuvalu and Vanuatu being classified by the United Nations as Least Developed Countries.<sup>39</sup>

In terms of industry, tourism is one of the key components of the economies in many of these countries, providing more than one-fifth of the GDP of Kiribati and 28 % of that of the Maldives.<sup>40</sup> Another major source of income is the revenue from fishing licences within the territorial waters, which provides the governments of some islands with substantial revenues.<sup>41</sup> In fact, Small Island States are quite dependent on their Exclusive Economic Zone (EEZ) for fishing activities, which gives the islands sovereign right over the exploitation of all marine and geological resources in waters within 200 nautical miles of the coastline, as will be described in more detail in Chap. 5.

Many of the Polynesian and Micronesian economies are also heavily dependent on aid and remittance income, with aid accounting for at least one third of GDP in places such as the Federated States of Micronesia, the Marshall Islands, Nauru or Nieu.<sup>42</sup> Thus, the income of many households in small islands is either directly or indirectly influenced by aid flows and hence it is important to consider this money from distant lands when considering the potential effects of climate change on development.<sup>43</sup>

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<sup>37</sup> David (2010).

<sup>38</sup> Barnett and Campbell (2010), p. 37.

<sup>39</sup> Barnett and Campbell (2010), pp. 36–45, p. 98.

<sup>40</sup> According to the CIA (2012).

<sup>41</sup> Barnett and Campbell (2010), pp. 37–43.

<sup>42</sup> Barnett and Campbell (2010), p. 42.

<sup>43</sup> Barnett and Campbell (2010), p. 42.

### 4.3.2 *The Small Island Developing States*

In 1998 AOSIS together with UNEP created the network of Small Island Developing States (SIDS), which included all the Island States belonging to AOSIS plus other island territories in the Caribbean and Pacific Oceans (such as the British overseas territory of Montserrat or Puerto Rico, a territory associated with the United States). At the beginning of 2011 the organization counted 51 members and Territories spread over the Pacific, Indian and Atlantic Oceans.<sup>44</sup>

Despite their cultural and geographical diversity, all of these islands face similar economical and environmental vulnerabilities.<sup>45</sup> They are highly susceptible to natural disasters, are vulnerable to global economic developments, have a general scarcity of natural resources, lack economies of scale, are far from large markets and have small but rapidly growing populations.<sup>46</sup> Crucially, these countries also have limited human, institutional and financial capacities to manage and use their limited natural resources on a sustainable basis.<sup>47</sup> Their link to the global capitalist system can be considered to be quite weak, and it has been said that it is the very lack of this global linkage that explains their high levels of vulnerability.<sup>48</sup> These States are generally not considered to contribute much to the causes of climate change, yet are expected to disproportionately suffer the consequences of it<sup>49</sup> and as such have been very vocal in climate change negotiations.

Generally their foreign policy is limited to very narrow fields due to the limited resources at their disposal. However, they have been quite active in shaping some treaties that they consider important to them, such as the United Nations Convention on the Law of the Seas (UNCLOS), for example.<sup>50</sup> Within the UN system, AOSIS serves as the voice of the SIDS,<sup>51</sup> and delegates from SIDS have played a key role in UNFCCC negotiations, being the first to propose a draft text during the Kyoto Protocol negotiations that called for cuts in carbon dioxide emissions.<sup>52</sup> SIDS have also worked on a number of other global climate change concerns and various regional projects.<sup>53</sup>

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<sup>44</sup> UNFCCC (2007).

<sup>45</sup> Warner et al. (2009), p. 6.

<sup>46</sup> See for example UNFCCC (2007), or Warner et al. (2009), p. 1.

<sup>47</sup> Warner et al. (2009), p. 5.

<sup>48</sup> Pelling and Uitto (2001), p. 49.

<sup>49</sup> As explained in the IPCC 4AR.

<sup>50</sup> Grant (2000), p. 181.

<sup>51</sup> Warner et al. (2009), p. 6.

<sup>52</sup> Warner et al. (2009), p. 22.

<sup>53</sup> Warner et al. (2009), p. 22.



### 4.3.3 *Climate Change and AOSIS*

AOSIS has been quite vocal in climate change negotiations as small islands are likely to suffer greatly from the effects of climate change. These effects could be broadly divided into two groups. First, the economy and the environment will be directly affected by climate change, as explained in Chap. 3. This includes, for example, increases in sea level and tropical cyclone intensity, which can have disastrous consequences for crops and infrastructure. Secondly, these islands are often isolated and could suffer from measures put in place to fight climate change on a global level, such as limitations in shipping or air travel.<sup>54</sup> Currently, the Kyoto protocol does not include emissions by aviation and shipping, though this could change in the future. However, the application of measures that would aim to reduce the effect of these on the climate change could be good for the planet on the global stage, yet negatively affect small islands at the local level.<sup>55</sup> This could be especially important for islands where the economy is dependent to a large extent on tourism, such as the Maldives, as an environmental tax on air travel could reduce the numbers of visitors to the country.

Historically, and starting with the Malé Declaration in 1989,<sup>56</sup> Small Island States have been strongly involved in climate change negotiations.<sup>57</sup> Despite the highly heterogeneous nature of nations that form AOSIS, this alliance has managed to become one of the key players in the UNFCCC negotiations.<sup>58</sup> It has been noted that this recognition in itself is an important success for Small Island States, and it is manifest in the acknowledgement of the especial vulnerability of Small Islands Developing States (SIDS) in the Convention text and the practice to grant them a seat at the various bodies established under the Convention and its 1997 Kyoto Protocol.<sup>59</sup> An important ingredient to the successful representation of the interests of these island countries lies in the coordination and participation as a bloc, which allows them to overcome some of the financial and human resources limitations that they face.<sup>60</sup> Also, AOSIS constitutes around one-fourth of developing countries, and close to one-fifth of the total UN membership, and thus building this coalition provides them certain power in terms of numbers.<sup>61</sup>

The SIDS noted in the Malé Declaration on the Human Dimension of Global Climate Change that there is a fundamental right to an environment capable of

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<sup>54</sup> David (2010).

<sup>55</sup> David (2010).

<sup>56</sup> Malé Declaration on Global Warming and Sea Level Rise, adopted by the Small States Conference on Sea Level Rise, held in Malé, Maldives, 14–18 November 1989.

<sup>57</sup> Grote (2011), p. 264.

<sup>58</sup> Betzold et al. (2011), p. 595.

<sup>59</sup> Betzold et al. (2011), p. 592.

<sup>60</sup> Betzold et al. (2011), p. 592.

<sup>61</sup> See AOSIS website and Betzold et al. (2011).

supporting a society.<sup>62</sup> In 2009 AOSIS issued another declaration that again stressed the adverse consequences that climate change would have for the survival of small islands, and pressed for the adoption of a package of mitigation measures that would limit global temperature rise to below 1.5 °C above pre-industrial levels by a reduction in greenhouse gas emissions by a 45 % reduction in greenhouse gas emissions by 2020.<sup>63</sup> They were also behind resolution A/64/281 of the UN General Assembly, which acknowledged that climate change may have security implications.<sup>64</sup> In the run-up to the Copenhagen summit various members of AOSIS continued to draw attention to the fact that many islands could become submerged in the future, such as the Cabinet of the Maldives holding a meeting underwater.<sup>65</sup>

The Copenhagen summit showed that it is not easy for AOSIS to structure their political goals adequately at the international stage and how their position is still very weak.<sup>66</sup> Nevertheless, it is interesting to see how its members are attempting to use the legal mechanisms available to them, or to push for the development of legal standards.<sup>67</sup>

Some analysis has also shown the submissions and interventions of AOSIS as a group might have decreased relative to those of the individual countries that constitute it, as the multiplication of issues under the climate change agenda has negatively affected the cohesion of the group.<sup>68</sup> One example of this is the attitude towards relocation, with the government of Kiribati keen to secure international agreements and pushing for recognition that climate change has contributed to their problems and acknowledges “relocation” as part of their obligations to compensate.<sup>69</sup> In contrast, the governments of the Federated States of Micronesia and Tuvalu have resisted the inclusion of “relocation” in international agreements, as they fear that if this is included then developing countries might think that the problem can be solved by relocating the affected populations instead of reducing greenhouse gas emissions.<sup>70</sup> Another disagreement relates to the extent that climate change should be considered to be a driver of migration, where in Tuvalu the predominant official view is that climate change should remain the focus of any multilateral or bilateral discussions about development, assistance and migration

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<sup>62</sup> Declaration on Human Dimensions of Global Climate change, [www.ciel.org/Publications/Male\\_Declaration\\_Nov07.pdf](http://www.ciel.org/Publications/Male_Declaration_Nov07.pdf), and Söderbergh (2011), p. 191.

<sup>63</sup> Maclellan (2009), p. 21.

<sup>64</sup> Maas and Carius (2012), p. 651.

<sup>65</sup> See BBC (2009) although the meeting was called a media stunt by some commentators, as highlighted by Gagain (2012).

<sup>66</sup> David (2010).

<sup>67</sup> Söderbergh (2011), p. 20.

<sup>68</sup> Betzold et al. (2011), p. 1.

<sup>69</sup> Interview between Jane McAdam and the Kiribati Solicitor-General David Lambourne, as explained in McAdam (2011), p. 116.

<sup>70</sup> Interview between Jane McAdam and the President Anote Tong of Kiribati, as explained in McAdam (2011), pp. 102–137. Is this correct?

(as officials worry that if more complex dimensions are added to the problem then this will detract from the urgency of the climate change threat).<sup>71</sup> By contrast one government official of Kiribati interviewed by McAdam observed how climate change could prove a “tipping point” for the many underlying stresses on the islands (such as overcrowding, unemployment, environmental and development), a point that would not be reached if the climate did not change.<sup>72</sup>

Nevertheless, and although it appears more difficult to achieve unity within its members, AOSIS still remains a fairly tight negotiating coalition.<sup>73</sup> This could be seen for example in the Climate Change Declaration that was adopted by AOSIS at the sidelines of the 67th UN General Assembly, which called for urgent action to address climate change and for a greater commitment to the reduction in greenhouse gas emissions.<sup>74</sup>

At UNFCCC meetings AOSIS often does appear to continue to speak with one voice, and regularly news agencies quote the group’s representative. For example, commenting on the outcome of the UNFCCC COP18 meetings at Doha, the BBC quotes the representative of AOSIS criticising the deal:

We see the package before us as deeply deficient in mitigation (carbon cuts) and finance. It’s likely to lock us on the trajectory to a 3,4,5C rise in global temperatures, even though we agreed to keep the global average temperature rise of 1.5C to ensure survival of all islands (. . .) There is no new finance (for adapting to climate change and getting clean energy) - only promises that something might materialise in the future. Those who are obstructive need to talk not about how their people will live, but whether our people will live.<sup>75</sup>

A key negotiating demand by AOSIS in recent climate change negotiations has been the adoption of a “loss and damage proposal”, drawing on numerous principles of international law, including polluter pays, intergenerational equity, trans-boundary harm and responsibility of a State.<sup>76</sup> The plan would establish historical baselines about weather hazards and quantify the assessments of new risks, establish an insurance system to cover countries with the costs associated with sudden climate impacts (such as tropical storms), and create an international solidarity fund that would compensate countries for economic and non-economic losses stemming from slow-onset climate impacts (such as coral bleaching, ocean acidification and sea level rise).<sup>77</sup> These damages could include the cost of relocation of the inhabitants if islands become uninhabitable, and the funds would come from premiums supported by contributions by industrialised countries based on their responsibility for greenhouse gas emissions.<sup>78</sup> Such a proposal seems to slowly be

<sup>71</sup> McAdam (2011), pp. 102–137.

<sup>72</sup> Interview between Jane McAdam and the Kiribati Solicitor-General David Lambourne, as explained in McAdam (2011), p. 116.

<sup>73</sup> Betzold et al. (2011).

<sup>74</sup> AOSIS (2012).

<sup>75</sup> BBC (2012).

<sup>76</sup> Trust (2012).

<sup>77</sup> Trust (2012).

<sup>78</sup> Trust (2012).

finding its way into negotiations, as one of the key outcomes of the COP18 in Doha was that a “pathway” was established to “provide vulnerable populations with better protection against loss and damage caused by slow onset events such as rising sea levels”.<sup>79</sup> In particular the COP<sup>80</sup>:

agrees that the role of the Convention in promoting the implementation of approaches to address loss and damage includes, *inter alia*: enhancing knowledge and understanding of comprehensive risk management approaches; strengthening dialogue among relevant stakeholders; and enhancing action and support, including finance, technology and capacity building, to address loss and damage;

requests developed country parties to provide developing country parties with finance, technology and capacity building;

decides to establish at COP 19 institutional arrangements, such as an international mechanism, to address loss and damage in developing countries that are particularly vulnerable to the adverse effects of climate change

requests the Secretariat: to carry out, prior to SBI 39, an expert meeting to consider future needs, including capacity needs associated with possible approaches to address slow onset events; and to prepare technical papers on non-economic losses, and on gaps in existing institutional arrangements within and outside of the Convention to address loss and damage.<sup>81</sup>

The inclusion of such an item has been described as an example of the success of the diplomatic process, though AOSIS is only perceived to have accepted the outcome of the COP18 in Doha because any agreement, however small, is better than nothing.<sup>82</sup> The fact that this mechanism has even found its way into the text shows the weight that an association such as AOSIS can have in the negotiations. It also represents an important shift in the principles behind climate negotiations, and a first step by industrialized countries in accepting responsibility for damage caused by climate change.<sup>83</sup>

## 4.4 Conclusions

Atoll Island States form part of the Alliance of Small Island States, a coalition of States within the United Nations that share a growing concern about the environment and the effects that climate change can have on the fragile ecosystems of islands. The first political manifestation of this organisation was at a 1989 conference held in Malé, where the countries that attended quickly increased their awareness of their vulnerability to sea level rise.<sup>84</sup> As a result these States have

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<sup>79</sup> Trust (2012).

<sup>80</sup> UNFCCC (2012).

<sup>81</sup> Earth Negotiations Bulletin (2012), p. 20.

<sup>82</sup> BBC (2012).

<sup>83</sup> BBC (2012).

<sup>84</sup> David (2010).

called on all countries to immediately limit their greenhouse gas emissions, and hence have invested much political effort into in the UNFCCC negotiations and the ratification of the Kyoto Protocol.

A key demand by AOSIS in recent climate change negotiations has been the adoption of a “loss and damage proposal”, which draws on numerous principles of international law, including polluter pays, intergenerational equity, trans-boundary harm and responsibility of a State. Such a proposal appears to be slowly finding its way into the negotiations, with the COP18 in Doha establishing a “pathway” for such a notion, which could lead to the creation of an international solidarity fund that would compensate countries for economic and non-economic losses stemming from slow-onset climate impacts (such as coral bleaching, ocean acidification and sea level rise). Such a notion represents an important shift in the principles behind climate negotiations, and a first step by industrialized countries in accepting responsibility for damage caused by climate change, which we will explore in more detail in Chap. 7.

## References

- AOSIS website (2012) Alliance of Small Island States. <http://aosis.info/aomembers/>. Accessed 28 May 2012
- AOSIS (2012) Press Release: Leaders of Small Islands Adopt Climate Change Declaration at UNGA, 28 September 2012. <http://aosis.org/press-release-leaders-of-small-islands-adopt-climate-change-declaration-at-unga/>. Accessed 10 Dec 2012
- Barnett J, Campbell J (2010) Climate change and Small Island States. Earthscan Ltd, London
- BBC (2009) Maldives Cabinet Makes a Splash. BBC News (17 October 2009). <http://news.bbc.co.uk/1/hi/8311838.stm>. Accessed 22 Mar 2012
- BBC (2012) UN climate talks extend Kyoto Protocol, promise compensation. <http://www.bbc.co.uk/news/science-environment-20653018>. Accessed 8 Dec 2012
- Betzold C, Castro P, Weiler F (2011) AOSIS in the UNFCCC negotiations: from unity to fragmentation? Center for Comparative and International Studies (CIS), Nr. 72. [http://www.cis.ethz.ch/publications/publications/WP\\_72.pdf](http://www.cis.ethz.ch/publications/publications/WP_72.pdf). Accessed 10 January 2013
- CIA (2012) The World Factbook. <https://www.cia.gov/library/publications/the-world-factbook/index.html>. Accessed 28 May 2012
- David G (2010) Existe-t-il une spécificité insulaire face au changement climatique? Vertigo 10 (3) (in French)
- Earth Negotiations Bulletin (2012) Summary of the UNFCCC Climate Change Conference COP 18/CMP8, Vol. 12, No. 567. Available at [www.iisd.ca/climate/cop18/enb](http://www.iisd.ca/climate/cop18/enb). Accessed 11 Dec 2012
- Gagain M (2012) Climate change, sea level rise, and artificial islands: saving the Maldives' statehood and maritime claims through the 'Constitution of the Oceans'. *Colombia J Int Law Policy* 23:77–120
- Grant TD (2000) States newly admitted to the United Nations: some implications. *Columbia J Transnatl Law* 39:177
- Grote J (2011) Implementing a new regime of stable maritime zones to ensure the (economic) survival of small island states threatened by sea-level rise. *Int J Mar Coastal Law* 26:263–311
- Hyvarinen J (2011) Legal issues and development of the international climate regime. Note by the Foundation for International Environmental Law and Development. August 2011. Available at

- <http://www.field.org.uk/files/fieldnoteunfccclegalissuesaugust2011.pdf>. Accessed 16 Aug 2012
- Maas A, Carius A (2012) Territorial integrity and sovereignty: climate change and security in the Pacific and beyond. In: Scheffran J et al (eds) *Climate change, human security and violent conflict*. Springer, Heidelberg, pp 651–665
- Malé Declaration on Global Warming and Sea Level Rise (1989) Adopted by the Small States Conference on Sea Level Rise, held in Malé, Maldives, 14–18 November 1989, UN Doc. A/C.2/44/7, 22 November 1989, Annex, at 2 et seq
- McAdam J (2011) Refusing refuge in the Pacific: (de)constructing climate-induced displacement in international law. In: Piguet E, Pécoud A, de Guchteneire P (eds) *Migration, environment and climate change*. UNESCO, Paris, pp 102–137
- MacLellan N (2009) *The future is here: climate change in the Pacific*. Oxfam report. [www.oxfam.org.au/climate-change](http://www.oxfam.org.au/climate-change). Accessed 23 Dec 2011
- Pelling M, Uitto J (2001) Small island developing states: natural disaster vulnerability and global change. *Environ Hazard* 3:49–62
- Schewe J, Levermann A, Meinshausen (2011) Climate change under a scenario near 1.5°C of global warming: monsoon intensification, ocean warming and steric sea level rise. *Earth System Dynamics* 2:25–31
- Söderbergh C (2011) Human rights in a warmer world: the case of climate change displacement working paper. Available at <http://lup.lub.lu.se/record/1774900>. Accessed 5 Jan 2012
- Trust (2012) Climate conversations – Small Island States need action on climate loss and damage. <http://www.trust.org/alertnet/blogs/climate-conversations/small-island-states-need-action-on-climate-loss-and-damage/>. Accessed 11 Dec 2012
- UNFCCC (2007) *Climate change: impacts, vulnerabilities and adaptation in developing countries*. <http://unfccc.int/resource/docs/publications/impacts.pdf>. Accessed 23 Mar 2012
- UNFCCC (2012) Press release: Doha climate conference opens gateway to greater ambition and action on climate change. [http://unfccc.int/files/press/press\\_releases\\_advisories/application/pdf/pr20120812\\_cop18\\_close.pdf](http://unfccc.int/files/press/press_releases_advisories/application/pdf/pr20120812_cop18_close.pdf). Accessed 10 Dec 2012
- Warner K et al (2009) Global climate change and small island developing states: financing adaptation. <http://www.careclimatechange.org>. Accessed 21 Dec 2011
- Webb AP, Kench PS (2010) The dynamic response of reef islands to sea-level rise: evidence from multi-decadal analysis of island change in the Central Pacific. *Global Planet Change* 72:234–246. doi:10.1016/j.gloplacha.2010.05.003

# Chapter 5

## Future Atoll Scenarios: Adaptation Strategies and Their Implication Under UNCLOS

### 5.1 Introduction

In this chapter, possible future scenarios and adaptation strategies for Atoll Island States against climate change will be discussed, together with the viability of these options from an economical, legal and engineering point of view. Adaptation to climate change is complex, and depends on a number of factors, such as the resilience, access to resources and financial capacity of the communities involved. As such, it is unlikely that all Atoll Island States will be able to attempt the same adaptation measures. In particular, middle-income countries such as the Maldives will arguably be able to afford more expensive adaptation strategies than poorer countries such as Tuvalu. Hence, the range of options open to each country will likely be different. Richer countries will probably be able to protect the circumference of key islands using costly coastal defences, which if accompanied with the gradual raising of the islands using materials dredged from nearby “failed” atolls, could ensure their long-term survival.

However, poorer countries will likely face difficulties to find a solution to the challenge posed by raising sea levels and increases in coral mortality, and this could lead to the eventual disappearance of their islands. The implications of the disappearance of some of these Atoll Island States with regards to sovereignty over their current territories and maritime areas will be dealt with in this chapter. The future legal status of the inhabitants of those islands and other ideas such as the possibility of forming a government-in-exile will be analysed later in Chap. 7. When thinking about these issues, it is important to keep in mind that international law is dynamic, and that it is continuously adapting to new political demands and circumstances. Hence it is possible that it will somehow adapt to the issues brought about by climate change,<sup>1</sup> though changes in international law are typically post-facto, usually taking place after a problem exists and people having started to suffer from it. Finally, it is important to note that the engineering solutions that will be

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<sup>1</sup> Wei (2011), p. 1.

outlined could be attempted by the poorer States, if they were to find the necessary finance. In this respect, it might be possible for these States to attempt to join a bigger country, which could provide them with the necessary financial resources to protect the islands in exchange for joint exploitation of their Exclusive Economic Zones (EEZs), as will be discussed in Chap. 6.

However, it is possible that many of the islands that form part of Atoll Island States will ultimately disappear, depriving them of the various maritime zones that can be derived from them. A key point in UNCLOS is how maritime zones are delimited, and for this it is important to understand the problems related to the determination of baselines and how these could change in the future due to climate change and sea level rise. In this chapter we will also detail the solutions which have been offered by various commentators on how to preserve these baselines, with several of them proposing that UNCLOS should be modified or that at least there should be a movement to a more progressive interpretation of some of its clauses. While we agree that such developments would be welcomed, we will argue that raising existing islands would be the most obvious and clear way of protecting the maritime zones that originate from them, and would not require any changes to UNCLOS. This line of argument differs slightly from that of Gagain<sup>2</sup> in that we are not calling for the creation of artificial islands to preserve maritime zones or sovereignty, but rather for the raising of existing islands. This would be a less costly alternative than the creation of new islands—as it would involve less materials and would be technically simpler and identical to what many countries already do around their coastline (i.e. in line with accepted State practice regarding the protection and management of coastlines around the world). In fact, attempting to change a treaty such as UNCLOS would result in a long negotiation process, which would involve the establishment of various committees, protracted discussions and an uncertain outcome. As UNCLOS already allows the raising of naturally formed islands and the protection of their shoreline, and if the objective of the international community was to save the maritime zones of Atoll Island States, it would be much cheaper and cost-effective to use this money and resources to elevate some key islands than to reopen political negotiations around UNCLOS. This would not only allow their respective populations to stay in place, but in essence would nullify many of the problems that will be presented in later chapters of this book.

In preparing the present chapter we have tried to be as comprehensive as possible in our study of all the possible scenarios that we have found in literature or that we could possibly think of. However, some of these scenarios (such as the idea of creating floating islands or recreating an island after it has disappeared) appear to make little objective sense. Nevertheless, we hope that by including such a comprehensive list of scenarios the reader can obtain a good idea of the legal problems involved in each of the engineering solutions that could be envisaged, while highlighting why some will probably never be attempted.

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<sup>2</sup>Gagain (2012).



## 5.2 Maritime Boundaries and Baselines

Although it could be assumed that the idea that a State can claim maritime zones around its territory is based on ancient traditions amongst nations, in fact these notions only became firm around the nineteenth century.<sup>3</sup> During that time a variety of doctrines existed regarding the extent of territorial seas, such as whether they could be determined by line-of-sight or the range of a cannon based on the shore.<sup>4</sup> By 1900, however, many countries had adopted the low water mark as the primary baseline from which to determine maritime zones.<sup>5</sup>

Though in the nineteenth century the idea of a maritime zone might have been important from a strategic-military point of view, nowadays their interest is generally related to the economic advantages that can be obtained from them. The EEZ that islands are able to claim around their territory is very important for the economy of many countries, as they are able to obtain fishing rights and explore underwater resources such as oil and gas. Confusion regarding maritime boundaries around the globe has potentially significant consequences in creating inter-State disputes, which could lead to conflicts and international instability.<sup>6</sup> Indeed, conflicts have already erupted over maritime areas and resources in the past, such as the Anglo-Icelandic “cod wars” in the 1950s and 1970s, and the 1988 Spratley Island clash between China and Vietnam.<sup>7</sup>

In order to understand what would be the legal consequences of climate change on Atoll Island States, we are going to examine relevant parts of the United Nations Convention on the Law of the Sea (UNCLOS).

### 5.2.1 UNCLOS and Maritime Zones

UNCLOS is a broad convention which establishes navigational rights, territorial sea limits, economic jurisdiction, legal status of resources on the seabed beyond the limits of national jurisdiction, passage of ships through narrow straits, conservation and management of living marine resources, protection of the marine environment, a marine research regime and a binding procedure for settlement of disputes between States, among other topics. The Convention entered into force on

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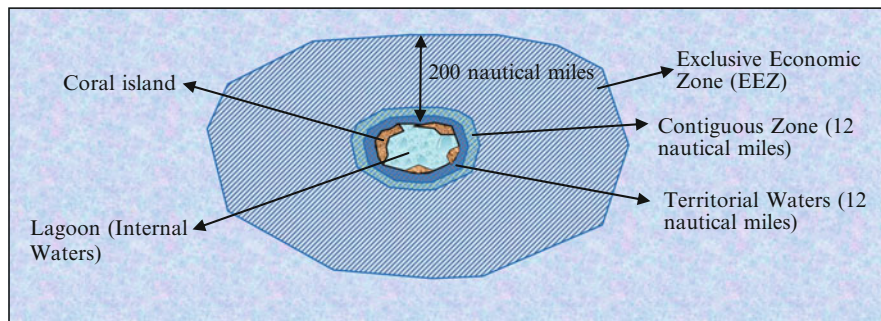
<sup>3</sup> Caron (1990), p. 629.

<sup>4</sup> Caron (1990), p. 629.

<sup>5</sup> Caron (1990), p. 629.

<sup>6</sup> Lusthaus (2010), p. 113.

<sup>7</sup> Lusthaus (2010), p. 114. Tensions in the area around the Spratley Islands appears to be intensifying at the time of writing this book, with multiple incidents between China and other countries in the area, such as the Philippines. BBC 2012.



**Fig. 5.1** Schematic representation of the various maritime zones around an atoll. Note that the continental shelf is not included in this diagram

16 November 1994 and resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), which took place from 1973 through to 1982.<sup>8</sup>

UNCLOS establishes a number of different rights for the coastal State over a number of regions adjacent to a certain baseline. The maritime zones outlined in UNCLOS include the territorial sea, the contiguous zone, the Exclusive Economic Zone (EEZ) and the continental shelf (see Fig. 5.1).

The territorial sea, according to Art. 3 of UNCLOS, is the area of the sea over which a coastal State can extend its sovereignty beyond its land territory and internal waters, which is limited to 12 nautical miles from the coastal baseline from which it is measured. The sovereignty of this area is extended to the airspace over the territorial sea and to its bed and subsoil (Art. 5 UNCLOS).

The EEZ is regulated by UNCLOS as an area beyond and adjacent to the territorial sea in which the coastal State possesses certain rights and jurisdiction and all other States possess certain rights and freedoms (Art. 55 UNCLOS III).<sup>9</sup> The coastal State possesses sovereign rights over the natural resources, whether living or non living, of the waters and seabed in the zone (Art. 56(1) UNCLOS III), while other States possess the freedoms of navigation and overflight (Art. 58 UNCLOS III). The breadth of the exclusive economic zone cannot exceed 200-nautical miles (370.4 km) from the baselines from which the breadth of the territorial sea is measured. This 200 nautical miles boundary represents a substantial area, giving the country control over 125,000 square nautical miles of sea (over 430,000 km<sup>2</sup>), which represents an area greater than that of medium size countries such as Japan or Germany. This EEZ is of great importance for the economy of Atoll Island States, as the resources derived from fishing are a main source of income for many of them, representing an important prospect for sustainable economic development, wellbeing and stability.

<sup>8</sup> United Nations Conference on the Law of the Sea (UNCLOS III) [http://www.un.org/Depts/los/convention\\_agreements/convention\\_historical\\_perspective.htm#Historical](http://www.un.org/Depts/los/convention_agreements/convention_historical_perspective.htm#Historical) Perspective, Accessed 16 July 2012.

<sup>9</sup> United Nations Convention on the Law of the Sea (UNCLOS) (1982). [http://www.un.org/Depts/los/convention\\_agreements/texts/unclos/closindx.htm](http://www.un.org/Depts/los/convention_agreements/texts/unclos/closindx.htm). Accessed 24 August 2009.

Finally there is the Extended Continental Shelf. The continental shelf is actually not a legal but rather a geographical concept, generally used by geologists to denote a part of the continental margin which is between the shoreline and the shelf break or, where there is no noticeable slope, between the shoreline and the point where the depth of the adjacent water is approximately between 100 and 200 m. However, this term is used in Art. 76 of UNCLOS as a juridical term, with Art. 76(1) providing the following definition:

the continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongations of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance

According to Art. 76, the coastal State may establish the outer limits of its juridical continental shelf wherever the continental margin extends beyond 200 nautical miles by establishing the foot of the continental slope. However, this would imply that there are two alternative definitions, the first of which can be called the “broad” continental shelf, and the second can be referred to as the “distance-based” continental shelf.<sup>10</sup> Hence, according to this article, if a State can prove that its physical continental shelf extends more than 200 miles, it would be able to claim this “broad” continental shelf under Art. 76(1). This in turn allows them access to natural resources over a distance of 200 miles, which explains why many States invest considerable amount of resources to investigate them. Even small countries, such as the Maldives, have declared continental shelves exceeding 200 miles from their baselines,<sup>11</sup> as shown in Fig. 5.2. This “broad” continental shelf also has a limit, as Art. 76(5) (6) generally<sup>12</sup> limits the continental shelf to 350 nautical miles from the baselines from which the breadth of the territorial sea is measured.<sup>13</sup>

One important difference between the two types of continental shelves (“broad” and “distance-based”) is the perceived nature and requirements to establish each of them. For the case of establishing the EEZ the State does not need to make a submission to the UN Commission on the Limits of the Continental Shelf (CLCS), but can just determine them by measuring 200 miles from the baseline. As these lines are not determined by geological or geomorphological factors drawing them is relatively straightforward.<sup>14</sup> For the case of the “broad” continental shelf the requirements are more complex, and according to Art. 76(9) States are required to supply information to the Secretary-General of the United Nations to permanently

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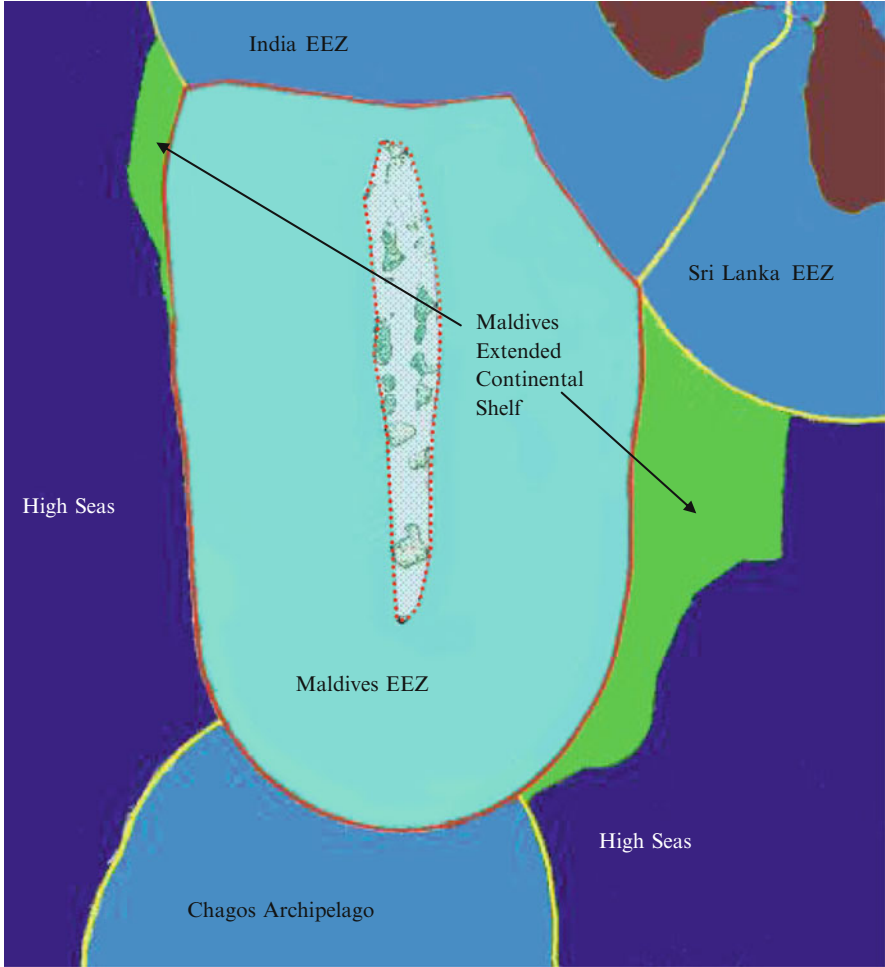
<sup>10</sup> Grote (2011), p. 269.

<sup>11</sup> Commission on the Limits of the Continental Shelf (2010). Submission by the Republic of the Maldives. [http://www.un.org/depts/los/clcs\\_new/submissions\\_files/mdv53\\_10/MAL-ES-DOC.pdf](http://www.un.org/depts/los/clcs_new/submissions_files/mdv53_10/MAL-ES-DOC.pdf).

<sup>12</sup> Wei (2011), p. 2.

<sup>13</sup> Though the articles note that this “does not apply to submarine elevations that are natural components of the continental margin, such as its plateaux, rises, caps, banks and spurs”.

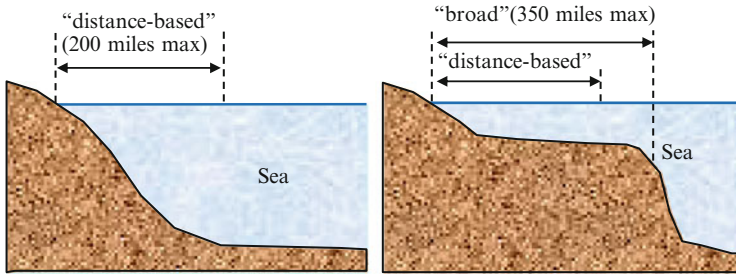
<sup>14</sup> Grote (2011), p. 294.



**Fig. 5.2** Maldives 200 miles EEZ and Extended Continental Shelf claimed in 2010. Map is adapted from the Commission on the Limits of the Continental Shelf (2010)<sup>15</sup>

describe the limit of the continental shelf. This involves assembling a team of experts to ascertain where the geographical limit of the continental shelf is located, something that can be open to different and competing interpretations (Fig. 5.3).

<sup>15</sup> Submission by the Republic of the Maldives. [http://www.un.org/depts/los/clcs\\_new/submissions\\_files/mdv53\\_10/MAL-ES-DOC.pdf](http://www.un.org/depts/los/clcs_new/submissions_files/mdv53_10/MAL-ES-DOC.pdf). The map shows the Maldives Archipelago at the centre, with a dotted line around the archipelago indicating the archipelagic baselines encompassing all the different atolls. Around this baseline is the 200 miles EEZ (which is shorter in areas where it overlaps the Indian EEZ, for example), and the Extended Continental Shelf claimed in 2010, which extends beyond the 200 miles of the EEZ. The EEZs of India, Sri Lanka and



**Fig. 5.3** Difference between the “distance-based” (i.e. 200 miles) and “broad” continental shelf (Grote 2011, p. 269)

### 5.2.2 UNCLOS and the Determination of Baselines

Baselines are a very important part of UNCLOS and the delimitation of maritime zones, as they represent the line from which the breadth of each of the maritime zones starts to be measured. They are also of great importance for the determination of the equidistance and media lines that are used to solve overlapping maritime claims between countries that have adjacent or opposite coasts. These lines generally follow the profile of the coastline, though the complex nature of coastal environments and the tides that affect them complicate the matter to some extent. Some areas of the world have extensive tidal ranges, that can be even higher than 10 m at places such as the Bay of Fundy<sup>16</sup> or the Severn Estuary.<sup>17</sup> This can result in the water retreating kilometres from its high-tide mark (which can be observed in places such as Southport, in the UK). Also, the presence of coral reefs can complicate the matter, as these reefs are often exposed to the sun at low-tide, and can be located kilometres away from the sandy beaches which typically form behind them. Thus, the law regarding baselines, as described in Arts. 5–15 of UNCLOS III, is also fairly complex.<sup>18</sup>

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that which would correspond to the Chagos Archipelago are also shown. The UK government enacted the BIOT Order 1965, which separated the Chagos Islands from what was their colony of Mauritius at the time. This created the British Indian Ocean Territory (BIOT). The islands were then made available to the US government, and secretly exiled the indigenous population of the entire Chagos Archipelago (around 1800 individuals at the time) to Mauritius. The US took possession in 1971, though the UK retains and currently exercises sovereignty over the islands. For more details on this and the problems and legal processes that this started see Allen 2008, p. 684.

<sup>16</sup> The Bay of Fundy is located on the Atlantic coast of North America, between the Canadian provinces of New Brunswick and Nova Scotia.

<sup>17</sup> It is the estuary of River Severn, which is the longest river in Great Britain.

<sup>18</sup> Which expand on the rules set forth in the 1958 Convention on the Territorial sea and Contiguous Zone, Apr. 29, 1958, 15 U.S.T. 1606, T.I.A.S. No. 5639, 516 U.N.T.S. 205, which entered into force Sept. 10 1964, according to Caron (1990), p. 632.

According to UNCLOS, the EEZ and other outer maritime boundaries are delimited from these baselines, which are by their nature located in the coastal zone of countries that have access to the sea. According to Art. 5 of this Convention, the baseline is normally taken as “the low-water line along the coast as marked on large-scale charts officially recognized by the coastal State”, although a number of exceptions exist. Special rules define the baselines for islands with fringing reefs or atolls. In this case “the baseline for measuring the breadth of the territorial sea is the seaward low-water line of the reef, as shown by the appropriate symbol on charts officially recognized by the coastal State” (Art. 6 of UNCLOS) and establish straight baselines when the coastline is deeply indented and cut into, or if there is a fringe of islands along the coast (Art. 7). The drawing of straight baselines is also provided in Arts. 47–48 regarding archipelagic States.

UNCLOS specifies that in drawing these straight lines, they should not significantly depart from the general direction of the coast so that the area in between them can be subject to the regime of internal waters. It is also not possible to draw them from areas of low-tide, unless a lighthouse or similar installation has been built on them that can permanently delimit the point. It is also possible to draw a baseline to a low-tide point if this has received international recognition. In determining these straight baselines it is possible for a coastal State to take into account economic interests relevant to the region, the reality and importance of which are evidenced by long usage.

Under some conditions, an Archipelagic State is entitled to draw straight archipelagic baselines that join the outermost points of the outermost islands and drying reefs of their archipelagos. These conditions, as set out in UNCLOS Art. 47, are that,

- The straight baseline must include the main islands and an area of water to land ration in the range of 1:1 and 9:1
- The baselines cannot exceed 100 nautical miles long, with the exception that 3 of the baselines may be up to 125 nautical miles in length
- The baselines cannot depart to any appreciable extent from the general configuration of the archipelago
- The baselines cannot be drawn to or from low-tide zones, unless a lighthouse or similar installation has been built that remains above sea level at all times, or that lies at least partly within the territorial sea of the nearest island
- Baselines cannot be drawn in a way to cut off from the high seas or the EEZ the territorial sea of another State.

It is important to remember that for the case of Atoll Island States, UNCLOS specifies that for

the case of islands situated on atolls or of islands having fringing reefs, the baseline for measuring the breadth of the territorial sea is the seaward low-water line of the reef, as shown by the appropriate symbol on charts officially recognized by the coastal State (Art. 7)

This article provides that only reefs that are exposed at low tide, and not wholly submerged reefs may be used as baselines. It is also not clear how far from the island the fringing reef may be situated before it ceases to be eligible to be used as a baseline, though for the case of atolls the reef is rarely very far from the shoreline.<sup>19</sup> Art. 6 also does not specify what should happen when there is a gap in the fringing reef, though many States have adopted the practice of drawing straight lines across the gap.<sup>20</sup>

It is worth keeping in mind that the definition of what constitutes a reef baseline might create a problem for Atoll Island States. It is possible that as a consequence of climate change and sea level rise a reef could go from a state of being exposed at low tide to being constantly submerged (if it cannot keep pace with sea level rise due to the multiple stresses outlined in Chap. 3). The reef could still exist, and even be in a fairly healthy state, but slower growth could lead to it falling progressively behind the rising seas, and this could somehow present a problem for the case of the delimitation of baselines. However, it is also worth noting that, provided that the island still exists behind the reef, this problem and its consequences are rather academic, as the baseline could still theoretically be read from the low-water mark on the beach. This would result in the baseline moving a few hundred meters or several kilometres landwards, though ultimately the island could continue to claim an EEZ and other maritime areas around it (assuming it was still inhabitable, i.e. that it could still be broadly classified as falling under the Scenario I or II presented later in this chapter).

### 5.2.3 *The Problem of Ocean Boundaries*

The current system of delimiting ocean boundaries does not provide clear solutions to the problem that these lines appear to be ambulatory in nature,<sup>21</sup> as the question of sea-level rise and its effects on maritime space and borderlines were not addressed by the 1982 Convention.<sup>22</sup> Essentially, if the baseline shifts, then the

<sup>19</sup> As opposed to the situation of the Great Barrier Reef in Australia, where the reef in some places is up to 150 miles from the coastline.

<sup>20</sup> SOPAC (2006).

<sup>21</sup> The LOSC in fact does not indicate whether the boundaries of the maritime zones move as baselines move. Baselines are clearly not fixed, as they are based on low-water marks, and these move following various morphological processes. This has led a number of commentators to conclude that these outer boundaries of the territorial sea must be ambulatory, see Soons (1990), p. 216 and Caron (1990), p. 634. This principle of the ambulatory nature of baselines and maritime zones is accepted by most researchers. All authors referenced in this chapter accept this concept of the ambulatory nature of baselines and a proof of this is that a significant number of papers have attempted to find solutions to this problem, see for example Rayfuse (2010), p. 3 and Grote (2011), pp. 271–276.

<sup>22</sup> As expressed by the President of the International Tribunal of the Law of the Sea (ITLOS), General Information—Judges: The Presidency, International Tribunal for the Law of the Sea, <http://www.itlos.org/index.php?id=17>. Accessed 26 March 2012, cited by Gagain (2012), p. 99.



maritime zones will shift along with it. Future increases in sea level can thus change the coastline of a country and possibly lead to conflicts between neighbouring States. For example, the present boundary between Cuba and the USA is based on the principle of equidistance between the normal baselines of each country, though a 1.5 m increase in sea level could submerge part of Florida, meaning that the present boundary would thus no longer reflect future equidistance.<sup>23</sup> Similar problems could present themselves in other locations in the world, such as in the Bay of Bengal.<sup>24</sup> Examples of such situations already exist, where the island of Bermeja in the Gulf of Mexico could no longer be found in September 2009, despite being in the maps for centuries.<sup>25</sup> The situation led to the USA stating that without an island Mexico (who originally owned Bermeja) could no longer claim an EEZ around it, vital to access the rich hydrocarbon subsoil in the Gulf.<sup>26</sup> Similarly the disappearance of New Moore Island, situated in the Bay of Bengal between India and Bangladesh, settled a dispute between India and Bangladesh, both of whom claimed it.<sup>27</sup>

For the case of Atoll Island States, many commentators have argued that a shift of the baseline towards the land would also imply the reduction of the maritime zones around this island, as the fringing reefs would be permanently flooded, and these reefs can serve as a baseline point.<sup>28</sup> The reality, as we have outlined in Chap. 3, is more complicated. Sea level-rise in itself does not guarantee that the reefs will be submerged, as corals can grow up to compensate, as they have often done in the past. However, if coral reefs are to die or their growth slows, then the reefs will not keep pace with the rising seas and the depth of the water above them will gradually increase. As they would no longer be exposed to the air at low tide, then they would no longer be able to be used as baselines. Although the beaches located in the coral islands (which are made of the skeleton of dead corals and foraminifera) behind the reefs could still be used as baselines, these would probably slowly be eroded by the rising waters and the baselines will thus also recede from the low-water mark of these beaches. Eventually, the islands would disappear, and this could prevent an Atoll Island State from drawing baselines around them.

For the case of the drawing of archipelagic baselines, the loss of a single island could represent the loss of one of those straight lines, which would also have significant consequences for the extent of the maritime zones that could be claimed. This would especially be the case for those islands situated in atolls that were at the outmost angles of the archipelagic polygon.

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<sup>23</sup> Houghton et al. (2010), p. 814.

<sup>24</sup> Houghton et al. (2010), p. 814.

<sup>25</sup> Paskal (2010), [http://www.nzherald.co.nz/world/news/article.cfm?c\\_id=2&objectid=10635956](http://www.nzherald.co.nz/world/news/article.cfm?c_id=2&objectid=10635956).

<sup>26</sup> Paskal (2010), [http://www.nzherald.co.nz/world/news/article.cfm?c\\_id=2&objectid=10635956](http://www.nzherald.co.nz/world/news/article.cfm?c_id=2&objectid=10635956).

<sup>27</sup> Paskal (2010), [http://www.nzherald.co.nz/world/news/article.cfm?c\\_id=2&objectid=10635956](http://www.nzherald.co.nz/world/news/article.cfm?c_id=2&objectid=10635956).

<sup>28</sup> UNCLOS Art. 6, as noted by Caron (1990), p. 637.



A further problem that exists is how only islands are able to claim maritime zones around them, and “rocks” are unable to claim such zones. Thus for the case of Atoll Island States a crucial point is what is considered as an island, as the EEZ would be measured from the baseline of each of the islands that constitutes the State. The regime of islands can be found in UNCLOS Art. 121.<sup>29</sup> According to this article, an island must meet a certain number of requirements:

1. An island is a naturally formed area of land, surrounded by water, which is above water at high tide
2. Except as provided for in paragraph 3, the territorial sea,<sup>30</sup> the contiguous zone, the exclusive economic zone and the continental shelf of an island are determined in accordance with the provisions of this Convention applicable to other land territory
3. Rocks which cannot sustain human habitation or economic life of their own shall have no exclusive economic zone or continental shelf

If the island shrank and became a “rock” it would also lose its previous ability to be used to draw baselines. How much an island would shrink as a consequence of sea level rise depends also on the type of the island, its geomorphological characteristics and the health of the coral reefs around it, as described in Chap. 3. Some islands are constituted of high cliffs composed of strong rocks that would be relatively immune to the effects of sea level rise, and in this sense the baseline would not change significantly. Other cliffs formed of weaker rocks would probably suffer more the effects of sea-level rise, and this would result in the cliffs progressively retreating from the sea, though this process would still take a comparatively long time. Atolls are probably the most vulnerable type of island, as they have no cliffs but instead are made of sand and gravel, with their survival hinging on the capacity of coastal reefs to keep pace with sea level rise, as described also in previous chapters.

### 5.3 Future Scenarios for Atolls Island States and Sovereignty Implications

The IPCC<sup>31</sup> highlights how “climate change puts the long-term sustainability of societies in atoll nations at risk”, and that some are facing the threat of completely disappearing from the map due to rising sea levels. The potential abandonment of

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<sup>29</sup> United Nations Convention on the Law of the Sea (UNCLOS) (1982). [http://www.un.org/Depts/los/convention\\_agreements/texts/unclos/closindx.htm](http://www.un.org/Depts/los/convention_agreements/texts/unclos/closindx.htm).

<sup>30</sup> The territorial waters, or territorial sea, as defined by the 1982 United Nations Convention on the Law of the Sea, is a belt of coastal waters extending at most twelve nautical miles from the baseline (usually the mean low-water mark) of a coastal state.

<sup>31</sup> Minura et al. (2007).

sovereign Atoll Island States can be used as the benchmark of the ‘dangerous’ change that the UNFCCC seeks to avoid”.<sup>32</sup>

Climatologists admit that the meteorological effects of climate change cannot be adequately predicted for many areas. However, there is a general consensus that any further global warming will bring with it further sea level rise. “Sea-level rise seems the most probable and perhaps the most globally uniform consequence of warming projected into the next century”.<sup>33</sup> As a result some of these Atoll Island States might lose one of the basic requirements to be a State: their own territory.<sup>34</sup> This potential problem raises a number of challenges regarding the sovereignty of these islands and the status of their current inhabitants, as discussed in Chap. 7.

It is worth noting that very little, if any, of the coastal erosion that has so far occurred around atoll islands can be attributed to climate change. Most of the causes behind the erosion so far observed are due to direct local influences, where interference with the delicate long-term sediment transport balance of the islands can dramatically alter the shoreline. The disappearance of some atoll islands in Tuvalu is often cited as a climate change problem, though there is some evidence that shows that many changes in the coastline are due to dredging and other alterations during the 2nd World War by the American Military<sup>35</sup> (as explained in Chap. 3). However, a rise in sea level due to climate change, combined with a potential increase in tropical cyclone intensity could alter the long-term morphological equilibrium of these islands and eventually render them uninhabitable. Flooding due to storm surges and the rising saltwater table resulting from sea level rise could destroy deep rooted food crops and undermine even coconut trees,<sup>36</sup> a tree which is otherwise highly salt tolerant and able to grow in the sand. Normally a rise in sea level would be counteracted by the natural growth in coral reefs, though as explained previously in Chap. 3 and in the IPCC, there is the fear

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<sup>32</sup> Barnett and Adger (2003), p. 333.

<sup>33</sup> Caron (1990), p. 622.

<sup>34</sup> It should be noted that not all States are members of the UN, and up to 1999 Kiribati, Nauru and Tonga were not part of the UN. For a more detailed discussion see Grant (2000), p. 181. The formulation of the basic criteria for statehood can be found in Art. I of the Montevideo Convention on the Rights and Duties of States, 1933. This states that a State as a person of international law should possess the following qualifications:

a permanent population; although no minimum limit is apparently prescribed. Currently the smallest States by population are the Vatican city with 768 inhabitants and Tuvalu with just under 10,000.

a defined territory; although a State must possess some territory, there appears to be no rule prescribing the minimum area of that territory. The smallest State by territory is Vatican City with 0.4 km<sup>2</sup>, the second smallest is Monaco with 1.5 km followed by Nauru, 21 km and Tuvalu 26 km.

a government; it is the governing power with respect to a certain territory.

the capacity to enter into relations with other states; this is more a consequence for statehood than a criterion for it, being a conflation of the requirements of government and independence.

<sup>35</sup> Webb (2005), p. 1.

<sup>36</sup> Rakova (2009).

that in the future corals will either not be able to grow quickly enough to follow the pace of sea level rise, or that many of these coral reefs will disappear altogether.

Atoll Islands States threatened by sea level rise are part of an archipelagic grouping rather than a single island, and these groups have a particular status under UNCLOS.<sup>37</sup> Smaller atolls would probably be the first to disappear,<sup>38</sup> and the larger, more populated islands are likely to survive for longer through a variety of adaptation measures.<sup>39</sup> The disappearance of each individual island would have consequences for the ability of an Archipelagic State to continue to claim an Exclusive Economic Zone (or EEZ, as outlined previously in this Chapter) around a section of its previous territory.

It is a complex task to predict what will actually occur to these islands in the future, but a number of scenarios could be envisaged,<sup>40</sup> as detailed in the following subsections. It is important to remember that, from an ecological and geomorphological point of view there would be many other intermediate scenarios. However, from a legal point of view it is more feasible to contemplate only clear cases.

In developing these scenarios we were trying to think about what could happen in the middle to long term. In the short term, the picture is probably quite different, as it is unlikely that these islands will disappear in the coming decades, and the more serious effects will probably be felt towards the end of the century or into next century. Particularly, in the short term it is unlikely that the inhabitants of these islands will migrate in great numbers. Generally, most individuals that presently leave do so due to economic reasons, and their remittances help support the economy of the islands,<sup>41</sup> as discussed in Chap. 7. Also, it is important to note that poor communities have a number of adaptation mechanisms at their disposal,<sup>42</sup> which can often be tied to traditional knowledge and the inherent capacity of human beings to adapt to changes in their environment, independent of their income. People have lived in their atolls for millennia, and it is unlikely that in the short term the entire population of the islands will leave. However, in the middle to long-term the environmental pressure could become so great that only considerable technology and financial resources could ensure the inhabitability of these territory as described in Chap. 3 and the scenarios below.

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<sup>37</sup> Which are set out in Arts. 46–54 of UNCLOS. Art. 46 States how:

“archipelagic State” means a State constituted wholly by one or more archipelagos and may include other islands;

“archipelago” means a group of islands, including parts of islands, interconnecting waters and other natural features which are so closely interrelated that such islands, waters and other natural features form an intrinsic geographical, economic and political entity, or which historically have been regarded as such.

<sup>38</sup> Vidal <http://www.guardian.co.uk/environment/2005/nov/25/science.climatechange>.

<sup>39</sup> Rakova (2009) and Minivan News (2009).

<sup>40</sup> According to Yamamoto and Esteban (2010), p. 3.

<sup>41</sup> Magnan et al. (2011), p. 5.

<sup>42</sup> Magnan et al. (2011), p. 5.

### 5.3.1 *Scenario I: No change*

Although the scientific consensus is that sea levels are rising (the IPCC<sup>43</sup> estimates that for the twentieth century the global average sea level rose at a rate of about 1.7 mm per year, and that sea level is projected to rise during the twenty-first century at a greater rate than during the twentieth century), it is possible that coral reefs could keep up with the rise in sea level. The IPCC 4AR<sup>44</sup> notes how corals might be able to grow upwards with sea level, or adapt to higher sea temperatures by hosting more temperature-tolerant symbiotic algae. Kench et al.<sup>45</sup> suggest that an increase in sea level of around 0.5 m alone is unlikely to physically destabilize islands such as the Maldives, which have existed for over 5,000 years, and have persisted on reefs despite a 2.5 m increase in sea level in the middle to late Holocene. They note how coral islands are morphologically resilient, and that they could be expected to persist under the scenarios of climate change and sea-level rise presented in the IPCC 4AR. Whether sea level will only rise by this amount and coral reefs survive global warming is of course a completely different matter, but the possibility exists that much of the current fear surrounding the disappearance of Atoll Island States will prove unfounded, and that their ecosystems will be far more resilient than anybody currently believes. Under such a scenario, a loss of sovereignty and climate induced population displacement would not take place. This “no change” scenario is however rather unlikely, as the current climate drivers are such that they are almost certain to cause wide-spread mortality and change in coral reefs, as described earlier in Chap. 3.

### 5.3.2 *Scenario II: Barren Rock*

It is claimed that rising water levels have already led to large scale damage to the vegetation in several atolls, such as the Carteret Islands in Papua New Guinea.<sup>46</sup> Many small islands are experiencing water stress even at present, as pollution and high levels of extraction are depleting this resource.<sup>47</sup> The impact of extreme weather events (such as “king tides”, as explained in Chap. 3) can also contribute to reducing the availability of fresh water<sup>48</sup> and push sand onto the islands, dramatically decreasing their fertility.<sup>49</sup> To solve water scarcity problems it would be possible to invest in desalination plants, and places such as Bahamas,

<sup>43</sup> Bindoff et al. (2007), FAQ 5.1 Is sea level rising?

<sup>44</sup> Bindoff et al. (2007), FAQ 5.1 Is sea level rising?

<sup>45</sup> Kench et al. (2005), p. 148.

<sup>46</sup> Vidal (2005) <http://www.guardian.co.uk/environment/2005/nov/25/science.climatechange>.

<sup>47</sup> Minura et al. (2007).

<sup>48</sup> Barnett and Adger (2003), p. 326.

<sup>49</sup> Rakova <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>.

Antigua and Barbuda, Barbados, the Maldives, Seychelles and Tuvalu (amongst others) have constructed some, though in the Pacific these systems are often only used in the dry season due to operational and cost problems.<sup>50</sup>

Coral bleaching would also lead to the disappearance of the fish stocks that depend on it for survival,<sup>51</sup> and coral reefs are not expected to be able to endure the multiple stresses currently affecting them<sup>52</sup> (as explained in Chap. 3). From the point of view of the marine life a completely “barren” situation is improbable, as even if corals die it is likely that something (such as macroalgae) would take their place of the corals (see Chap. 3). One possibility is that corals that are faster growing and can tolerate higher temperatures will become dominant, while the slower growers (often the massive reef building corals, like brain and star corals) would be unable to keep up with sea level rise and die out. Thus, there would be a change in the species composition of reef communities. A more serious possibility is that the coral reef ecosystem would reach an environmental tipping point, and rapidly shift into an alternative state.<sup>53</sup> This alternative state would likely be an algal-dominated community, as discussed in Chap. 3, which has much less biodiversity and fisheries benefits. Although such an algal-dominated community is not a barren environment, the number of people who would be able to live from it would be severely reduced. Also, the islands would become more vulnerable to coastal erosion due to sea level rise, which could eventually lead to the disappearance of the island (Scenario III).

If both the cultivation of food on the land itself was rendered impossible due to higher salinity levels and fisheries were to collapse then food insecurity would dramatically increase, though for a period of time people could still live on it by obtaining supplies from outside (Fig. 5.4). This is indeed what appears to be the case for the Carteret Islands.<sup>54</sup>

From the legal point of view what would happen in the case where the islands could no longer sustain a human population is a complex issue, and the State would probably lose the right to claim an Exclusive Economic Zone (EEZ), since “barren rocks” cannot be a basis for claiming it [UNCLOS Art.121(3)]. However, the Atoll Island State could continue to claim a territorial sea and a contiguous zone since these elements are not regulated by the article regarding island statute, but on provisions of UNCLOS applicable to “other land territory”, Art. 212(2). In addition, it would also lose sovereign rights over the continental shelf if it had not established its outer limits according to UNCLOS. It could be possible to claim that the interpretation of an island should rely on Art. 121(1) of UNCLOS and not Art. 121(3), and thus maintain a claim to the EEZ, though the legal case for this is quite complicated. This would be in effect similar to what the Japanese

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<sup>50</sup> Mimura et al. (2007).

<sup>51</sup> Barnett and Adger (2003), p. 326.

<sup>52</sup> Westmacott et al. (2000).

<sup>53</sup> Kench et al. (2009), p. 187.

<sup>54</sup> Vidal (2005) <http://www.guardian.co.uk/environment/2005/nov/25/science.climatechange>.

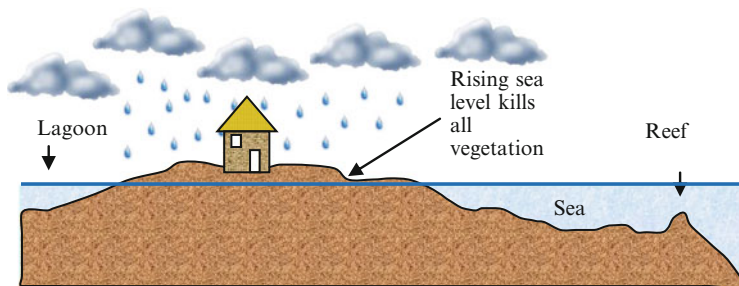


Fig. 5.4 Scenario II

government is doing for the case of Okinotorishima, which is located in the south part of the province of Tokyo, and is constituted of two barren rocks located 1,400 yards apart and no more than two feet out of the water at high tide.

Okinotorishima is the subject of controversy between the Chinese and Japanese governments. The Chinese government recognises Japanese sovereignty over Okinotorishima, but instead maintain that it is a rock (not an island) which cannot sustain human and economic life, and hence that this does not grant Japan an EEZ around it.<sup>55</sup> They also do not accept the fact that the island is natural, considering the protection structures and enlargements that have been built around it by Japan.

On the other hand, the Japanese government claims that it has been making efforts to save the island by constructing circular blocks of steel and concrete around them. Also, corals are being planted around the island to increase its size and help to buttress the support of the formation.<sup>56</sup> The Japanese government regards Okinotorishima as an island, as it considers that Art. 121(1) provides the requirements of an island and Art. 121(3) states the requirements of a rock. In this way as Okinotorishima fulfils the requirement of Art. 121(1) of UNCLOS it is not bound by Art. 121(3).<sup>57</sup>

Terashima argues that Okinotorishima would be able to hold EEZ by stating that:

If “rocks which can sustain human habitation or economic life of their own” is set as the condition for designation of an island without actually requiring such habitation in practice, then there are grounds for the interpretation that the possibility of meeting the condition alone is sufficient. If such is the case, the condition itself will evolve along with progress in science and technology, leading to uncertainty in the requirements to be met<sup>58</sup>

Following this interpretation, it would be possible for Atoll Island States which have a non-submerged “rock” to claim their EEZ even after suffering from the effects of sea-level rise, as these lands could potentially be able to sustain human

<sup>55</sup> Yoshikawa (2007) [www.japanfocus.org/products/details/2541](http://www.japanfocus.org/products/details/2541).

<sup>56</sup> Hogg (2007) <http://news.bbc.co.uk/2/hi/asia-pacific/6758271.stm>.

<sup>57</sup> Xue (2012), p. 352.

<sup>58</sup> Hiroshi Terashima as cited by Xue (2012), p. 353.

habitation or economic life of their own in the future. On the other hand, Jon Van Dyke claims that Okinotorishima is the description of an uninhabitable rock that cannot sustain economic life of its own.<sup>59</sup> According to this interpretation, therefore, it would not be possible to claim an EEZ for Scenario II. However, the Japanese case is different from that of Atoll Island States in the sense that the survival of Japan as a country is not in question. Also, the protective infrastructure which the Japanese government has put in place to preserve the rocks is not to mitigate the effects of the sea level rise, but to prevent erosion by wave action. At present there is also no doubt of the Japanese sovereignty over the rocks since the Chinese government has not put that into question,<sup>60</sup> something that could be different for the case of Atoll Island States if their sovereignty is put into question, as we will discuss in Chap. 7.

### 5.3.3 Scenario III: Submergence

The stress placed on coral reefs<sup>61</sup> combined with sea level rise and a potential increase in tropical cyclone intensity could increase the rates of coastal erosion and eventually lead to the complete disappearance of low lying islands, forcing their inhabitants to relocate to other lands.

Point 3 of Art. 121 of UNCLOS<sup>62</sup> is clear in that an island which is entirely submerged (Scenario III) would lose its ability to claim an EEZ around it. Further implications of this scenario (such as the problems of relocation) for the inhabitants of the island will be discussed in later chapters of this book.

The prospect of coral islands around the world disappearing rises the possibility that many maritime zones that can presently be claimed from them could revert to the status of “high seas”. Houghton et al.<sup>63</sup> point out how a sea level rise of 1.5 m would fully submerge Okinotorishima, which could at first appear to be a way of resolving the long and bitter dispute between China and Japan. This could mean that the area around it would revert to the status of “high seas”, which are areas where the principle of high freedom of the seas still applies and which are to be considered the common heritage of mankind.<sup>64</sup> These areas have thus been described as the “global commons”.<sup>65</sup> Under Art. 87 of UNCLOS all countries can explore and exploit the natural resources on a “first come, first served” basis.<sup>66</sup>

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<sup>59</sup> Dyke (1988).

<sup>60</sup> Caron (2008), p. 640.

<sup>61</sup> Westmacott et al. (2000), p. 11.

<sup>62</sup> United Nations Convention on the Law of the Sea (UNCLOS), 1982 [http://www.un.org/Depts/los/convention\\_agreements/texts/unclos/closindx.htm](http://www.un.org/Depts/los/convention_agreements/texts/unclos/closindx.htm).

<sup>63</sup> Houghton et al. (2010), p. 815.

<sup>64</sup> According to UNCLOS, as explained by Soons (1990), p. 214.

<sup>65</sup> Rayfuse (2010), p. 2.

<sup>66</sup> Though it has been pointed how this could ultimately create an environmental tragedy, Houghton et al. (2010), p. 815.

As Caron points out, there has been increasingly greater claims by coastal States over the ocean, a phenomenon that has been labelled “creeping jurisdiction”.<sup>67</sup> This would bring into question the fairness of the present boundary system, and whether it would not be fair for all States to be able to gain access to the resources that can at present only be exploited by one State.<sup>68</sup>

However, such a solution would clearly not be in the interest of Atoll Island States, as they could gradually lose control over large areas of the sea as the various islands within their territory are submerged, which would in turn deprive them of important government revenues (in the form of fishing licences, for example, as explained in Chap. 2). For the case of the poorer Atoll Island States, such as Tuvalu or Kiribati, it could lead to the eventual complete loss of sovereignty over their entire territory.

However, this option of allowing large areas of the sea to revert to the legal status of “high seas” could be beneficial to some States who do not stand to lose by sea level rise due to the steepness of their coastlines or their ability to protect them. Such States might thus resist the attempts of other States to freeze maritime zones, as they could see it as a legal encroachment of areas that could revert to the status of “high seas”. As the fishing fleets of many nations on earth freely navigate and exploit the “high seas”, the increase in the size of these areas could be seen by some as a welcome reverse from a situation where they have been diminishing due to the extension in the size of EEZs of many States following the application of the UNCLOS.<sup>69</sup> Although Grote does mention how many of the distant-water fishing States have vulnerable coasts or possess small islands that generate maritime zones, she also notes how some countries might gain maritime space as the maritime limits of their neighbours recede.<sup>70</sup>

Clearly, the appearance of such a group or block of States promoting the expansion of high seas would not be in the interest of Atoll Island States. It would thus seem important that Atoll Island States effectively use all diplomatic and legal means at their disposal (including their membership of AOSIS and other international bodies) to attempt to prevent such a position from crystallizing, by attempting to highlight the financial, geopolitical (security) and moral implications of such propositions. These efforts should be centred in attempting to obtain a freeze of maritime boundaries, regardless of the future extent of atoll islands. Failure to achieve a wide consensus amongst States could be disastrous to Atoll Island States. It could potentially create a dual parallel regime, with some States accepting a freezing of maritime boundaries (under any of the measures highlighted in later in this Section) and others not agreeing to respect these areas, a situation which would be very unfortunate for Atoll Island States (Fig. 5.5).<sup>71</sup>

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<sup>67</sup> Caron (1990), p. 649.

<sup>68</sup> This issue is explored in more depth in Caron (1990), p. 648.

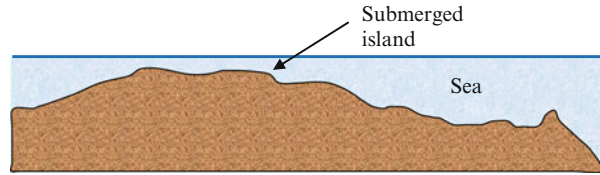
<sup>69</sup> Grote (2011), p. 302.

<sup>70</sup> Grote (2011), p. 302.

<sup>71</sup> As these states often have very limited resources it is already quite difficult to effectively patrol their maritime areas, and it would be impossible to really do so if other States did not recognise them at all.



Fig. 5.5 Scenario III



A number of possible solutions that could be used to freeze maritime zones have been proposed by various authors, and some of these solutions will be outlined in the next few pages. Each of these solutions, in turn, offers different benefits to various States, and the conflict between them will become more pronounced as low-lying coastal areas become uninhabitable or submerged as a result of sea-level rise.<sup>72</sup> It is important to remember, however, that UNCLOS does not explicitly state that baselines will move with raising sea levels, as at the time this law was drafted this issue was of low concern.<sup>73</sup> However, this conclusion can be inferred from certain provisions that describe under which conditions certain limits are fixed, which would in turn indicate how under other situations baselines would be temporary. One such example is that of deltas, which are typically zones of relative rapid geomorphological evolution, and where UNCLOS Art. 7 provides a temporary legal stability of straight lines around them. Another example is that of the continental shelf,<sup>74</sup> which under Art. 76(9) obliges a State to supply information to permanently delimit it, from which can be concluded *a contrario* that the other maritime zones might only be temporary in nature.<sup>75</sup>

It is to be expected that in the coming years a number of countries, and particularly Small Island States, might want to see changes made to UNCLOS to protect their economic interests, and although it is difficult to foresee how this will play out in international negotiations, each of these scenarios has important repercussions for Atoll Island States. It is important to also consider the geopolitical risks and possibility for conflicts that can be associated to the current ambulatory nature of baselines.<sup>76</sup>

### 5.3.3.1 Permanent Fixing of Ocean Boundaries

A way of solving the problems that would originate from the disappearance of islands would be to permanently fix ocean boundaries, as the current system of delimiting territorial sea (based on ambulant baselines) might cause conflicts among countries over the dispute of ocean resources.<sup>77</sup> In the case where either

<sup>72</sup> Houghton et al. (2010), p. 813.

<sup>73</sup> Grote (2011), p. 269.

<sup>74</sup> Caron (1990), p. 642.

<sup>75</sup> Grote (2011), p. 269.

<sup>76</sup> Caron (1990), p. 636.

<sup>77</sup> Caron (1990), p. 638 and Soons (1990), p. 218.

most or the whole area of the island were submerged (with most or all of the population leaving the islands) but were the baselines were frozen, the successor State would exercise sovereignty over the submerged islands.<sup>78</sup> The idea of a successor State is not without its complications, and would require the relocation of population and possibly the acquisition of lands in other parts of the planets, or the formation of a de-territorialized government, all of which will be discussed with more detail in Chap. 6.

One of the problems inherent to this solution could be agreeing on a specific date on which to fix ocean boundaries, as increases in sea levels have been identified in past decades and it may be difficult to agree on a date when coastlines were sufficiently unaltered by climate change.<sup>79</sup> For example, the island of Bermeja “lost” by Mexico could “re-emerge” under such an agreement, if the date for the fixing of ocean boundaries was prior to the time when Mexico could no longer find it.<sup>80</sup> Various dates have been proposed regarding when boundaries should be fixed, ranging from the date of entry into force of UNCLOS (either in general or the date that each country entered into it), or the date on which the baselines were submitted or publicized with the Secretary General of the United Nations.<sup>81</sup>

Fixing the maritime boundaries of States has important geopolitical and cartographical implications. Although in the short term it would not significantly affect the territories and maps of most States, one can envisage how centuries or millennia later in some areas there would be a significant discrepancy between political and geophysical maps.<sup>82</sup> Thus, when proposing the fixing of ocean boundaries it would be important to consider the long-term implications of setting such a precedent.

The fixing of boundaries also poses a significant problem as it challenges the fundamental notion on which UNCLOS is based, namely that “the land dominates the sea”.<sup>83</sup> This could create much international opposition, as countries that would lose from such an arrangement would likely oppose it, and it seems rather improbable that consensus could be reached. However, the alternative would represent a double harm for the inhabitants of Atoll Island States, as they would first suffer from anthropogenic climate change depriving them of their lands, and then by international law depriving them of their seas.

There are a number of different legal basis that could be used to attempt the fixing of ocean boundaries, and these will be discussed in the next sections.

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<sup>78</sup> Hayashi (2010), p. 107.

<sup>79</sup> Indeed it could be argued that sea level change is also natural, and that it has been changing for millennia, making any such attempts to agree on a date even more difficult. See also Maas and Carius (2012), p. 657.

<sup>80</sup> Maas and Carius (2012), p. 657.

<sup>81</sup> As required by Art. 16 of UNCLOS, see Rayfuse (2010), p. 6.

<sup>82</sup> Although Caron argues that even nowadays there is not such a close relation between the shoreline and the present baseline, due to the acceptance of drying rocks as baselines, the use of straight baselines and the fact that nowadays seamen are often out of visual and even radar contact with the coastline. See Caron (1990), p. 643.

<sup>83</sup> Grote (2011), p. 273

### Cartographical Fixing of Boundaries through Art. 76(9) of UNCLOS

Rayfuse<sup>84</sup> suggests how through an interpretation of Art. 76(9) of UNCLOS, where States should deposit information “permanently describing the outer limits of its continental shelf”, it could be possible to argue they can maintain their existing continental shelf even if baselines retreat. In order to do so, the State must first make a submission to the Commission on the Limits of the Continental Shelf, as specified in Art. 76(8), where

The Commission shall make recommendations to coastal States on matters related to the establishment of the outer limits of their continental shelf. The limits of the shelf established by a coastal State on the basis of these recommendations shall be final and binding

This makes it clear that once these boundaries are agreed, their nature is permanent.<sup>85</sup> Soons notes how it is very interesting that this provision of Art. 76 (9) only appears to apply to the continental shelf and not to the EEZ, even though the regime of the EEZ includes jurisdiction over seabed resources.<sup>86</sup> However, in this respect this article is very clear, and appears to allow for the permanent fixing of boundaries based on the continental shelf.

Grote notes how it is necessary for this procedure to be completed before maritime boundaries can be fixed,<sup>87</sup> though given the timescales involved for Atoll Island States to disappear, it should not be too difficult to complete all relevant procedures. For the case of the Atoll Island States the most difficult problem might regard funding, as the establishment of the continental shelf requires teams of geologists, geographers and oceanographers to make an assessment of where the edge of the continental shelf is located. Though a country such as the Maldives clearly has the resources to do so,<sup>88</sup> smaller countries such as Tuvalu might find it more difficult to finance such research. Nevertheless, there might be other venues available to Atoll Island States, such as relying on the good-will of international academics, NGOs or ODAs. Grote also notes how a voluntary trust fund was created in 2000 to allow Small Island Developing States to prepare submissions of their outer continental shelf limits beyond 200 miles.<sup>89</sup>

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<sup>84</sup> Rayfuse (2010), p. 3.

<sup>85</sup> Soons (1990), p. 216.

<sup>86</sup> It is also not clear if this provision was originally intended to apply exclusively to this “broad” continental shelf or also to the EEZ. Thus, it would seem unjust if a “distance-based” EEZ that was 200 nautical miles was treated differently than a 210 nautical miles “broad” continental shelf, just because of geomorphological reasons, especially in the case where the loss of sea areas would be significant, as explained by Soons (1990), p. 217.

<sup>87</sup> Grote (2011), p. 294.

<sup>88</sup> And the Maldives has indeed already submitted a map showing the proposed limits of its continental shelf, as can be see from Fig. 5.2, which is a map is adapted from the Commission on the Limits of the Continental Shelf (2010). Submission by the Republic of the Maldives. [http://www.un.org/depts/los/clcs\\_new/submissions\\_files/mdv53\\_10/MAL-ES-DOC.pdf](http://www.un.org/depts/los/clcs_new/submissions_files/mdv53_10/MAL-ES-DOC.pdf).

<sup>89</sup> See UNGA Res. 55/7 of 30 October 2000, Annex II, Trust fund for the purpose of facilitating the preparation of submission to the Commission on the Limits of the Continental Shelf for developing States, as explained in Grote (2011), p. 288.

To understand the application of this Art. 76(9) it is important to note that this provision was not inserted into the UNCLOS to counter the effects of sea-level rise on maritime boundaries, but rather to establish a permanent division between the areas that are under the jurisdiction of a State and those that are “common heritage of humankind”.<sup>90</sup> Nevertheless, this article could be used to justify the claim to a continental shelf around an area that subsequently disappears under the sea.<sup>91</sup>

However, it is not clear whether providing information to fix the “broad” continental shelf would also be able to fix the “distance-based” continental shelves.<sup>92</sup> This problem is particularly important for the case of Small Island States, as these islands often do not have a large continental shelf around them, especially regarding the case of Atoll Island States.<sup>93</sup> For the case of the Maldives, as shown in Fig. 5.2, an Extended Continental Shelf (i.e. a “broad” continental shelf, according to Grote<sup>94</sup>) was claimed in 2010, though it was not claimed in all areas around the archipelago. Particularly in the areas to the west no Extended Continental Shelf has been claimed. This presents an interesting situation, as the extent of the EEZ would move in this area in accordance with what would happen to the archipelagic baselines, though in the areas where the Maldives is able to claim an Extended Continental Shelf, these would in theory be fixed.<sup>95</sup> However, there are still a number of problems that would exist for a State that would lose all its territory. The Extended Continental Shelf line would have to close (i.e. form a complete polygon, something that might not happen, as shown in Fig. 5.2 for the case of the Maldives, as for the western side of the Archipelago there is no Extended Continental Shelf line) and also it is not clear if an entity that can no longer be recognised as a State by other countries (on the basis that it lacked a defined territory and population, as discussed in more detail in Chap. 6) can continue to claim any maritime zones, including a continental shelf.

Fixing the boundaries in this way also presents a legal problem, as a reduction in the size of the island would result with the baseline moving inward, and thus the maritime zones could grow to over the limits given to them in UNCLOS, violating Art. 76.<sup>96</sup> It would also mean that the landward-facing maritime zones (internal and archipelagic waters) would shrink as the land area decreases.<sup>97</sup> Eventually, once all the islands disappear then the archipelagic and internal waters would completely

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<sup>90</sup> Grote (2011), p. 274

<sup>91</sup> Soons (1990), p. 225.

<sup>92</sup> Grote (2011), p. 274 and Soons (1990), p. 217.

<sup>93</sup> For the case of Funafati atoll in Tuvalu, sea depth of over 1,000 m can be reached within 2.3 km of the shore of the atoll, see Fitchett (1987).

<sup>94</sup> Grote (2011), p. 267.

<sup>95</sup> As Art. 76 of the UNCLOS provides that the continental shelf's outer limits can be fixed by placing charts and information to describe it at the UN Secretary General, and the limits of this area depend on geological and geomorphological factors, as explained by Soons (1990), p. 216.

<sup>96</sup> For example the EEZ and continental shelf are generally restricted to 200 and 350 miles, respectively.

<sup>97</sup> Grote (2011), p. 275.

disappear, leaving only an EEZ, though this would also represent a strange situation under UNCLOS as it currently stands.

### Cartographical Fixing of Baselines Through Inaction<sup>98</sup>

Hayashi proposes an amendment to the existing law which would enable Islands States to maintain the baseline points which were fixed originally on an island, as well as the territorial sea, the contiguous zone, the EEZ and the continental shelf. His amendment states:

a coastal State may declare the baselines established in accordance with the provisions of UNCLOS as permanent once it has shown them on charts of an adequate scale or described them by a list of geographical coordinates, and given due publicity thereto, notwithstanding subsequent changes in geographic features of coasts or islands caused by climate and other natural processes.<sup>99</sup>

Thus this requirement to provide information to delimit the baselines might allow Island States to permanently fix them by not re-surveying the area in the future. In essence, the State would survey the islands at present and publish international charts delimiting their location, and then neglect to update these charts in the future. It is of course current practice for baselines to be shown in charts and for these to remain in place till they are redrawn again, even if the low-water line has moved.<sup>100</sup> The expense required to survey baselines and the relatively low benefit that this can bring to a developing country means that in practice these lines are seldom re-surveyed.

However, the practicalities involved in how often baselines are surveyed does not alter the legal bias of the current law of the sea from one of ambulatory to permanently fixed baselines.<sup>101</sup> To propose this strategy of not re-surveying baselines would end up blurring the difference between the factual existence and the legal consecration of a situation.<sup>102</sup>

Also, Art. 7(2) allows for a straight baseline to be drawn “because of the presence of a delta and other natural conditions” that make the coastline unstable and “notwithstanding subsequent regression of the low-water line” until it is changed by the coastal State. Claiming that an atoll is, like a delta, a morphologically dynamic environment could allow an Island State to draw a straight permanent baseline around an island. However, this article appears to have only been intended to apply to deltas,<sup>103</sup> and it is unlikely that it could apply to atolls,

<sup>98</sup> This is referred to as a strategy of “Masterly Inactivity” by Grote (2011), p. 279.

<sup>99</sup> Hayashi (2010), p. 106.

<sup>100</sup> Grote (2011), p. 279

<sup>101</sup> Caron (1990), p. 641 and Rayfuse (2010), p. 4.

<sup>102</sup> Grote (2011), p. 279.

<sup>103</sup> Caron (1990), p. 635.

though a broader interpretation could be subsequently made through practice or by a treaty.<sup>104</sup>

In this case the EEZ would not change in size [as opposed to under the principle explained before of attempting to fix boundaries through Art. 76(9)] and hence not break the distance limits of maritime zones. However an interesting result would be that the areas inundated that lie inside the baseline would effectively become “internal waters”, and hence the extent of these would increase in size. Archipelagic waters would also remain constant, as they are drawn from the baselines of various island to encircle the whole archipelago, and as the baselines remain constant then so would the archipelagic waters.<sup>105</sup>

Grote<sup>106</sup> notes how this solution could be seen to represent “an unjustified encroachment on other States’ right of passage”, as the State that governs them can exclude the entrance of foreign vessels at will. However, the areas which would become internal waters are now land areas and seafaring vessels can easily contour them, and thus it is unlikely that there would significant objections to this aspect of the problem. Grote<sup>107</sup> also notes how,

It is doubtful whether foreign ships should have a right of innocent passage through the waters covering newly inundated land, which might have featured places of great cultural or social value and over which the coastal State has previously exercised unrestricted sovereignty. After all, the stabilization of maritime zones has been advocated as fair and equitable because it preserves the currently accepted allocation of national authority over parts of the earth’s surface.

In other words the expansion of internal waters actually only really changes the nature of the territory over which a State has sovereignty from land to internal water. Despite this change of status the implication is that geographical sovereignty over certain areas of the planet is preserved, and hence the allocation of different parts of the planet actually does not change.

A further consideration arises from the practical nature of what vessels would actually be able to cross these waters. Even if the islands become submerged it is unlikely that the areas that are currently land would be covered in a significant depth of water (at least in the short term), which means that only the smallest vessels would be able to cross them. One could argue that most vessels that a country would object to have in its waters (i.e. for example those of scientific, commerce, commercial fishing or military nature, which require significant water depths to manoeuvre) would be unable to cross them for centuries to come, even assuming significant sea level rise takes place. Of course in the course of several centuries the depth of this water could continue to increase and allow bigger vessels to cross the area and this would become a more important consideration, though

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<sup>104</sup> Wei (2011), p. 3.

<sup>105</sup> Grote (2011), p. 275.

<sup>106</sup> Grote (2011), p. 275.

<sup>107</sup> Grote (2011), p. 275.

again for the case of atolls the extent of these waters would be of relatively small size anyway and large vessels would have no problem in sailing around them.

Another problem with the strategy of attempting to fix cartographical baselines lies in the fact that this policy is retrospective in character, as it can only be applicable “after sea-level has become a *fait accompli*”.<sup>108</sup> For the case of Atoll Island States, to effectively do nothing during the coming century, in the hope that sovereignty could be preserved under the technical issue of how frequently baselines are surveyed, does not appear a good line of action. To provide some legitimacy, however, it would be better if the Atoll Island State had some sort of domestic legislation that formulated the interval or way in which these baseline surveys were carried out. For example, a technical code of practice could be elaborated which only provided for the drawing of maps every 100 years or so. However, while this could help in the short term, while the islands retreated or they were just below sea water,<sup>109</sup> in the long term the use of satellite images could allow other States to challenge the existence of the islands.

### Use of Bilateral Treaties

Another venue open to countries is the bilateral or multilateral delimitation of maritime boundaries.<sup>110</sup> Often when there is a dispute between two States regarding their maritime boundary negotiations can help to fix it. This delimitation is theoretically definitive and could thus continue to be applied even if the baseline was to move afterwards.<sup>111</sup> Art. 62(2) of the 1969 Vienna Convention on the Law of Treaties (VCLT) states that a fundamental change of circumstances may not be invoked to terminate or withdraw from a treaty if that treaty establishes a boundary.<sup>112</sup> In principle, when the boundary has been fixed, changes in the geographical configurations of baselines as a result of sea level rise would not result in changes to the boundary line.<sup>113</sup> Such a strategy would thus allow Atoll Island States to achieve legal recognition of their claims by entering voluntary boundary delimitation agreements with their neighbours.<sup>114</sup>

However, as Grote<sup>115</sup> notes, while this solution may be legally sound there are a number of problems for its practical application. For the case of Small Island States the closest neighbour is often too far away and hence none of their areas overlap, meaning that it is not possible to delimit these areas through a contractual

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<sup>108</sup> Grote (2011), p. 279.

<sup>109</sup> Making it difficult to estimate from satellite photographs, for example.

<sup>110</sup> Rayfuse (2010), p. 5.

<sup>111</sup> Rayfuse (2010), p. 5.

<sup>112</sup> Vienna Convention on the Law of Treaties, Art. 61.

<sup>113</sup> Soons (1990), p. 227.

<sup>114</sup> Grote (2011), pp. 279–280.

<sup>115</sup> Grote (2011), p. 281.

agreement.<sup>116</sup> This can be seen in the case of the Maldives, where for example there is no neighbour to the west, as shown in Fig. 5.2. Even in the cases where there is a neighbouring State that is close enough, reaching an agreement with them would only fix one of the borders. The various maritime areas around the country are all bound by a single line that encloses the whole area. Hence, if only one section of this line exists it would be impossible for the territory to be correctly delimited. This solution, as Grote<sup>117</sup> notes, is “inherently confined to certain States or regions” and is rather a partial solution to a more general problem experienced by many countries.

To see how permanent these boundary treaties would actually be, Soons makes a distinction between treaties where the delimitation of the continental shelf was explicitly intended to be permanent<sup>118</sup> and others in which it is not.<sup>119</sup> However, Lusthaus also points out how despite Art. 62(2) of the Vienna Convention, it could still be possible for States to call past delimitation agreements into question, or how confusion over boundaries can lead to maritime incidents and escalate into serious conflict.<sup>120</sup> Conflicts can often lead to the redrawing of borders, which would also not work in the interest of Atoll Island States.

### 5.3.3.2 Change in the Customary International Law

Customary International Law is a non written law which reflects how consistent practice by States is believed to also represent a legal obligation. In this case the idea is that changes in customary international law could provide certainty about what would happen to the various maritime zones as the sea level continues to rise. Such a “new rule” of customary international law would stipulate that international boundaries would be fixed, something that is seen as desirable by many authors.<sup>121</sup> This solution is termed as a “progressive” interpretation of the law by Grote<sup>122</sup> According to it Atoll Island States would try to create a new customary rule under which maritime zones are unaffected by sea level rise, by continuing to exercise their rights over them,<sup>123</sup> and maintaining that this conduct is allowed under UNCLOS as it provides no clear rules on this subject.<sup>124</sup>

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<sup>116</sup> Grote (2011), p. 281.

<sup>117</sup> Grote (2011), p. 281.

<sup>118</sup> Here Soons cites the 1965 continental shelf delimitation between the United Kingdom and the Netherland, were subsequent seaward shifts of the Netherland’s baseline of up to 7 km—though natural and artificial processes- did not affect the delimitation of the continental shelf, see Soons (1990), p. 227.

<sup>119</sup> Although Soons concludes that even in this situation it would be difficult for either of the two States to really break the treaty, see Soons (1990), p. 228.

<sup>120</sup> Lusthaus (2010), p. 115.

<sup>121</sup> Caron (1990), pp. 650–651, Grote (2011), p. 284, Soons (1990), p. 225.

<sup>122</sup> Grote (2011), p. 284.

<sup>123</sup> Soons (1990), p. 225.

<sup>124</sup> Grote (2011), p. 285.



One of the problems with this solution is that treaty law cannot easily be overridden by subsequent customary law. However, as Grote<sup>125</sup> explains, a subversion of conventional rules through later State practice would not be the issue in this case, because UNCLOS does not explicitly prescribe the ambulatory nature of baselines and maritime limits, but remains silent on the point. The new customary rule would therefore complement rather than replace the regime laid down in UNCLOS.

Another problem with this solution is that it is retrospective in nature, in that Atoll Island States would have to wait to suffer from the effects of sea-level rise before asserting that the “continued exercise of their rights over the area in question indicates the evolution of a new rule of international law”.<sup>126</sup> Statements by States of what they will do in the future are not enough to create customary international law.<sup>127</sup> States could, of course, submit charts delimiting their maritime areas and baselines, and indicate that these are intended to be permanent, though it is unclear if they would be accepted by other States without a legitimizing basis.<sup>128</sup> This is especially the case as although a State could specify that the charts are intended to be permanent, it is unclear whether this would be accepted by other States, given the current ambulatory nature of the UNCLOS.

There is also the matter of the amount of time that would be required for a new customary international rule to be created.<sup>129</sup> During this time the status of the waters that are beyond the shifted maritime limits would not be clear.<sup>130</sup> Furthermore, it is uncertain how many countries would have to recognise this new rule for it to become a customary international rule,<sup>131</sup> and what would happen if certain countries chose to ignore this rule and create one of their own. The coastal States that wish for this new rule would have to inform other States of their intention to use this rule and hope that these do not protest.<sup>132</sup> For a customary international law to be created it is necessary that it is universal and it is not just a small number of countries who are implementing it. Thus, even if a small number of countries chose the practice of claiming that they were maintaining their maritime zones despite their shifting baselines, this would not mean that the practice would become customary international law.<sup>133</sup>

However, there is also the possibility that such a practice, even if rejected by some other countries, could become “local” or “regional” customary international law.<sup>134</sup> In this sense, it might be possible for the members of AOSIS to collectively

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<sup>125</sup> Grote (2011), p. 284.

<sup>126</sup> Grote (2011), p. 285.

<sup>127</sup> Grote (2011), p. 285.

<sup>128</sup> Grote (2011), p. 285.

<sup>129</sup> Grote (2011), p. 286.

<sup>130</sup> Grote (2011), p. 286.

<sup>131</sup> Grote (2011), p. 286.

<sup>132</sup> Soons (1990), p. 225.

<sup>133</sup> Grote (2011), p. 286.

<sup>134</sup> Grote (2011), p. 286.

accept these measures as international law, which would thus govern all its members in various parts of the planet, or for just all the small Island States in the Pacific to adopt such rules.<sup>135</sup>

Nevertheless, the attention that the matter of ambulatory baselines is receiving and the increasing need for raw materials and food around the planet could also work against it. In the past such a measure could have worked due to other States not giving the matter much attention, and allowing enough time to pass for it to become accepted international custom. However in a future of increasingly scarce natural resources other States could start exploiting the resources as the maritime zones receded, according to a more strict interpretation of the concept of ambulatory baselines. It is actually unlikely that the Atoll Island State would have the resources to adequately police such areas, especially considering that even nowadays they cannot properly police their waters against intruding fishing fleets, and in the future they would probably be dealing with far more pressing problems, such as defending the coastline of the remaining islands or attempting to relocate their population to other lands.

This could lead to two different interpretations of what is customary international law. On one side there would be Atoll Island States and other countries set to lose control over certain areas unless maritime boundaries are fixed, and on the other there would be States which would seize the chance to exploit resources that they would claim would now be “high seas” (and thus “global commons”). These opportunistic States are not actually bound to respect the immovability of maritime limits and thus the geographical extent of the Atoll Island States would vary depending on the point of view of whether each other State had accepted their claim or not. The possibility of this happening is not a very good prospect for Atoll Island States.

### 5.3.3.3 Amendment or Drafting of a New International Treaty

There is also the possibility that an international exception could be created for the case of Atoll Island States. Rather than attempting to negotiate a revision to any international treaty, with the problems associated with this, Atoll Island States (through organisations such as AOSIS) could attempt to obtain an explicit exception only for their case. This is unlikely to be opposed by other countries, as many of these islands are situated comparatively far from other States and thus there is relatively little overlapping of economic areas of interest with other countries (particularly for the case of Atoll Island States such as the Tuvalu, Kiribati and the Marshall Islands, which are probably the locations mostly at risk). It could be possible, for example, to include an “amendment” or “declaration” that only provides for the fixing of boundaries around atolls islands on the grounds that their morphological dynamical nature is similar to that of deltas. Thus, the drawing

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<sup>135</sup> Grote (2011), p. 286.

of permanent baselines would be based on the notion that the ground shifts over time, and hence that it is better to permanently fix its position in international charts. If the islands were to disappear in the future it could be claimed that this is a “temporary” feature of the geomorphological processes of these islands (which are dynamic in nature, and that could re-appear in the future) and ownership could still be claimed based on this. Of course, the basis for this claim over land that “temporarily” disappears would represent quite a new concept in law. It is increasingly evident, however, that traditional law systems are based on the naturalistic human notions that the planet is immutable, as human beings typically think that the ground around them is static (which is relatively adequate considering the limited life-span of one individual, but not considering the physical processes that coastal areas undergo). However, given the long history of several nations and the modern scientific understanding of the planet, these traditional visions of law are probably no longer adequate, and international law should move to a more progressive view of how to interpret international boundaries.

The problem of attempting to modify the UNCLOS or to draft a new treaty is that, although many countries might not oppose it on the grounds of helping Atoll Island States, they might object to it on the grounds of how it will affect their claims. For example, the issue of atolls is at the heart of the disputes between a number of countries in the South China Sea, centred around the Parcel and Spratly Islands.<sup>136</sup> Thus, attempting to make even a small change to the UNCLOS or to draft a new treaty risks having many countries attempt to include their own modifications to benefit their own claims elsewhere. Grote indeed notes how “In practice no State has an interest in reopening negotiations of the UNCLOS and thereby risking to unravel the “package deal” agreed upon the Third Law of the Sea Conference”.<sup>137</sup>

#### **5.3.3.4 Collective Implementation Mechanisms of a New Regime of Stable Maritime Zones**

Due to the difficulty of trying to amend UNCLOS as it currently stands, or attempt to draft a new treaty, Grote suggests that Atoll Island States should use their numerical power within the UN General Assembly to propose and implement a new rule of international law providing for stable maritime zones.<sup>138</sup> This could take the form of either a UN General Assembly resolution on stable maritime zones

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<sup>136</sup> The Spratly Archipelago are claimed in their entirety or partially by Vietnam, China, Taiwan, Malaysia, the Philippines and Brunei, see Lusthaus (2010). Nevertheless since there are issues regarding the effective and continuous occupation of the islands by each country and there is a lack of acquiescence by other claimants regarding the claims of sovereignty over the islands the dispute is far from reaching a solution. In turn, this dispute could become even more complex in the context of sea level rise.

<sup>137</sup> Grote (2011), p. 289

<sup>138</sup> Grote (2011), p. 287.

which would lay out the regime in a legally non-binding yet authoritative instrument, or a new Implementation Agreement on Sea-Level Rise to UNCLOS.<sup>139</sup> This new Implementation Agreement on Sea-Level Rise

would not directly modify the LOSC, which does not expressly stipulate the baselines and outer maritime limits shift with rising sea levels. Just as would be the case with a new rule of customary international law developed to this effect, it would rather complement the existing regime, “implementing” its rules on baselines and maritime limits<sup>140</sup>

The problem with such an agreement would be deciding from when it would come into effect. Grote suggests that the shifting of baselines that takes place before States join the regime would be disregarded, and this would encourage States to join sooner rather than later in order to minimize the loss of maritime zones.<sup>141</sup> However some States have already “lost” territory, and it might be difficult for them to agree to such a treaty, as there would be a significant benefit for them to make the treaty retroactive.<sup>142</sup> Grote herself notes how protests might arise from States asserting conflicting rights over a certain area, or from States contending that the maritime limits or baselines were drawn in contravention of internationally recognised rules.<sup>143</sup> To address the first problem a State could restrict its claim to the undisputed parts of maritime zones.<sup>144</sup> It seems likely that an Atoll Island State, faced with the prospect of losing all claims over maritime areas, would be happy to reach a compromise with other adjacent States, as even the loss of some part of their potential maritime zones would be preferable to not solving the dispute and the prospect of losing all claims.

Also, despite the likelihood that many States would benefit from a fixing of boundaries, there is the possibility of some States attempting to somehow gain from the situation when these territories could revert to the status of “high seas”, and thus attempting to block such an Implementation Agreement. Grote suggests that if opposition to this proves too great, and if it may come at the risk of fragmentation (where non-participants States would be free to reject a new regime) a UN General

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<sup>139</sup> Grote (2011), p. 288.

<sup>140</sup> Such an Implementation Agreement would then stipulate that “a coastal state can deposit with the Secretary-General of the United Nations charts and relevant information, including geodetic data, permanently describing its baselines and outer limits of its maritime zones” and would simply “extend the existing regime of fixed continental shelf limits to the other maritime zones” according to Grote (2011), p. 290.

<sup>141</sup> Grote (2011), p. 291.

<sup>142</sup> Such situations have actually already taken place, where the island of Bermeja, in the Gulf of Mexico, that led to the USA stating that without an island Mexico (who originally owned Bermeja) could no longer claim an EEZ around it, see Paskal (2010), [http://www.nzherald.co.nz/world/news/article.cfm?c\\_id=2&objectid=10635956](http://www.nzherald.co.nz/world/news/article.cfm?c_id=2&objectid=10635956).

<sup>143</sup> Though it is not clear to what extent third states can assert conflicting rights over a maritime area, if they are not directly involved in the dispute, for more details see Grote (2011), p. 298.

<sup>144</sup> In this case only the undisputed parts could be subject to a claim of permanency. Only in the case where the various States could solve their differences and publish joint maps depicting the limits of the maritime zones would these then also become permanent. See Grote (2011), p. 297.

Assembly resolution on maritime zones could be pursued.<sup>145</sup> Atoll Island States could use their weight within AOSIS and other international associations to push for such a vote. AOSIS has a considerable amount of influence within the UN General Assembly due to its ample membership, and this could be put to good use in attempting such a resolution. Although it would be non-legally binding in nature, a resolution freezing maritime boundaries could have significant political and legal consequences.<sup>146</sup> If a large enough number of countries voted in favour of such a measure this could represent a significant shift in customary international law, though it is far from clear in the current complex geopolitical climate regarding maritime zones how each country would react to such a resolution.

Nevertheless, attempting to implement such a mechanism would provide Atoll Island States with a valid course of action in the short to middle term, and one where they do not have to wait to see what happens before obtaining an answer to their problems. Such discussions could somehow be inserted into the current UNFCCC talks, and it might be possible for the leaders of Atoll Island States to attempt to gain enough support at these negotiations to seek a favourable solution either through an Implementation Agreement or a favourable vote at the UN General Assembly. Although general agreement is unlikely to take place in the short term, these islands are likely to remain in place for decades to come, as outlined in Chap. 3. Thus, moving in this direction could prove to be a “no regrets” strategy for Atoll Island States, as even if they are ultimately unsuccessful their situation would not be any different to not having tried at all.

### ***5.3.4 Scenario IV: Protection of a Naturally Formed Island by Coastal Structures***

Entire sections of low-lying islands could be protected from the effects of tropical cyclones and rising waters by the usage of sea dykes, in a similar way to what happens in the Netherlands. This would be costly, and for example in Okinotorishima the Japanese government has already spent 29.3 billion yen protecting two rocks<sup>147</sup> (as explained in Scenario III). However, it is not clear whether many Atoll Island States have the financial resources necessary to implement such costly schemes, and the IPCC 4AR notes how “the costs of overall infrastructure and settlement protection are a significant proportion of GDP, and well beyond the financial means of most Small Island States”.<sup>148</sup> It has been

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<sup>145</sup> Grote (2011), p. 304.

<sup>146</sup> Grote talks about the legal significance of UN General Assembly resolutions, and if a State votes to freeze maritime zones it would be precluded from subsequently rejecting this principle, see Grote (2011), p. 309.

<sup>147</sup> Kagami (2005).

<sup>148</sup> Minura et al. (2007) IPCC 4AR.

estimated that a temporary sea wall for one Marshall Island atoll would cost US \$100 million, more than twice the wealth the country produces annually.<sup>149</sup> Nevertheless, such defence infrastructure has already been constructed in several locations in the Maldives,<sup>150</sup> with one project defending the coastline with tetrapods costing US\$4,000 per meter of the coastline,<sup>151</sup> though tetrapods alone would not be enough to ensure the formation of a waterproof dyke (as tetrapods are highly permeable). Table 2.3 shows how the GDP of Atoll Island States is small, and most of the islands are only a few metres above sea level at most (for the case of the Maldives 80 % of the land area is 1 m or less above sea level<sup>152</sup>). In places like the Carteret islands<sup>153</sup> some limited schemes have been implemented in the past, though these works are themselves vulnerable to erosion and their overall effectiveness is not very clear,<sup>154</sup> as shown in Fig. 5.6 for the case of Independent Samoa. As tropical cyclones are expected to increase in strength in the future and deeper water levels will allow bigger waves to reach the coastline (see Chap. 3), sea defences would need to become even more massive than what would be required nowadays,<sup>155</sup> further undermining the economic case for these structures. Also, the loss in natural beauty resulting from these protection works could be detrimental to the local economy, as many of these islands depend on tourism for much of their revenues (90 % of government tax revenue in the Maldives originates from tourism<sup>156</sup>). Generally the creation of these protection works could ultimately prove to be unsustainable. The smaller Atoll Island States such as Tuvalu or Kiribati have less economic resources than bigger ones such as the Maldives, and would find it even more difficult to attempt such schemes (see Table 2.3).

Strictly speaking the construction of coastal defences could result in a (very modest) landward movement of the baseline from which the EEZ is measured. In this case the high-water mark will not move (as it would be protected by the structure), but the low-water line (which determines the baseline) could move towards the land if the beach in front of the coastal structure was eroded<sup>157</sup> or the reefs were to disappear. While morphological processes will determine whether the beach will be eroded or not, the construction of coastal defences and sea walls does often lead to increased erosion. This would hence displace the baseline, though this would probably only be by a few dozen metres rather than kilometres.

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<sup>149</sup> BBC (British Broadcasting Corporation) Island Disappears Under the Seas (1999), <http://news.bbc.co.uk/2/hi/science/nature/368892.stm>.

<sup>150</sup> Minivan News 2009 Seawall built around Dhuvaaafaru [http://www.minivannews.com/news\\_brief.php?id=6878](http://www.minivannews.com/news_brief.php?id=6878).

<sup>151</sup> Warner et al. (2009), p. 42.

<sup>152</sup> CIA Website (2012), [www.cia.gov](http://www.cia.gov) website.

<sup>153</sup> Rakova <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>.

<sup>154</sup> Rakova <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>.

<sup>155</sup> Takagi et al. (2011), p. 30.

<sup>156</sup> CIA Website (2012), [www.cia.gov](http://www.cia.gov).

<sup>157</sup> Bird and Prescott cited by Grote (2011), p. 277.



**Fig. 5.6** Damage coastal defences in Independent Samoa

Also, it is not clear whether it would be possible to preserve the vegetation behind the defensive works from dying, as a rise in the saltwater level and high tides could effectively kill trees and crops.<sup>158</sup> This would raise the question once more of what is an inhabitable island, as discussed in Scenario II.

Eventually, as the sea level continued to increase, the defence works could create a situation where the islands would be at a lower level than the surrounding sea, similar to that of the polders in the Netherlands. Although the sovereignty of the Netherlands over these areas is not questioned (and indeed during the centuries over 3,000 polders have been created<sup>159</sup>), the polders contain farmable lands that rely on a complicated system of waterworks.<sup>160</sup> The hypothetical “polder-like” atoll island

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<sup>158</sup> Rakova (2009).

<sup>159</sup> Wikipedia (2009), <http://en.wikipedia.org/wiki/Polder>.

<sup>160</sup> The Netherlands have spent centuries reclaiming lands from the sea through a complex system of sea dikes and drainage systems mean that a considerable area of the country is composed of lands that are located under mean sea level (and that would be flooded if sea dikes did not exist). The lands behind these coastal defences are referred to as polders, and they form a characteristic landscape that is crucial to the survival of the country. Considerable effort is invested in their maintenance, as any break in them can have potentially catastrophic consequences. Throughout the centuries, indeed, the Netherlands have suffered a number of flooding events when sea defences were broken by particularly high storm surges. The most recent disaster occurred in 1953, when a severe extratropical cyclone combined with a high spring tide resulted in water levels being 4.55 m above the Normal Amsterdam Water Level (NAP). The resulting flooding led to deaths in many neighbouring countries, 307 in the UK and 28 in the Flanders in Belgium. For the case of the Netherlands several sea dikes were breached, which resulted in massive flooding and loss of life. 1,365 km<sup>2</sup> of land were inundated (about 9 % of the Dutch farmland) and 1,836 lives were lost. The Dutch people and government extracted



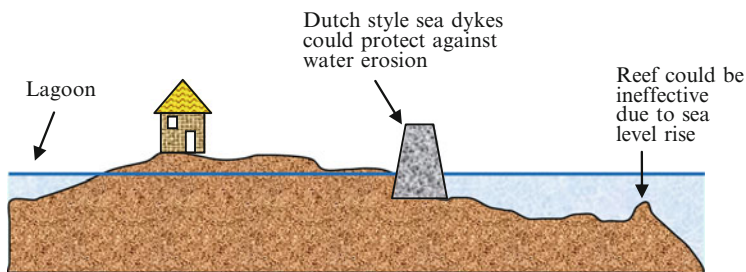


Fig. 5.7 Scenario IV

would be in the best of cases a barren piece of land due to the high salinity of the water under it. More likely, water would seep under the defence works due to the pressure differential and inundate the area behind it, requiring expensive ground improvement works and constant pumping. This is unlikely to be either cheap or sustainable, and the consequences for sovereignty over the coral island would be similar to those of Scenario II, as discussed previously.

Caron<sup>161</sup> notes how the construction of sea defences only makes sense in the most densely populated and productive areas of a country, and how in order to preserve EEZs countries might attempt to protect remote or uninhabited parts of their territory, leading to a wasteful use of resources. In summary, it appears that although the construction of coastal dykes could extend the time that humans could continue inhabiting the islands, progressively increasing quantities of food would have to be imported (Fig. 5.7).<sup>162</sup> With time this scenario would become similar to that outlined in Scenario II (that of a barren rock).

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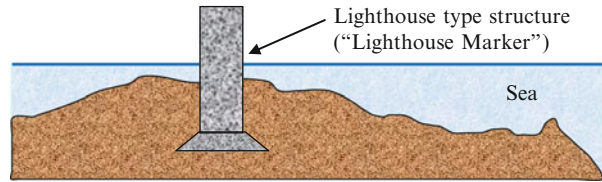
many hard lessons from this incident, and 20 days after the floods the Delta commission was inaugurated. Eventually in 1958 the Delta Law was passed, which would lead to the enormous “Delta Works”, which are a dramatic series of dams and flood protection works destined to protect the Netherlands from future repetitions of this catastrophe. Sea level rise does, of course, pose a serious problem to the safety of these protection works, and it appears likely that it will be necessary for the Dutch government to reinforce some of the coastal defences to deal with it. However, there appears to be little doubt that in the same way that the Netherlands decisively responded to the 1953 storms, action will be also taken against other consequences of climate change. The Dutch people, it can be argued, have the history, expertise, commitment and financial resources to adapt to this particular problem. It is a problem that Dutch engineers are aware of, and discussions are often heard about the consequences of these problems for the country. In this respect the Delta Program is currently assessing possible scenarios (including sea level rise and climate change) and are due to give their recommendations in 2014 for suggestions to protect the Netherlands for the next 200 years. To implement the measures suggested from 2020 there will be a Delta Fund of about 1 billion euros per year to provide suitable financial stability and reduce the Delta Programme dependency on economic and political developments. Hence, although sea level rise will require a number of adaptation measures, there appears to be little chance of any sizeable areas of the Netherlands being flooded, and hence the problems will be different in nature to those of Atoll Island States. See Deltawerken online (2011) <http://www.deltawerken.com/>.

<sup>161</sup> Caron (1990), p. 640.

<sup>162</sup> Rakova <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>.



Fig. 5.8 Scenario V



### 5.3.5 Scenario V: Lighthouse

With the islands completely submerged a tall structure such as a lighthouse could be built to keep a claim on the adjacent waters.<sup>163</sup> Such a structure would be populated by a limited number of people, such as maintenance personnel or weather observers (Fig. 5.8).

Although it would inevitably be very costly to construct and maintain, this kind of construction could be used to attempt to prevent the island from being classified as a barren rock under Art. 121(3) of UNCLOS. However, its effectiveness in achieving this and allowing the Atoll Island State to claim ownership over the surrounding seas would probably be limited. It is unclear whether these people could be considered as a population,<sup>164</sup> as it would also be necessary for the islands to have an “economic life of their own”. Furthermore, it is actually unlikely that an Atoll Island State would be able to fund a sufficiently large structure to house over 50 individuals,<sup>165</sup> which has been suggested as the minimum number of people required to consider that an island has an “economic life of its own”.<sup>166</sup> Moreover, in the preliminary work on the Convention on the Law of the Seas III, military and governmental facilities do not fulfil the requirement of economic life<sup>167</sup> and hence it is unlikely they would prevent the island from being re-classified as a rock.

In a solution that is not exclusively related to the protection of sovereignty, but of baselines, Hayashi<sup>168</sup> suggests the construction of lighthouses on low-tide elevations in order to use them as basepoints, or by interpreting the provision on unstable coasts to draw straight baselines between them. These baselines would not change after being drawn and publicised, independent on whether the low water lines moved or not.

<sup>163</sup> This has also been called a “sovereignty marker” Scenario, though it is unlikely that such a structure can really assert sovereignty over an area, see Yamamoto and Esteban (2010), p. 3.

<sup>164</sup> The number of people to inhabit an island was already discussed by Dyke and Gurish (1988) In their definition, human inhabitation would be the capacity of living in the island on the basis of the natural resources of the island, in a stable community which is an institutionalized human group without external assistance. In this “stable” community 5 people would be considered few, but if there were 50 people it would be enough for it to be classified as inhabited.

<sup>165</sup> Yamamoto and Esteban (2010), p. 5.

<sup>166</sup> Dyke and Gurish (1988).

<sup>167</sup> Kagami (2005).

<sup>168</sup> Hayashi (2010), p. 106.

Such a structure could also be seen as a “sovereignty marker”, built to claim ownership over an area of “Historic Waters”. The doctrine of Historic Waters was developed in the late nineteenth century and it justifies the treatment of bays and other areas of sea as internal waters when there has been a continued exercise of governmental authority over them, to which other State acquiesces.<sup>169</sup> According to Grote it would thus be possible for a State to exercise sovereignty over an area of the sea or EEZ which had fallen outside the outer limits of what it could claim (due to the retreat of its baselines) by invoking this principle.<sup>170</sup> As a consequence, as the baselines recede, the breadth of the territorial sea would gradually become more than the 12 nautical miles stipulated by UNCLOS, and the outer limit of the EEZ would grow to over 200 nautical miles.<sup>171</sup> In fact, such a solution would not be a classical case of historical waters, but would be a new category of such type of areas.

Grote,<sup>172</sup> however, is quite critical of this solution, noting how it would require the coastal State to continuously exercise its rights in the areas concerned during a certain period of time, during which the status of the area would be open to challenge by other countries. Caron also notes how the assertion of historical rights is more easily contested than the location of a baseline.<sup>173</sup>

In fact, many Atoll Island States are already incapable of asserting their exclusive fishing rights against the intrusion of fishing fleets from other countries, and it is unlikely that they would be able to enforce them in the future. In effect, as Soons notes, “acquiescence by the community of States may be inferred from the absence of protest by interested States”.<sup>174</sup> However, continued intrusion by fishing boats could be used to prove a lack of effective jurisdiction or control over these maritime areas. Indeed, it is very difficult to see how after the disappearance of the last islands an Atoll Island State could continue to police its former territory from a distance, even with the presence of a lighthouse installation manned by a few individuals. For that to happen the State would have to continue in some form, either by acquiring some territory overseas or becoming some sort of de-territorialized entity (as will be described in more detail in Chap. 6). For the case were it acquired some land it would be necessary for that territory not to be land-locked in order for patrol ships to be able to operate from it. It should be emphasized, however, that the ability of countries to really operate successful naval operations far from their bases is restricted to a very limited number of navies, and this would clearly be outside the capability of a small country. For the case of a de-territorialized entity which did not hold any land territory this proposition would be even more difficult, as it would be extremely unlikely that any host country

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<sup>169</sup> Soons (1990), p. 224.

<sup>170</sup> Grote (2011), p. 281.

<sup>171</sup> Soons (1990), p. 216.

<sup>172</sup> Grote (2011), p. 282.

<sup>173</sup> Caron (1990), p. 651.

<sup>174</sup> Soons (1990), p. 223.

would allow patrol boats to operate from its territory. A merger of an Atoll Island State with another country (as proposed in Chap. 6) could allow it to access the resources of the State it was merging with, though this would make the case for a claim under the “Historic Waters” more difficult, as the legitimacy of the country could be called into question.

Grote also notes there are other problems, such as how the historic waters doctrine is only concerned with sovereign rights over a certain area of water, and how “it is questionable whether the jurisdictional and other rights allocated to a State within its EEZ would persist under this approach”.<sup>175</sup> Soons notes how the qualification of “historic” requires for a certain time to lapse since the changes in baselines took place, and how it is likely that due to sea level rise baselines will be continuously receding in the future.<sup>176</sup> Grote thus concludes that attempting to use this doctrine could be dangerous, as the coastal State would have to suffer the effects of sea level rise before knowing if this way of action is successful.<sup>177</sup> Thus, the construction of such a structure does not make any sense from either a legal or financial point of view, and if Atoll Island States had the resources necessary to build and operate such installations, this money would be better invested in the construction of coastal defences or the preservation of coral reefs.

### 5.3.6 Scenario VI: Houses on Piles

Another possibility for the case of an atoll where the coral reefs fail to keep up with sea level rise is for the inhabitants to start building houses on piles or stilts. In this case the houses would still be above sea level, in a way not too dissimilar to the houses in Venice or to popular tourist resorts in the Maldives (see Fig. 5.9). The Motuans of Papua New Guinea also live on houses built on stilts over the sea, which are made from wood and typically last for 20–30 years. These houses are typically 3.5–4 m above sea level and hence are not flooded even during high tides.

From an engineering point of view this kind of technology is not too expensive, and creating higher piles to cope with increases in sea level would not present an excessive challenge, especially if modern building materials were to be employed (see Fig. 5.9). Progressive increases in water depth would, however, result in higher waves in the area behind the fringing reef, though this is also unlikely to pose a serious engineering problem. Nevertheless such solutions could be very expensive

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<sup>175</sup> Grote (2011), p. 283.

<sup>176</sup> Soons (1990), p. 224

<sup>177</sup> Grote (2011), pp. 282–283.



**Fig. 5.9** Many popular tourist resorts in the Maldives are on top of water

and thus not clearly within the financial reach of the poorer Atoll Island States.<sup>178</sup> Furthermore, under such a scenario the issue of securing adequate food supplies would become critical, as a species shift from corals to macroalgae could severely reduce fish stocks (see Chap. 3), and the lack of land would require most other food to be imported. Nevertheless, the inhabitants could theoretically live of a mixture of fishing and tourism.

In this case, where the island is totally submerged but only houses on stilts remain above the sea level, it would be difficult to claim sovereignty over the former territory, since the only element left above the sea would be an artificial structure. This scenario, however, differs from Scenario V in that it would be able to sustain a higher number of people in these elevated housing structures, which could be considered a population. Nevertheless this fact would not be able to support the claim that the area continued to be an island. One of fundamental principles of the Law of the Seas is that “the land dominates the sea”,<sup>179</sup> i.e., it is the possession of coastal land which gives the coastal State rights over waters off its coast. For the case of Venice and the Maldives, the water area on which the houses are located is close to islands (in the case of Venice it is a coastal lagoon surrounded by land or small islands such as Lido). In fact, there have been attempts by individuals to

<sup>178</sup> The President of Kiribati mentioned in a speech to the 16-nation Pacific Island Forum how he had been looking at a \$2 billion plan that involved “structures resembling oil rigs”, as reported by Vidal (2011) <http://ourworld.unu.edu/en/artificial-island-could-be-solution-for-rising-pacific-sea-levels/>.

<sup>179</sup> ICJ, North Sea Continental Shelf Cases (Federal Republic of Germany v. Denmark; Federal Republic of Germany v. Netherlands), Judgement of 2 February 1969, at para.96: “. . .since the land is the legal source of the power which a State may exercise over territorial extensions to seaward, it must first be clearly established what features do in fact constitute such extensions.”

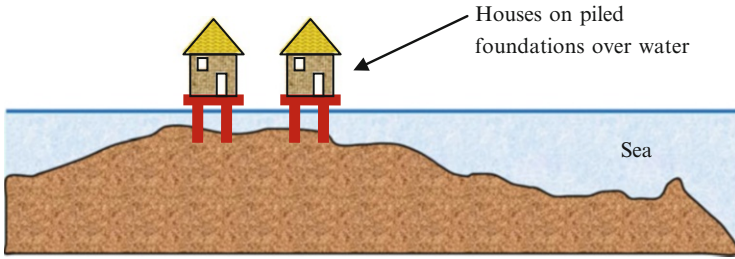


Fig. 5.10 Scenario VI

create a State out of artificial installations in the sea,<sup>180</sup> though this appears to be highly controversial<sup>181</sup> and to defy many parts of UNCLOS.

This scenario would thus have similar consequences to that of the construction of a lighthouse (Scenario V), and is unlikely to allow the preservation of sovereignty of an Atoll Island State over its former maritime zones (Fig. 5.10).

### 5.3.7 Scenario VII: Elevation of an Entire Island

Another possible scenario to counter the effects of rising sea levels would be to use sea dykes (as in Scenario IV above) and to then raise the level of the ground behind the protection structures. This could be done, for example, by dredging materials from a nearby location, such as another island that had failed to keep up with the rising sea levels. This piling of sand is often used in the construction of artificial islands, and famous examples can be found off the coast of Dubai. Also, rubbish could be used to create landfill areas which would gradually raise the levels of some areas of the islands. In fact, the disposal of rubbish is currently a great problem in atolls, and for the case of the Maldives household waste is disposed of at an artificial island 7 km from the capital (Thilafushi, which has been nicknamed “Rubbish Island”).<sup>182</sup> This artificial island is actually increasing in size by about 1 m<sup>2</sup> a day, though it is relatively low-lying like the rest of the Maldives.<sup>183</sup> The use of rubbish to raise islands also requires considerable engineering effort in order that the local environment is not negatively affected, though these types of islands have been constructed successfully in other countries. It is not even necessary to use rubbish,

<sup>180</sup> Such as an attempt to declare a new State in a British World War II anti-aircraft platform located off the coast of the UK, see The Principality of Sealand, <http://www.sealandgov.org/> Accessed 27 March 2012.

<sup>181</sup> For more details on how an artificial island is not considered as an island by art. 80 UNCLOS, see Gagain (2012), p. 101.

<sup>182</sup> BBC News (2011) Maldives ‘Rubbish Island’ is ‘overwhelmed’ by garbage, <http://www.bbc.co.uk/news/world-asia-16072020>.

<sup>183</sup> Business Insider (2011) <http://www.businessinsider.com/artificial-islands-2011-7#12-thilafushi-1>.

as sand can be sourced from nearby areas, as in the case of Hulhumalé island in the Maldives,<sup>184</sup> which has a level of around 2 m above sea level, higher than the average for the rest of the country<sup>185</sup> (the capital island Malé is only 1 m above sea level).

Needless to say that raising islands in such a way would be expensive and from the moment they were raised would rely on periodic engineering works to continue to elevate the islands as sea-levels gradually continue to increase throughout time. It is important also to note that raising an island would also mean that all structures on it would get covered by sand as it is piled up on the existing ground level, which would require the building of new houses and infrastructure on the new elevated terrain. In addition it would be necessary to remove all fertile topsoil and then place it on top of the raised land, as otherwise the sediments used to raise the land would be rather unproductive for agriculture.

The survival of the island would rely on the strength of its engineering works, and it would thus be crucial to correctly design the coastal defences around them. As sea level rises the depth of the water in front of the defensive works would gradually increase (especially if coral reefs were not able to keep up with sea level rise or these structures negatively affect coral growth, as outlined in Chap. 3). This will require not only the continuous upgrading of the coastal defences to keep up with sea level rise but also to protect against the increasingly bigger waves that will be able to reach the coastline (higher water depth would mean bigger waves reaching the structure due to reduced wave breaking attenuation, as explained in more detail in Chap. 3). Failure to design the structures correctly could have catastrophic consequences, as once the hard structures that protect the edge of the island are destroyed the soil and sand behind them would be extremely vulnerable to erosion by sea waves. This is a well known problem in coastal engineering, and hence a breach would not only have a local effect (as would happen at present) but might result in the massive loss of lives and property in a wide area behind the breach. Essentially, the island would progressively move from a state where the biggest waves break offshore on the reef (and hence have relatively low strength by the time they reach the beach) to a situation where progressively higher waves would be breaking onto the coastal defences. This would actually require coastal defences to be built to a much higher specification than those constructed nowadays, as the survival of the island would hinge entirely on these defences, something which is not the case nowadays. Hence the structures would have to be designed for high order low frequency events (with return periods of 1 in several 1,000 years, in a

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<sup>184</sup> Which by 2020 is expected to have a population of 20,000 people, according to the Housing Development Corporation (2012) Website, a housing development corporation owned by the government of the Maldives, undertaking to construct housing projects in the country. <http://www.hdc.com.mv/development/introduction.php>. Sand is being obtained from nearby “coral sand”, DEME (Dredging, Environmental & Marine Engineering) (2012) website, [http://www.deme.be/projects/maldive\\_hulhumale.html](http://www.deme.be/projects/maldive_hulhumale.html).

<sup>185</sup> Schmetzer (2000) <http://community.seattletimes.nwsources.com/archive/?date=20000227&slug=4007063>.

similar way to how the flood defences in the Netherlands are constructed at present), which would be far more expensive than what is currently built to protect the coastline of small islands.

Such an island would thus cease to be a completely natural feature but rather would rely on engineered knowledge for its survival. However, in order to determine its status it is crucial to know whether it fits into the definition of “naturally formed” or not. Art. 121(1) of UNCLOS establishes that an island is “a naturally formed area of land, surrounded by water, which is above water at high tide”.<sup>186</sup> Thus, the key point would be whether such an engineered island would become an artificial island or not. Art. 80 of UNCLOS is clear on the status of artificial islands and states how “artificial islands, installations and structures do not possess the status of islands”. UNCLOS establishes a number of responsibilities attributable to the State that builds any such islands,<sup>187</sup> but does not allow an artificial island to act as a baseline from which to derive maritime zones.<sup>188</sup>

It is clear that an island such as Hulhumalé in the Maldives, which has been created through the entire reclamation of a land area that did not exist before, fits the definition of an artificial island.<sup>189</sup> Before reclamation works began this land did not appear on any map and thus its existence does not rely on natural processes, but on engineering expertise.<sup>190</sup>

However, the situation would be entirely different for an island that had been naturally formed, such as the case of Malé (the capital of the Maldives), and then protected. This island has been completely surrounded by concrete protective structures,<sup>191</sup> which have been called the “Great Wall of Malé”, as they stand around 2 m high around the one-square mile coral island.<sup>192</sup> Despite the fact that these islands are protected by engineering works and that this modifies the environment around them (which would then probably require constant engineering work for them to survive, as explained previously), they are never referred to as “artificial islands”. In fact, coastal protection works are typical in most areas of the world, as they are required to protect the coast against erosion, which typically originates

<sup>186</sup> The development of the term “naturally formed” with regards to previous treaties on maritime law can be found in Gagain (2012), p. 98.

<sup>187</sup> Which would include the need to give other States notification of their construction or maintain a permanent warning system. More details on the responsibilities and benefits that a State can obtain from artificial islands can be found in Gagain (2012), p. 101.

<sup>188</sup> In fact it only allows a small zone of safety around it, which might not exceed 500 m from the outer edge, Gagain (2012), p. 106.

<sup>189</sup> Gagain (2012), p. 82.

<sup>190</sup> And this is recognised by some commentators, such as Gagain (2012). Here the author proposes a modification to UNCLOS to “Expand the Legal Status of Artificial Islands for the Purpose of Maintaining Maritime Claims and Statehood. However, it is not really clear whether there is much international appetite for any modifications of the UNCLOS.

<sup>191</sup> Kench et al. (2009), pp. 180–213, and Fritz et al. (2006), pp. S137–S154

<sup>192</sup> Schmetzer (2000) <http://community.seattletimes.nwsources.com/archive/?date=20000227&slug=4007063>.



from human interferences with coastal processes.<sup>193</sup> In fact, it is extremely unlikely that any coastal State would argue that engineering works render a coastline artificial, as it would mean that the nature of their own coastlines would be called into question. Tsaltas et al.<sup>194</sup> also appear to come to the same conclusion, and add that for the case of islands situated in atolls:

Both atolls and fringing reefs are natural formations, but land preservation techniques can also be applied on them, in order to prevent their loss or to create new land. (. . .). A loss which apart from its environmental consequences will affect maritime zones, since “the baseline for measuring the breadth of the territorial sea is the seaward low-water line of the reef”. The area that stands landward of the baseline is assimilated to the internal waters zone, so coastal States have the right to manage it at will, as long as they do not expand the baseline.

Soons<sup>195</sup> does raise concerns about the possibility were islets which would have disappeared as a result of sea level rise but maintained by artificial means could no longer be considered as “naturally formed”.<sup>196</sup> However, atolls are morphologically complex areas, and from a coastal engineering perspective it would be very difficult to prove what would have happened to any island if protection had not been there. Morphological processes in these areas, as explained in Chaps. 2 and 3, are still not entirely understood, and it could always be possible to argue that if coastal defences had not been constructed then the corals would have been healthier, and they would have been able to keep up with sea level rise. Furthermore, the raising of islands is something that has been carried out before, and has not resulted in any calls to re-designate their coastlines as artificial. Despite raising these concerns, Soons also concludes that

It is submitted, however, that this provision, apart from the fact that it relates to the EEZ, is concerned exclusively with newly constructed artificial islands. The artificial conservation of an island once formed by nature does not result in its losing its international legal status of ‘island’. This is the case if the artificial conservation was exclusively intended to preserve the baseline for the purpose of maritime delimitation. Maintaining sea areas may for one coastal State (for example, the Maldives) represent an equivalent and legitimate interest as compared to another coastal State (for example, the Netherlands) maintaining its land territory.

It is also submitted that the artificial conservation of an islet exclusively for the purpose of preventing it from degenerating, as a result of sea level rise, to the status of ‘rock’ as provided in Article 121, paragraph 3 of the Law of the Sea Convention (and thus no longer generating an EEZ) should be considered as permissible.

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<sup>193</sup> This is well documented in coastal engineering literature and practice. For a good historical overview of coastlines in various countries at different stages of development see Shibayama (2009).

<sup>194</sup> Tsaltas et al. (2010), p. 12.

<sup>195</sup> Soons (1990), p. 222.

<sup>196</sup> As according to Art 121 of UNCLOS an island is a “naturally formed area of land, surrounded by water, which is above water at high tide”.



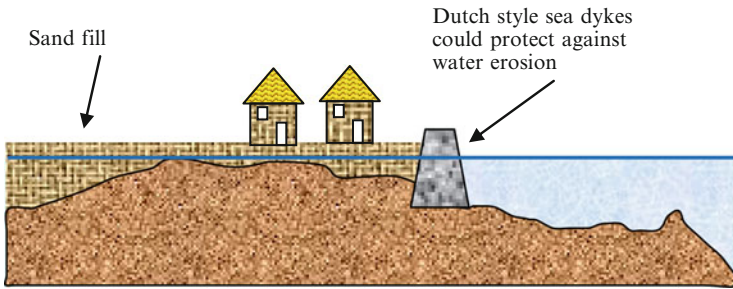


Fig. 5.11 Scenario VII

Art. 11 of the UNCLOS also states how

For the purpose of delimiting the territorial sea, the outermost permanent harbour works which form an integral part of the harbour system are regarded as forming part of the coast. Off-shore installations and artificial islands shall not be considered as permanent harbour works.

This provides further evidence of the possibility of using coastal defences to mark the external edge of the baseline, which would not turn a naturally formed island into an “artificial island” (Fig. 5.11). Raising a part of an island also will not result in it being classed as artificial in the same way that constructing a port often requires the raising and levelling of land next to the coastline. Therefore, protecting the circumference of a naturally formed island does not prevent a country from using it to claim a baseline, and essentially, if a small island wanted, it could classify its entire circumference as a port<sup>197</sup>).

Indeed, one example of the rising of an area of land that would otherwise “naturally” be below sea can be found in the events of March 2011 in Japan. On March 11, 2011, a large earthquake of magnitude 9.0 on the Richter scale occurred offshore the northeast coast of Japan. This very strong earthquake generated a major tsunami which devastated large parts of Japan’s north-eastern coastline. Buildings, including many well-engineered reinforced concrete structures, were washed away or suffered extensive damage, while numerous ships as well as large boats were left stranded inland. Historically, this *Great Eastern Japan Earthquake and Tsunami of 2011* was one of the worst tsunamis that affected Japan since records began, and has been described as one in several 1,000 years event. Also, the earthquake caused a dramatic sinking of land in Japan, and was the cause of regional lowering of the North-eastern part of the country by around 78 cm,<sup>198</sup> with maximum reported values of vertical subsidence of up to 1.2 m. This left many ports in the Tohoku area under the water, as can be seen in Fig. 5.12, which are

<sup>197</sup> However, it would not be possible to do so if the island had not been “naturally formed”, as Art. 11 of the LOSC states how “Off-shore installations and artificial islands shall not be considered as permanent harbour works”.

<sup>198</sup> As reported by the Geospatial Information Authority of Japan.



**Fig. 5.12** Raising the level of Ishinomaki Port (Miyagi Prefecture in Japan) following the subsidence caused by the *Great Eastern Japan Earthquake and Tsunami of 2011*. This clearly showcases how the raising of a coastal area that has been “submerged” by a natural hazard (in this case land subsidence due to an earthquake) does not result in the land being considered as artificial. To the authors’ knowledge, nobody has questioned whether this area is still part of Japan, or whether the baselines should retreat as a result of this subsidence

currently being raised by piling sand and gravel on top of the previous land and re-surfacing the port. Despite these engineering works, there has been no mention that these boundaries are now artificial, as the key point is that they were originally naturally formed. Although they have been subsequently naturally lowered by plate tectonic action, UNCLOS does not mention anything on this issue, as the maintenance and management of coastlines is an accepted practice. The fact that structures remain in the area and prompt action was by the Japanese authorities is also important in this regard, and if a coastline was allowed to completely disappear the legal consequences might be different. However, it is clear that raising an existing coastline for defence purposes is a common and accepted activity throughout the world.

The essential point for the preservation of sovereignty over an island is that this should be above the water, and whether this fact is facilitated by artificial structures is irrelevant.<sup>199</sup> While there is some arguments over whether an island can be catalogued as artificial if it would have disappeared had it not protected by defensive structures (such as arguments over Okinotorishima, as explained previously), the case for atolls at present appears quite strong. First, there is no question

<sup>199</sup> Grote (2011), p. 278.

as to whether many atolls are currently islands as defined in UNCLOS, a fundamental difference with Okinotorishima, whose status has long been in dispute. On such raised islands it would be relatively easy to have a functioning agriculture, which would ensure that the inhabitants have an “economic life of their own”. Moreover, there are legal precedents on how the construction of defence works allows a claim of sovereignty over areas which were previously covered by water, such as the case of the polders in the Netherlands.

The artificial protection of shoreline, however, is expensive.<sup>200</sup> For the case of Atoll Island States these defences would have to be accompanied with a rising of the level of the island by artificial means, such as by dredging nearby sand and placing it on top of the islands. If this is not carried out then the islands risk losing their vegetation cover and being re-catalogued as barren rocks, as explained in Scenario II, with the consequent danger of losing their EEZs. It might possible that other countries would be willing to share some of the cost of improving these defences and raising the island, through Overseas Development Aid Programs (ODAs) or climate change Adaptation Funds (as explained in Chap. 4). Also, there is the chance that external powers that need the natural resources contained in the EEZs of these countries would be willing to share the costs in return for access to those resources. This could create a “win-win” situation where Atoll Island States get access to finance to build coastal defences and raise the island in return for trading its resources.<sup>201</sup> Grote<sup>202</sup> also points out a very important aspect of coastal defences, in that increased wave reflection from hard structures can contribute to erosion, and could move the water mark all the way to the foot of the seawall. Although it is possible to build improved and less reflecting coastal structures, often any such constructions do lead to deterioration in water quality,<sup>203</sup> which can have a detrimental effect on corals. For the case of Atoll Island States, the low-water mark is often the edge of the coral reef,<sup>204</sup> which can be located hundreds of meters from the shoreline. An important consideration is thus whether the construction of hard measures can lower the water quality,<sup>205</sup> which could kill the corals and prevent reefs from keeping up with sea level rise. The consequent retreat in baselines would of course lead to a reduction in the EEZ and territorial waters, though the effect is likely to be limited to a few hundred meters, or a few kilometres, at maximum. Not only that, many of these Atoll Island States have an economy that strongly depends on tourism, and the destruction of coral reefs and the substitution of beaches by coastal defences could have the perverse effect of

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<sup>200</sup> As explained before some countries already have the financial ability to carry it out, such as the Maldives. However for others such as Tuvalu it would probably be financially ruinous.

<sup>201</sup> Maas and Carius (2012), p. 657.

<sup>202</sup> Grote (2011), p. 277.

<sup>203</sup> Although much effort can be made to attempt to minimize environmental effects, the sensitive nature of corals and the complexity of atolls makes it difficult to entirely remove these effects.

<sup>204</sup> Lusthaus (2010), pp. 115–116.

<sup>205</sup> By increasing its turbidity, for example.

depriving them of important means of income. Thus, while the construction of such works is clearly within the reach of middle-income countries such as the Maldives, they could ultimately affect the economy of the country and lead to the long-term unsustainability of these measures. In essence, it is important to consider that sea level rise will probably continue for centuries to come, and while it would be possible to continue elevating the islands, this would only be possible if the required financial resources exist. The death of corals and disappearance of the beaches that they nourish could thus ultimately lead to the impoverishment of many Atoll Island States, and ensure that this option is also eventually economically unsustainable.

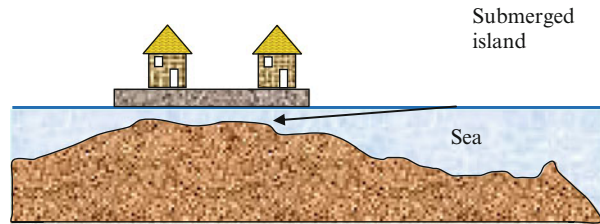
It should nevertheless be emphasized that rising an island at the same time as protecting its perimeter would be the only currently accepted legal way of ensuring that their edges could be used as baselines, provided that the islands remain of sufficient size (i.e. if they were allowed to reduce in size and turn into “Okinotorishimas” this would no longer be the case, as they would no longer be able to sustain a population). It is important also that the island should at no point disappear, as attempting to rebuild it later could lead to it being denominated an “artificial island” (as explained in Scenario IX). Nevertheless, although such engineering works are within the financial ability of certain countries such as the Maldives, it is probably outside the current reach of poorer and economically weaker countries such as Tuvalu. In all cases, however, recurring to such protection represents a more dangerous and expensive course of action than attempting to preserve the health of corals, as explained in Chaps. 2 and 3. Thus, we are not arguing that all can be solved by engineering works, but this would represent a last line of action if these States were to lose the coral communities on which back they have lived for generations. Preserving these coral communities is by far the most adequate mean of ensuring the sustainable existence of coral islands and the baselines derived from them, though this appears to be difficult if strong mitigation measures are not taken by all countries around the globe.

Another problem with this engineering approach, as Caron<sup>206</sup> argues, is how in the attempt to preserve maritime zones States might divert assets into preserving baselines rather than attempting more appropriate and effective climate change mitigation and adaptation strategies. Indeed, finding a way to develop in a sustainable way that preserves the coral reefs is far more desirable than attempting to protect the baselines of every island in an archipelago. In practice, however, it would only be necessary for an Archipelagic State to protect a limited number of islands as they are able to draw straight archipelagic baselines between them according to the UNCLOS. Thus, an Atoll Island State would only really need to preserve 3 or “key” 4 coral islands in order to continue to claim a large EEZ around it. This would result in the concentration of the entire population of the country in a reduced number of “island-fortresses”, defended against the rising seas by concrete walls of ever increasing height, and constantly elevating the ground behind these walls using dredged materials. An important consideration, as we have explained

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<sup>206</sup> Caron (1990), pp. 639–640.

**Fig. 5.13** Scenario VIII,  
Floating Islands



previously, would also be whether such an option is economically sustainable, and if it could have other perverse effects on the islands, such as driving away the essential tourism which forms the cornerstone of the economy of many of them. This could ultimately lead to a vicious cycle that would leave the country impoverished and unable to access the necessary resources to continue protecting the islands.

### 5.3.8 Scenario VIII: Floating Island

Floating islands have been suggested by a number of commentators as a possible solution to the case of sinking islands.<sup>207</sup> Although there are some precedents for these kind of structures,<sup>208</sup> it is unlikely that sufficiently large structures could be built to accommodate the population of entire atolls. Also, the cost involved in building such structures would be prohibitive, especially considering the financial resources available to Atoll Island States.<sup>209</sup> It would be far cheaper and easier to protect and raise the islands, and much simpler from an engineering point of view. Furthermore, it is likely that any such a structure would be considered in the worst case as a ship,<sup>210</sup> or as an “artificial island” at best, and thus would not allow for any maritime zones to be claimed around it. In fact this scenario would neither meet the principle that land dominates the sea nor most of the criteria of what defines an island according to UNCLOS, making this scenario extremely unappealing for Atoll Island States (Fig. 5.13).

<sup>207</sup> A number of futuristic solutions are listed in Vidal (2011) <http://ourworld.unu.edu/en/artificial-island-could-be-solution-for-rising-pacific-sea-levels/>.

<sup>208</sup> Such as for example Joysxee next to Isla Mujeres in Cancun, Mexico, as reported by Mader (2011) <http://www.kickstarter.com/projects/scottmader/grand-launch-recycled-plastic-bottle-ecological-ar>.

<sup>209</sup> In fact the idea of these structures is not realistically contemplated by many, as highlighted in the closing statement of Vidal (2011) <http://ourworld.unu.edu/en/artificial-island-could-be-solution-for-rising-pacific-sea-levels/>.

<sup>210</sup> And for example Joysxee is considered by the Mexican government as a boat, according to Mader (2011) <http://www.kickstarter.com/projects/scottmader/grand-launch-recycled-plastic-bottle-ecological-ar>.

### ***5.3.9 Scenario IX: Reconstruction of an Island After it has Disappeared***

This scenario is somehow different to previous ones, as it would involve the inhabitants of a certain atoll allowing it to disappear, and then attempt to reconstruct it again at a later stage. This can be done in a similar way to what is described in Scenario VII, by building retaining walls around the island and then filling the inside with sand or other materials. However such a scenario appears at present quite unlikely, though it is possible that in the future the inhabitants of a place like Tuvalu would be forced to move to other lands, but at a later stage some of their descendents, having grown rich in other countries could attempt to re-create their ancestral lands by re-building islands in exactly the same place were current day atolls stand.

However, in this case the legal consequences are somewhat different to those outlined in Scenario VII. The fact that the island is allowed to disappear is the main issue here, as Art. 121(1) of the UNCLOS established that an island needs to be “naturally formed”. These atolls as they exist at present have been naturally formed, and even if protected using sea walls would still remain “naturally formed” geographical features. If they are allowed to disappear, this would be part of a “natural destruction” of the islands. However, unless they were to naturally re-appear at a later stage, it would be difficult to argue that building seawalls and filling the area with sand could constitute a “naturally formed” island. Even in the case where this engineered island was occupying the exact same territory of the previous naturally formed island, it would still constitute an artificial island. Thus, it is of paramount importance that coral islands are not allowed to disappear, as once they do re-creating them by engineering means will not confer on them the same status they have at present. Clearly as artificial islands they have no right to an EEZ or other territorial waters, though it is likely that they would be allowed the 500 m safety zone around them, as discussed previously.

The issue of sovereignty in this case would also be complex, and would probably depend on whether other islands in the archipelago still existed (i.e. if the State still had some territory at the time when the island was re-created), or if not, if the State had enjoyed some sort of continuity after the disappearance of the last island (this will be discussed in more detail in Chap. 6). In the case when there was some sort of continuity it is likely that the descendants of the current islands could claim sovereignty over their new artificial islands, in a similar way to how the Holy See took over the Vatican City. However, if there is no State continuity after the last of the islands disappears, either because of a lack of will on the part of the descendants or because no other State is prepared to recognise this continuity, claiming sovereignty would be more difficult. In essence, it would mean creating a new State, something which can often be complicated as it is often not easy for new States to be admitted to the international community.

It is also possible to envisage even more complex scenarios, where for example the islands were made to re-appear not by building concrete walls and infilling with sand, but by planting corals around them (if in the future some corals adapt to the changing environmental conditions that could make them disappear in the first place, as explained in Chap. 3) and allowing the sand to slowly build up again. However, this would take a considerable amount of time, and it's difficult to see how this would be feasible in terms of the time-scales and cost involved. Nevertheless, in this case the issue of whether the islands were naturally formed or not would be even more complex, and would involve discussions of whether the corals species used were natural or not (i.e. if they had been selectively bred or genetically engineered, could they still count as natural?) and if the planting of corals could be considered natural or not. This planting would have an engineering objective in mind (forcing the reappearance of an island), and in this sense would appear to make it an artificial island, and which would be different to the planting of corals with only the issue of preservation in mind. Looking at a timescale of millennia, it could be ultimately possible that the islands could re-appear by themselves in the distant future (if greenhouse gas emissions eventually return to present day levels), in which case the issue of whether they were natural or not would not be in doubt, though the ability of the descendants of current inhabitants to reclaim the islands would still depend on some sort of State continuity in the interim.

## 5.4 Conclusions

We would like to strongly emphasize that we believe international agreements should be pursued so that future climate change can be kept to a minimum, ensuring the survival of coral reefs and thus the preservation of sovereignty of Atoll Island States. If such agreements cannot be reached, then several Atoll Island States could eventually be at risk of disappearing due to the combined effects of sea level rise, an increase in ocean acidity and temperature (that could severely damage coral reefs) and the potential for stronger tropical cyclones. The present chapter proposed a number of different scenarios of what could happen to these islands, and discussed each of these according to the current United Nations Convention on the Law of the Sea (UNCLOS). Different remediation strategies were proposed in order for these States to attempt to continue claiming an Exclusive Economic Zones around them, which could be lost if they became "barren rocks" or disappeared under the sea. Some of these (such as the idea of creating floating islands or recreating an island after it has disappeared) appear to make little objective sense. Their inclusion does not mean that we consider all of them to be feasible, but rather it comes from an attempt to be as thorough as possible when considering all options, and to highlight how some of the solutions sometimes proposed make little engineering or legal sense.



The fact that human habitation and “economic life of its own” are concepts which at present are not well defined is also highlighted. This should be the target of further discussion, as these concepts could become crucial to the preservation of the interests of Atoll Island States under UNCLOS. In fact, it appears that to preserve those interests it would be better to interpret the term economic life as also including activities surrounding the island and not only on it, or to fix the outer limits of maritime zones. This would insure the ability of Atoll Island States to continue exploiting their EEZs for the benefit of their populations, even if these have to migrate to different lands.

Much has been written about how to preserve the baselines that allow EEZs to be determined, and various commentators<sup>211</sup> have proposed that UNCLOS should be modified, or that at least there should be a movement to a progressive interpretation of some of its clauses. While we agree that such developments would be welcome, Scenario VII (building coastal defences around the perimeter of existing islands and periodically elevate them to compensate for sea level rise) represents the only engineering solution that would be legally proven to preserve baselines according to UNCLOS as it now stands (and we believe it would be very difficult to alter or negotiate another treaty). Although the economic and social consequences of the death of the corals on atolls would be significant, protecting the islands by engineering means would assure their continued existence. In countries where tourism is an important revenue source, visitors could still stay at hotels in shallow water regions next to the islands, possibly on stilts. Food would be farmed in the existing islands, which would be periodically elevated using dredged materials. Given the timescales available, the population would have enough time to adapt and gradually strengthen coastal defences. Nevertheless, the death of the coral colonies would result in a decrease in food security, a reduced income from tourism and increased vulnerability to natural disasters, amongst many other losses (as highlighted in Chap. 3). It could also result in a loss of some maritime territory, depending on which islands are protected. Such a scenario would entirely avoid the discussion on whether statehood could be maintained without territory and population (see Chap. 6). However, many of the countries potentially affected are classed as developing, and it is necessary to take into consideration that “poorer” countries such as Tuvalu would probably lack the funds and adaptive capacity to undertake such expensive engineering projects. A “middle-income” country with a significant population, such as the Maldives, has a much greater ability to build infrastructure to protect its population. This can already be witnessed in the construction of artificial islands or the protection of the whole circumference of the capital, Malé, with concrete coastal defences. Such a country is likely to “engineer” its existing islands so that its territory will not disappear in the short to mid-term, even if the corals that make up the atolls die. Indeed, such a method of protecting existing islands is internationally accepted, and thus represents the clearest path for an Atoll Island State to preserve its maritime zones and sovereignty.

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<sup>211</sup> See for example Grote (2011).



Generally speaking, and if the issues at hand was the preservation of the poorer Atoll Island States, an Atoll Island State Defence Fund could be created, potentially using finance from a “loss and damage” mechanism that is currently being discussed (see Chap. 4). If the Atoll Island cannot protect at least one of its islands then there are a number of other possible solutions for Atoll Island States to attempt to preserve their sovereignty such as the cession of territory,<sup>212</sup> a merger with another State<sup>213</sup> or becoming a de-territorialized States,<sup>214</sup> as we will discuss in Chap. 6.

## References

- Allen S (2008) International law and the resettlement of the (outer) Chagos Islands. *Hum Rights Law Rev* 8(4):683–702
- Barnett J, Adger N (2003) Climate dangers and atoll countries. *Clim Change* 61:321–337
- BBC Island Disappears Under the Seas (1999). <http://news.bbc.co.uk/2/hi/science/nature/368892.stm>. 14 June 1999. Accessed 23 Aug 2009
- BBC News (2011) Maldives ‘Rubbish Island’ is ‘overwhelmed’ by garbage, <http://www.bbc.co.uk/news/world-asia-16072020>. 8 December 2011. Accessed 18 Dec 2011
- Bindoff NL et al (2007) Climate change 2007: the physical science basis. Contribution of Working Group I to the 4th Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge
- Burkett M (2011) The nation ex-situ: on climate change, deterritorialized nationhood and the post-climate era. *Clim Law* 2:345–374
- Business Insider (2011) The 12 coolest artificial islands on Earth. <http://www.businessinsider.com/artificial-islands-2011-7#12-thilafushi-1>. 1 September 2011. Accessed 18 Dec 2011
- Caron D (1990) When law makes climate change worse: Rethinking the law of baselines in light of a rising sea level. *Ecol Law Q* 17:621–653
- Caron D (2008) Climate change, sea level rise and the coming uncertainty in oceanic boundaries: a proposal to avoid conflict. In: Seoung-Yong Hong, Jon Van Dyke (eds) *Maritime boundary disputes, settlement processes and the law of the sea*. Martinus Nijhoff, The Hague, pp 1–18
- CIA Website (2012) [www.cia.gov](http://www.cia.gov) website. Accessed 19 Feb 2009
- Commission on the Limits of the Continental Shelf (2010) Submission by the Republic of the Maldives. [http://www.un.org/depts/los/clcs\\_new/submissions\\_files/mdv53\\_10/MAL-ES-DOC.pdf](http://www.un.org/depts/los/clcs_new/submissions_files/mdv53_10/MAL-ES-DOC.pdf). Accessed 26 Mar 2012
- Deltawerken online (2011) <http://www.deltawerken.com/>. Accessed 29 May 2012
- DEME (Dredging, Environmental & Marine Engineering) (2012). [http://www.deme.be/projects/maldive\\_hulhumale.html](http://www.deme.be/projects/maldive_hulhumale.html). Accessed 26 Mar 2012
- Dyke JV (1988) Speck in the ocean meets law of the sea. Letter to the New York Times. January 21 1988. Accessed 18 Aug 2009

<sup>212</sup> Soons (1990), p. 230.

<sup>213</sup> UN High Commissioner for Refugees 2011, p. 18, Soons (1990), p. 230 and Caron (1990), p. 350.

<sup>214</sup> Rayfuse (2010), p. 10 including application of the United Nations International Trusteeship system in order to create an *ex-situ* nation which would consist of a de-territorialized State, see Burkett (2011).

- Dyke JV, Gurish J (1988) The exclusive economic zone of the Northwestern Hawaiian Islands: when do uninhabited islands generate an EEZ? *San Diego Law Rev* 25:425–494
- Fitchett K (1987) Physical effects of hurricane Bebe upon Funafati atoll, Tuvalu. *Aust Geogr* 18 (1):1–7
- Fritz H et al (2006) Maldives field survey after the December 2004 Indian Ocean Tsunami. *Earth Spectra* 22(S3):S137–S154
- Gagain M (2012) Climate change, sea level rise, and artificial islands: saving the Maldives' statehood and maritime claims through the 'constitution of the oceans'. *Colomb J Int Law Policy* 23(1):77–12
- Grant TD (2000) States newly admitted to the United Nations: some implications. *Columb J Transnatl Law* 39:177–192
- Grote J (2011) Implementing a new regime of stable maritime zones to ensure the (economic) survival of small island states threatened by sea-level rise. *Int J Mar Coast Law* 26:263–311
- Hayashi M (2010) The adverse impacts of sea level rise on the right of islands and island states over their surrounding sea areas: procedural options of international legal measures for mitigating impacts. In: Proceedings of international seminar on island and oceans. 29, 30 November and 1 December 2010, pp 103–111
- Hogg C (2007) Japan uses coral to “grow” islets. BBC News. Available at <http://news.bbc.co.uk/2/hi/asia-pacific/6758271.stm>. Accessed 9 Feb 2012
- Houghton et al (2010) Maritime boundaries in a rising sea. *Nat Geosci* 3:813–816
- Housing Development Corporation (2012). <http://www.hdc.com.mv/development/introduction.php>. Accessed 26 Mar 2012
- International Court of Justice (1969) North Sea Continental Shelf Cases (Federal Republic of Germany v. Denmark; Federal Republic of Germany v. Netherlands), Judgement of 2 February 1969
- International Tribunal of the Law of the Sea (ITLOS) General information – judges: the presidency, International Tribunal for the Law of the Sea. <http://www.itlos.org/index.php?id=17>. Accessed 26 Mar 2012
- Kagami Y (2005) Sustainable development as catalytic agent - Art. 121(3): the attempt of Okinotorishima's recovery. Relatory on the revitalization of Okinotorishima. Ocean Policy Research Foundation 2005 (Original in Japanese)
- Kench PS et al (2005) New model of reef-island evolution: Maldives, Indian Ocean. *Geology* 33 (2):145–148
- Kench PS et al (2009) Coral reefs. Chapter 7. In: Slaymaker O, Spencer T, Embleton-Hamann C (eds) *Geomorphology and global environmental change*. Cambridge University Press, Cambridge, pp 180–213
- Lusthaus J (2010) Shifting sands: sea level rise, maritime boundaries and inter-state conflict. *Politics* 30(2):113–118
- Maas A, Carius A (2012) Territorial Integrity and Sovereignty: climate change and security in the Pacific and beyond. In: Scheffran J et al (eds) *Climate change, human security and violent conflict, hexagon series on human and environmental security and peace*, vol 8. Springer, Berlin, pp 651–665. doi:10.1007/978-3-642-28626-1\_32
- Mader S (2011) Birthing of floating recycled plastic bottle eco art island. <http://www.kickstarter.com/projects/scottmader/grand-launch-recycled-plastic-bottle-ecological-ar>. Accessed 27 Mar 2012
- Magnan A et al (2011) In light of climate change, can coral archipelagos be defined as vulnerable “resource systems”? In: 4th congress of the Asia & Pacific network, 14–16th September 2011. Available at [http://www.reseau-asie.com/userfiles/file/H02\\_magnan\\_coral\\_archipelagos\\_climate\\_change.pdf](http://www.reseau-asie.com/userfiles/file/H02_magnan_coral_archipelagos_climate_change.pdf). Accessed 28 Aug 2012
- Minivan News (2009) Seawall built around Dhuvaafaru. [http://www.minivannews.com/news\\_brief.php?id=6878](http://www.minivannews.com/news_brief.php?id=6878). 14 July 2009. Accessed 23 Aug 2009

- Minura N et al (2007) Small islands. Climate change 2007: impacts, adaptation and vulnerability. Contribution of Working Group II to the 4th Assessment Report of the IPCC. Cambridge University Press
- Paskal C (2010) Strange case of the disappearing islands. NZherald. [http://www.nzherald.co.nz/world/news/article.cfm?c\\_id=2&objectid=10635956](http://www.nzherald.co.nz/world/news/article.cfm?c_id=2&objectid=10635956). Accessed 28 Mar 2012
- Principality of Sealand (2012). <http://www.sealandgov.org/> Accessed 27 Mar 2012
- Rakova U (2009) How-to guide for environmental refugees. Ourworld 2.0. <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>. Accessed 23 Aug 2009
- Rayfuse R (2010) International law and disappearing states: utilising maritime entitlements to overcome the Statehood Dilemma, University of New South Wales Faculty of Law Research Series, Paper 52. <http://law.bepress.com/unswwps/flrps10/art51>. Accessed 19 Apr 2012
- Schmetzer U (2000) The rising ocean threatens to sink low-lying Maldives. The Seattle Times. <http://community.seattletimes.nwsources.com/archive/?date=20000227&slug=4007063>. Accessed 26 Mar 2012
- Shibayama T (2009) Coastal processes: concepts in coastal engineering and their applications to multifarious environments, vol 28, Advanced series on ocean engineering. World Scientific, Singapore
- Soons AHA (1990) The effects of a rising sea level on maritime limits and boundaries. Neth Int Law Rev 37(2):207–232
- SOPAC (2006) Regional maritime boundaries project task visit. Republic of Marshal Islands & Federated States of Micronesia. Pacific Islands Applied Geoscience Commission. 5–19th Feburary 2006. <http://sopacpendium.spc.int/data/Reports/PR0411.pdf>. Accessed 16 Mar 2013
- Takagi H et al (2011) Assessment of future stability of breakwaters under climate change. Coast Eng J 53(1):21–39
- Tsaltas G et al (2010) Artificial islands and structures as a means of safeguarding state sovereignty against sea level rise. A law of the sea perspective. In: 6th ABLOS conference contentious issues in UNCLOS - surely not?. International Hydrographic Bureau, Monaco, 25–27 October 2010. <http://www.gmat.unsw.edu.au/ablos/ABLOS10Folder/S2P3-P.pdf>. Accessed 9 Aug 2012
- UNCLOS (1982). [http://www.un.org/Depts/los/convention\\_agreements/texts/unclos/closindx.htm](http://www.un.org/Depts/los/convention_agreements/texts/unclos/closindx.htm). Accessed 24 Aug 2009
- Vidal J (2005) Pacific “Atlantis: First Climate Change Refugees”. The Guardian Newspaper, 25 November 2005. <http://www.guardian.co.uk/environment/2005/nov/25/science.climatechange>. Accessed 15 Aug 2009
- Vidal J (2011) Artificial island could be solution for rising Pacific sea levels. OurWorld 2.0. <http://ourworld.unu.edu/en/artificial-island-could-be-solution-for-rising-pacific-sea-levels/> Accessed 27 Mar 2012
- Warner K et al (2009) Global climate change and small island developing states: financing adaptation. <http://www.careclimatechange.org>. Accessed 21 Dec 2011
- Webb A (2005) Tuvalu Technical Report - Coastal Change Analysis Using Multi-Temporal Image Comparisons – Funafuti Atoll, EU EDF 8/9 –SOPAC Project Report 54, Reducing Vulnerability of Pacific ACP States. Available at internet at [http://docs.tuvaluilands.com/2006\\_Funafuti\\_Coastal\\_Change\\_Report\\_ER0054.pdf](http://docs.tuvaluilands.com/2006_Funafuti_Coastal_Change_Report_ER0054.pdf). Accessed 19 Aug 2009
- Wei D (2011) Receding maritime zones, uninhabitable states and climate exiles, How international law must adapt to climate change. Foundation for International Environmental Law and Development (FIELD). [www.field.org.uk/files/climate\\_exiles\\_dw.pdf](http://www.field.org.uk/files/climate_exiles_dw.pdf). Accessed 17 Apr 2012
- Westmacott S et al (2000) Management of bleached and severely damaged coral reefs, International Union for the Conservation of Nature. Gland, Switzerland
- Wikipedia (2009) <http://en.wikipedia.org/wiki/Polder>. Accessed 19 Feb 2009
- Yamamoto L, Esteban M (2010) Sovereignty issues of the disappearance of Island States. Ocean & Coastal Management 53:1–9. doi: 10.1016/j.ocecoaman.2009.10.003

- Yoshikawa Y (2007) The US-Japan-China mistrust spiral and Okinotorishima. *The Asia-Pacific Journal: Japan Focus* [www.japanfocus.org/products/details/2541](http://www.japanfocus.org/products/details/2541). Accessed 29 Jan 2009
- United Nations Convention on the Law of the Sea (2012) [http://www.un.org/Depts/los/convention\\_agreements/convention\\_historical\\_perspective.htm#Historical Perspective](http://www.un.org/Depts/los/convention_agreements/convention_historical_perspective.htm#Historical_Perspective). Accessed 16 July 2012
- Xue G (2012) How much can a rock get? In: Norduis MH et al (eds) *The law of the sea convention: US accession and globalization*. Martinus Nijhoff, The Hague, pp 371–381

# Chapter 6

## Alternative Solutions to Preserve the Sovereignty of Atoll Island States

### 6.1 Introduction

...the first problem is a lack of sufficient consensus on the criteria for statehood. Also the establishment of legally binding criteria, as opposed to politically judged factors, is not widely supported in practice. Many authors maintain that states consider various factors, but the final determination ranges from a purely political one to one at least intimately bound to political considerations, not as a neutral assessment of fixed criteria.<sup>1</sup>

The 1933 Montevideo Convention in its Art. 1 enumerates the criteria for statehood, which are a permanent population, a defined territory, a government and the capacity to enter into relations with other States. However, during its existence a State might increase or decrease in territory, its population oscillate and the capacity to enter into relations with other States vary.<sup>2</sup> As Worster points out, the criteria for statehood is contentious and practice has not been consistent in international law. Although it is taken for granted that the Montevideo requirements should be met, there is ample evidence demonstrating that opportunism also plays an important role on the establishment and recognition of States.<sup>3</sup>

The effectiveness of Atoll Islands as States has already been put in doubt due to their geographic isolation, limited natural resources and tiny populations.<sup>4</sup> Nevertheless, despite these limitations there is currently no doubt as to whether they constitute States. Thus, the question that needs to be asked is whether statehood can be maintained even with the loss of some of the elements required by the Montevideo Convention, and for the case of Atoll Island States whether this is necessarily linked to a territory.<sup>5</sup> Although these criteria exist, it is difficult to say

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<sup>1</sup> Worster (2009), pp. 158–159.

<sup>2</sup> Emanuelli (2003), p. 1277.

<sup>3</sup> Worster (2009), p. 153.

<sup>4</sup> Grant (2000), p. 181.

<sup>5</sup> Although as McAdam points out, before the territory disappears due to the sea level rise it is more probable that other indicia of statehood, such as a permanent population, an effective government

that there is a consistent custom in international law that would necessarily follow what the Montevideo Convention on the Rights and Duties of States requires.<sup>6</sup>

Thus it is important to distinguish between the elements necessary to establish statehood and the requirements to ensure a State's continuing existence. In the present chapter we will discuss how as there is a lack of consensus on the requirements for statehood, its continuity would not rely exclusively on the strict criteria set out in the 1933 Montevideo Convention. A blend of legal and political judgements could in fact ultimately determine whether statehood can be preserved, and we will thus argue how it is not clear to what extent statehood can be extinguished because of the lack of territory or even government, since once statehood is established there is a presumption of continuity.<sup>7</sup>

This question is essential to Atoll Island States as it would not only determine their ability to continue utilising the resources which had previously been within their EEZ (such as fisheries) but also from the point of view of preserving the cultural identity of their citizens. Atoll Island States are often seen as being all essentially alike, as are their human populations, when they are recognised at all.<sup>8</sup> However, inhabitants of Atoll Island States have a strong connection to their islands, and even as some appear resigned to the fact that they might have to leave the islands in the future, they are hoping to periodically return to them in order to have a connection to their heritage.<sup>9</sup> Losing their islands would not only potentially deprive their inhabitants of residing in a sovereign State encompassing the lands where they were born, but would also violate their right to dispose of their own wealth. Art. 1(2) of the International Covenant on Civil and Political Rights sets forth that

All peoples may, for their own ends, freely dispose of their natural wealth and resources without prejudice to any obligations arising out of international economic co-operation, based upon the principle of mutual benefit, and international law. In no case may a people be deprived of its own means of subsistence.

Indeed, it could be argued that even if they were to relocate to other lands, the inhabitants of Atoll Island States could never be satisfactorily compensated for the loss of their physical bases.<sup>10</sup> The IPCC 4AR notes how the population of many small islands have "long developed and maintained unique lifestyles, adapted to their natural environment".<sup>11</sup> In fact, the loss of such cultures could not only have consequences for the islanders but would constitute also a loss for human heritage.

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and the capacity of enter into relations with other states will have been challenged, McAdam (2012), p. 131.

<sup>6</sup> Worster (2009), p. 153.

<sup>7</sup> Kreijen (2004), p. 332, see also McAdam (2012), p. 128 referring to Crawford (2006), p. 715.

<sup>8</sup> Barnett and Campbell (2010), p. 2.

<sup>9</sup> Rakova (2009).

<sup>10</sup> Barnett and Adger (2003), p. 331.

<sup>11</sup> Mimura et al. (2007), section 16.3.2, [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg2/en/ch16s16-3-2.html](http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch16s16-3-2.html).

The preservation of statehood would have positive cultural and psychological effects for the inhabitants of these islands.<sup>12</sup> On the other hand, the loss of all territory would not only deprive islanders of all means of subsistence but could put into question their citizenship.<sup>13</sup> Other privileges that are derived from statehood, such as the membership of international organizations, diplomatic immunity, trade relations, eligibility for development loans or aid from the International Monetary Fund (IMF) and the World Bank or accessing the International Court of Justice (ICJ) could also be affected.<sup>14</sup>

A list of possible solutions for Atoll Island States to attempt to preserve their sovereignty against the threats highlighted in Chaps. 2 and 3 (which would include sea level rise, increases in coral mortality and stronger tropical cyclones) encompass the following:

- Cession of territory<sup>15</sup>
- Construction of coastal protection works and raising the level of the islands (Scenarios IV and VII given in Chap. 5)
- Construction of artificial islands and amendments of UNCLOS to accept artificial islands as a “defined territory”<sup>16</sup> (as outlined also in Chap. 5)
- Merger with another State<sup>17</sup>
- De-territorialized State,<sup>18</sup> including application of the United Nations International Trusteeship system in order to create an *ex-situ* nation which would consist of a de-territorialized State<sup>19</sup>

In this chapter we will not deal with the second and third solutions, based on the use of engineering works, as we already discussed them in detail in Chap. 5. We also wish to note once more that it is also likely that if an Atoll Island State can afford to build an artificial island it would choose to build defences and elevate an existing island instead, as outlined in Chap. 5. Hence, the idea of building an artificial island to preserve sovereignty is unrealistic and would not make sense from a financial or engineering point of view, as these resources would be put to much better use preserving existing lands, which have a clear status under UNCLOS<sup>20</sup> (see Scenario VII in Chap. 5).

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<sup>12</sup> Burkett (2011), p. 369.

<sup>13</sup> Though it should be noted that although statelessness occurs when the individual is not considered as a national by any State under the operation of its law. See Convention relating to the Status of Stateless Persons, Art. 1(1).

<sup>14</sup> Maas and Carius (2012), p. 658.

<sup>15</sup> Soons (1990), p. 230.

<sup>16</sup> Gagain (2012).

<sup>17</sup> UN High Commissioner for Refugees (2011), p. 18, Soons (1990), p. 230, and Caron (1990), p. 650.

<sup>18</sup> Rayfuse (2010), p. 10.

<sup>19</sup> Burkett (2011).

<sup>20</sup> However, there are theoretical suggestions that an artificial island would be a solution for maintaining the statehood of these islands. See Gagain (2012).

In order for a country to preserve its statehood, according to a strict interpretation of the Montevideo Convention, it could attempt to acquire new territory in foreign lands.<sup>21</sup> The territory could be purchased as a State, or the population could be accepted into another country, acquiring land as individuals but preserving at least some degree of autonomy over lands belonging to a different State. The purchase of territory, in fact, does not result in an automatic transfer of sovereignty, as will be explained later in this chapter. This type of solution could eventually result in a situation similar to that status of indigenous populations in Canada and New Zealand.<sup>22</sup> However under such a scenario the Atoll Island State would probably lose its statehood, though its former inhabitants might still be able to indirectly manage the resources of the newly acquired lands under some form of autonomous local government.

It should be noted that this type of solutions (cession of territory or merger with another State) were often applied in colonial times to bring non-European people to the realm of international law.<sup>23</sup> In past centuries treaties of cession, the creation of protectorates, conquest or the annexation of territories were standard methods to acquire territory. Historically, Atoll Island States were already a stage for colonialist ambitions since many European States could vastly profit from extracting copra, cotton, sugar cane, whales teeth, copper and other Pacific island resources.<sup>24</sup>

The solutions that we will be presenting in this chapter create theoretical scenarios for the governments of Atoll Island States, who might see their inhabitants depart from their current islands and either attempt to resettle to another territory or scatter around the world in a diaspora that would leave them divided amongst various countries. If the State could acquire some territory they could, however, at least maintain some form of geographic cohesion.<sup>25</sup> On the other hand, if there is no single territory for the entire population to relocate to it would be challenging for the government to provide services for a diffuse population spread over various countries.

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<sup>21</sup> This solution has been suggested by United Nations High Commissioner for Refugees on the submission of Climate Change and Statelessness: an overview supported by the International Organization for Migration (IOM) and the Norwegian Refugee Council (NRC) to the 6<sup>th</sup> session of the Ad Hoc Working Group on Long-Term Cooperative Action (AWG-LCA 6) under the UN Framework Convention on Climate Change (UNFCCC) 1 to 12 June 2009, Bonn, Germany, and scholars such as Soons (1990).

<sup>22</sup> Kelman (2008), p. 21.

<sup>23</sup> Anghie (1999), p. 32.

<sup>24</sup> Teaiwa (2005), pp. 173–174.

<sup>25</sup> It is unlikely, however, that an Atoll Island State would build an artificial island in a territory that was outside its original area, or that it would choose such an option over the construction of coastal defences around an existing island, as explained in Chap. 5. Building an artificial island is cheaper in shallow areas, and thus even if atolls were to disappear the relative shallow area around the reefs would be a much better place to build an artificial island than a deeper area elsewhere. It is clear that an Atoll Island State, provided it had sufficient financial resources, would choose to protect an existing island and its infrastructure rather than allow the last of its original islands to disappear, which would lead to them being catalogued as “artificial” islands, as explained in Chap. 5.



In fact, migrating to foreign lands is nothing new for the inhabitants of Atoll Island States. Even nowadays a part of the population of these States is living abroad,<sup>26</sup> with a meaningful amount of the income of islanders coming from remittances.<sup>27</sup> Resettlement of the entire population of small islands has taken place in the past and thus it would not be the first time that this kind of arrangement has been made. The Carteret islands have, for example, attempted to internally relocate its population to nearby larger islands.<sup>28</sup>

Historical accounts of displacement in the Pacific and Indian oceans are numerous.<sup>29</sup> The mining of phosphate by the British colonial administration displaced the population of the island of Banaba in the 1940s. The entire population was relocated to Rabi Island, which currently belongs to the Republic of Fiji.<sup>30</sup> Another example is that of the Chagossians (the inhabitants of the Chagos Islands in the Indian Ocean, close to the Maldives, as shown in Fig. 5.2) who were displaced by the UK government from Diego Garcia to the Mauritius and Seychelles due to military interests, but were not provided with land to resettle in.

The Banaban and Chagossian cases, although not related to sea level rise, will also be discussed in this chapter. They represent cases of population displacement among island dwellers and provide some examples of what type of governmental arrangements were provided after resettlement as well as the challenges currently faced by those displaced and their descendants. Although these forced displacements took place in the colonial context, they have a number of common points with the case of Atoll Island States. While Banabans were resettled to an uninhabited island, Chagossians were even less fortunate and were relocated without any systematic long-term plan. Both have in common the fact that they were displaced without the population being previously consulted and that this was caused solely due to the political and economic interests of an industrialized nation, in this case Great Britain.

Thus, if the population of Atoll Island States is displaced because of the emissions of greenhouse gases, which allowed the economic development of industrialized nations, the ultimate reasons for the relocation will be similar to those of the Banabans and Chagossians. In the past, the reason was either to appropriate natural resources or due to military interests, while in the future it will be due through the consequences of climate change (as highlighted in Chap. 3) that stem from the greenhouse gas emissions by industries in the past and present.

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<sup>26</sup> For example 17.6 % of the Tuvaluan population lives abroad, in p. 7, but only 1 % of Kiribadians do. See Secretariat of the Pacific Community (2007), p. 31

<sup>27</sup> Connel and Brown (2005).

<sup>28</sup> Views on the Possible Security Implications of Climate Change to be included in the report of the Secretary-General to the 64<sup>th</sup> Session of the United Nations General Assembly, Fiji, Marshall Islands, Micronesia (Federated States of), Nauru, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu, available on the internet at [http://www.un.org/esa/dsd/resources/res\\_pdfs/ga-64/cc-inputs/PSIDS\\_CCIS.pdf](http://www.un.org/esa/dsd/resources/res_pdfs/ga-64/cc-inputs/PSIDS_CCIS.pdf), p. 11.

<sup>29</sup> See the cause of relocation at Campbell et al. (2005), p. 21.

<sup>30</sup> Ferris et al. (2011), p. 26.

Nevertheless, differences do exist between the case of Atoll Island States, which are member States of the UN, and that of Banabans and Chagossians, which were not independent States at the time. Although Banabans were given an island to relocate to they did not become an independent country, with the islanders currently holding dual citizenship.<sup>31</sup> These forced displacements of populations took place in a time when self-determination was not an established principle.<sup>32</sup> Currently, the problem of the disappearance of coral islands represents a test to the self-determination principle, as it will challenge whether Atoll Island States can preserve their political organization despite the potential lack of a territory and population.

## 6.2 The Lack of Consensus on the Criteria for Statehood

The possible submergence of Atoll Island States raises the question of whether they can survive as a State without a population and/or territory. It could be assumed that as the States are the main subjects of international law, its definition would be clear. However, this is far from being the reality and many attempts of defining what constitutes a State have been carried out.<sup>33</sup> According to Art. 1 of the 1933 Montevideo Convention on the Rights and Duties of States, the elements of a State are a permanent population, a defined territory, a government and the capacity to enter into relations with other States. It is generally agreed that territory is one of the key elements of statehood, though huge areas of land existed in the past without any State (in the present sense of the word) exercising territorial sovereignty over it (i.e. *terra nullius*). However, it has been postulated that the latter cannot exist without the former.<sup>34</sup>

If Atoll Island States manage to acquire lands in other places after the last of their islands has been submerged they could argue to still possess a territory and therefore could claim that their statehood is preserved even after its geographical location has changed. A territory is claimed to be a necessary element of statehood on account that it allows a State and its government to be effective by having a physical identity.<sup>35</sup> However, could we take for granted that the Montevideo

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<sup>31</sup> Banaban Island is under the sovereignty of Kiribati and Rabi island, which is the island they were resettled in, belongs to the Republic of Fiji.

<sup>32</sup> On the self-determination stage after the WW2, “. . . in the years after 1945 the question whether self-determination was a legal right or a principle was a divisive issue. Self-determination as a legal right threatened to bring about significant changes in the political geography of the world, not limited to the dismemberment of Empires. . .” See Crawford (2006), p. 108.

<sup>33</sup> Bathon (2001), p. 609.

<sup>34</sup> Raič (2002), p. 59.

<sup>35</sup> Stahl (2010), p. 30 Citing James S. Anaya & Robert A. Williams Jr., The Protection of Indigenous People’s Rights over lands and natural resources under the Inter-American Human Rights System.

Convention, which is signed only by countries of western culture in the American continent,<sup>36</sup> is a *jus cogens*<sup>37</sup> law and that in order to have its statehood recognized an entity which seeks recognition should necessarily fulfil the four criteria established in its Art. 1? As Grant points out the Montevideo definition of statehood was at best a “soft law”.<sup>38</sup> Moreover, if it is binding, it is only to the small number of American States that were party to it.<sup>39</sup>

However, during the course of history “there are certain actors of international law that were treated like States (and are even sometimes defined as States) although they did not meet all the criteria that are traditionally deemed necessary for them to be called as such”.<sup>40</sup> As Agnew points out

territoriality, the use of territory for political, social, and economic ends, is in fact a strategy that has developed more in some historical contexts than in others. Thus, the territorial state, as it is known to contemporary political theory, developed initially in early modern Europe with the retreat of non territorial dynastic systems of rule and the transfer of sovereignty from the personhood of monarchs to discrete national populations. That modern state sovereignty, as usually construed, did not occur overnight following the Peace of Westphalia in 1648 is now well established.<sup>41</sup>

In the eighteenth century, legitimism would equate the State to personal ownership of a land by a monarch. A dynasty enjoyed historic rights to rule a State.<sup>42</sup> In the nineteenth century, the contiguity or geographic doctrine, which assumes geographical proximity, would state that the acquisition of territory would not rely on the effective control of a territory, as long as adjacent lands were not subjected to another sovereign’s effective control. It is important to note that territories which were not constituted on the European model of a State were considered as *terra nullius*.<sup>43</sup> This theory benefited Europeans by assuming that lands which were inhabited by indigenous populations that did not possess political or social systems similar to their own did not constitute a State according to the criteria of the time, thus allowing them to occupy the lands. Atoll Island States were also part of the societies that were considered by European powers as *terra nullius*, allowing them to take control over these territories.

The 1933 Montevideo Convention’s criteria are historically contingent<sup>44</sup> and can perhaps change over time as it has occurred in the past with previous criteria of

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<sup>36</sup> The Convention was signed by the United States, Argentina, Brazil, Chile, Colombia, Cuba, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela.

<sup>37</sup> *Jus cogens* is a group of laws which are hierarchically superior and in which no derogation is allowed. They are recognized as being essential to the maintenance of an international legal order.

<sup>38</sup> Grant (1999), p. 456.

<sup>39</sup> Grant (1999), p. 456.

<sup>40</sup> Acquaviva (2005), p. 9.

<sup>41</sup> Agnew (2005), p. 441.

<sup>42</sup> Grant (1999), p. 419.

<sup>43</sup> Grant (1999), p. 421.

<sup>44</sup> Grant (1999), p. 456.

statehood, such as legitimacy. Nevertheless, theories to determine statehood in the past served the interests of European countries,<sup>45</sup> particularly in the eighteenth and nineteenth centuries. In fact, the future submergence of islands could test to what extent after self-determination came into the international scene Atoll Island States could use international law to preserve their statehood.

A further problem related to the use of the Montevideo criteria to strictly require States to have a territory is that the treaty concerns itself with the creation of a State and not with its extinction.<sup>46</sup> As Grant points out in the case of belligerent occupation:

it therefore appears to be the case that once an entity has established itself in international society as a State **it does not lose statehood by losing its territory or effective control over that territory**. To be sure the Montevideo Convention was concerned with whether an entity becomes a State, not with how an entity might cease to be a State<sup>47</sup> (emphasis added)

From a legal point of view there are two competing theories regarding the recognition of States as such.<sup>48</sup> The declaratory theory looks at the purported States assertion of its sovereignty within its territory to determine if it can act on the international stage.<sup>49</sup> According to this theory, recognition is based on specific criteria and the determination on whether a State exists or not is based on fact, not on the discretion of an individual State.<sup>50</sup> On the other hand, according to the constitutive theory obtaining the status of a State is not automatic, but depends on the recognition by other States.<sup>51</sup> Both theories have their criticisms and problems.<sup>52</sup> A problem with the declaratory theory is that States do not acquire rights on the international scene until they are recognised.<sup>53</sup> The problem with the constitutive theory is that even when a State is not recognised by others it does not mean that its territory is regarded as *terra nullius*.<sup>54</sup> In addition, there is a risk that the requirement of recognition by other States fosters the abuse of power by certain States.<sup>55</sup>

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<sup>45</sup> Anghie (1999), p. 2, where the author explains how positivism instead of naturalism determined what should be considered a State. While naturalism in the sixteenth century based the subject of international law on a sovereign State, positivism expelled the non-European world of legality by distinguishing civilized and non-civilized nations.

<sup>46</sup> Grant (1999), p. 435.

<sup>47</sup> Grant (1999), p. 435.

<sup>48</sup> Worster (2009), p. 115.

<sup>49</sup> Worster (2009), p. 115.

<sup>50</sup> Worster (2009), p. 115.

<sup>51</sup> Worster (2009), p. 115.

<sup>52</sup> For an extensive discussion on this see Worster (2009), p. 115.

<sup>53</sup> This can be seen for example on the case of Somaliland, which meets the four conditions required by the Montevideo Convention for statehood (a permanent population, a defined territory, a government, and the capacity to enter into relations with other states) but has not been recognised by any State yet, despite declaring independence from Somalia in 1991, according to Eggers (2007), p. 217.

<sup>54</sup> Worster (2009), p. 115.

<sup>55</sup> Worster (2009), p. 115.

Regarding the case of Atoll Island States, if they were to lose their entire territory (and thus no longer have a population in the geographical area they currently occupy) at some point in the future they would lack some of the elements of statehood required by the Montevideo Convention, as explained previously. It has been argued that for States who do not fulfil all the requirements of statehood stated in the Montevideo Convention recognition would follow the constitutive theory, while for entities that do fulfil them recognition by other States would be declarative. For example, the Holy See (located in the Vatican City) is recognised as a State in international law, although it lacks a permanent population. The recognition of the Vatican City would therefore have a constitutive and reparative effect since the lack of population would place doubts on its statehood.<sup>56</sup> In the same way, it could be argued that since Atoll Island States would lack some statehood elements, future continuing recognition by other States would have also a reparative effect.

Therefore, the lack of territory, one element of statehood, would not prevent a State from being so if other States agree to recognise it as such. However, Atoll Island States could potentially face the inherent problem associated with the constitutive theory: a high vulnerability to the abuse of power by other States in deciding or not on the continuity of a State. International courts either apply one theory or another. For example, the International Criminal Tribunal for the former Yugoslavia (ICTY) in the Celebici case argued that the conflict within the former Yugoslavia was international after there was international recognition of Croatia and Bosnia and Herzegovina, which means that the constitutive theory was backed.<sup>57</sup> This necessary recognition often thus depends on political choices and not on legal requirements.

It is important to note how Art. 6 of the UN Charter provides that States can only be expelled from the UN for persistently breaking the principles of the Charter and after recommendations of the UN Security Council.<sup>58</sup> Also, Atoll Island States appear to be willing to maintain their separate identity, EEZs and seat at the UN, as expressed for example by the Tuvalu Government spokesman.<sup>59</sup> Thus, it would be up to other countries to stop recognizing these States and breaking-off diplomatic relations, though non-recognition by other UN member States does not necessarily lead to expulsion from the UN (such in the case of Turkey not recognizing Cyprus or North Korea recognising South Korea).<sup>60</sup> The issue of recognition (constitutive

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<sup>56</sup> Grant (1997), p. 678.

<sup>57</sup> Worster (2009), p. 135.

<sup>58</sup> Maas and Carius (2012), p. 659.

<sup>59</sup> Maclellan (2009). It is also important to note that small Island States can get revenue from a variety of other sources, and for example the government of Tuvalu obtains revenue from the selling of coins and stamps, renting its telephone country code for “900” lines and the lease of its internet domain name (“.tv”, which is worth approximately US\$ 50 million over 10 years, see Grant (2000), p. 177.

<sup>60</sup> Maas and Carius (2012), p. 651.

theory) appears particularly important, and in recent times<sup>61</sup> there have been much State practice connecting recognition with the appearance of new States.<sup>62</sup> Particularly interesting is the case of Bosnia, with the US and the EU recognising and cementing a legal status that would have otherwise probably remained in doubt.<sup>63</sup> However, if only some countries recognise a certain State, it is not really clear if it thus represents a State only to them or to the world. There are a number of political entities such as Kosovo, Taiwan, Abkhazia and South Ossetia that enjoy only very limited recognition.<sup>64</sup> In fact, the recognition by other States can often involve vested political and economical interests. An extreme example of the political character of the recognition of States is the recognition of Abkhazia, which was a province of Georgia during Soviet times. Nauru recognized the independence of Abhakazia on December 15, 2009 in exchange of \$50 million in aid for this recognition.<sup>65</sup>

An argument that rebuts the constitutive theory is given by Acquaviva,

throughout the history of modern international relations, the main feature of subjects of international law has been their ability to assert that they are not subordinates to other authorities; in other words, subjects of international law were those entities *superiorem non recognoscentes*, able not to recognize any superior within the international community. This feature is at the basis of the fact that the international community is not structured as a hierarchical society, but rather as a community of (formal) peers.<sup>66</sup>

If States cannot be in a subordinate position to other States that would mean that the declarative theory would prevail. States should not depend on others to exist. Nevertheless, even when a State does not depend on others to exist, the lack of recognition of its status by the international community would limit its activities. This consequence can be clearly understood by the following claim:

Though political communities (...) can without recognition continue to operate as states within the 4 walls of their domestic territorial enclave, they cannot enter into relations with any other state unless that other state expressly or by putting up with such relations impliedly recognize(s) that political community as a subject of international law.<sup>67</sup>

The effectiveness of Atoll Island States as sovereign States has already been put into question due to their geographic isolation, limited natural resources and tiny

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<sup>61</sup> Particularly in connection to the events in the 1990s relating to the appearance of new states in Eastern Europe and the former Soviet Union.

<sup>62</sup> Grant (2000), p. 177.

<sup>63</sup> Grant (2000), p. 177.

<sup>64</sup> And some other entities, such as Transnistria, Nagorno Karabakh and Somaliland are actually not recognized by any member of the UN, as explained in Maas and Carius (2012). Somaliland is a particularly interesting case, as despite having a constitutional working democracy, passports and others aspects of a normal country, it is still not recognized by any government, and its president is treated like a regional governor, see Lacey (2006), [http://www.nytimes.com/2006/06/05/world/africa/05somaliland.html?\\_r=1](http://www.nytimes.com/2006/06/05/world/africa/05somaliland.html?_r=1).

<sup>65</sup> Farley (2010), p. 794.

<sup>66</sup> Acquaviva (2005), p. 36.

<sup>67</sup> Farley (2010), p. 792.

populations<sup>68</sup>. However, the classical view that statehood is exclusive to entities with substantial political and economic gravity can be considered as anachronistic.<sup>69</sup> Indeed, Atoll Island States have been accepted into the UN and play a role in many international forums, having a prominent voice within many UN organisations, including the UNFCCC (as detailed in Chap. 4). Some of these Atoll Island States, such as Kiribati and Tonga, were admitted to the UN as late as 1999, proving how the sovereignty of small States is currently widely accepted.

Therefore, the UN could be thought of as a collective recognition mechanism, with Art. 4(1) of the UN Charter providing that States can be considered for membership of the organisation, though this is an exclusive provision in the sense that only States may be admitted.<sup>70</sup> In fact, there are a number of States that have existed without being part of the UN, though most of them have been recognised by a number of other countries.<sup>71</sup> Switzerland is one example of this, and Tuvalu was also not a part of the UN for most of its history, though it was recognised as a State since its independence from the UK in 1978.<sup>72</sup>

Once a State is recognised as such (and this recognition part is key to it being considered a State by the rest of States), is it possible then for other States to de-recognise it and break-off diplomatic relations, under the grounds it no longer abides by the criteria of the Montevideo Convention? One possible answer could be given by Art. 6 of Montevideo Convention which establishes that

The recognition of a state merely signifies that the state which recognizes it accepts the personality of the other with all the rights and duties determined by international law.

**Recognition is unconditional and irrevocable.** (emphasis added)

Thus, not only recognition is irrevocable according to Art. 6 of the Montevideo Convention, but the presumption of continuity of a State (a well established principle) claims that once a State has its statehood tested, there is a presumption that it continues to exist even without meeting all the requirements. According to Krejjen, the principle could be summarized as “States may have a complicated birth, but they do not die easily”.<sup>73</sup> The rationale for this presumption is explained by Marek,

the starting point for the development of the rule (i.e. the presumption in favour of the continuity of the State) was not providing by theoretical considerations, but by practical concern for the maintenance of international rights and obligations - in other words for the security and stability of international legal relations.<sup>74</sup>

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<sup>68</sup> Grant (2000), p. 181.

<sup>69</sup> Grant (2000), p. 181.

<sup>70</sup> Grant (2000), p. 177.

<sup>71</sup> Grant (2000), p. 177.

<sup>72</sup> Grant (2000), p. 177.

<sup>73</sup> Krejjen (2004), p. 37.

<sup>74</sup> Marek, cited by Krejjen (2004), p. 37.

What would really happen if an Atoll Island State lost all of its territory remains to be seen, though the lack of precedent for something like this could mean that different States would hold competing views about whether to continue recognising its sovereignty. However, even if most countries decided to break-off diplomatic relations, the government of an Atoll Island State could preserve an international status even if no longer classed as a normal State, as will be explained later in this chapter.

The continued existence of a sovereign entity is also linked to the question of how effective that entity is. Nevertheless there are some historical examples of States which were not effective anymore, but this was not an obstacle for them to continue to be considered as States. This includes, for example, entities which were annexed illegally, such as Ethiopia, Austria, Poland or the Baltic States.<sup>75</sup> In the case of Poland, Yugoslavia and Czechoslovakia they were accepted as having international status as governments-in exile by the Allied Powers during World War 2.<sup>76</sup> Moreover, there are effective entities that are not considered as States, such as Taiwan and the Turkish Republic of Northern Cyprus. Therefore, as Crawford points out “the proposition that statehood must necessarily be equated with effectiveness is not supported by this practice”.<sup>77</sup>

Another case which illustrates how the lack of one of the elements of statehood after its establishment does not lead to its demise can be seen in Somalia’s case, where due to the presumption of continuity of statehood the country did not lose its status despite lacking a government for a long time.<sup>78</sup> The question is whether the same could happen in the case of a lack of territory. It could be argued that the presumption of continuity exists for as long as the government of an Atoll island States is actively trying to find a new territory to resettle its population. In essence, the lack of territory for a certain period of time or the relocation to another area should not present insurmountable obstacles to preserve the statehood of the Atoll Island States, and examples of this [such as the Sovereign Military Order of St John of Jerusalem of Rhodes and of Malta (SMOM) or the Holy See] will be presented later in this chapter. Nevertheless, first we will discuss how an Atoll Island State could attempt to solve the problem of lack of territory by attempting to acquire new lands and what would be the legal consequences of this.

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<sup>75</sup> Crawford (2006), p. 97.

<sup>76</sup> Bathon (2001), p. 621.

<sup>77</sup> Crawford (2006), p. 97.

<sup>78</sup> Raič (2002), p. 71.



### 6.3 Cession of Territory

In the cession of territory a transfer of sovereignty over a certain territory would take place between the owner-State and an Atoll Island State that has lost the last of its current islands.<sup>79</sup> Cession of territory represents a “bilateral mode of acquisition which requires the co-operation of the two States concerned, whereas all the other modes<sup>80</sup> are unilateral”.<sup>81</sup> It is important to note that if this cession of territory or the union with another State are not possible then the continuity of statehood would rely only on the recognition of other States,<sup>82</sup> as explained earlier in this chapter.

Exchanges of territory have actually occurred frequently in the course of history. In the eighteenth century these transfers were common between countries, when monarchs could cede territory by marriage or testament.<sup>83</sup> However, Oppenheim disagrees that a monarch could cede a territory in an absolute government,<sup>84</sup> a point of view shared by Vattel, who stated that

I know that many authors, and particularly Grotius, give long enumerations of the alienations of sovereignties. But examples often prove only the abuse of power, not the right. And besides, the people consented to the alienation, either willingly or by force.<sup>85</sup>

Vattel disagreed with the voluntarism of monarchs, stating that the territory of a State could not be considered as a private inheritance.<sup>86</sup> He argues that,

the nation alone has a right to subject itself to a foreign power, the right of really alienating the state can never belong to the sovereign, unless it is expressly given to him by the entire body of the people.<sup>87</sup>

Since these thoughts express current interpretations of what a State and territory means to its population, a cession of territory should be carried out with express consultation with them. Previously it was quite simple for the sovereign to deal with a treaty of cession as it was his or her exclusive decision, though nowadays that process would involve consultations with the populations in order to attempt that no harm is caused to the people who live in a certain land.

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<sup>79</sup> Oppenheim (2008), p. 376.

<sup>80</sup> Other modes of acquisition are occupation of a territory that is not under sovereignty of any State, prescription, by which the title flows from an effective possession over a period of time, accession or accretion, where the shape of land is changed by the processes of nature and subjugation or conquest, Jennings (1963), pp. 6–7.

<sup>81</sup> Jennings (1963), p. 17.

<sup>82</sup> UN High Commissioner for Refugees (2011), p. 19.

<sup>83</sup> Oppenheim (2008), p. 379.

<sup>84</sup> Oppenheim (2008), p. 379.

<sup>85</sup> Beaulac (2003), para. 1342 quoting Vattel in Vattel’s doctrine on territory transfers in international law and the cession of Louisiana to the United States of America.

<sup>86</sup> Vattel (1758), para. 61. Available on the Internet at <http://www.lonang.com/exlibris/vattel/vatt-105.htm>, access on 22 August 2011.

<sup>87</sup> Beaulac (2003) p. 1343.

Voluntary cessions of territory between countries have also taken place in more modern times, such as the selling of Louisiana by France to the United States in 1803,<sup>88</sup> Alaska by Russia to the United States in 1867,<sup>89</sup> or Denmark ceding the Danish West Indies to the United States in 1917.<sup>90</sup> The treaty of cession must be followed by tradition, which is the transfer of the property,<sup>91</sup> but after the ratification of the treaty. Western States believed indigenous people did not possess political structures that could be considered as being subjects of international law, and were thus susceptible to being taken over. Therefore, they would buy and sell these territories at their will, without consultation with local inhabitants.

Cession of territory due to an environmental disaster also has a precedent in the 1870s when Iceland suffered a volcanic eruption that worsened poverty in the island. In this occasion Canada granted Icelanders a piece of land and provided them with Canadian citizenships, guaranteeing them a dual Canadian/Icelandic citizenship. Afterwards, New Iceland joined the province of Manitoba and was completely integrated into Canada.<sup>92</sup>

However, and although the cession of territories is not rare in history,<sup>93</sup> Rayfuse points out that for the case of Atoll Island States (that could become submerged) it is unfeasible from a practical perspective since currently it would be difficult to find a State

which would agree to cede part of its territory unless the territory is uninhabited, uninhabitable, not subject to any property, personal, cultural or other claims, and devoid of all resources and any value whatsoever to the ceding state.<sup>94</sup>

Currently, and taking into account the evolution of the self-determination principle, it would be quite difficult to find a land which would be available for the resettlement of the whole population of a country.

Nevertheless, even if unlikely it is worth to consider what would be the possible consequences if some country was prepared to cede some lands to an Atoll Island State. In fact, there is precedent for the case in which the majority of the population of a State resettled in a land different to that which it originally occupied but managed to preserve its identity, and there are also examples where the populations

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<sup>88</sup> Treaty concerning the Cession of Louisiana to United States, 20 October 1803. Available on the internet at [http://www.archives.gov/exhibits/american\\_originals/louistxt.html](http://www.archives.gov/exhibits/american_originals/louistxt.html).

<sup>89</sup> Treaty concerning the Cession of the Russian possessions in North America by his Majesty the Emperor of all the Russians to the United States of America: June 20, 1867, available on the Internet at <http://memory.loc.gov/cgi-bin/ampage?collId=llsl&fileName=015/llsl015.db&recNum=572>.

<sup>90</sup> Convention on the cession of Danish West Indies, between the United States and Denmark, January 25, 1917, Available on the Internet at <http://www.doi.gov/oia/pdf/vitreaty.pdf>.

<sup>91</sup> Oppenheim (2008), p. 379.

<sup>92</sup> Rayfuse (2009), p. 8.

<sup>93</sup> Other cessions of territory which were cited by Oppenheim are: Russia sold her territory in America to the USA, Spain sold the Caroline Islands to Germany in 1899, Denmark sold the islands of St. Thomas St John and St Croix in the West Indies to the USA.

<sup>94</sup> Rayfuse (2010), p. 9.

of small islands were forced to relocate. These examples can perhaps give a hint of what are the possible consequences of such a relocation and thus warrant further discussion.

In their search for an alternative land to relocate to, Atoll Island States could attempt to acquire a number of different types of lands, which could be broadly divided into two different groups:

- Islands, where the Atoll Island State would acquire (in some form or another) the entire island of another country
- Portions of land belonging to a larger landmass, which would result in the sharing of a small island or a territory being located in a continental mass or large island.

This possibility that the acquired land would be part of a larger land mass would arguably constitute a fundamental change to the culture of the islanders, as they would move from a situation of relative isolation to having to interact with other groups of people. It would also represent a change from having the sea as the boundary of their lands to a situation where people and goods could move more easily through the territory. The citizens of these islands would also cease to be the main actors in the new land (for the case where there was no transfer of sovereignty that accompanied the cession of land). While this of course can result in advantages, it also represents a shift from a situation in which it is relatively easy for the islanders to keep control of what is happening in their territory. What type of border controls are established would depend on the status of the acquired land and the arrangements the Atoll Island State would reach with the country ceding the land.

### ***6.3.1 The Boers and the Preservation of the Government in a New Territory***

Although the case of the Boers is not an example of cession of territory, but rather of the transfer of a sovereign entity to a new territory, it might serve as an example of how an entire cultural group migrated while preserving its identity and government. The Dutch settled The Cape of Good Hope in 1652 and, notwithstanding some short interruptions, the area remained under Dutch sovereignty until 1806. During this time (before the colony was ceded to Great Britain) Boer farmers were constantly moving the location of their settlements. After the change in administration from the Netherlands to Great Britain in 1814 there was discontent amongst the population, who did not agree with several policies of the new colonial State (such as the abolition of slavery in 1833) and most of the African-Dutch community decided to form the Free State of Orange, the African-Dutch Republic and the

Colony of Natal.<sup>95</sup> In other words, the population decided to establish a new colony on an independent basis on lands that were considered as “*terra nullius*”, with no restrictions imposed by Great Britain.

The example of the Boers thus constitutes a case where a total change of territory took place, with the old entity preserving its sovereignty while relocating to new lands.<sup>96</sup> In fact the resettlement was possible due to the fact that Western Nations and their colonists assumed that all lands around them were *terra nullius*, allowing them to profit from their occupation regardless of whether other people already inhabited the lands.

This solution of the total transfer of a population to a new territory is unlikely to happen at present as it appears unlikely that any State will be willing to cede some of their land to another country, as we will discuss in the next section. A more viable solution would be perhaps to establish a treaty of fusion between the disappearing State and another State.<sup>97</sup>

### **6.3.2 Political Climate Regarding the Purchasing of Territories by Atoll Island States**

The former president of the Maldives, Mohamed Nasheed,<sup>98</sup> had showed interest in purchasing lands in 2008 to avoid the loss of statehood that could result from the Maldives becoming submerged by the oceans.<sup>99</sup> As a possible list of countries that could offer lands he mentioned Sri Lanka and India, since they have a culture, cuisine and climate similar to that of the Maldives. The funds for acquiring these territories would come from a “sovereign wealth fund” generated by a tax on tourists.<sup>100</sup> Although this could appear to be a straightforward and appealing solution<sup>101</sup> it is probably unlikely that the Maldives would face such a need to relocate, at least in the middle term (as we have explained in Chap. 5). The Maldives have actually been investing in other solutions such as the man-made protections<sup>102</sup> and thus probably have the resources to reinforce the perimeters of a limited number of existing islands and elevate them to compensate for sea level

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<sup>95</sup> Acquaviva (2005), p. 14.

<sup>96</sup> Acquaviva (2005), p. 15.

<sup>97</sup> Soons (1990), p. 230.

<sup>98</sup> BBC (2012a), Maldives President Mohamed Nasheed resigns amid unrest, available at <http://www.bbc.co.uk/news/world-asia-16922570>.

<sup>99</sup> Martin (2010) “Climate Change and International Migration”, by the German Marshall Fund of the United States.

<sup>100</sup> Randeep (2008) <http://www.guardian.co.uk/environment/2008/nov/10/maldives-climate-change>, [http://news.bbc.co.uk/2/hi/south\\_asia/7719501.stm](http://news.bbc.co.uk/2/hi/south_asia/7719501.stm).

<sup>101</sup> Rayfuse (2010), p. 8.

<sup>102</sup> Including the construction of artificial islands like Hulhumalé.

rise. Nevertheless, poorer nations such as Kiribati or Tuvalu could struggle to find the necessary resources to raise the level of existing islands, and could be forced to relocate. In this sense, Kiribati also demonstrated interest in 2012 to purchase 25 km<sup>2</sup> of land on Viti Levu (which belongs to the Republic of Fiji), an investment that was approved by the cabinet of president Anote Tong.<sup>103</sup> Another option mentioned would be the renting of islands. One such plan has already been approved by the Minister of Marine Resources and Fisheries of Indonesia, Fadel Muhammad. According to this plan, the Indonesian government will not rent the island to another state, but rather to a Maldives investor, PT Safari International Resort. PT Safari is planning to rent the island for the next 30 years at a cost of Rp 100 billion.<sup>104</sup>

In 2008 Tuvalu had requested the government of Australia to grant resettlement to Tuvaluans, though the Australian government did not support the request. However, representatives of Torres Strait Islands, which belong to Australia, informally offered Tuvalu the use of one of their islands.<sup>105</sup> It should be noted, however, that these islands themselves would also suffer the effects of climate change, and that they might face the problem of a massive influx of people from the low-lying swampy southern coast of Papua New Guinea.<sup>106</sup>

Political changes in the government of Atoll Island States can also cause changes to these plans. This can be demonstrated by the fact that although the previous government of Tuvalu had plans to purchase a piece of land in Fiji and to build some infrastructure these plans were not kept for a long time.<sup>107</sup>

To highlight the challenges that these theoretical solutions could pose to the inhabitants of Atoll Island States (such as cession of territory and merger with another State) it is worth considering two case studies related to the relocation of islanders, that of the Banabans and Chagossians.

### ***6.3.3 Purchase of Rabi and Resettlement of Banabans: Examples of Cession and Merger of Territory***

The experience of Banabans can serve to illustrate the consequences that a total transfer of population between two islands can have on its inhabitants. Through the study of this case we argue that the solution of purchasing territory was feasible

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<sup>103</sup> Pacific island to buy piece of Fiji as climate plan <http://www.newscientist.com/article/dn21581-pacific-island-to-buy-piece-of-fiji-as-climate-plan.html>.

<sup>104</sup> Jakarta Post (2010) <http://www.thejakartapost.com/news/2010/04/01/govt-approves-plan-rent-tabuhan-island-maldives-investor.html>.

<sup>105</sup> Displacement Solutions (2009) [http://displacementsolutions.org/files/documents/DS\\_Climate\\_change\\_strategies.pdf](http://displacementsolutions.org/files/documents/DS_Climate_change_strategies.pdf).

<sup>106</sup> Boege (2010), p. 21.

<sup>107</sup> McAdam (2012), p. 145.

during the times of colonialism, though it brought a number of challenges and problems to these populations, some of which persist today. However, although the study of such a case can highlight the perils involved in such a solution, we would nevertheless like to emphasize in the current context these solutions are unlikely to be applied due to the challenge of finding a State which would be willing to relinquish some of its territory (as we outlined in the previous section).

### 6.3.3.1 The Banaban Displacement

The fate of the Banaban people started to radically change when their island was annexed by British Empire after it was found that 80 % of the island was composed of phosphate.<sup>108</sup>

“Between 1901 and 1979, all but 60 hectares of their 595 ha home island of Banaba<sup>109</sup> was mined and shipped off by colonial interests”.<sup>110</sup> This sentence summarizes the reason why Banabans were forced to leave their island. The beginning of the Phosphate extraction goes back to 1900, when the Pacific Islands Company secured the sole rights to mine the Island for 999 years in exchange for 50 pounds per year.<sup>111</sup> Phosphate, used as a fertilizer, boosted the development of farming in New Zealand and Australia. In 1901 a British warship raised a British flag in the island, which was then considered as a protectorate, though it was transformed into a colony in 1916.<sup>112</sup> In 1942 Japanese troops occupied the island and left three years later, moment in which the British Phosphate Commission decided to relocate the remaining population to Rabi island, 2,400 km away from Banaba Island and belonging to what is nowadays the Republic of Fiji.<sup>113</sup> Rabi island was purchased with the Banaban Provident Fund of the islanders. Currently, the island itself is under the sovereignty of Kiribati,<sup>114</sup> while Banabans live in Rabi island, which is part of the Republic of Fiji.

The administration system in Rabi Island was set forth in the 1945 Banaban Settlement Ordinance No. 28. The community was under the control of Europeans, who became advisors to the Banabans. In the 1960s the Banabans gained more autonomy under the Rabi Council of Elders. Banabans enjoyed freedom of movement to Banaban island and their land interests, payment of annuities from mining

<sup>108</sup> Hindmarsh (2002), pp. 15–16.

<sup>109</sup> It is also called Ocean Island and it is located in the west-central Pacific Ocean. The island has a circumference of about 6 miles (10 km). Banaba is the location of the highest point in Kiribati, reaching 87 metres above sea level. See <http://www.britannica.com/EBchecked/topic/51280/Banaba>, Accessed on 23 March 2012.

<sup>110</sup> Hindmarsh (2002), p. 9.

<sup>111</sup> Hindmarsh (2002), p. 15.

<sup>112</sup> Hindmarsh (2002), p. 17.

<sup>113</sup> Hindmarsh (2002), p. 10.

<sup>114</sup> Hindmarsh (2002), p. 10.

in Banaba.<sup>115</sup> In 1979, mining was finished and the Banabans lost their annuity, making their economic situation more precarious (although they still have their trust fund).<sup>116</sup> The only formal employer on Rabi is the Rabi Island Council, the institute that manages the Rabi Island Trust Fund, which employs 30 % of the households (through government paid jobs, such as nurses, policemen or teachers). Most of the population lives out of subsistence farming (53 % of households) or have small businesses (7 %).<sup>117</sup> Thus it is clear that Banabans have limited resources to develop economically, and that their autonomy is limited by economic factors since there are not many jobs available in Rabi island. This in turn places at risk their cultural heritage and many have been forced to migrate to other islands in Fiji in order to seek better opportunities.

Regarding their legal status, the Banabans were classified as Fijians according to the 1970 Constitution, under the same category as indigenous Fijians. Other groups, such as the Tuvaluan community, were registered as “General voters”. However, following the Constitutions of 1990 and 1997 the status of the Banabans shifted from “Fijians” to “Generals”. Thus, currently their legal status within Fiji is that of a minority group, in the same way as that of Rotumans, Indians, Europeans, part Fijian and Chinese minorities. Due to this status they have limited rights and educational benefits, which could result in future generations being left out of the mainstream economic and educational benefits.<sup>118</sup> In practice, this means that Banabans are no longer able to gain access to special benefit schemes of affirmative action available to indigenous Fijians. Banabans can vote in national elections and the process of formal naturalization started in 2005 when the government stipulated that they should apply for citizenship in three months.<sup>119</sup>

Banaban island is currently under Kiribati’s sovereignty<sup>120</sup> and its status is provided in the Chapter IX of the Kiribati Constitution. These provisions include some safeguards to Banabans, such as that the right over their land will not be affected by virtue that they live in Rabi island (Art.119), all land that was acquired by the Crown before Kiribati Independence Day would be returned to the Banabans upon the completion of Phosphate extraction [Arts.119, 2 (b)], Banabans are entitled to enter and reside in Banaba, and the administration of Banaba is provided by the Banabans through the Banaba Island Council [Art.121(1)].<sup>121</sup> Banabans, therefore, have their status established in legislation both in Kiribati and the Republic of Fiji.

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<sup>115</sup> Hindmarsh (2002), p. 24.

<sup>116</sup> Hindmarsh (2002), p. 28.

<sup>117</sup> Kumar et al. (2006), p. 136.

<sup>118</sup> Kitaguchi et al. (2004), p. 848.

<sup>119</sup> Kumar et al. (2006), p. 139.

<sup>120</sup> President Anote Tong mentioned that Banaba, which is the highest land in Kiribati, could host the government of Kiribati in order to assure the presence in the territory, see McAdam (2011), p. 109.

<sup>121</sup> Sigragh and King (2004), pp. 1046–1047.

A number of similarities can be found between the re-settlement of the Banabans and the case of Atoll Island States deciding to relocate.<sup>122</sup> For instance, as Edwards points out, in both cases the direct cause of relocation is man-made. For the case of the Banabans, phosphate mining was clearly the main factor that caused the forced resettlement of the islanders, an action on which they were not consulted. For the case of Atoll Island States, the displacement would be caused by sea-level rise due to the emissions of greenhouse gases and the death of the coral reefs, both of which are a consequence of anthropogenic interference in the global climate,<sup>123</sup> as outlined in Chap. 3. However, the relocation of the Banabans had a clear agent, the British Commission (which planned the resettlement), while for the case of Atoll Island States there is no clear identifiable agent, since the actors of climate change are diffuse. In both cases, though, the indirect cause of the relocation has as its source the economic development of industrialized countries. The mined phosphate which was used as a fertilizer contributed to farming in Australia and New Zealand, and major emissions of greenhouse gases has boosted the development of many countries since the industrial revolution. At the time of the resettlement of the Banabans the issue of self-determination was not one that was thoroughly embraced throughout all countries and territories, and the British Empire was able to force the movement of populations without consultation of those who would be implicated by such major changes. UNCLOS had not been established at that time,<sup>124</sup> and therefore discussions of EEZs, continental shelves and other maritime zones did not take place, as all territories were within the British Empire anyway. Currently, these questions would be unavoidable.

At the time when the Banabans were relocated such propositions were far easier, though nowadays countries would be extremely wary of doing this, for reasons explained later in this chapter. The islanders could relocate to an island already inhabited, though this would probably generate problems of adaptation to a new community<sup>125</sup> and of preserving their identity and culture. Moreover, the ever present hope of discovering oil, gas or other valuable resources under the seabed dissuades States nowadays from selling their territory.

Using the case of the Banabans as an illustration, it becomes clear that even if the population of Atoll Island States manages to obtain a new piece of territory their economic situation would be hardly satisfactory, as it is unlikely that they will be given land of much value in terms of natural resources.<sup>126</sup> The governments might be able to claim some income from fishing rights around their existing EEZ (if they managed to retain control of it, as outlined in Chap. 5, though the potential impacts of climate change on fish stocks is also something to be considered<sup>127</sup>), but

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<sup>122</sup> Edwards (2011), p. 8.

<sup>123</sup> Edwards (2011), p. 9.

<sup>124</sup> UNCLOS was established in 1982.

<sup>125</sup> Displacement Solutions (2009).

<sup>126</sup> Rayfuse (2009), p. 8.

<sup>127</sup> UN High Commissioner for Refugees (2011), p. 13.



otherwise it is unlikely that any new piece of land that they could obtain would offer them many opportunities. If an Atoll Island State was to lose its EEZ, it would be fair that in compensation it should be given an EEZ in another country, but the potential areas that could be given are also unlikely to be of great value.<sup>128</sup> If a third State accepts to cede land to an Atoll Island State, then it appears that in return it might have to agree on a joint access with that State to the archipelago's resources<sup>129</sup> while the islands are not completely submerged. If only a rock is left above the water at high tide, a possible successor State (which could be the State ceding land to the Atoll Island State) would be entitled to territorial sea and contiguous zone, although it would probably not be able to secure its EEZ, as discussed in Chap. 5. Furthermore, if they had not managed to permanently delimit the outer limits of the continental shelf then this could potentially also be lost.<sup>130</sup> Maritime resources have always been highly valued, and in a world of ever-increasing need for raw materials and resources the awareness of which areas have any potential value is forever increasing. Hence it is unlikely that any State would agree to relinquish control over any land that can give a claim to maritime areas, as there have been examples of how a State has voluntarily handed over control of a certain area (for example the sale of Alaska to the U.S.A.), and then valuable natural resources have been found on it.

By inhabiting Rabi and keeping Banaba island, Banabans have actually increased the territory in which they reside, though they now fall under the jurisdiction of both Kiribati and Fiji. However since Banaba cannot currently support any agriculture or population the result is that they increased their responsibilities without having the resources to sustain the administration and infrastructure of both islands. For the case of Atoll Island States, it could be theoretically possible for them to keep two different territories for some period of time while there is a meaningful "inhabitable" piece of land that is not submerged in their native archipelago, so that they could preserve their maritime rights (see Chap. 5). However, once the last island is completely submerged they would lose this great economic resource. Therefore, careful planning for what could become a predictable situation appears necessary.

The case of the Banabans can provide good insight into the challenges that Atoll Island States could face in resettling to another territory. It will be difficult to resettle in inhabited lands within another State's territory and claim sovereignty over them, as the local population would have to share the land with the newcomers.<sup>131</sup> This type of transfer has occurred in the past in the cession of

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<sup>128</sup> Rayfuse (2009), p. 8.

<sup>129</sup> Kelman (2008), p. 21.

<sup>130</sup> Hayashi (2010), p. 106. Note that often States claim a continental shelf larger than the extent of the EEZ, and that thus this discussion is more complicated than summarised here. For more details see the different scenarios outlined in Chap. 5.

<sup>131</sup> Nauru Local Government Council turned down resettlement to Australia because such scheme "would lead to assimilation of the Nauruans into metropolitan communities where they settled". See McAdam (2012), p. 151.

Alaska or the Virgin Islands, but nowadays such a proposition would be even more challenging since States are not supposed to dispose of their territory without consulting the local population. Therefore, although it could be envisaged how a State might be prepared to allocate some territory for a certain group of people to inhabit, it appears more difficult that a State would be prepared to surrender sovereignty over that piece of land so that another State might start exercising sovereignty over it. If the inhabitants of an Atoll Island State migrate to other States but do not acquire any land for the population to resettle, they could attempt to establish a place to base their government facilities and become a de-territorialized entity such as the Sovereign Military Order of Malta (SMOM), as will be explained later in this chapter. This would rely on the recognition of other States, and *de jure* recognition by other States is of key importance to maintain sovereignty for governments who could lose territorial control of all of their lands.<sup>132</sup>

The resettlement of the Banabans was not caused by climate change but imposed by the British Empire on the local population. However, their experience can give an example of how the entire population of a Pacific island fared after they were forcibly displaced to an uninhabited island of different geographical characteristics. The case of Banabans involved both a cession of territory (since an entire island was purchased for their resettlement) and the merger with other entities (since they are now part of Fijian and Kiribati States).

### 6.3.3.2 The Chagossian Displacement

The Chagos Archipelago (“the Chagos”) is a small group of atolls in the Indian Ocean, lying south of the equator, about halfway between India and Africa.<sup>133</sup> The largest island in the archipelago is Diego Garcia, leased to the US by the UK, and which currently hosts a US military base. The Chagos archipelago belonged to the British Colony of Mauritius for about 200 years and on the verge of becoming independent was excluded from Mauritius to become the British Indian Ocean Territory (BIOT) on November 1965 under the BIOT Order of the Queen of England. Through this Order the Chagos continued to belong to the United Kingdom while Mauritius became independent in 1968.<sup>134</sup> The archipelago is thus currently under American and British control, though the Republic of Mauritius also claims sovereignty over it. The Americans control the base and the British manage the police, court system, work and entry permits.<sup>135</sup>

In order to build the base, the UK expelled the entire population, about 1,800 people at the time.<sup>136</sup> By purchasing Chagos Agalega, the only company on the

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<sup>132</sup> Maas and Carius (2012), p. 658.

<sup>133</sup> Nauvel (2006), p. 96.

<sup>134</sup> Nauvel (2006), p. 100.

<sup>135</sup> Nauvel (2006), p. 97.

<sup>136</sup> Allen (2008), p. 684.

island (which was involved in the extraction of copra), the UK claimed that copra production had declining profits, thus ending the extraction and resettling the inhabitants to other islands.<sup>137</sup> The process of expelling the residents started by reducing food supplies, forcing people to leave the island. In 1971 the remaining inhabitants were removed from Diego Garcia to Peros Banhos and Solomon, and finally in 1973 to Mauritius, where there were neither resettlement nor reintegration plans for them. In the same year the British government agreed to pay £650,000 to the government of Mauritius for the resettlement, an amount that took 5 years to be handed to the Chagossians. Later in 1979 the government agreed to pay £1.25 million. Eventually, a final settlement was made in 1982 and the inhabitants received £4 million. The Mauritian government established a trust to manage the funds.<sup>138</sup>

Although the main cause of their displacement differs from that of the Banabans and Atoll Island States, it also has human influence at its core. While in the displacement of Banaban at least the inhabitants were guaranteed an entire island where they could resettle and did not become stateless, Chagossians, on the other hand, arrived in Mauritius and Seychelles without any piece of land reserved for them to resettle to. Hence this represents a case when the displacement of a population took place without any organized system or assistance provided for the resettlement (Table 6.1).

## 6.4 Status of Acquired Territories

Only a formal cession of land at the State-to-State level would enable the inhabitants of Atoll Island States to treat any acquired land as part of their own territory.<sup>139</sup> As Crawford points out, “international law defines ‘territory’ not by adopting private law analogies of real property, but by reference to the extent of government power exercised, or capable of being exercised with respect to some area and population”.<sup>140</sup> Thus, the territory of a State is not like a private property which can be sold and automatically transferred to the purchasing State. It is an operation which requires agreement between States, and what is characteristic of a State’s territory is the power that its government has over it.

However, the forced displacement of Banabans and the purchase of Rabi Island, which belonged to Lever’s Pacific Plantation Pty. Ltd and was sold to the Western Pacific High Commission, was similar to a real property transaction since the whole island was bought in order to receive a new population. It was not necessary to deal with a sovereign entity, but rather with the plantation company in Rabi Island since

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<sup>137</sup> Bradley (1999), p. 86.

<sup>138</sup> Bradley (1999), p. 86.

<sup>139</sup> McAdam (2012), p. 149.

<sup>140</sup> McAdam (2012), p. 147 referring to Crawford (2006), p. 56.

**Table 6.1** Comparison of Banabans and Chagossians in relation to the possibility of the future relocation of Atoll Island States

	Atoll Island States	Banabans	Chagossians
Cause of displacement	Sea level rise and the possible death of coral reefs (and other climate change related causes brought about by anthropogenic influences in the climate)	Phosphate extraction destroyed the environment of the island	Construction of a military base required removing all local population
Cession of territory	This solution could preserve their status as a sovereign country although it is probably not feasible since it is unlikely any other country would agree to provide lands	Yes. Purchase the uninhabited island of Rabi which belongs to Fiji Republic (while the Banaban Island belongs to Kiribati)	No. Population spread over Seychelles and Mauritius
Merge of territory	This solution would result in a loss of sovereignty to the Atoll Island State	Yes. Their old territory was merged with Kiribati while the new island belongs to Fiji	No. They did not have any exclusive territory in which the population could resettle
Statehood	Yes. Tuvalu, Marshall Islands, Maldives and Kiribati are all States (and members of the UN), but if they merge with another country they could lose it	No. Before the resettlement Banaba was part of the British Empire. Currently, the constitutions of Kiribati and Fiji guarantee some rights	No. Chagos was separated from Mauritius before independence. The population was relocated before independence was declared. This has perpetuated UK sovereignty over the territory
Resettlement location	Still to be decided, if any. Many inhabitants of these islands currently reside in other States, such as Australia or New Zealand	Another uninhabited island	Other inhabited islands and States
Statelessness	It can be avoided if dual citizenship is granted or if other States continue to recognise the sovereignty of the Atoll Island State	No, they have dual citizenship	Yes, they lost British citizenship, but recovered it after 30 years

(continued)

**Table 6.1** (continued)

	Atoll Island States	Banabans	Chagossians
Type of territory for resettlement	If population resettles to a larger land mass it would represent change of identity and possibly the assimilation of the population	Island	Islands
Beneficiaries of the resettlement of the Islanders	Primarily large polluting nations, which can continue to pollute without taking drastic mitigation action	Australia and New Zealand: main recipients of the mined phosphate	US and UK: established military base in Diego Garcia
Plans for resettlement	Some indications have been made by some countries (such as the Maldives or Kiribati) that they could be eventually forced to resettle. However, no formal plans exist yet	Yes, partially. An island was acquired, but lack of infrastructure and jobs caused impoverishment	No. UK provided some compensation to Mauritius to invest on the resettlement, but it took a long time for the Chagossians to receive it

there was no government<sup>141</sup> that existed before the purchase of the island. In the following section we will examine some of the potential implications of the acquisition and merger of territory from the point of view of Atoll Island States. As we have explained earlier, it is unlikely that Atoll Island States could acquire lands of any meaningful value and it is more probable that the poorer States should as Tuvalu would eventually end up as some sort of de-territorialized entity, a point that will be discussed later in this chapter.

### 6.4.1 *Merger of Territory*

One point to consider is that for the case of Atoll Island States most of the discussion by various commentators regarding the acquisition of new lands has centred on islands (i.e. where an Atoll Island State would acquire an island in another country and gain full sovereignty over it). This can then lead to the discussion regarding the acquisition of new EEZ areas, which has the potential to create conflict, as one small island can actually command an EEZ over an extensive area.

However, it could be possible for an Atoll Island State to merge with another State, a possibility suggested by Soons and Caron.<sup>142</sup> In this case an Atoll Island

<sup>141</sup> Rabi island was put for sale by the Tongan king in 1855 and was transformed into plantation fields. See Kempf (2011).

<sup>142</sup> Soons and Caron, cited in Rayfuse (2010), p. 9.

State that believed it could end up disappearing would “merge” with another State before this situation happened, “ceding” its ownership over its existing territory and maritime claims. The union with another State could create a new State or the Atoll Island State could subsume into an existing State.<sup>143</sup> Maritime zone boundaries could be settled between the two countries before the merger. The consequence of this suggestion, according to Rayfuse, is that pre-existing maritime zones would remain effective, but the zones would belong to the host state. The disappearing State would in effect purchase new land in the host State by ceding its maritime zones to this State. In addition, the host State would also represent the interests of the relocated population.<sup>144</sup> It has been suggested, however, that some of the potential countries that could receive the population might not be willing to accept the whole population of the island, but would be interested in acquiring the remaining land of Atoll Island States due to the benefits associated with the Exclusive Economic Zone and the continental shelf.<sup>145</sup> However, given the size of the populations involved and the considerable benefits that could be obtained (the population of Tuvalu, for example, is around ten thousand people<sup>146</sup> but currently have an EEZ of around 757,000 km<sup>2</sup><sup>147</sup>) it is not implausible that large countries would be willing to accept all inhabitants. Nevertheless, some commentators have questioned whether the population would be willing to move<sup>148</sup> and relinquish their independence, especially while the islands still existed.

The difference between the cession of territory and the union with another State is that in the former the territory would belong to the Atoll Island State, enabling its continuity as a sovereign country,<sup>149</sup> while in the case of a union with another State the Atoll Island State would lose its statehood. In this case, it could be argued that some sort of autonomy could still be preserved, similarly to the regimes that establish the rights of indigenous populations in Canada and New Zealand<sup>150</sup> or to the case of the Banabans, although this would depend on the exact negotiations that would take place at the time. Most of the population could be absorbed by the host State and a place set apart for the distinct socio-political and cultural identity of the islanders to be preserved, though it is also likely that a significant number of individuals would scatter amongst different countries.

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<sup>143</sup> UN High Commissioner for Refugees (2009), p. 18.

<sup>144</sup> Rayfuse (2010), p. 9.

<sup>145</sup> Stahl (2010), p. 34.

<sup>146</sup> 10,619 according to the CIA Factbook (2012) <https://www.cia.gov/library/publications/the-world-factbook/geos/tv.html>.

<sup>147</sup> Pacific Islands Forum Secretariat (2012), <http://www.forumsec.org/pages.cfm/about-us/member-countries/#tuvalu>.

<sup>148</sup> As an example of a refusal to settle in another land, Nauru Local Government Council rejected proposals of settling to Australia. See McAdam (2012), pp. 149–153.

<sup>149</sup> By changing its geographical location, as in the case of the Boers case mentioned earlier in this chapter.

<sup>150</sup> Kelman (2008), p. 21.

In this case, the purchase of land would ideally not just be done as an exercise in the acquisition of private property, but under the agreement that the areas purchased would have their own autonomous government,<sup>151</sup> possibly similar to what exists in many federal countries.<sup>152</sup> Of course this is not necessarily an easy task, and such an undertaking might require the consultation of the population of the country through a referendum. The merger would nevertheless represent a clear loss of status for the population of the Atoll Islands States since they would from that point fall under the sovereignty of another State and would lose the capacity to maintain international relations.

However, if the former Atoll Island State obtained a certain level of autonomy it would be able to preserve its self-government and self-determination. The characteristics of an autonomous territory are not defined uniformly and vary widely amongst countries, but it could include a territorial government which would provide freedom from control or interference in the executive, legislation and judiciary powers,<sup>153</sup> democratic participation of the population which would enable elected representatives to preserve political power; economic and social jurisdiction which would provide autonomy regarding economic and internal affairs.<sup>154</sup>

This form of political organization could be established to preserve the culture, language and economic resources of the population of the Atoll Island State. The extent to which it can be achieved depends on to what State they would relocate to, and this might be especially important if resettlement was to a State that was ethnically uniform, as autonomy could ensure that culture and traditions were preserved.

Although it could be claimed that if the former sovereign people of Atoll Island States move to a new territory they could later claim their right to self-determination in order to secede from the host State,<sup>155</sup> it would be difficult to

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<sup>151</sup> Benedikter defines autonomy as “a means of internal power sharing aimed at preserving the cultural and ethnic character of a region and ensuring a major dimension of regional democratic self-government”. See Benedikter (2009), p. 10.

<sup>152</sup> See Kelman (2006), p. 8. Other governance models for re-creating island communities include: Provinces, e.g. Prince Edward Island, Canada; Sub-national states, e.g. Tasmania, Australia; Sovereign states, e.g. Barbados; Full self-government in free association with a governing country, e.g. the Cook Islands and Niue with respect to New Zealand; Self-administering territory, e.g. Tokelau with respect to New Zealand; Compact of free association with a governing state, e.g. the Federated States of Micronesia and Palau with respect to the USA; A commonwealth in political union with a governing state, e.g. the Northern Mariana Islands with respect to the USA; Overseas territories, e.g. St. Helena and Pitcairn Island with respect to the UK; A dependency of a territory, e.g. Ascension Island and Tristan da Cunha with respect to St. Helena; Semi-autonomous, e.g. Zanzibar with respect to Tanzania.

<sup>153</sup> This can involve for example a level of autonomy involving parallel and complementary justice systems, such as those for indigenous people in Canada and New Zealand, see Kelman (2008), p. 21.

<sup>154</sup> Benedikter (2009), p. 13.

<sup>155</sup> Stahl (2010), p. 30.

assure economic independence without access to marine resources, which would make this proposition difficult in practice. As explained previously, it is unlikely that whatever lands could be potentially offered would be of much value. It would be of course possible to obtain an income from other sources, such as offshore banking or tourism, though again it would at present seem difficult that such activities could be successful in any lands that would be ceded (due to their possible remoteness, lack of infrastructure and the necessary skills and finance that would be required).

## 6.5 De-Territorialized State

Atoll Island States could survive as sovereign entities not only due to the presumption of continuity but also because territory is not necessary for the preservation of statehood, at least after statehood has been established.<sup>156</sup> For example, The Polish, Yugoslav, Czech and Baltic states governments which were annexed by the Axis powers and the Soviet Union between 1936 and 1940 continued to have legal personality and recognition, at least by the Allied Powers.<sup>157</sup> Thus, statehood (in the eyes of certain countries at least) is not necessarily lost following the total loss of territory of a recognised government. Nevertheless, for the case of Atoll Island States climate change and its related consequences could cause the total disappearance of the territory itself, rather than the former government being chased out by an invader. This situation of the territory itself disappearing represents a new situation, at least in modern times, but it does not imply necessarily that statehood (which has already been acquired through the de-colonization process) would be lost. As Crawford points out, in the early part of the twenty-first century international legal doctrine and theory is more pluralist due to the fact that non-State entities can acquire a distinct international status.<sup>158</sup> Although some countries could stop recognizing the sovereignty of submerged Atoll Island States and cut diplomatic relations, States can only have their UN membership rescinded by breaking the principles of the Charter and after recommendation of the United Nations Security Council (Art. 6 of the Charter of the United Nations).

In the long term, though, if coral islands are progressively eroded (as explained in Chap. 3), leaving an area of land devoid of vegetation (a “rock” under UNCLOS, as per Scenario II in Chap. 5), it would be difficult for the Atoll Island State to claim an EEZ around it. However, as long as this uninhabited rock is still above sea level it falls within Art. 121 (3) of UNCLOS and the State would still keep sovereignty over it. Nevertheless, as more and more islands disappear the Atoll Island State

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<sup>156</sup> Grant (1999), p. 435.

<sup>157</sup> Grant (1999), p. 435.

<sup>158</sup> Crawford (2006), p. 254.



would see its revenues slowly decrease, which would make the upkeep of the government and services it provides increasingly difficult.

Eventually, if the Atoll Island State was to physically lose all the islands that make its territory (through a combination of coastal erosion and sea level rise), it would find itself in a situation that has certainly not occurred in modern history. Although it is of course possible that a State could obtain new lands, as explained in previous sections of this chapter,<sup>159</sup> it is more likely that third countries will offer residency to Atoll Island States citizens than give them sovereignty over any land offered. In this section we will explore the logic, precedents and implications for a de-territorialized State.

### ***6.5.1 De-Territorialized States in History and Nowadays***

In fact, the concept of sovereign entities without a territory is already perceived and recognized by some States, such as for example The Sovereign Military Order of St John of Jerusalem, of Rhodes and of Malta (SMOM), or the International Committee of the Red Cross (ICRC). Both are considered as sovereign and have a standing invitation to the UN General Assembly.<sup>160</sup> However neither is considered an international organization or a non-member state (such as the Holy See), and have no voting rights.<sup>161</sup>

The ICRC is formed as an association under the Swiss civil code, and is funded by contributions made by members and donations. Our discussion will concentrate in the other two cases, as they present more clear examples of the concept of a de-territorialized entity. Nevertheless it is important to note that international law has also been recognizing the right of other entities to exercise aspects of functional sovereignty at the international level, such as in the case of European Union. The term “other entity” has also been used in other treaties, such as the United Nations Fish Stock Agreement.<sup>162</sup>

#### **6.5.1.1 The Sovereign Military Order of St John of Jerusalem, of Rhodes and of Malta (SMOM)**

The Sovereign Military Order of St John of Jerusalem, of Rhodes and of Malta (SMOM) is an ancient religious order currently dedicated to the provision of medical services. Throughout its history it was sovereign over the islands of Rhodes (1310–1528) and then Malta (1530–1798), from where it was ejected by Napoleon

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<sup>159</sup> Maas and Carius (2012), p. 659.

<sup>160</sup> Maas and Carius (2012), p. 659.

<sup>161</sup> Maas and Carius (2012), p. 659.

<sup>162</sup> Rayfuse (2010), p. 11.

in 1798. Up to that date the SMOM was a State, though from then on it has still retained sovereignty under international law, despite no longer being classified as a State.<sup>163</sup> The Papal tribunal added that “the status of the sovereign Order (. . .) is functional, that is to say, intended to assure the fulfilment of the scope of activities of the Order and its development throughout the world”.<sup>164</sup> Also, they still have their own government and issue passports, but detain a personality recognized by certain States only.

The organs of the SMOM (which are not subject to taxation) are hosted by Italy and the Order enjoys sovereign immunity in countries that recognize it. Currently, the Order has formal diplomatic relations with 102 States and missions to some European countries, as well as to European and international organisations.<sup>165</sup>

### 6.5.1.2 The Holy See and Vatican City

The Vatican City and the Holy See form another clear example of an entity that, while possessing a clear territory today, has not always done so. Until 1870 the Pope was sovereign over the so-called Papal States, which were then annexed by Italy during the unification of the country. Subsequently the Papal See was recognised as a State despite possessing no territory, until it was granted sovereignty over the Vatican City by the Lateran Treaties of 1929.<sup>166</sup> Although the Holy See lacked any territory during this period this did not affect its status as a subject in international law,<sup>167</sup> as it continued to send legates and emissaries which were recognised by countries throughout the world.<sup>168</sup>

Although it could be claimed that this notion of a de-territorialized entity no longer applies to the case of the Vatican as it now possesses a territory, the reality is more complex, as Martens explains.<sup>169</sup> The fact is that “the Vatican and the Holy See are two separate entities” whose relationship in international law is not clear either.<sup>170</sup> According to this commentator there are several competing theories:

According to the monistic theory, there is only one subject of international law, although it is not clear what this subject is. There are three possible candidates. In the first hypothesis, the Holy See is the only subject of international law, Vatican City State is only a territory with extra-territorial rights, but not a separate subject of international law. The second hypothesis is exactly the opposite: because of the Lateran Treaty, the Holy See is no longer

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<sup>163</sup> The Sovereign Military Hospitaller Order of Saint John of Jerusalem Official Website (2008) <http://www.orderofmalta.org/site/struttura.asp?idlingua=5>.

<sup>164</sup> Crawford (2006).

<sup>165</sup> The Sovereign Military Hospitaller Order of Saint John of Jerusalem Official Website (2008) <http://www.orderofmalta.org/site/struttura.asp?idlingua=5>.

<sup>166</sup> Rayfuse (2009), p. 10.

<sup>167</sup> Acquaviva (2005), p. 13.

<sup>168</sup> Martens (2006), p. 743.

<sup>169</sup> Martens (2006), p. 754.

<sup>170</sup> Martens (2006), p. 730.

a subject of international law – only Vatican City State is a subject of international law. The Holy See however can use the advantages of Vatican City State. A third hypothesis is somewhat related to the first one, or least with regard to the result: Vatican City State is not a subject, but an object of international law, because all its competences are taken over by the Holy See<sup>171</sup>

In fact, as Martens explains, the concept of how the Holy See is categorized is highly complex, as States hold diplomatic relations with it and not with the Vatican City, and this leads to different authors classifying both of these entities (The Holy See and the Vatican City) as either a State, entities *sui generis* (comparable to the SMOM) or “other entities – selected anomalies”. The position of the Holy See within the United Nations is also not questioned, where it is a Permanent Observer State, party to diverse international instruments and member of various United Nations subsidiary bodies, specialized agencies and international intergovernmental organizations.<sup>172</sup> This is despite the fact that the Holy See as such does not have a permanent population or defined territory, and although it currently has a link with the Vatican City (which does possess these elements) it did not possess these between 1870 and 1929. In a certain way it could be claimed that the Holy See was a “government-in-exile” during this time, although the link is far from perfect and far more nuanced in this case.<sup>173</sup>

Nevertheless it could be possible for an Atoll Island State whose territory disappeared to fall within a similar framework as that of the Holy See. Essentially such a State could claim to be waiting for future events to re-establish control over a territory<sup>174</sup> in a way similar also to that of governments-in-exile.

Therefore, the acquisition of lands by an Atoll Island State might not necessarily be the only solution and a number of compromise and intermediate solutions can be envisaged. For example, in order to prevent the issue of statelessness (see Chap. 7) one possibility would be that some small portion of territory could be ceded to the disappearing State to ensure its continued existence,<sup>175</sup> a sort of “Vatican” solution. If other States were to agree that this still represented the same State it could prevent its inhabitants from potentially becoming stateless.<sup>176</sup> The government of an Atoll Island State could acquire land in another country and settle within it, but only be granted full sovereignty over a small portion of one city or village, similar to the Vatican within Rome.<sup>177</sup>

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<sup>171</sup> According to French canon lawyer Roland Minnerath, as summarized by Martens (2006), p. 754.

<sup>172</sup> Martens (2006), p. 758.

<sup>173</sup> For a more detailed explanations of the legal complexities of the relation between them see Martens (2006), p. 83.

<sup>174</sup> This could be for example the possible future reappearance of the islands, during a period in which sea level started to come down.

<sup>175</sup> UNHCR (2009), p. 2. <http://www.unhcr.org/4a1e50082.html>.

<sup>176</sup> UNHCR (2009), p. 2. <http://www.unhcr.org/4a1e50082.html>.

<sup>177</sup> Where Italy recognized exclusive and absolute power and sovereign jurisdiction of the Holy See over the Vatican City. A special case is made for St. Peter’s Square, which is part of the

The citizens could then buy property and lands around this one area, which would continue to remain part of the “host” State, but could retain their identity and nationality by holding full sovereignty over a small patch of land comprising government buildings and institutions. In essence, these ceded lands would not be much different to an “enlarged embassy”, and it could be possible that certain countries would agree to such an arrangement, especially if the area was landlocked and thus unable to give rise to any claims on EEZs or other maritime zones.

### 6.5.2 *Political Trusteeship*

Rayfuse proposed a trusteeship to be established in order to manage the assets of the citizens of Atoll Island States which would find themselves living in host States or in diaspora.<sup>178</sup> This authority would represent the de-territorialised State at the international level and the interests of citizens in their new host States.<sup>179</sup> Burkett suggests that a form of preserving self-determination and sovereignty for the case of Atoll Island States would be the establishment of a new international law actor, a de-territorialised state<sup>180</sup> which would be a hybrid structure that would allow long-distance governance and preserve the holding of resources in the best interest of the people.<sup>181</sup> Burkett applies as the basis of the model the UN Political Trusteeship, with certain modifications being made to adapt it to the particularities of Atoll Island States. The Political Trusteeship was created after World War 2 and according to it the natural resources of a territory should be kept in the hands of the local population. The territories eligible are (1) territories placed under the Mandate System; (2) territories which were controlled by the defeated powers of World War 2; and (3) any territory brought under the system voluntarily by the States responsible for their administration.<sup>182</sup> The UN Trusteeship System excludes members of the United Nations due to the principle of sovereign equality.<sup>183</sup> The role of the trustee was to care of the ward and to promote the evolution of the trusted territory so that it could eventually be self-administered. It had a “civilizing mission”.<sup>184</sup>

According to Burkett, the modified trusteeship would be essential to maintain the sovereignty and self-determination of the populations of Atoll Island States. The

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Vatican City but continue to be open to the public and subject to the powers of Italian policy, thought the power of this police interestingly ends right at the foot steps leading into the basilica. For a more detailed explanation of how this arrangement works see Martens (2006), p. 729.

<sup>178</sup> Rayfuse (2010), p. 11.

<sup>179</sup> Rayfuse (2010), p. 11.

<sup>180</sup> De-territorialised states is called as nation ex-situ by Burkett, see Burkett (2011).

<sup>181</sup> Burkett (2011), p. 345.

<sup>182</sup> Art. 77 (1) of the UN Charter.

<sup>183</sup> Burkett (2011), p. 364.

<sup>184</sup> Wilde (2009), p. 103.

main difference between the traditional Political Trusteeship System (which purportedly had as its main objective to enable a territory to achieve self-determination<sup>185</sup>) and that proposed for Atoll Island States is that it would have as its scope the preservation of existing sovereignty.

For the case of Atoll Island States the trusteeship would be established by the Security Council or General Assembly.<sup>186</sup> In order to preserve the sovereignty of the endangered State the United Nations and its member States would only act to support the transition to a de-territorialised state.<sup>187</sup> According to Burkett, the Trustee would serve as a body which governs alongside the existing ex-situ government of the endangered State and would facilitate an orderly transition for its inhabitants; amongst its functions would be to provide diplomatic protection to the citizens of the Atoll Island States living in other States.<sup>188</sup>

The concept of the creation of a de-territorialised State would be an interesting possibility, and theoretically speaking a political trusteeship would ensure that Atoll Island States could preserve their resources and culture in a host State.<sup>189</sup> It would afford all the rights and benefits of sovereignty and the government would exercise authority over a diffuse people. It assumes that the population would not be concentrated only in one location, but rather that it would be spread over various countries.<sup>190</sup> This possibility of the existence of a de-territorialized State is a good starting point to discuss how the governments of these Atoll Island States could propose ways of managing their EEZ (if they could still claim them in the future, as discussed in Chap. 5) by having their government relocated to another country. Some authors claim that preserving the statehood of Atoll Island States would help to maintain their personal and group pride ideology, traditionally associated with a territorialized entity.<sup>191</sup> These de-territorialized States are somewhat similar to the idea of having a government-in-exile; the difference between a de-territorialized State and the government-in-exile is that in the latter there is expectation that the government could eventually return to its original territory, which would not be the case for a de-territorialized State.

The application of the political trusteeship could prove to be a structure that assists in safeguarding the statehood of Atoll Island States. However, it could also be interpreted as a lack of capacity by Atoll Island States to deal with this transition by themselves and thus require external intervention to ensure their new status before the international community. Would Atoll Island States really require the assistance of the UN and an Administering Authority to deal with their future problems? The political trusteeship was a decolonizing instrument, but its

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<sup>185</sup> <http://www.un.org/en/decolonization/its.shtml>.

<sup>186</sup> Burkett (2011), p. 364.

<sup>187</sup> Burkett (2011), p. 346.

<sup>188</sup> Burkett (2011), p. 365.

<sup>189</sup> Burkett (2011), p. 346.

<sup>190</sup> Burkett (2011), p. 346.

<sup>191</sup> Burkett (2011), p. 367.

application to independent States could be interpreted as a mechanism that undermines their sovereignty.

Even if these types of de-territorialized entities could be established, a number of practical problems could affect them. The historical experience of governments-in-exile can provide some useful insight into some of the challenges that a de-territorialized State would face once it no longer held any territory, as will be explained in the next section.

## 6.6 Government-in-Exile

It could be argued that effective government and not territory is essential to preserve political power.<sup>192</sup> This claim can be backed by the fact that governments-in-exile and international organizations have had their status guaranteed in international relations. The case of Somalia<sup>193</sup> and other governments-in-exile highlights how *de jure* recognition of a State by other States is of key importance to the issue of recognition, as a government without territory can still be recognised as a State by other countries.

Governments-in-exile have frequently been recognized by their allies as governments of an enemy-occupied State during the course of the conflict and pending its outcome.<sup>194</sup> The possibility exists that in the case of the disappearance of the territory of an Atoll Island State a government-in-exile could be created, as in the case of the Polish government during World War II. However, governments-in-exile normally exist on the assumption of restoring power in their own country, and until recently have been more connected to situations of international (Poland and the Baltic Countries during World War II) or national conflicts (Taiwan and China). In World War II, after Germany's invasion, Poland's government-in-exile was constitutionally continuous with the pre-1939 government.<sup>195</sup> After the Yalta and Potsdam Agreements, Poland's population and territory were redistributed and a different constitutional system was imposed, though in practice the State remained the same as before 1939.<sup>196</sup>

The difference between an Atoll Island State whose territory disappeared and a government-in-exile is that while the latter would have the possibility of restoring its power over a determined territory, the former cannot expect to recover its current territory in the near future since the coral islands that constitute it would no longer

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<sup>192</sup> Acquaviva (2005), p. 34.

<sup>193</sup> Where through many years the internationally recognized government only controlled small areas of the capital (and at times not even that, before the intervention of Ethiopian troops in 2006), see BBC (2012a, b).

<sup>194</sup> Crawford (2006), p. 688.

<sup>195</sup> Crawford (2006), p. 692.

<sup>196</sup> Crawford (2006), p. 692.

be there. A change of focus from States to other non-State entities would ensure more attention to the case of the Atoll Island States, and thus to the needs of some of these developing nations.<sup>197</sup>

International law emphasizes the political power of States and hence governments-in-exile are a neglected feature of international politics with their achievements under-reported and their existence under-theorized.<sup>198</sup> Most of the geopolitical holes are not visible for western strategists since there is a tendency on focusing on States that have global resources or with important historical or cultural ties to industrialised countries.<sup>199</sup> However, that does not mean that they do not exist. The Tibetan Government-in-Exile, for example, is an entity which tries to preserve a polity by providing health services, education system for Tibetans living in India and Nepal, a voluntary taxation system, the issuing of Tibetan passports and implementation of democratic parliamentary elections.<sup>200</sup> Although it struggles to keep the polity, the Tibetan Government-in-Exile is not internationally recognized and lacks sovereignty over a territory. In addition, it has neither a police nor a military force and cannot legally defend its citizens.<sup>201</sup>

However, the key problem for the case of Atoll Island States is that governments-in-exile are usually recognised because they have the prospect of one day returning to their territory. Maas and Carius argue that “this option may be unavailable for island states until sea-levels begin to fall again”.<sup>202</sup> This is actually an important point, as in the future eventually sea levels will probably fall once again, if societies learn to live without fossil fuels and due to global long-term climate cycles. Hence, although in the short-term these atolls could disappear, there is always the prospect that they could once again re-appear (although of course this would not be certain even if sea levels went down, as it would depend also on the ability of corals to evolve<sup>203</sup> and re-colonize the islands<sup>204</sup>).

Even if Atoll Island States do not have power over any territory, their citizens could be prevented from becoming stateless by this continued recognition as governments-in-exile. In fact, the idea of these States becoming governments-in-exile could obtain favour amongst a number of other governments, if it is made clear that it is anchored on the rationale that one day the atolls could re-appear. As governments-in-exile have been recognised by various States throughout history the concept is not new, and would not involve lengthy discussions about its implications. In fact the only difference would be that the government would

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<sup>197</sup> McConnell (2009a), p. 1911.

<sup>198</sup> McConnell (2009a), p. 1906.

<sup>199</sup> McConnell (2009a), p. 1906.

<sup>200</sup> McConnell (2009b), p. 116.

<sup>201</sup> McConnell (2009b), p. 116.

<sup>202</sup> Maas and Carius (2012), p. 659.

<sup>203</sup> Assuming of course they still even existed as a species.

<sup>204</sup> The IPCC 4AR also notes how it would take thousands of years for greenhouse gas concentrations in the atmosphere to reduce, even if emissions completely cease.

have been ousted not by the invasion of a military power, but by climate change brought by emissions of greenhouse gases, mostly from developed States.

## 6.7 Recognition Scenarios

Essentially, following the arguments presented in the previous section for de-territorialised States and governments-in-exile it would be possible to envisage a number of different scenarios for Atoll Island States that lost all their present lands<sup>205</sup>:

- A “**Continued Recognition Scenario**”, where Atoll Island States that are completely submerged would continue to be recognised by other States, preserving all membership of international organisations, though their seat of government would be in another land. They could also, for example, keep their status as UN members or be granted the status of Permanent Observer at United Nations, as what happens with the SMOM. It is possible that States which are geographically closer to them would accept to host their organs of government, though it could also be reasonable to have the States which were responsible for major emissions of greenhouse gases to share the burden of receiving not only part of the population of these countries, but to also assure their preservation as sovereign entities. The question which remains is whether the international community would accept this form of statehood.<sup>206</sup> If the ability of the de-territorialized State to emit passports is recognised then the issue of preserving the nationality of its citizens (something that will be discussed in more detail in Chap. 7) becomes more straightforward, such as in the case of the SMOM.
- A “**Selective Recognition Scenario**”, where only some States would continue to recognise Atoll Island States whose entire territory had become submerged, with others breaking-off diplomatic relations. However, as stated previously, it is unlikely that the country could be expelled from the UN, as States can only be expelled for consistently breaking the principles of the Charter and after this has been recommended by the UN Security Council. Lack of recognition by some UN members does not necessarily mean the expulsion from the UN or other bodies, as in the case of Turkey and Cyprus.<sup>207</sup> This scenario could represent a problem for the citizens of the country, since there is the possibility that their passport would not be recognized by some countries. This would imply issues of statelessness *de facto*, as explained in Chap. 7. The case where only some countries recognized these States could also lead to very complex legal and

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<sup>205</sup> These scenarios have been adapted from those presented in Maas and Carius (2012), p. 659.

<sup>206</sup> Yamamoto and Esteban (2010), p. 6.

<sup>207</sup> Maas and Carius (2012), p. 659.



geo-political situations. It could be possible, for example, for one country to recognize the submerged Atoll Island State, provide it with a place to relocate its seat of government and financial funds, in return for access to resources within its former EEZ. Other countries, hoping to access these resources, could choose not to recognize the country, and pretend those areas had become “high seas”.

- A “**Complete Loss of Statehood Scenario**”. Atoll Island States, deprived of their territory, would be expelled from the UN and other international organisations, with their international personality not recognised by anybody. This is unlikely to occur since it would be difficult to expel the country from the UN, as mentioned previously. It is probably an extreme scenario, especially given the strength of organisations such as AOSIS within the UN. Nevertheless, if this scenario became reality the islanders would clearly become stateless, as discussed in more detail in Chap. 7.

The ideal of preserving the statehood of Atoll Island States follows the notion that every nation deserves its own State.<sup>208</sup> It is probable that in the future the issue of sovereignty and statehood will become far more complex than nowadays.<sup>209</sup> Sovereignty and statehood might cease to be an absolute concept and become more blurred and relative. It might consist of several types of entities, some of which can already be seen today. Supra-national entities such as the European Union would be at the top, followed by “traditional” sovereign States (some of which would be sharing their sovereignty with those supra-national entities, as the current members of the EU do), followed by State-like entities with limited or no recognition (such as Taiwan, Kosovo or Somaliland), and other sovereign “de-territorialized” entities at the bottom, such as the SMOM or potentially Atoll Island States, if they fail to obtain a better solution. Maas and Carius further note how<sup>210</sup>:

Various international forums, such as the climate negotiations or the Doha development round, have revealed the great diversity of interests and thus also the very limited space for consensus in several policy areas. (...) Instead, it is quite likely that fragmentation may further increase, with various states choosing to recognize or not recognize states dispossessed by climate change. The main consequence of climate change in the Pacific and elsewhere may thus be that international relations become more complex and approaches to deal with various entities claiming political legitimacy become more pragmatic in absence of global consensus. Yet, this would erode the global system of nation states symbolized by the United Nations further, making the definition of states ever more arbitrary and blurred. (...) While this would open up possibilities for developing innovative, more reflective and adequate institutions and mechanism on a regional level, this global devolution may also bear the risk of fracturing international solidarity in times when the challenges of climate change would require global, coordinated responses.

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<sup>208</sup> Biswas (2002), p. 184.

<sup>209</sup> Maas and Carius (2012), p. 662.

<sup>210</sup> Maas and Carius (2012), p. 662.

## 6.8 Conclusions

It is unlikely that States which have already been recognised as such can lose their status even after losing one of the elements required by the Montevideo Convention (such as population, government or a defined territory). Rather, it appears that Atoll Island States can preserve their status by relying on the recognition of other States. In this case, the continuity of recognition by other States and international organizations would have a reparative effect to compensate for the lack of territory and/or population, giving birth to a State *sui generis*. Essentially, there is a difference between the criteria for the initial recognition of statehood and its continuity. However, a common point between them is that both the birth and continuity of a State rely on a blend of legal and political judgements which could ultimately determine whether statehood can be preserved, even after the last island in an archipelago disappears. Conversely, if there is lack of recognition of statehood after the Atoll Island State has lost its territory then the significance of land as an essential element of statehood will be reconfirmed.

The cession of territory, one of the solutions suggested to enable Atoll Islands States to acquire new territory, was used mainly in the past by Western countries to increase their colonial lands. However, at present it is unlikely that this type of solution could be applied for the case of Atoll States since it is unlikely that any sovereign States will be willing to cede a part of their own territory. If a cession of territory ever took place it would represent a change in the pattern of international relations, as Atoll States would be applying the same instrument that European States used many times to guarantee their territorial acquisitions in Africa and Asia. The suggestion to apply this solution, however, seems to be misplaced because it overlooks how developing States could face great challenges when trying to apply an instrument that was used to increase territorial influence of developed States in the past.

However, even in the case where a certain Atoll Island State was not able to find lands on which to resettle and its population scattered throughout the world it does not necessarily mean that the State would lose its condition as a subject of international law. The issue of whether a de-territorialized State is possible draws attention to entities such as governments-in-exile which are outside the rule of a “traditional State”. These entities are often overlooked by international law because they are not connected to the more prominent and powerful States. Atoll Island States belong to the category of “developing States”, and thus in this sense trying to secure an exception to established international practices could be challenging. If Atoll Island States can preserve their statehood in a scenario in which one of the elements of statehood required by the Montevideo Convention is missing it will demonstrate not only that the continuity of statehood does not necessarily relate to the existence of all of these elements, but that the issue of recognition relies also on politics.

There have been some past and present examples of sovereign entities without land, in addition to the presumption of the continuity of statehood. The international personality of these States could be preserved because sovereignty can be practiced

in networks across space,<sup>211</sup> which would be equivalent to having a de-territorialized State (a concept which does not fit within the classical interpretation of statehood). This certainly poses some challenges since territoriality has long been emphasized as the almost exclusive way of exercising political power. Nevertheless, there are subjects of international law which do not hold any territory, or did not hold it during certain periods of time, and that was not an obstacle for them to be recognized as sovereign entities before international law.

Obviously, for the case where an Atoll Island State became a de-territorialized entity the population would have to actually relocate to foreign lands. The question of people who are forced to leave their homes due to the sea level rise has been frequently discussed in literature,<sup>212</sup> and this will be analysed in more detail in Chap. 7.

## References

- Acquaviva G (2005) Subjects of international law: a power-based analysis. *Vanderbilt J Int Law* 38(2):345–396
- Agnew J (2004) Sovereignty regimes: territoriality and state authority in contemporary world politics. *Ann Assoc Am Geogr* 95(2):437–461
- Agnew J (2005) Territoriality and state authority in contemporary world politics. *Ann Assoc Am Geogr* 95(2):437–461
- Allen S (2008) International law and the resettlement of the (outer) Chagos Islands. *Hum Rights Law Rev* 8(4):683–702
- Anghie A (1999) Finding the peripheries: sovereignty and colonialism in nineteenth century international law. *Harv Int Law J* 40 (1):1–71. Available at <http://teachers.colonelby.com/krichardson/grade%2012/carleton%20int%20law%20course/week%203/findingperipheries.pdf>. Accessed 7 July 2012
- Barnett J, Adger WN (2003) Climate dangers and atoll countries. *Clim Change* 61:321–337
- Barnett J, Campbell J (2010) Climate change and small island states: power, knowledge and the South Pacific. Earthscan Ltd., London, UK. ISBN 978-1-84407-494-5
- Bathon M (2001) The atypical international status of the Holy See. *Vanderbilt J Transnatl Law* 34(3):597–632
- BBC (2012a) Maldives President Mohamed Nasheed resigns amid unrest, 7 February 2012. Available at <http://www.bbc.co.uk/news/world-asia-16922570>. Accessed 15 Aug 2012
- BBC (2012b) Somalia profile. <http://www.bbc.co.uk/news/world-africa-14094632>. Accessed 29 Mar 2012
- Beaulac S (2003) Vattel's doctrine on territory transfers in international law and the cession of Louisiana to the United States of America. *Louisiana Law Rev* 63:1327–1359
- Benedikter T (2009) What is political autonomy about? Fundamental features of political autonomy. In: Benedikter T (ed) Solving ethnic conflict through self-government – a short guide to autonomy in Europe and South Asia. Eurac Research, Bolzano, Esperia srl, Lavis/Trento, pp 5–14. Available at [http://www.eurac.edu/en/research/institutes/imr/Documents/Deliverable\\_No\\_9\\_Update\\_Set\\_educational\\_material.pdf](http://www.eurac.edu/en/research/institutes/imr/Documents/Deliverable_No_9_Update_Set_educational_material.pdf). Accessed 15 June 2012

<sup>211</sup> Agnew (2004), p. 441.

<sup>212</sup> Renaud et al. (2007), p. 14.

- Biswas S (2002) W(h)ither the Nation State? National and State Identity in the face of fragmentation and globalization. *Glob Soc* 16(2):175–198
- Boege V (2010) Challenges and pitfalls of resettlement measures: experiences in the Pacific Region. Paper presented at the ESF-UniBi-ZiF research conference on environmental change and migration: from vulnerabilities to capabilities, Bad Salzuffen, 5–9 December 2010. COMCAD Working Papers, No. 12
- Bradley R (1999) Diego Garcia-Britain in the dock. *IBRU Boundary and Security Bulletin* Spring 82–88. [https://www.dur.ac.uk/resources/ibru/publications/full/bsb7-1\\_bradley.pdf](https://www.dur.ac.uk/resources/ibru/publications/full/bsb7-1_bradley.pdf). Accessed 16 May 2012
- Burkett M (2011) The nation ex-situ, on climate change, deterritorialized nationhood and the post-climate era. *Clim Law* 2:345–374
- Campbell J et al. (2005) Community relocation as an option for adaptation to the effects of climate change and climate variability in Pacific Island countries (Asia Pacific Network for Global change research). [http://www.sprep.org/att/irc/ecopies/pacific\\_region/643.pdf](http://www.sprep.org/att/irc/ecopies/pacific_region/643.pdf). Accessed 7 Mar 2012
- Caron D (1990) When law makes climate change worse: rethinking the law of baselines in light of a rising sea level. *Ecol Law Q* 17:621–653
- Connel J, Brown RPC (2005) Remittances in the Pacific, an overview, Asian Development Bank. Available at [http://apgml.org/frameworks/docs/8/ADB\\_remittances-pacific\\_Mar2005.pdf](http://apgml.org/frameworks/docs/8/ADB_remittances-pacific_Mar2005.pdf). Accessed 13 June 2012
- Convention on the Cession of Danish West Indies (1917) Between the United States and Denmark, January 25, 1917. Available on the Internet at <http://www.doi.gov/oia/about/upload/vitreaty.pdf>. Accessed 22 Aug 2011
- Crawford J (2006) *The creation of states in international law*. Oxford University Press, Oxford
- Displacement Solutions (2009) Climate-change displaced people and housing, land and property rights. Preliminary strategies for rights-based planning and programming to resolve climate-induced displacement. [http://displacementsolutions.org/files/documents/DS\\_Climate\\_change\\_strategies.pdf](http://displacementsolutions.org/files/documents/DS_Climate_change_strategies.pdf). Accessed 4 Nov 2012
- Edwards JB (2011) A small rock sample with a big impact' Phosphate mining and the relocation of the Banabans to northern Fiji in 1945: lessons for climate change-forced displacement, Mining and mining policy in the Pacific: history, challenges and perspectives, Nouméa, 21–25 November 2011
- Eggers AK (2007) Sharpening the cutting edge of International Human Rights Law: unresolved issues of war crimes tribunals: when is a state a state? The case for recognition of Somaliland. *Boston College Int Comp Law Rev* 30(12):211–222
- Emanueli C (2003) State Succession, then and now, with special reference to the Louisiana purchase (1803). *Louisiana Law Rev* 63(4):1277–1291
- Encyclopedia Britannica (2012) Banaba. Available at <http://www.britannica.com/EBchecked/topic/51280/Banaba>. Accessed 23 Mar 2012
- CIA Factbook (2012) <https://www.cia.gov/library/publications/the-world-factbook/geos/tv.html>. Accessed 10 May 2012
- Farley BR (2010) Calling a state a state: Somaliland and international recognition. *Emory Int Rev* 24:777–820
- Ferris E et al. (2011) On the front line of climate change and displacement learning from and with Pacific Island countries, The Brookings Institute –project on international displacement. Available at internet at [http://www.brookings.edu/~media/research/files/reports/2011/9/idp%20climate%20change/09\\_idp\\_climate\\_change.pdf](http://www.brookings.edu/~media/research/files/reports/2011/9/idp%20climate%20change/09_idp_climate_change.pdf). Accessed 16 Dec 2012
- Gagain M (2012) Climate change, sea level rise, and artificial islands: saving the Maldives's statehood and maritime claims though the 'constitution of the oceans'. *Colo J Int Environ Law Policy* 23(1):77–120
- Grant TD (1997) Between diversity and disorder: a review of Jorri C. Duursma, fragmentation and the international relations of micro-states: self-determination and statehood. *Am Univ Int Law Rev* 12(4):629–686

- Grant TD (1999) Defining statehood: the Montevideo Convention and its discontents. *Columbia J Transnatl Law* 37(2):403–457
- Grant TD (2000) States newly admitted to the United Nations. *Columbia J Int Law* 39(1):177–192
- Hayashi M (2010) The adverse impacts of sea level rise on the rights of islands and island states over their surrounding sea areas: procedural options of international legal measures for mitigating impacts. In: *Proceedings of international seminar on Islands and Oceans*, Ocean Policy Research Foundation, Tokyo, 2010, pp 103–111
- Hindmarsh G (2002) One minority people – a report on the Banabans-formerly of Banama (Ocean Island) who were relocated to Rabi Island in Fiji. Available at <http://www.banaban.info/Minpeople.pdf>. Accessed 10 June 2012
- Jakarta Post (2010) Government approves plan to rent Tabuhan Island to Maldives investor, April 1, 2010. Available at <http://www.thejakartapost.com/news/2010/04/01/govt-approves-plan-rent-tabuhan-island-maldives-investor.html>. Accessed 8 Feb 2011
- Jennings RY (1963) *The acquisition of territory in International Law*. Manchester University Press, Manchester
- Kelman I (2006) Island security and disaster diplomacy in the context of climate change. *Les Cahiers de la Sécurité* 63:61–94. English version available at <http://www.disasterdiplomacy.org/kelman2006cce.pdf>. Accessed 20 Dec 2012
- Kelman I (2008) Island evacuation. *Forced Migr Rev* 31:20–21
- Kempf W (2011) Translocal entwinements: toward a history of Rabi as a Plantation Island in Colonial Fiji. Göttingen: GOEDOC, Dokumenten- und Publikationsserver der Georg-August-Universität. Available at <http://webdoc.sub.gwdg.de/pub/mon/2011/kempf.pdf>. Accessed 25 Dec 2012
- Kitaguchi M et al. (2004) Economic vulnerabilities – Banabans-Japanese relations, *Islands of the World VIII*. International conference, Changing Islands- Changing Worlds, 1–7 November 2004, Kinmen Island, Taiwan, pp 842–851
- Kreijen G (2004) State failure, sovereignty and effectiveness: legal lessons from the decolonization of sub-Saharan Africa. Koninklyke Brill NV, Leiden
- Kumar S et al. (2006) Poverty and deprivation amongst ethnic minorities in Fiji: the case of Ni Solomoni and Rabi Islanders. *Fijian Stud* 4(1):125–142
- Lacey M (2006) The Signs Say Somaliland, but the World Says Somali. *The New York Times*, 5<sup>th</sup> June 2006. [http://www.nytimes.com/2006/06/05/world/africa/05somaliland.html?\\_r=1](http://www.nytimes.com/2006/06/05/world/africa/05somaliland.html?_r=1). Accessed 29 Mar 2012
- Maas A, Carius A (2012) Territorial integrity and sovereignty: climate change and security in the Pacific and beyond. In: Scheffran J et al. (eds) *Climate change, human security and violent conflict*, Springer, Heidelberg, pp 651–665
- Maclellan N (2009) The future is here: climate change in the Pacific. Oxfam report. [www.oxfam.org.au/climate-change](http://www.oxfam.org.au/climate-change). Accessed 23 Dec 2011
- Martens K (2006) The position of the Holy See and Vatican City State in international relations. *Univ Detroit Mercy Law Rev* 83:729–760
- Martin SF (2010) Climate change and international migration, by the German Marshall Fund of the United States. Available at <http://www.ehs.unu.edu/file/get/7103>. Accessed 10 Dec 2012
- McAdam J (2011) Refusing refuge in the Pacific: (de)constructing climate-induced displacement in International Law. In: Pigué E et al. (eds) *Migration, environment and climate change*. UNESCO, Paris, pp 102–137
- McAdam J (2012) *Climate change, forced migration, and international law*. Oxford University Press, New York
- McConnell F (2009a) Governments-in-exile: statehood, statelessness and the reconfiguration of territory and sovereignty. *Geogr Compass* 3(5):1902–1919
- McConnell F (2009b) Democracy-in-exile: the “uniqueness” and limitations of exile in Tibetan Democracy. *Sociol Bull* 58(1):115–144

- Mimura et al. (2007) Small islands. Climate change impacts, adaptation and vulnerability. Contribution of Working Group II to the 4<sup>th</sup> Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge
- Nauvel C (2006) A return from exile in sight? The Chagossians and their struggle. *Northwestern J Int Hum Rights* 5(1):96–126
- Oppenheim L (1905) *International law- a treatise*, volume I-Peace Longmans, Green and Co. London
- Pacific Islands Forum Secretariat (2012) <http://www.forumsec.org/pages.cfm/about-us/member-countries/#tuvalu>. Accessed 10 May 2012
- Raič D (2002) Statehood and the law of self-determination. Martinus Nijhoff, Leiden
- Rakova U (2009) How-to guide for environmental refugees. Ourworld 2.0. <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>. Accessed 23 Aug 2009
- Randeep R (2008) Paradise almost lost: Maldives seek to buy a new homeland. *The Guardian*, November 10, 2008. Available at <http://www.guardian.co.uk/environment/2008/nov/10/maldives-climate-change>. Accessed 8 Feb 2011
- Rayfuse R (2009) Whither Tuvalu? International law and disappearing states, University of New South Wales Faculty of Law Series, Research Paper No. 2009-9
- Rayfuse R (2010) International law and disappearing States: utilizing maritime entitlements to overcome the statehood dilemma, University of New South Wales Faculty of Law Research Series, paper 52
- Reardon S (2012) Pacific island to buy piece of Fiji as climate plan. Available on the internet at <http://www.newscientist.com/article/dn21581-pacific-island-to-buy-piece-of-fiji-as-climate-plan.html>. Accessed 21 Mar 2012
- Renaud F et al. (2007) Control, adapt or flee- how to face environmental migration? *Intersections, Interdisciplinary Security Connections Publication Series of UNU-EHS*, No. 5/2007
- Secretariat of the Pacific Community (2007) Kiribati 2005, Volume 2: analytical report. Census available at <http://www.spc.int/prism/country/KI/stats/Census2005/reports/KIR%20Report%202005%20-%20Volume%20II%20-%20FINAL.pdf>. Accessed 16 Sept 2012
- Sigragh KR, King S (2004) Essentially being Banaban in today's world: the role of Banaban Law "TE RII NI BANABA" (Backbone of Banaba). In: A changing world, islands of the world VIII conference, Kinmen Island, 1–7 November 2004, pp 1032–1050. Available at internet at <http://www.banaban.info/ISISA2004Paper-Ken.pdf>. Accessed 16 Dec 2012
- Soons HA (1990) The effects of a rising sea level on maritime limits and boundaries. *Netherlands Int Law Rev* 37(2):207–232
- Stahl S (2010) Unprotected ground: the plight of vanishing island nations. *New York Int Law Rev* 23(1)
- Teaiwa KM (2005) Our sea of phosphate: the diaspora of Ocean Island. In: Harvey G, Thompson CD Jr (eds) *Indigenous diasporas and dislocations: Unsettling Western Fixations*. Ashgate, London, pp 169–192
- The Sovereign Military Hospitaller Order of Saint John of Jerusalem Official Website (2008) <http://www.orderofmalta.org/site/struttura.asp?idlingua=5>. Accessed 1 Aug 2008
- Treaty concerning the Cession of Louisiana to United States (1803) 20 October 1803. Available on the internet at [http://www.archives.gov/exhibits/american\\_originals/louistxt.html](http://www.archives.gov/exhibits/american_originals/louistxt.html). Accessed 22 Aug 2011
- Treaty concerning the Cession of the Russian possessions in North America by his Majesty the Emperor of all the Russians to the United States of America (1867) June 20, 1867. Available on the Internet at <http://memory.loc.gov/cgi-bin/ampage?collId=llsl&fileName=015/llsl015.db&recNum=572>. Accessed 22 Aug 2011
- UN High Commissioner for Refugees (2009) Climate change and statelessness: an overview. In: 6th session of the Ad Hoc Working Group on Long-Term Cooperative Action (AWG-LCA 6) under the UNFCCC, Bonn, 1–12 June 2009

- UN High Commissioner for Refugees (2011) Climate change and the risk of statelessness: the situation of low-lying island states, PPLA/2011/04. Available at: <http://www.unhcr.org/refworld/docid/4e09a4ba2.html>. Accessed 18 Apr 2012
- United Nations (2012) The UN and decolonization history, International Trusteeship System. <http://www.un.org/en/decolonization/its.shtml>. Accessed 25 May 2013
- Vattel E (1758) The law of nations or the principles of natural law, book one, chapter five. Available on the Internet at <http://www.lonang.com/exlibris/vattel/vatt-105.htm>. Accessed 22 Aug 2011
- Wilde R (2009) From trusteeship to self-determination and back again: the role of the Hague regulations in the evolution of international trusteeship, and the framework of rights and duties of occupying powers. *Loyola Los Angeles Int Comp Law Rev* 31:85–142
- Worster WT (2009) Law, politics, and the conception of the state in state recognition theory. *Boston Univ Int Law J* 27(115):115–170
- Yamamoto L, Esteban M (2010) Sovereignty issues of the disappearance of island states. *Ocean Coastal Management J* 53:1–10, doi: [10.1016/j.ocecoaman.2009.10.003](https://doi.org/10.1016/j.ocecoaman.2009.10.003)

# Chapter 7

## Climate Change Displacement in Atoll Island States

### 7.1 Introduction

Since the beginning of time migration has been used by humans as an adaptation measure to adapt to changes in environmental conditions. There is a wide wealth of literature that tries to map different migration patterns and historical events to changing weather, and it has been postulated for example that the fall of the Roman Empire might have been influenced by the migration of tribes due to colder temperatures across the planet.<sup>1</sup> Thus, the displacement of groups of people due to changing environmental conditions is nothing new, though it could be argued that in the future the difference will be that the need for these movements will be at least partly due to the consequence of anthropogenic influences on the global environment.

The way in which such a complex phenomenon as migration is perceived will determine the way in which it is regulated in international law and its institutions,<sup>2</sup> and this will decide whether it can receive protection under these instruments. However, whose perception is the one that matters in this case? Currently, in a context where developed States are attempting to find solutions to block the mass influx of migrants from developing countries, it is unlikely that a new category of migrants affected by climate change could be considered as worthy of protection. McAdam specifies the distinction between those who would be worthy of protection and those who are not based on:

- (a) Whether such a movement is perceived as voluntary or involuntary; if it is voluntary it means that it would not deserve any protection
- (b) The nature of the trigger (for example if it is a slow-onset process or a natural disaster); in the case of a slow-onset process it would probably not be easy to find any framework for protection

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<sup>1</sup> Büntgen et al. (2011), p. 578.

<sup>2</sup> McAdam (2011b), p. 107.



- (c) Whether international borders are crossed or not; people who did not cross the borders are considered as a matter for local governments and treated as Internally Displaced Peoples (IDPs)
- (d) The extent to which there are political incentives to characterize something as linked to climate change or not; factors such as poverty can also trigger movements and climate change would relate to social and economical causes of movement
- (e) Whether the movement is driven or aggravated by human factors, such as discrimination.<sup>3</sup>

The problem is that often the issue of migration cannot be easily classified, as the circumstances which make people migrate are case specific and thus a complex number of issues are interwoven. In the present chapter, however, we will not attempt to understand the complexity of all these causes for each type of migrant, but will focus exclusively on the situation of the inhabitants of Atoll Island States, who might have to leave their islands due to the processes outlined in Chaps. 3 and 5. Their situation is interesting because it represents a case in which the whole population of a State would have to migrate to other countries. The fact that this population is from developing countries which historically did not play any role in the establishment of international law<sup>4</sup> and which obtained their independence less than a century ago could expose some of the inherent problems in international law, which for a great part of its history (according to some authors<sup>5</sup>) still perpetuate the colonial mechanisms inherited from the nineteenth century.

Settlement abandonment is actually a fairly common occurrence throughout the history of humanity.<sup>6</sup> The nature of this process is quite complex and takes place in many stages as the vulnerability of a certain population increases, with many authors mentioning a combination of “push” and “pull” factors at play.<sup>7</sup> These include economic (poverty and unemployment), social (education, family links, welfare), security (risk of persecution, general instability) and environmental concerns (environment degradation, natural disasters).<sup>8</sup> A human settlement can thus move from a situation of population increase or stability to one of population decline, with the growing out-migration in turn further eroding the adaptive capacity of the remaining population.<sup>9</sup> Should the driving conditions persist for a long time (i.e. unless the stressors were to stabilise or disappear) then eventually a state of instability occurs, where the resources required for adaptation become

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<sup>3</sup> McAdam (2011b), p. 107.

<sup>4</sup> Anghie (2006), p. 741.

<sup>5</sup> Anghie (2006), p. 741.

<sup>6</sup> McLeman (2011), p. S108.

<sup>7</sup> Söderbergh (2011), p. 13.

<sup>8</sup> Söderbergh (2011), p. 13.

<sup>9</sup> McLeman (2011), p.S109.

**Table 7.1** Settlement abandonment process (adapted from McLeman<sup>a</sup>)

	Stage 0. Prosperous human settlement	Stage 1. Rising vulnerability, population rising or stable	Stage 2. Transition to population decline	Stage 3. Abandonment
Exposure to drivers	– The settlement is not subjected to any unusual environmental or anthropogenic stresses	– Drivers (anthropogenic and/or environmental) emerge or increase in frequency and/or severity	– Extended duration, increased severity, and an exacerbation of the effects due to combinations of multiple drivers – Potential emergence of additional drivers – Problems might be magnified by inadequate or inappropriate institutional responses	– Existing drivers persist and intensify – Additional drivers may emerge – Out-migration reduces adaptive capacity and itself becomes a driver
Adaptation responses	– No exceptional adaptation measures required	– <i>In situ</i> adaptation responses dominate – Adaptation is done by residents autonomously and/or by institutions	– <i>In situ</i> adaptation resources become increasingly drained – Other settlement destinations grow in appeal – Autonomous out-migration emerges, temporary and/or permanent in duration – Population instability and decline ensues	– <i>In situ</i> adaptive options become exhausted – Autonomous out-migration grows – Temporary migration becomes indefinite – Population decline accelerates – Institutional decisions become critical in determining outcome

<sup>a</sup>McLeman (2011), p. S117

increasingly depleted.<sup>10</sup> Eventually, the local conditions become so bad that all the inhabitants would be forced to leave (see Table 7.1).

The challenge is to identify what constitutes a voluntary and involuntary forced movement during this process of settlement abandonment, as often the lines between them are blurred, and many choices might involve a mixture of both.<sup>11</sup>

<sup>10</sup> McLeman (2011), p. S109.

<sup>11</sup> McAdam (2009), p. 3.

McAdams argues that this would be one of the reasons why a Convention on climate change displacement is an inappropriate response to the problem.<sup>12</sup> In the case of gradual environmental change displacement will start as a voluntary process (to a certain extent) and will become forced as the region becomes uninhabitable due to (for example) lack of potable water or longer periods of flooding.<sup>13</sup> In the same way that it can be claimed that this displacement has other causes (such as seeking better economic opportunities), the emphasis on only one factor<sup>14</sup> can lead to the result many developed countries appear to desire: preventing the establishment of a framework for the protection of people displaced by climate change stressors. Yet another argument is that in most cases the displacement is likely to be predominantly internal or gradual and not in the proportion that has been always argued.<sup>15</sup>

The body of jurisprudence that is used to discuss climate change movements is currently based on natural and environmental disasters, which typically cause a sudden movement of people, while climate change is often considered as a slow onset movement.<sup>16</sup> The former has a clear cause, such as floods, tsunamis, earthquakes, but in the latter the drivers cannot be identified with the same certainty. However, according to the scientific community (as exemplified in the IPCC 4AR and in Chap. 3) it is widely accepted that climate change will lead to an increase in intensity and/or frequency of some natural disasters, such as floods or tropical cyclones. But how to distinguish what part of these events becomes more extreme as a consequence of climate change? In practical terms the protection which is provided to victims of natural disasters could also be applied in certain cases to climate change displacement, as the problem could become related to the increase in the frequency of episodic events finally making an area uninhabitable.

There are various challenges regarding the question of whether a refugee, Internal Displaced People (IDP), complementary protection or temporary protection legal frameworks can be applied. Would the movement of people from Atoll Island States be voluntary or not? What would be necessary to identify the motives for migration? For the case where there are frequent storms and flooding (which could harm agricultural activities) if the population decides to go somewhere else, would this be considered environmental displacement or migration? To what extent the inhabitants would have to wait for the increase in sea level to cause the destruction of their crops to leave? Since the displacement caused by a deterioration of the environment can also have other drivers it is difficult to clearly establish a

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<sup>12</sup> McAdam (2011a), p. 14.

<sup>13</sup> Refugee Studies Centre (2011), p. 14.

<sup>14</sup> In this case whether the movement is “voluntary” or “involuntary”, which is a distinction that is very difficult to make.

<sup>15</sup> UN High Commissioner for Refugees (2011b), p. 8.

<sup>16</sup> Examples of slow-onset movement causes are land degradation, deforestation and forest degradation, declining abundance of fish, erosion of river banks and beaches, contamination of water resources, and coral degradation. See Barnett and Webber (2009), p. 7.

definition of what constitutes a “climate-change displaced person”. However, the main question is whether by focusing in such differences there is the possibility that a mechanism of protection can be established.

A variety of possible solutions have been proposed for the populations of Atoll Island States, ranging from stretching the 1951 Convention Relating to the Status of Refugees, to complementary protection (which is directed at asylum seekers who should not be returned to their countries of origin because of the risk of suffering human rights violations), to a creation of a new Convention to deal with climate-change displaced people. Furthermore, once these States become unable to provide basic services to their citizens, UNHCR<sup>17</sup> concluded that they would become *de facto* stateless, even if the government could secure continuity in its status as a State (see Chap. 6 for more details on how this could happen). Statelessness *de jure* occurs when the person is not considered as a national by any State under the operation of its law<sup>18</sup> and not due to the physical disappearance of a State. Under either situation, the citizens of Atoll Island States would be effectively in a limbo, becoming dependent on international solidarity to find a solution to their uncertain status. However, being in this limbo might not be the main issue, as it might be more important whether there is a political environment for the establishment of a new protection system, since these were created in the past due to the lack of a protection structure for each specific case.

In this chapter, we will discuss these issues to demonstrate that there is a gap of protection for the population of Atoll Island States and how the creation of a treaty to protect them would represent a change of paradigm in international human rights law, and thus why developed countries will probably not be willing to accept such a framework.

The discussions on what would be the best framework to protect the inhabitants of Atoll Island States usually starts with stretching the protection provided by the Convention Relating to the Status of Refugees. However, climate change displacement was not foreseen by this Convention, and the question is whether an overstretching interpretation is acceptable. Instead, we are going to argue that since the number of possible migrants for the case of Atoll Island States is not that high, a better approach would be to form bilateral agreements with countries that could accept the population of these States. However, it is clear that such a solution would not assist the development of a framework for the citizens of other States who are displaced by climate change. Thus, this solution would be case-specific, and would aim to solve only the problems of Atolls Island States. Even with a lack of bilateral agreements, soft law could assist on developing the protection system for displaced people. Soft law plays an important role in providing response to the needs of international social facts when there is a deadlock in the making of a legally binding instrument, which is exactly the case of what currently appears to happen with climate change displacement.

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<sup>17</sup> UN High Commissioner for Refugees (2011a), p. 14.

<sup>18</sup> Convention Relating to the Status of Stateless Persons, Art. 1(1).

## 7.2 Terminology Discussion

Many researchers have discussed how to designate individuals who are forced to leave their lands of origin due to environmental reasons. A variety of terms have been used by different authors to designate these people, such as “environmental refugees”, “climate refugees”, or “environmentally displaced people”. In this last term, the word “displaced” is used to emphasize the involuntary character of the movement.<sup>19</sup> However, as McAdam points out, there is at present no internationally agreed definition of what it means to be an environmental “migrant”, “refugee” or “displaced person”, and hence there is no common ground on which to systematically progress on the discussion about how to respond to these situations.<sup>20</sup>

The term “climate” or “environmental refugees”, coined in the 1980s,<sup>21</sup> is technically inaccurate because only the traditional type of refugees are actually protected under the 1951 Convention Relating to the Status of Refugees. The United Nations High Commission for Refugees (or UNHCR, a part of the UN with the mandate to provide protection for refugees<sup>22</sup>) avoids the use of the terms “environmental refugee” or “climate refugee” because they are inaccurate and misleading<sup>23</sup> and perhaps due to the fear that they could raise misconceptions that UNHCR should also extend its protection to them.

According to these definitions (and notwithstanding the fact that the term refugee is not accurate in this sense) the denomination of “environmental refugees” would be seen to apply to certain situations when a sudden environmental event (such as a volcanic explosion or a tsunami) forces the population of an area to flee.

<sup>19</sup> Refugee Studies Centre (2011), p. 11.

<sup>20</sup> McAdam (2009), p. 3.

<sup>21</sup> Söderbergh (2011), p. 2.

<sup>22</sup> Ways of providing protection by UNHCR are enlisted in the *Statute of the Office of the United Nations High Commissioner for Refugees*, 14 December 1950, A/RES/428(V), available at: <http://www.unhcr.org/refworld/docid/3ae6b3628.html>. Accessed 26 January 2012. Para. 8 provides that “The High Commissioner shall provide for the protection of refugees falling under the competence of his Office by: (a) Promoting the conclusion and ratification of international conventions for the protection of refugees, supervising their application and proposing amendments thereto; (b) Promoting through special agreements with Governments the execution of any measures calculated to improve the situation of refugees and to reduce the number requiring protection; (c) Assisting governmental and private efforts to promote voluntary repatriation or assimilation within new national communities; (d) Promoting the admission of refugees, not excluding those in the most destitute categories, to the territories of States ;(e) Endeavouring to obtain permission for refugees to transfer their assets and especially those necessary for their resettlement; (f) Obtaining from Governments information concerning the number and conditions of refugees in their territories and the laws and regulations concerning them; (g) Keeping in close touch with the Governments and inter-governmental organizations concerned; (h) Establishing contact in such manner as he may think best with private organizations dealing with refugee questions; (i) Facilitating the co-ordination of the efforts of private organizations concerned with the welfare of refugees.”

<sup>23</sup> See UNHCR (2011c), Summary of Deliberations on Climate Change and Displacement, UNHCR expert meeting 26–28 February, 2011, Bellaggio, Italy.

These “environmental refugees” would also include “climate refugees”, those people who would be fleeing their homelands due to changes in the climatic conditions of an area.

Among other reasons why the term “environmental refugees” should not be used it is worth mentioning the political connotations associated with it, as it is often employed by refugee lobby groups and anti-refugee lobby groups to pressure governments, and therefore the term has specific policy implications.<sup>24</sup> It could be also argued that this term was created in part to depoliticize the causes of displacement which allow States to derogate their obligation to provide asylum.<sup>25</sup>

It is important to understand that there is a certain narrative emerging, which portrays the inhabitants of Atoll Island States as the first “climate refugees” in the planet. This has been emphasized by the representatives of some of these nations, and for example the government of Tuvalu has marketed its population as the world’s first “climate refugees”.<sup>26</sup> This has, however, drawn criticism from some of the inhabitants of those same nations.<sup>27</sup> Farbotko and Lazrus<sup>28</sup> quote the opinions of several individuals of Tuvalu, such as:

We wouldn’t like to eventually get forced out of our place and be classed as environmental refugees. That has a negative attachment to it. It’s like considering ourselves like second-class citizens in the future. (. . .) And the question is, who has the right to deny myself the joy of feeling human, of feeling fully human? Because we are born equal and we should be treated equally.<sup>29</sup>

The governments of other Atoll Island States such as Kiribati also reject this terminology. They believe it steals inhabitants of their dignity, and instead present the population as a potential labour force that could be re-skilled and make an economic contribution to developed countries in the region.<sup>30</sup> The perception of refugees amongst the populations of these islands is not one of people with resilience, but rather as passive victims relying on handouts and with no prospects for the future.<sup>31</sup> Men also describe this situation as one of failure to be able to provide and protect for their family, and would rather not be seen on this way.<sup>32</sup> When speaking of the prospect of relocation to other countries, they describe the

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<sup>24</sup> Dun et al. (2007), p. 3.

<sup>25</sup> Kibreab (1997), p. 21.

<sup>26</sup> McAdam (2009), p. 6.

<sup>27</sup> See for example Farbotko and Lazrus (2011), pp. 382–390 and McNamara and Gibson (2009), pp. 475–483.

<sup>28</sup> Farbotko and Lazrus (2011), p. 387.

<sup>29</sup> Opinion of an NGO Director in Funafuti, as interviewed by Farbotko and Lazrus (2011), p. 387.

<sup>30</sup> Speech of Aote Tong, President of Kiribati at the Australian National University, 19 June 2008 (<http://news.anu.edu.au/?p=437>) as quoted by McAdam (2009) p. 7.

<sup>31</sup> McAdam (2011b), p. 116.

<sup>32</sup> Interview between Jane McAdam and the Kiribati Solicitor-General David Lambourne, as explained in McAdam (2011b), p. 116.

importance of becoming active and valued members of a community.<sup>33</sup> Part of the discomfort of the population seems to stem from the fact that they are not being forced to flee their lands due to the actions of their governments, but are aware of the fact that they might have to do so in the future due to the influence of other countries on their environment.<sup>34</sup>

The term “environmental refugee” can thus be miss-leading from a legal point of view and unwelcomed by the inhabitants of Atoll Island States. In this book the term “climate-change displaced people” will be used to define those who may have to leave due to climate change stressors (and in particular the inhabitants of Atoll Island States). It would form a subgroup of the bigger group “environmentally displaced people”. However, in many cases it might not be so easy to distinguish between the two, as climate change will probably bring about an increase in natural disasters (as explained in Chap. 3).

One of the first problems in defining these groups of people would be how to differentiate between migrants that are moving to improve their standard of living and those that are escaping adverse environmental conditions.<sup>35</sup> Using Table 7.1, it is clear that any migration that occurs during Stage 0 (that of a prosperous settlement) would be for economic or personal reasons, and in Stage 3 it would be due to environmental causes (the area becoming uninhabitable). However, in between these two stages both of the drivers would be somehow inter-related. Increasingly adverse environmental conditions would mean that many inhabitants would not be able to sustain an adequate standard of life, forcing them to migrate. The ultimate cause would be environmental, though the inhabitants could theoretically still try to stay by accepting increasing hardships and a lower quality of life. Also, migration is in many ways an adaptation process, where part of the population migrates and sends home remittances, a portion of which will be used to attempt to increase the adaptive capacity of those that stayed in place. This appears to already be the case in many Atoll Island States, where migration has for a long time been part of the economic life of the islands.<sup>36</sup> Hence, the situation is far more complex than what is often pictured.

Climate-change displaced people could be classified depending on how far they will be displaced,<sup>37</sup> with each type posing different legal and policy challenges to the country and its relations with other countries:

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<sup>33</sup> Interview between Jane McAdam and the Kiribati Solicitor-General David Lambourne, as explained in McAdam (2011b), p. 116.

<sup>34</sup> Interview between Jane McAdam and the Kiribati Solicitor-General David Lambourne, as explained in McAdam (2011b), p. 116.

<sup>35</sup> Myers (2001), p. 162.

<sup>36</sup> See Farbotko and Lazrus (2011), p. 2.

<sup>37</sup> The classification was adapted from Displacement Solutions (2009), pp. 16–17.

- Local Displacement, people displaced by sea-level rise, lack of clean water, increasingly frequent storm surges or coastal inundation could relocate within a short distance to higher lands.<sup>38</sup> An example of where this has already happened (though not related to climate change) includes some villages in Samoa, where the local inhabitants decided to relocate to higher areas following the 2009 Samoan tsunami.<sup>39</sup> The problem for Atoll Island States is that, unlike places such as Samoa, there is no higher ground nearby to relocate to, and hence this option is not really open to them.
- Internal Displacement. This would be people who are displaced inside the borders of their own country, but far from their places of origin.<sup>40</sup> An example of this would be the inhabitants of the Carteret Islands in Papua New Guinea, some of whom have started to relocate to the larger island of Bougainville.<sup>41</sup> For the case of Atoll Island States it is likely that at first the inhabitants of some of the more vulnerable atolls will have to relocate to more stable or protected islands, but ultimately as the last of the islands is threatened then this could force all inhabitants to leave their country altogether.
- Regional or Inter-Continental Displacement,<sup>42</sup> which would involve the individuals from one country moving to another nearby (regional displacement) or far-away nation, such as for example the citizens of Tuvalu moving to New Zealand or the U.K.

### ***7.2.1 Distinction Between Environmentally Displaced People and Climate-Change Displaced People***

The International Organization for Migration (IOM) proposes to define “environmental migrants” as

persons or groups of people who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move either within their country or abroad.<sup>43</sup>

<sup>38</sup> Disasters are considered to be the major driver of short-term displacement and migration, and an increase in the intensity and frequency of these events can increase the number of temporarily displaced people, see Warmer et al. (2009), p. IV.

<sup>39</sup> Mikami et al. (2011).

<sup>40</sup> The people who undergo this type of displacement have been termed “internally displaced people” or IDPs. As yet there is no international instrument on IDPs, as technically these people would be within their national boundaries and international law cannot govern them. For the case of Atoll Island States this issue is not crucial as ultimately there will be nowhere for them to relocate to within the boundaries of their country. However, for more details on IDPs see Atapattu (2009), p. 607.

<sup>41</sup> Rakova (2009).

<sup>42</sup> This could also be referred to as “international migration”, see Martin (2010).

<sup>43</sup> International Organization for Migration (IOM) 2007, p. 2.



In the present book, we prefer to use the term environmentally displaced people, to avoid the connotation that the word “migrant” gives, as it is often associated with economic migrants.

Not all environmentally displaced people, however, will be displaced due to climate change. In fact, many great environmental disasters (such as the eruption of the volcano in the island of Montserrat<sup>44</sup>) are entirely natural in origin or are dependent on direct human interference with the local environment.<sup>45</sup> Although these situations force the inhabitants of an area to seek refuge in other lands, none are the result of anthropogenic interference with the global climate. Many of these can also be caused by changing local weather conditions (for example as a consequence of the drying of the sea of Aral the local climate was changed, decreasing local rainfall and causing desertification<sup>46</sup>). Thus, in this book we have decided to use the term climate-change displaced people to refer to those that are forced to move as a consequence of changing global environmental conditions (such as raising sea levels or changing rainfall patterns) caused by anthropogenic increases in greenhouse gas emissions rather than local alterations in the weather. Since the object of the study is the displacement of the inhabitants of Atoll Island States it will specifically refer to sea level rise and the reasons why coral islands cannot keep up with it (such as the possible death of coral reefs caused by ocean acidification and the warming of the sea, as explained in Chap. 3).

It would be challenging to distinguish between those that are displaced by natural weather oscillations (such as periodical draughts that affect different parts of the planet) and events exacerbated by anthropogenic influences on the global climate. For example, an event such as the Ethiopian famine of the mid 1980s was caused by a draught, and other events such as the civil war in Darfur in Sudan have also been attributed to environmental problems (among other causes),<sup>47</sup> though these are generally not claimed to be influenced by human interference on the global climate. In this case, the drought in the 1970s strained the coping mechanisms of sedentary and nomadic populations in the region, reducing the land available to both types of communities, leading to subsequent violence.<sup>48</sup> Also, many of these environmental problems cannot be divorced from the political realities that influence them.<sup>49</sup> In fact, as McAdam points out there is an “absence of sound empirical evidence about the links between environmental degradation and migration, and the numbers of people likely to be affected”.<sup>50</sup>

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<sup>44</sup> McLeman (2011), p. S111.

<sup>45</sup> International Organization for Migration (IOM), 2007. The sea of Aral is an example of this interference with the local environment, see McLeman (2011), p. S110.

<sup>46</sup> Park (2001), p. 397.

<sup>47</sup> Suliman and Osman (2011), p. 57.

<sup>48</sup> Söderbergh (2011), p. 10.

<sup>49</sup> McAdam (2009), p. 4.

<sup>50</sup> McAdam (2009), p. 4

Nevertheless, climate-change displaced people (especially in the case of the inhabitants of Atoll Island States) can be characterised as populations that cannot return to their homes; possibly migrating in large numbers and collectively; following a predictable pattern since the need for relocation as a result of climate change is evident and; having a moral claim for assistance against industrialized countries which are the major emitters of greenhouse gas.<sup>51</sup>

The number of people that could be displaced as a consequence of climate change is highly uncertain, with predictions ranging from 150 million to a billion people.<sup>52</sup> The Stern review, one of the most quoted and authoritative review on climate change in 2007 says that 200 million would be a conservative number.<sup>53</sup> In the Asia-Pacific region alone it has been estimated that by 2050 about 75 million people could be forced to leave their homes due to climate change, with the number growing to 150 million by 2100.<sup>54</sup> For the case of Pacific Islands (not just atoll islands) it is believed that there is the potential for up to 8 million people to be forced to relocate.<sup>55</sup> Considering only Atoll Island States, such as Kiribati, Tuvalu and the Maldives, the numbers of people involved are small, involving around 576,900 people<sup>56</sup>(as seen in Table 2.3 in Chap. 2). However, from a legal perspective the number of people who might have to move does not affect the normative response to the issue, although this might have important consequences for the way in which the response is implemented.<sup>57</sup>

In formulating possible solutions to the problem of any of these categories, it is important to consider whether it will affect all environmentally displaced people or only climate-change displaced people. Atapattu<sup>58</sup> argues that “it would be better to establish a legal framework to deal with all environmentally displaced people with specific principles governing those who have crossed an international border”. However, grouping these two together appears flawed, as it would make the victims of climate change (where this can be attributed mostly to other States) equal to the individuals of countries which mismanaged their own environment. Is it fair for a country that did not mismanage its environment to have to deal with the plight of the citizens of another country that did? From an ethical perspective a State should always attempt to help citizens of other countries, though a difference should be made on who caused the environmental problems.

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<sup>51</sup> Hodgkinson et al. (2010), p. 10.

<sup>52</sup> Displacement Solutions (2009), p. 15.

<sup>53</sup> Stern (2007), p. 77.

<sup>54</sup> Maclellan (2009), p. 37.

<sup>55</sup> Maclellan (2009), p. 37.

<sup>56</sup> Of course this number could grow in the future due to natural population growth in the islands. However, it is unlikely that the inhabitants of all these countries will be forced to migrate, as some (such as the Maldives) probably have the resources necessary to protect and raise the islands, as discussed in Chap. 4.

<sup>57</sup> McAdam (2009), p. 3.

<sup>58</sup> Atapattu (2009), p. 607.

Nevertheless, certain protective measures could be applied even in this case, such as the principle that no one should be sent back to their home countries to suffer persecution (known as the principle of *non-refoulement*<sup>59</sup>). Some regional instruments could serve as example of how other forms of displacement could be protected with the application of this principle, as will be discussed later in this Chapter.

### 7.3 The 1951 Convention Relating to the Status of Refugees and “Climate-Change Displaced People”

Although there are substantial differences between climate-change displaced people and those who are eligible for refugee status, many authors have discussed the protection framework for the former based on a possible favourable interpretation of the 1951 Convention Relating to the Status of Refugees. The problems with this approach will be discussed in this section.

Refugee law is not considered to apply to environmentally displaced people (or to the climate-change displaced people subgroup) as they do not fulfil the conditions to become refugees. The Convention relating to the Status of Refugees in its Art. 1 defines a person eligible for this status as someone who

Owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable, or owing to such fear, is unwilling to avail himself of the protection of that country; or who, not having a nationality and being outside the country of his former habitual residence as a result of such events, is unable or, owing to such fear, is unwilling to return to it.

The 1951 Convention stresses out the “persecution” by authorities of the country, local populace and sizeable fractions of the population<sup>60</sup> as the basis for refugee protection. This definition was determined initially by the context that followed World War 2 and later largely in response to Cold War expectations and needs.<sup>61</sup> The UNHCR Handbook on Procedures and Criteria for Determining Refugee Status (UNHCR Handbook), a guide to determine who qualifies as a refugee, does not include victims of natural disasters. In addition, a study requested by UNHCR reaches the conclusion that the root-causes of a person’s displacement must be of political nature, which therefore excludes victims of natural disasters from the definition of the refugee known to international law.<sup>62</sup>

According to McAdam and Saul, there are three main obstacles to apply the Convention Relating to the Status of Refugees to climate change induced displacement:

<sup>59</sup> Convention Relating to the Status of Refugee, art. 33(1).

<sup>60</sup> UNHCR Handbook, para.65.

<sup>61</sup> Hong (2001), p. 323.

<sup>62</sup> Hong (2001), p. 331, referring to Jacques Vernant, the Refugee in the Post- War World 5-7 (1953).

1. The requirement of being outside the country of origin, which causes a problem for people who have not crossed an international border (this, however, will ultimately not apply to the inhabitants of Atolls Island States, as it is possible that some of these countries will become completely submerged, forcing their inhabitants to flee to foreign lands, as explained in Chap. 3)
2. That climate change should be considered as persecution and
3. That the persecution is on the grounds of race, religion, nationality, political opinion or membership of a particular social group.<sup>63</sup>

Regarding points 2 and 3 it is not clear what would be the agent of persecution and whether a vulnerable group can be characterized as being persecuted in the context of climate displacement. Would the agent of persecution be climate change itself or the State?

The first possibility would mean that rising sea-levels, increases in salinity, earthquakes and floods would characterize the persecution. In the second case it would relate to the lack of measures from States suffering from climate change to remedy these crisis situations. When a refugee status assessment is made, the agent which persecutes the asylum seeker can be his or her State of origin, but other agents can also be recognized as a persecutor.<sup>64</sup> In a far stretching interpretation, which could assist those who were forced to leave due to climate change, it could be argued that persecution could occur when there is a deliberate intention by a State to harm a determined social group.<sup>65</sup> Moreover, if a certain group of people suffer human rights violations due to climate change, it could also be claimed that there is possibility of asking for protection.<sup>66</sup> The nexus<sup>67</sup> could be established by

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<sup>63</sup> McAdam and Saul (2008), pp. 7–8.

<sup>64</sup> “Persecution is normally related to action by the authorities of a country. It may also emanate from sections of the population that do not respect the standards established by the laws of the country concerned. A case in point may be religious intolerance, amounting to persecution, in a country otherwise secular, but where sizeable fractions of the population do not respect the religious beliefs of their neighbours. Where serious discriminatory or other offensive acts are committed by the local populace, they can be considered as persecution if they are knowingly tolerated by the authorities or if the authorities refuse, or prove unable, to offer effective protection”, para.65, UNHCR Handbook.

<sup>65</sup> Especially if this is a vulnerable group such as women, children or indigenous people, who are considered to be the groups most affected by poverty, see Ammer (2009), pp. 51–52.

<sup>66</sup> “Being *unable* to avail himself of such protection implies circumstances that are beyond the will of the person concerned. There may, for example, be a state of war, civil war or other grave disturbance, which prevents the country of nationality from extending protection or makes such protection ineffective. Protection by the country of nationality may also have been denied to the applicant. Such denial of protection may confirm or strengthen the applicant’s fear of persecution, and may indeed be an element of persecution”, para. 98, UNHCR Handbook.

<sup>67</sup> Nexus or causal link is established when the well-founded fear of persecution is on account of one of the protected grounds, which are race, religion, nationality, political opinion or membership in a social group.

connecting the well-founded fear of being persecuted due to other characteristics, such as gender and age.<sup>68</sup> However, this interpretation does not take into consideration that the government of the State of origin cannot be burdened alone by the consequences of the climate change.

Exploring possibilities of defining “persecution” by the government of a certain State in the context of environmental degradation, there are some that argue that this could constitute a form of persecution if there is a delayed response such as what happened for example in the Chernobyl disaster. In this case there were arguments that the impacts were accentuated by the actions of the Soviet government at the time and that “environmental refugees” could be considered as a social group which would be under the protection of Art. 1 of the Convention Relating to the Status of Refugees.<sup>69</sup>

However, these interpretations of “persecution”, which only brings accountability for States which are facing the environmental consequences caused by climate change, still do not place any responsibility on developed countries, which are mainly to blame for the causes of the displacement. The challenge of applying the concept of “persecution” and “well-founded fear” are demonstrated by the decision of New Zealand Refugee Status Appeals Authority:

This is not a case where the appellants can be said to be differentially at risk of harm amounting to persecution due to any one of these five grounds. **All Tuvalu citizens** face the same environmental problems and economic difficulties living in Tuvalu. Rather, the appellants are **unfortunate** victims, like all other Tuvaluan citizens of the **forces of nature** leading to the erosion of coastal and the family property being partially submerged at high tide.<sup>70</sup> (emphasis added)

It becomes clear by this decision that particular characteristics such as a person’s background or beliefs are required by the New Zealand Refugee Status Appeals Authority to constitute persecution. However, there are authors who claim that the affected population (in this case the inhabitants of Tuvalu) are members of a “particular social group” who are being persecuted. Under such an approach it is argued that Tuvaluans have “immutable characteristics” -their culture, home, and history- for which they suffer persecution.<sup>71</sup> This interpretation of “particular social group” addresses the causes of persecution, but it does not deal with who is the agent of persecution. When the government does not have the capability to protect its entire population, but would do it if it could, can that be considered as persecution? Would the agent of persecution be high greenhouse gas emitting industrialized States?

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<sup>68</sup> Ammer (2009), pp. 51–52.

<sup>69</sup> Williams (2008), p. 508.

<sup>70</sup> Cited by UN High Commissioner for Refugees (2011b), p. 14, Refugee Appeal No. 72189/2000, RSAA (17 August 2000).

<sup>71</sup> Duong (2010), p. 1265.

Massive human rights violations are also included as a factor to grant refugee status according to the Cartagena Declaration.<sup>72</sup> Furthermore, The Organization of African Unity (OAU) Convention governing the specific aspects of refugee problems in Africa allows for “events seriously disturbing public order in either part or the whole of his country of origin or nationality” as legitimate grounds for refugee status.<sup>73</sup> The Cartagena Declaration also establishes that refugees can be persons who are forced to leave their homes due to “circumstances seriously disturbing the public order”.<sup>74</sup> The expansive language of the African Union Convention and the Cartagena Declaration could encompass environmentally displaced people, but some critics argue that the protection offered by these regional agreements would be insufficient as they offer only temporary protection<sup>75</sup> (even though it would cover political intended persecution, as mentioned previously). The reasoning would be similar to violations of human rights due to civil war or natural disaster. It is important to focus on the fact that the Convention Relating to the Status of Refugees intends to protect refugees rather than establishing persecution responsibility for States. Therefore, human rights violations could be a ground to grant refugee status to climate-change displaced people, rather than attempting to establish what the origin of these violations are.

Despite these last points, it appears clear that the Convention Relating to the Status of Refugees is not applicable to climate-change displaced people, and thus the rights and protection options available to those affected are uncertain under international law, with no agency having a mandate to protect them.<sup>76</sup> In fact, this is something that has been agreed by a multitude of scholars and other actors in the

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<sup>72</sup> Americas - Miscellaneous, *Cartagena Declaration on Refugees, Colloquium on the International Protection of Refugees in Central America, Mexico and Panama*, 22 November 1984, available at: <http://www.unhcr.org/refworld/docid/3ae6b36ec.html>, para.3.

<sup>73</sup> Organization of African Unity, Convention governing the specific aspects of refugee problems in Africa, art. I, para.2, June 20, 1974, 1001 U.N.T.S.45.

<sup>74</sup> Paragraph 3. To reiterate that, in view of the experience gained from the massive flows of refugees in the Central American area, it is necessary to consider enlarging the concept of a refugee, bearing in mind, as far as appropriate and in the light of the situation prevailing in the region, the precedent of the OAU Convention (Art. 1, paragraph 2) and the doctrine employed in the reports of the Inter-American Commission on Human Rights. Hence the definition or concept of a refugee to be recommended for use in the region is one which, in addition to containing the elements of the 1951 Convention and the 1967 Protocol, includes among refugees persons who have fled their country because their lives, safety or freedom have been threatened by generalized violence, foreign aggression, internal conflicts, massive violation of human rights or other circumstances which have seriously disturbed public order. Americas - Miscellaneous, *Cartagena Declaration on Refugees, Colloquium on the International Protection of Refugees in Central America, Mexico and Panama*, 22 November 1984, available at: <http://www.unhcr.org/refworld/docid/3ae6b36ec.html>.

<sup>75</sup> Havard (2007), p. 77.

<sup>76</sup> McAdam and Saul (2008), p. 7.

debate.<sup>77</sup> Not only is this the case, but it is also unclear whether the application of this law would be the most advantageous scenario for the inhabitants of Atoll Island States. Refugee law can only be applied once a person has arrived to another State, and this may encourage spontaneous arrivals rather than a more planned movement, and thus is likely to be a far more traumatic experience.<sup>78</sup>

Finally it is important to note that although there are many challenges to the application of the Convention Relating to the Status of Refugees and its Protocol to the case of climate-change displaced people, States which ratified the Convention have discretion to interpret and extend the scope of protection. However, many States are instead trying to narrow down the scope of people who qualify for protection within their borders.<sup>79</sup> Therefore, and due to all these problems in attempting to apply an extensive interpretation of the Convention Relating to the Status of Refugees, some researchers have started to discuss a possible protection mechanism which would encompass climate-change displaced people.

### ***7.3.1 A Convention to Protect Climate-Change Displaced People?***

As explained in the previous section, the Convention Relating to the Status of Refugees cannot be applied in its present form to environmentally displaced people (or to the subgroup of climate-change displaced people). As a result there have been numerous suggestions for a Convention to protect climate-change displaced people.<sup>80</sup> Most of these proposals were made by academics, though there has also been a proposal by the government of the Maldives,<sup>81</sup> who in 2006 suggested that an amendment should be made to Art. 1A(2) of the Convention Relating to the Status of Refugees to provide an extension of protection to “climate refugees”.<sup>82</sup>

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<sup>77</sup> It has even been suggested by the term “environmental refugee” could even undermine the current refugee protection regime, according to Söderbergh (2011), p. 43. This author also cites how UN High Commissioner for Refugees, Mr. António Manuel de Oliveira Guterres, has repeatedly stated that environmentally displaced people in general cannot be considered refugees, p. 4.

<sup>78</sup> McAdam points out how it would be more appropriate for States to designate particular countries as demonstrating sufficient, objective characteristics to justify this movement, rather than having each individual proving how climate change is personally affecting them, in McAdam (2011b), p. 119.

<sup>79</sup> Moberg (2009), p. 1115.

<sup>80</sup> McAdam (2011b), p. 103.

<sup>81</sup> First meeting to discuss a Protocol on environmental refugees: recognition of environmental refugees in the 1951 Convention and the 1967 Protocol relating to the status of refugees, 14 and 15 August 2006, Maldives.

<sup>82</sup> McAdam (2011b), p. 103.

The extension of the concept would include people who are either internally or internationally displaced by the destruction of the environment due to natural disasters and anthropogenic influences.<sup>83</sup> In December 2009 the Bangladeshi Finance Minister also suggested that the Convention Relating to the Status of Refugees could be revised to protect climate-change displaced people, as this Convention had already been through other revisions.<sup>84</sup>

In this section we will explain how although several proposals could assist the case of climate-change displaced people the political and theoretical obstacles for its creation can undermine the chances of these proposals becoming reality. First, however, it is worth mentioning some of the major proposals that have been put forward by various groups of scholars.

A Draft for a Convention on the International Status of Environmentally displaced people was prepared by legal scholars at the University of Limoges led by Michel Prier.<sup>85</sup> David Hodgkinson, Tess Burton, Heather Anderson and Lucy Young also propose an alternative Convention on Climate Change persons that aims to protect internal and international displacement, which would establish criteria to designate a collective status for climate-change displaced people.<sup>86</sup> Falstrom suggests the framework of the Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment<sup>87</sup> could be applied to the case of environmentally displaced people. The advantage of applying the Convention against Torture is that it would guarantee that environmentally displaced people would not be returned to the countries where they could be in danger due to environmental problems, though at the same time it would not guarantee permanent residency.<sup>88</sup> Prier and Falstrom's proposals have a more comprehensive character than a Convention that only deals with climate change displacement, since they would include people who are displaced by environmental disasters and not only by climate-change.

Birmann and Boas suggested the creation of a "UNFCCC Protocol on the Recognition, Protection, and Resettlement",<sup>89</sup> and in their Protocol proposal they focus on the causes of the displacement.<sup>90</sup> They do not include a "voluntary"

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<sup>83</sup> Ramos (2011), p. 114.

<sup>84</sup> Grant, et al. (2009), <http://www.guardian.co.uk/environment/2009/nov/30/rich-west-climate-change>.

<sup>85</sup> Available on the internet at: [http://www.cidce.org/pdf/Draft%20Convention%20on%20the%20International%20Status%20on%20environmentally%20displaced%20persons%20\(second%20version\).pdf](http://www.cidce.org/pdf/Draft%20Convention%20on%20the%20International%20Status%20on%20environmentally%20displaced%20persons%20(second%20version).pdf), Accessed on 15 January 2012.

<sup>86</sup> Hodgkinson et al. (2010).

<sup>87</sup> Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment was adopted on 10 December 1984, and came into force on 26 June 1987.

<sup>88</sup> Falstrom (2001), p. 11.

<sup>89</sup> Birmann and Boas (2008), p. 12.

<sup>90</sup> They highlight three main possible causes, sea level rise, extreme weather events, and drought and water scarcity, p. 10.



element to recognize “climate refugee”<sup>91</sup> and extend the protection to internal and international migrants. Docherty and Giannini note that the definition provided by Boas has legal and scientific shortcomings and that it limits the protection to those suffering from certain prescribed climate change consequences, not allowing for future scientific discoveries on other problems to be included for protection.<sup>92</sup>

The proposal of Docherty and Giannini encompasses six elements to be met for an individual to be considered as a victim of climate change. These authors in fact recognize that a Convention would be a complementary effort to assist these populations<sup>93</sup> and hence argue that the problem of climate change displacement requires an inter-disciplinary approach which would involve science, economics, technological innovation, development, and poverty alleviation. Furthermore, it would require policies to decrease the number of people who need to leave. Elements for recognition of the “climate-change refugee” would be:

1. Forced migration
2. Temporary or permanent relocation
3. Movement across national borders
4. Disruption consistent with climate change
5. Sudden or gradual environmental disruption
6. A “more likely than not” standard for recognition for human contribution to the disruption<sup>94</sup>

The forced migration element differs from the proposal of Biermann and Boas, which does not include a “voluntary” element to the protection. Docherty and Giannini’s proposal also includes a global fund to finance the costs of the displacement, and those protected by it would not be able to receive assistance until they acquire a new nationality or could return home.<sup>95</sup> However, this could potentially leave the inhabitants of Atoll Island States unprotected if they became stateless, as explained later in this chapter.

The proposal of Docherty and Giannini introduces some of the principles of refugee protection, such as that of *non-refoulement*, which does not allow the return of asylum seekers who can face persecution and human rights violation into their countries of origin.<sup>96</sup> In their proposal, this principle would mean that displaced

<sup>91</sup> Biermann and Boas (2008), pp. 12-13.

<sup>92</sup> Docherty and Giannini (2009), p. 368.

<sup>93</sup> Docherty and Giannini (2009), p. 360.

<sup>94</sup> Docherty and Giannini (2009), p. 372.

<sup>95</sup> Docherty and Giannini (2009), p. 369.

<sup>96</sup> Art. 33 of the Convention Relating to the Status of Refugees states that 1. “No Contracting State shall expel or return (*refouler*) a refugee in any manner whatsoever to the frontiers of territories where his life or freedom would be threatened on account of his race, religion, nationality, membership of a particular social group or political opinion. 2. The benefit of the present provision may not, however, be claimed by a refugee whom there are reasonable grounds for regarding as a danger to the security of the country in which he is, or who, having been convicted by a final judgment of a particularly serious crime, constitutes a danger to the community of that country.

people should not be returned to areas where the land cannot sustain them, lacking the subjective factor of individual fear, which makes the refugee different from the mass of people.<sup>97</sup> For the case of the inhabitants of Atoll Island States, the case could even be stronger, as eventually a stage could be reached when it was not only impossible for the land to provide an adequate environment for humans, but that the ground itself would not even exist and returning the people would mean letting them drown (as explained in Chaps. 3 and 5).

The suggestions mentioned above range from offering at least the principle of *non-refoulement* to environmentally displaced people to the establishment of a global fund and securing a new nationality, among other rights. However, and although the proposals could in the future be agreed on by the international community and become a Convention, the fact remains that at the moment climate-change displaced people do not have a specific instrument to guarantee their rights.

### ***7.3.2 Challenges Regarding the Creation of a Convention to Protect Climate-Change Displaced People***

It is generally perceived by a number of commentators that there is a lack of political will to elaborate a Convention to protect people who are displaced by environmental and climate change reasons. Applying this Convention would also be difficult since that would weaken the existent framework of protection.<sup>98</sup>

McAdam, for example, opposes the view that a Convention would be the most appropriate solution for the case. Firstly, she emphasizes that treaty proposals are premised on assumptions about climate change and human movement do not have their roots in empirical studies.<sup>99</sup> For instance, the movement of people is likely to be predominantly internal<sup>100</sup> and not international, and that the treaties proposed attempt to address only international movement. Therefore, this commentator argues that there is a risk that the time and resources invested would be in detriment of other possible responses. Moreover, McAdam argues that suggesting that only climate change is the cause of displacement is not appropriate since there are

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<sup>97</sup> As explained previously, the subjective criteria requires that the applicant has a well-founded fear of being persecuted by their own government.

<sup>98</sup> Foundation for International Environmental Law and Development (FIELD) 2011, p. 7.

<sup>99</sup> See Chimni (1998), pp. 364–365, although many policies which were put into practice regarding refugee issues are also not necessarily based on empirical studies. Chimni explains how the theory of voluntary repatriation of refugees was not a result of extensive studies of the issues involved, but rather the combination between convenient theory, untested assumptions and the interests of States serving the interests of developed countries.

<sup>100</sup> One example is that there are nearly as many internal migrants in China alone (approximately 130 million people) as international migrants in all countries (estimated in 190 million in 2005) in Barnett and Webber (2009), p. 15.

other socio-economic factors that might influence the displacement of people, and therefore establishing the link between climate change and displacement would be almost impossible.<sup>101</sup>

Essentially, should the question of displacement be addressed in terms of what drives it, or rather in terms of the needs of those who move<sup>102</sup>? In this sense Wood created the term “ecomigrant”, which is a broad concept that includes anyone whose need to migrate is influenced by environmental factors. According to him, both economic and ecological factors exist in migration and it is difficult to separate them.<sup>103</sup> McAdam points out that

while international human rights law principles should inform any decisions relating to movement, a protection-like response may not necessarily respond to communities’ human rights concerns, especially those relating to cultural integrity, self-determination and statehood<sup>104</sup>

Although the link between climate change and displacement is not straightforward, the fact of not being able to “isolate” climate change is not necessarily an obstacle for the creation of a Convention. Authors often stress the difficulty in separating/isolating the factors and by doing so they also imply that the remaining elements which cause displacement do not deserve a protection framework. Part of the problem arises from the fact that if the remaining social economic factors were included<sup>105</sup> the Convention would protect not only climate change victims, but also individuals that coincidentally suffer from the lack of financial capacity of their governments to support adaptation policies. In any case, these are individuals who will be in need of assistance, but many policy makers and governments prefer an isolated approach instead of a holistic one. It is also no coincidence that this approach is preferred by many as it is widely known that economic and social agendas have not been the first priority in human rights bodies. They were always interpreted as deserving secondary treatment since their implementation should be made progressively. The populations of the States which will be more severely affected by climate change also typically suffer from a variety of other social and economic problems, and discussions on many of these issues are still avoided by the majority of developed States (a fact that can be seen by the small number of States

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<sup>101</sup> McAdam (2011a), pp. 1–26, and Myers (2001), p. 162.

<sup>102</sup> McAdam (2011b), p. 106.

<sup>103</sup> Castles refers to Wood, William B. In Castles (2002), pp. 1–2.

<sup>104</sup> McAdam (2011b), p. 106.

<sup>105</sup> It is important to note that if these other socio-economical factors were not important, then they would not be worth mentioning.

that ratified the International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families<sup>106</sup>).

States also lack the political will to negotiate a new instrument that would add more groups of people that could potentially fall under their protection.<sup>107</sup> This lack of political will might be related to security concerns which take for granted that environmental displaced people will “invade” developed countries, threatening welfare systems. The tendency after the end of Cold War is to establish policies to send back the flows of asylum seekers, and it is unlikely that developed States will create policies to receive other categories of people and consequently increase their perceived “burden”.

Hence, and although well elaborated suggestions of a Convention for environmentally displaced people and climate-change displaced people have been put forward, the obstacles for its negotiation and creation could prove to be insurmountable. A more viable approach for the case of Atoll Island States could be an agreement with host States which guarantees the same rights enumerated by the Convention proposals outlined in the previous section. For example, Hodgkins suggests that a possible solution could be to create bilateral agreements with host States<sup>108</sup> located close to them, in order to preserve their cultural heritage.<sup>109</sup> Bilateral agreements would not involve many actors, making the negotiations less complex than if it was a multi-party treaty. In addition, the characteristic of the movement of the population of Atoll Island States is different from that of climate change displacement as the temporary protection suggested by authors regarding the proposed Conventions should be replaced by a permanent resettlement. However, it would be difficult for Atoll Island States to have much negotiation strength without offering anything in return to potential host countries. In this case, the discussion regarding EEZ’s and the cession of territory explained in Chap. 6 could serve as a negotiation instrument for Atoll Island States.

Instead of using “hard law” options, climate change displacement could be tackled first using a soft law instrument, and then gradually be introduced into the domestic laws of various countries. Due to the present lack of legally binding instruments, and if no Convention can be approved, any protection for climate-change displaced people would fall under the existing United Nations Guiding

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<sup>106</sup> The International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families was ratified by 45 States and has 34 signatories in May 2012. The States which ratified the Convention are the ones who are sending the workers and not the ones who are receiving them. Available on the internet at [http://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtsg\\_no=IV-13&chapter=4&lang=en](http://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtsg_no=IV-13&chapter=4&lang=en).

<sup>107</sup> McAdam (2011a), p. 14.

<sup>108</sup> For many Pacific Island Nations the cases of Australia or New Zealand are often cited as possible host countries, due not only to the local proximity but other past and present cultural and historical links. Other possible destinations could include developing countries such as the Philippines or Indonesia, though it might be more difficult for these countries as they will themselves be facing increasing pressures due to the effects of climate change.

<sup>109</sup> Hodgkinson et al. referring to Biermann and Boas, p. 15.

Principles on Internal Displacement,<sup>110</sup> which is a soft law and thus not legally binding. It should also be emphasized how this document is a guide, which addresses only internal and not international displacement, and thus it would be more advantageous for Atoll Island States to push for some other sort of agreement as outlined previously.

### ***7.3.3 A Metaphor of Human Rights and the Creation of a Convention to Address Climate Change Displaced People***

Although the human rights movement is located within the historical continuum of “euro-centrism” as a civilizing mission, and therefore as an attack on non-European cultures, it is critical to note that it was European and not non-European atrocities that gave rise to it.<sup>111</sup>

In order to cover the lack of an existing regime which would provide an appropriate response to climate change displaced people, researchers have been attempting to apply the existent refugee system, complementary system and jurisprudence of regional and national human rights systems to draw analogies between refugees and climate change displaced people.

Whether this is the most appropriate method to address the topic is not certain, since even the researchers that propose such responses recognize that there are fundamental differences between the needs of climate-change displaced people and asylum seekers. For instance, the refugee procedure is based on individual examination, which would be impossible for climate-change displaced people since the results of climate change would affect uniformly all the inhabitants of a given region. This contrasts with what happens to asylum seekers, who have to claim and prove that they have an individual characteristic that makes them fear persecution by their own governments. Essentially this means that in the refugee system protection is limited to those who face a specific risk and not one that is faced generally by everybody in the same country.<sup>112</sup> It is interesting to note that these notions have changed in time, and that this was not the approach of the League of Nations High Commissioner for Refugees, which was established in 1924 and promoted population transfers and exchanges differently from the modern notions of individual rights.<sup>113</sup> In addition, climate-change displaced people would not

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<sup>110</sup> UN High Commissioner for Refugees, Guiding Principles on Internal Displacement, 22 July 1998, E/CN.4/1998/53/Add.2, available at: <http://www.unhcr.org/refworld/docid/3c3da07f7.html>.

<sup>111</sup> Mutua (2001), p. 208.

<sup>112</sup> See Immigration and Refugee Board of Canada, VB1-01229 in which the claimant argued that was fearing the excessive radiation leaking from damaged nuclear reactors in Fukushima and the panel rejected her claim since the risk was generalized and not specific as required by the Refugee Convention.

<sup>113</sup> Bosweel (2002), <http://isanet.ccit.arizona.edu/noarchive/boswell.html>.

serve any political interests for developed countries, as refugees did in the past during the Cold War.<sup>114</sup>

The provisions of the 1951 Convention Relating to the Status of Refugees clearly intended to protect individuals who were fleeing civil and political rights abuses rather than those who were fleeing poverty. In this sense the Convention was originally designed to protect people who would have found themselves escaping mainly ethnic and racial persecution under the Nazi regime, though it also intended to cover violations committed by the Soviet Union.<sup>115</sup>

To what extent is it possible for a legal instrument with a defined scope to extend its objective? The limits of the Convention Relating to the Status of Refugees were tested by Cold War politics when geographical and chronological limitations were removed through the Protocol Relating to the Status of Refugees (1967).<sup>116</sup> However, after the end of the Cold War the original regional character of restrictive legal and administrative measures has reappeared in European countries and the United States, in order not to provide refugee protection to asylum seekers who were coming from various regions.<sup>117</sup> Such examples can be seen in the creation of temporary protection to deal with the mass influx coming from the former Yugoslavia countries in the nineties, when the 1951 Convention protection was replaced by a temporary protection regime.<sup>118</sup> Recently European countries and the USA are creating other ways to dismantle the protection offered by the 1951 Convention Relating to the Status of Refugees. Furthermore, treaty making in the area of human rights has, in general, become very difficult due to a rapidly growing plurality of ideas and positions among States since the end of the Cold War.<sup>119</sup>

Under these circumstances it would be challenging to negotiate a protection mechanism targeting a new group of persons in the framework of human rights. Not only because States have limitations in their capacity to host people fleeing environmentally degraded areas, but also because this is not in the political interests of developed countries. These countries are typically unwilling to increase the perceived “burden” placed on their societies by receiving more people and to recognize their own responsibility regarding the emissions of greenhouse gases. In fact, most developed States appear to desire to restrict rather than improve this refugee regime, and it appears likely that in the future the system will worsen rather than improve.<sup>120</sup>

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<sup>114</sup> See Chimni (1998), p. 351. The author describes how after the Cold War finished and the refugee did not possess any ideological value. Developed countries started applying restrictive measures for the entrance of refugees.

<sup>115</sup> Bosweel (2002), <http://isanet.ccit.arizona.edu/noarchive/boswell.html>.

<sup>116</sup> Chimni (1998), p. 3.

<sup>117</sup> Chimni (1998), p. 3.

<sup>118</sup> Chimni (1998), p. 3.

<sup>119</sup> Kälin (2001), p. 2.

<sup>120</sup> Castles (2002), p. 12

Climate change displacement represents a complete reversal of the traditional refugee paradigm. Under the traditional Convention Relating to the Status of Refugees individuals flee their country of origin because of persecution by their government, but in the case of climate-change displacement people would try to seek protection in the countries that contributed the most to this climate-change.<sup>121</sup>

In this context a metaphor developed by Mutua, which explains each actor's role in international human rights law, can help us understand how a mechanism for the protection of climate-change displaced people would challenge the framework of international human rights<sup>122</sup> and of international environmental law. The use of this metaphor does not mean that there are no other obstacles to the creation of a new Convention, such as the multiple causal nature of the displacement of people or the slow onset of the movement, as mentioned earlier in this chapter. In this section we focus on the lack of political will that arises from the fact that such a Convention would open an exception to each actor's role in the current human rights framework.

Mutua's human rights metaphor distinguishes three major actors in the human rights system: "savages", "victims" and "saviours". States are considered as "savages" when they fail to implement international human rights instruments and commit violations, mostly related to civil and political rights, against people under their jurisdiction. "Victims" are those individuals mistreated by their own governments, which despite seeking national redress are left without any response by the State; and "saviours" are mostly the international bodies, including the United Nations and other International non-governmental organizations that usually have their foundations in the major cities of developed countries. These international bodies point out human rights violations that take place mainly in developing countries (either by government officials or due to the lack of remedies by the State concerned), working as a watchdog of regimes that fail to protect their own citizens.

In this context, human rights treaties would be a tool to assure that developing States guarantee the enjoyment of rights to their own citizens. It is on this point on which a treaty on climate-change displaced people would be unusual in the current international human rights system. Human rights treaties often aim to implement the values of Western developed countries on developing countries. A climate change displacement Convention would have a different character since it would impose duties on developed States. How to protect people who might be displaced by anthropogenic environmental changes? The system of international human rights is composed by instruments that require the investigation, prosecution and punishment of violators, the "rogue States" that do not implement the treaties that they have ratified. In the case of climate change issues it is not simple to define who are these "rogue" States, as all countries currently emit greenhouse gases. This in

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<sup>121</sup> See UN High Commissioner for Refugees (2011b), p. 12, or McAdam (2011b), p. 116.

<sup>122</sup> Mutua (2001), pp. 201-245.

itself is completely unrelated to whether they guarantee the human rights of their citizens or not.

Going back to the origins of human rights law might help to understand that a climate-change displacement Convention would defy the philosophy behind the current human rights system. From the genesis of the movement, human rights were not conceived with the idea to protect or save non-Europeans. The Convention Relating to the Status of Refugees is an example of this. It was established with a geographical and temporal clause that would allow as refugees citizens of European States. Only in 1967, the Protocol Relating to the Status of Refugees enlarged the protection to other nationalities.<sup>123</sup>

Although developing countries currently participate in the making of United Nations treaties the levers of power at the organization and other international law-making institutions have traditionally been out of the reach of the third world.<sup>124</sup> The displacement of people by sea level rise emphasizes that those typically pictured as “saviours” (i.e. those from developed countries) are in this case in the uncomfortable position of “savages”, as they are contributing to an increase in the vulnerability of Atoll Island States due to their emissions of greenhouse gases.<sup>125</sup> Therefore, developed countries would be failing to play their perceived role of “saviours” and “guardians” of societies that eliminate the problems of victims in distant States.<sup>126</sup>

Furthermore, displacement due to environmental reasons has usually been caused by changes in global climate, which traditionally had been attributed to the work of deities or the vagaries of nature. Even nowadays, some people do not believe that climate change is caused by human activities, but rather that it is due to long-term planetary trends.<sup>127</sup> Until recent times, with the development of science, these situations were not attributed to human activities and States would not consider that they had an obligation to compensate others for climate conditions.<sup>128</sup> *Ab initio* it appears that not all States will be willing to accept the casual connection between the changes in the environment and the emission of greenhouse gases, and the straightforward connection between climate change and human displacement. It is also unlikely that developed countries would be happy to switch their position

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<sup>123</sup> Art. 1(3)The present Protocol shall be applied by the States Parties hereto without any geographic limitation, save that existing declarations made by States already Parties to the Convention in accordance with Art. I B (I) (a) of the Convention, shall, unless extended under Art. I B (2) thereof, apply also under the present Protocol.

<sup>124</sup> Mutua (2001),p. 216.

<sup>125</sup> Knox (2009), p. 489.

<sup>126</sup> Mutua (2001), p. 228.

<sup>127</sup> The Rasmussen report shows data that claims that 39% of the interviewed people believe that climate change is due to planetary trends and 40% believe that this is due to human activity. The [http://www.rasmussenreports.com/public\\_content/politics/current\\_events/environment\\_energy/energy\\_update](http://www.rasmussenreports.com/public_content/politics/current_events/environment_energy/energy_update). Note that we are not climate sceptics, and that the inclusion of this footnote is merely to acknowledge that views on what is causing climate change are not necessarily uniform.

<sup>128</sup> Weiss (2008), p. 616.



from one of “saviours” to “savages” by admitting their own responsibility in causing the displacement of people through the release of greenhouse gases into the atmosphere. A way of redeeming the “wrongs” caused would be to accept those displaced into their countries. If developed countries accepted this, their role would be dual, as both “savages” and “saviours”. What would remain the same is that the “victims” would once again be from developing countries, as they have lower adaptive capacities and resilience compared to people in the more industrialized countries.

However, despite of the fact that developing States will probably suffer more the consequences of climate change than developed States, this does not necessarily mean that they should be considered only as “victims” in the context of these environmental issues. Both developed and developing States have in common the fact that they defend their self-interests prior to being more proactive in environmental affairs.<sup>129</sup> Therefore, developing and emergent countries would actually have a dual simultaneous role as both “savages” and “victims”. While developed States, in their role as “saviours”, typically place socio-economic rights as a secondary priority in their discourses concerning human rights, the exactly opposite policy by developing States (i.e. emphasizing socio economic rights) hampers their efforts to commit to environmental negotiations. Such a situation was summarised by the statement by Indira Ghandi that “poverty is the worst form of pollution”,<sup>130</sup> demonstrating that discussions of environmental issues can be interpreted as a hindrance to development.

Atoll Island States, despite being at the centre of the current debate on climate change (through their membership of AOSIS, as explained in Chap. 4) and taking an active part in climate change negotiations, lack the power to force developed countries to actually sign any legally binding treaties. The UN system in a sense gives small States a disproportionate power in comparison to their population (where for example a small State such as Tuvalu has the same weight at the general assembly as China, despite a difference in five orders of magnitude in their respective populations). Bodansky, for example questions

why should Nauru with a population of approximately 7.000, have an equal say in global issues as China and India, with populations one hundred times as large? Why should AOSIS have forty two votes while the US comprising 50 semi-sovereign states and a population more than 10 times as large has only one?<sup>131</sup>

However, despite this the UN system does not allow small States to force their will on more populous members, and as such despite small States being at the centre of the discussions they are far from being at the centre of the decision-making processes. To make developed States accept the rule of the “savages”, i.e. the countries that they typically criticise through country reports and which could result in them accepting an influx of people into their own backyards, is a challenging task which is likely to

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<sup>129</sup> Beyerlin (2006), p. 266.

<sup>130</sup> Quoted in Najam (2005), p. 308.

<sup>131</sup> Quoted in Beyerlin (2006), p. 282.

frighten the governments of many countries. Hence there does not seem to be much political support for this at the moment,<sup>132</sup> and it appears unlikely that a Convention that will include climate-change displaced people will be created in the near future.

However, a good alternative for a Convention to protect climate-change displacement would be the use of soft law<sup>133</sup> or bilateral agreements. As in the case for internally displaced people, for which The Guiding Principles on Internal Displacement<sup>134</sup> were created, the ambiguity of the status of a soft law on climate-change displacement would avoid a sense of caution from the instrument, allowing its application. This constitutes one of the advantages for the use of a soft law document,<sup>135</sup> as will be explained later in this chapter. Therefore, a more conciliatory approach would be possible if a soft law instrument was used, which would be better than dividing the world into developed and developing States or as “saviours”, “victims” and “savages”, since climate change poses a global scale challenge. In fact all categories of countries are responsible for climate change to some extent, as all are greenhouse gas emitters, and emphasizing a divide would be counterproductive as arguably what the world needs is to focus on what unites us rather than what separates us.<sup>136</sup>

## 7.4 Complementary and Temporary Protection

It could be argued that another alternative for the protection of climate-change displaced people would be to include them in the framework of complementary and temporary protection. However, this could be difficult since the concept of “serious harm”, which is required for example by EU Council Directive 2004/83/EC, does not include environmental displacement. Moreover, temporary protection applies to the sudden rather than the slow onset movements that are believed will probably be caused by climate change. Nevertheless, there is a remote possibility that climate-change displacement could be included under these types of protections.

Complementary protection denotes protection granted by States on the basis of an international agreement or treaty outside the Convention Relating to the Status of Refugees framework. Such protection may be based on a human rights treaty, such as the International Covenant on Civil and Political Rights (ICCPR), the Convention against Torture, or the Convention on the Rights of the Child.<sup>137</sup>

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<sup>132</sup> Displacement Solutions (2009), p. 8.

<sup>133</sup> Soft law is a non legally binding instrument, such as principles, declarations, resolutions, etc.

<sup>134</sup> The Guiding Principles on Internal Displacement is a non binding instrument based on international humanitarian and human rights law and analogous refugee law, serving as an international standard to guide governments, international organizations and all other relevant actors in providing assistance and protection to IDPs.

<sup>135</sup> Abe (2005), p. 233.

<sup>136</sup> Mickelson (2009), p. 411.

<sup>137</sup> McAdam (2007), pp. 2–3.

One of the main pillars of such protection is the principle of *non-refoulement*: States should not return to their country of origin individuals who are at risk of suffering due to reasons that are established in the Convention Relating to the Status of Refugees. The main provision regarding this principle can be found in the 1951 Convention Relating to the Status of Refugees which establishes that:

No Contracting State shall expel or return ('refouler') a refugee in any manner whatsoever to the frontiers of territories where his life or freedom would be threatened on account of his race, religion, nationality, membership of a particular social group or political opinion.

This article does not allow any restrictions to its application and it is also an obligation under the 1967 Protocol to Refugees, according to Art. I(1) of that instrument.

Other instruments that offer some degree of complementary protection include the United Nations Declaration on Territorial Asylum, regional instruments such as the Organisation of African Union (OAU) Convention Governing the Specific Aspects of Refugee Problems in Africa, the American Human Rights Convention, the Resolution on Asylum to Persons in Danger of Persecution, adopted by the Committee of Ministers of the Council of Europe on 29 June 1967, the United Nations Convention against Torture, the International Covenant on Civil and Political Rights or the European Convention for the Protection of Human Rights and Fundamental Freedoms.<sup>138</sup>

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<sup>138</sup> Art. 3(1) of the UN Declaration on Territorial Asylum unanimously adopted by the General Assembly in 1967 [res. 2312 (XXII)]. "No person referred to in Art. 1, paragraph 1, shall be subjected to measures such as rejection at the frontier or, if he has already entered the territory in which he seeks asylum, expulsion or compulsory return to any State where he may be subjected to persecution." The OAU Convention Governing the Specific Aspects of Refugee Problems in Africa of 1969 gives expression in binding form to a number of important principles relating to asylum, including the principle of non-refoulement. According to Art. II (3): "No person shall be subjected by a Member State to measures such as rejection at the frontier, return or expulsion, which would compel him to return to or remain in a territory where his life, physical integrity or liberty would be threatened for the reasons set out in Art. I, paragraphs 1 and 2." Art. 22(8) of the American Human Rights Convention adopted in November 1969 provides that "In no case may an alien be deported or returned to a country, regardless of whether or not it is his country of origin, if in that country his right to life or personal freedom is in danger of being violated because of his race, nationality, religion, social status or political opinions." In the Resolution on Asylum to Persons in Danger of Persecution, adopted by the Committee of Ministers of the Council of Europe on 29 June 1967, it is recommended that member governments should be guided by the following principles: "1. They should act in a particularly liberal and humanitarian spirit in relation to persons who seek asylum on their territory. 2. They should, in the same spirit, ensure that no one shall be subjected to refusal of admission at the frontier, rejection, expulsion or any other measure which would have the result of compelling him to return to, or remain in, a territory where he would be in danger of persecution for reasons of race, religion, nationality, membership of a particular social group or political opinion." Art. III (3) of the Principles concerning the Treatment of Refugees adopted by the Asian-African Legal Consultative Committee at its Eighth Session in Bangkok in 1966, states that: "No one seeking asylum in accordance with these Principles should, except for overriding reasons of national security or safeguarding the populations, be subjected to measures such as rejection at the frontier, return or expulsion which would result in compelling him to return to or remain in a territory if there is a well-founded fear of persecution endangering

### 7.4.1 *Under What Circumstances Could Complementary or Temporary Protection Possibly be Applied to Environmentally Displaced People?*

The EU Council Directive 2004/83/EC has as its main objective to make Member States apply an uniform criteria when identifying individuals who should receive international protection and to provide them with at least minimum benefits.<sup>139</sup> The Directive establishes subsidiary protection to a

country national or a stateless person who does not qualify as a refugee but in respect of whom substantial grounds have been shown for believing that the person concerned, if returned to his or her country of origin (or of former habitual residence) would face a real risk of suffering **serious harm**, and to whom the exclusion clause does not apply, and is unable, or, owing to such risk, unwilling to avail himself or herself of the protection of that country.<sup>140</sup>

The question of whether this definition could include individuals displaced due to environmental reasons requires the analysis of the term “serious harm” provided in the Directive. It enumerates as possible causes the death penalty or execution, torture, inhuman or degrading treatment or punishment, and serious and individual threat to a civilian’s life or person by reason of indiscriminate violence in situations of international or internal armed conflict.<sup>141</sup> Thus, although this EU Directive does not seem to be applicable to the case of environmentally displaced people, Kolmannskog and Myrstad argue that these communities could be protected by applying the regime of temporary protection for the case of a sudden influx of people due to an environmental crisis, since Art. 2(c), which sets out the Directive’s scope of application, does not provide an exhaustive list of persons that would qualify for temporary protection.<sup>142</sup> However, for the case of climate-change displaced people this could represent a problem, especially if the effects are

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his life, physical integrity or liberty in that territory.” The United Nations Convention against Torture Art. 3 provides that no State Party shall expel, return (“refouler”) or extradite a person to another State where there are substantial grounds for believing that he or she would be in danger of being subjected to torture. In the same way, Art. 7 of the International Covenant on Civil and Political Rights has been interpreted as prohibiting the return of persons to places where torture or persecution is feared. Art. 3 of the European Convention for the Protection of Human Rights and Fundamental Freedoms has been interpreted by the European Court of Human Rights as implicitly prohibiting the return of anyone to a place where they would face a “real and substantiated” risk of ill-treatment in breach of the prohibition of torture or inhuman or degrading treatment or punishment.

<sup>139</sup> Number 6, European Union: Council of the European Union, *Council Directive 2004/83/EC of 29 April 2004 on Minimum Standards for the Qualification and Status of Third Country Nationals or Stateless Persons as Refugees or as Persons Who Otherwise Need International Protection and the Content of the Protection Granted*, 19 May 2004, 2004/83/EC, available at: <http://www.unhcr.org/refworld/docid/4157e75e4.html> [accessed 27 February 2012].

<sup>140</sup> Art. 2(e) Qualification Directive.

<sup>141</sup> Art. 15. Qualification Directive.

<sup>142</sup> Kolmannskog and Myrstad (2009), p. 4.

permanent or long-lasting, such as the disappearance of islands. Also, climate-change impacts might have a slow onset, with the population slowly abandoning the settlement, which would not cause a collective mass displacement.

Temporary protection has the scope to establish minimum standards for providing protection in the case of a mass influx of displaced persons from third countries which are unable to temporarily return to their country of origin.<sup>143</sup> The difference between complementary and temporary protection is that the latter consists of a short-term emergency response to a large amount of asylum seekers, while the former is not an emergency protection system. It is an alternative to the refugee status granted by the 1951 Convention and 1967 Protocol. Therefore, individuals that could receive complementary protection would receive instead temporary protection in an emergency event.<sup>144</sup>

An example of how a State can amplify protection based on humanitarian grounds is how the Brazilian government extended protection to the case of Haitians affected by the 12 January 2010 earthquake. Although Brazilian Refugee Protection Law<sup>145</sup> does not include natural disasters as a reason to provide asylum, the Brazilian Immigration National Council issued Normative Resolution n° 97 (12 January 2012)<sup>146</sup> providing permanent residence to the Haitians.

The national legislation of some countries also provides temporary protection for the case of environmental disasters in a foreign State. The US 1965 Immigration and Nationality Act,<sup>147</sup> section 244 establishes a Temporary Protected Status (TPS) for conditions of environmental disaster or armed conflict in a foreign State which results in a disruption of living conditions, when the foreign State has requested the designation and is unable, temporarily, to handle the return of its own nationals. In these cases, this designation can be granted to certain countries, as decided by the Attorney General.<sup>148</sup>

The Finnish and Swedish Aliens Act recognise the need for protection caused by natural disasters. According to the Finnish Aliens Act, “aliens residing in the country are issued with a residence permit on the basis of a need for protection if [...] they cannot return because of an armed conflict or **environmental disaster** (emphasis added)”.<sup>149</sup> The Swedish Aliens Act, in its “others in need of protection”

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<sup>143</sup> Art. 1, European Union: Council of the European Union, Council Directive 2001/55/EC of 20 July 2001 on Minimum Standards for Giving Temporary Protection in the Event of a Mass Influx of Displaced Persons and on Measures Promoting a Balance of Efforts Between Member States in Receiving such Persons and Bearing the Consequences Thereof, 7 August 2001, OJ L.212-223 7.8.2001, 2001/55/EC, available at: <http://www.unhcr.org/refworld/docid/3ddcee2e4.html>. Accessed 27 February 2012.

<sup>144</sup> Mandal (2005), p. 3.

<sup>145</sup> Law n° 9.474/97.

<sup>146</sup> Claro (2012), p. 68.

<sup>147</sup> US (1965) Immigration and Nationality Act.

<sup>148</sup> Currently, the United States is providing this type of status to El Salvador, Haiti, Honduras, Nicaragua, Somalia, Sudan and South Sudan, <http://www.uscis.gov/portal/site/uscis/menuitem.eb1d4c2a3e5b9ac89243c6a7543f6d1a/?vgnextoid=848f7f2ef0745210VgnVCM100000082-ca60aRCRD&vgnextchannel=848f7f2ef0745210VgnVCM100000082ca60aRCRD>.

<sup>149</sup> Section 88 *Need for protection* (1).

section encompasses foreign nationals who cannot return to their home country because of an environmental disaster.<sup>150</sup> Kolmannskog argues that the Swedish *travaux préparatoires* recognize that natural disasters might cause a temporary need for protection as well as longer-term disaster scenarios such as the “sinking” islands, identifying the need for international burden-sharing and durable solutions.<sup>151</sup>

Kolmannskog implies that the same understanding of environmental disasters could apply to climate change displacement although there is a difference on the grounds that environmental disasters cause a sudden mass displacement and climate change displacement might not be characterised by this sudden onset but be more gradual. However in this respect it is important to consider that climate change displacement can also cause an increase in the number of natural disasters, which could cause sudden massive displacements of people. An atoll that had its environment severely damaged as a consequence of slowly rising sea levels and dying corals could survive for a number of years, and then have an episodic event (such as a tropical cyclone) cause massive damage and force its inhabitants to flee, as outlined in Chap. 3. On these grounds it might be possible to place the victims of climate change under this kind of protection. However, awaiting such an event would place the inhabitants at great danger, as a significant number of individuals could perish. Attempting to seek protection in such a way could thus prove a dangerous course of action for the inhabitants of Atoll Island States.

## 7.5 Use of Bilateral Agreements

As discussed earlier in this Chapter a Convention to protect environmental and climate change displacement is unlikely to be agreed anytime soon. A more feasible approach for Atoll Island States would probably be the establishment of bilateral agreements with potential host States.

In fact, a number of bilateral programs already exist, and although not established to specifically deal with climate change problems they can serve as a model for the development of future agreements to deal with possible displacements. Bilateral agreements generally deal with geopolitical and economic relationships, and allow States to develop responsive policies in a timeframe that corresponds to the capacity of the countries involved.<sup>152</sup> The advantage of this approach is that the parties involved can discuss directly how the citizens would migrate and what rights could be secured by them. These agreements could be

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<sup>150</sup> Chapter 5 Refugees and others in need of protection 2 § nr. 3. English version of the Swedish law is available at <http://www.sweden.gov.se/content/1/c6/06/61/22/fd7b123d.pdf>.

<sup>151</sup> Kolmannskog (2009), p. 4.

<sup>152</sup> Williams (2008), p. 518.

drafted relatively quickly, especially compared to multilateral treaties involving many parties, which would be more costly and time-consuming to agree.

Some examples of existing bilateral agreements that manage migrant's rights currently allow the inhabitants of Pacific Islands to relocate to Australia or New Zealand. The New Zealand's Pacific Access Category enables 75 residents from Tuvalu to immigrate to New Zealand, and the seasonal labour scheme will allow up to 5,000 workers from 5 Pacific nations to work within the agricultural sector.<sup>153</sup> The agreement establishes a special quota for citizens of Tuvalu (with individual quotas for Kiribati, Fiji, and Toga) to get residence in New Zealand, with their partners and dependent children. However, there are some limitations to those who can apply for the Programme.<sup>154</sup> Australia has also recently developed a Pacific labour program which will allow Pacific islanders to work in the agricultural sector and which is seen by many as a precursor to a larger plan that could allow larger numbers of Tuvaluans to settle in Australia.<sup>155</sup> There is likely to be increasing pressure for these quotas to be raised, as the number of applicants for these programs has increased dramatically in recent times (yearly applications from Tuvalu have increased from 100 in 2002/3 to 600 in 2007/8 and in Kiribati from 300 in 2002/3 to 3,000 in 2007/8).<sup>156</sup>

There are, however, a number of problems with these schemes. One of them is their temporary nature, where those who take part only go for a certain amount of time to earn some money and ease the shortage of non-skilled labour in the agricultural sector of the countries sponsoring it.<sup>157</sup> The schemes are not in themselves designed to address the issue of climate change displacement, though they can contribute to strengthen the adaptive capacities of the home countries through the remittances sent home by those who take part in them.

A further problem is that these schemes could prove inefficient if the population of Atoll Island States continues to increase.<sup>158</sup> In this respect the government of Kiribati has finalised its Integrated Land and Population Development Programme, as part of the broader National Republic of Kiribati Climate Change Adaptation

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<sup>153</sup> Displacement Solutions (2009), p. 35.

<sup>154</sup> Williams (2008), p. 515.

<sup>155</sup> Displacement Solutions (2009), p. 22.

<sup>156</sup> Maclellan (2009), p. 36.

<sup>157</sup> Boege (2010), p. 22.

<sup>158</sup> Assuming that the population growth rate stays the same, allowing 75 people in Tuvalu to emigrate (out of a total population of just over 10,000) each year to New Zealand would only ensure that the population remains stable in the future, according to the authors' own calculations. For the case of Kiribati much larger numbers would be required each year just to keep the population from growing.

(CCA) Strategy.<sup>159</sup> The Government plans to stabilise the population at 125,000 by 2025 though a combination of large-scale inter-island relocation (to decrease overcrowding in the capital, which at 8,000 persons per square kilometre has a population density similar to Hong Kong) and family planning programs.<sup>160</sup> Kiribati does not see this as a forced displacement but rather as a long, thought out, planned process, which will require developing the education and skills of their populations to better adapt to the labour demands of other countries.<sup>161</sup>

It is important to consider also that these programs have typically been gestures of goodwill or constructed as migration policies, rather than protection responses.<sup>162</sup> So far neither Australia nor New Zealand have shown a willingness to accept the entire population of these islands, in spite of the fact that Tuvalu's 10,000 or so inhabitants would be a fraction of the 200,000 immigrants that settle in the country each year.<sup>163</sup> Also, it seems that many of the islanders are actually reluctant to move and some eventually return home,<sup>164</sup> although of course this situation could change in the future if the environment in the islands deteriorates.

Regarding a regional solution the UNFCCC currently promotes regional policy development, including adaptation strategies, as Williams notes.<sup>165</sup> We also agree that a regional response or bilateral agreements would be the best solution for Atoll Island States. However, when there are irreconcilable differences and many challenges exist to setting up a binding agreement, another possible solution that could be explored is the use of soft law. Indeed, in cases of bilateral negotiations on climate change displacement or migration some countries prefer to keep the level of compromise to Memoranda of Understanding, a non-legally binding agreement.

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<sup>159</sup> Assuming that the population growth rate stays the same, allowing 75 people in Tuvalu to emigrate (out of a total population of just over 10,000) each year to New Zealand would only ensure that the population remains stable in the future, according to the authors' own calculations. For the case of Kiribati much larger numbers would be required each year just to keep the population from growing.

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<sup>161</sup> Maclellan (2009), p. 37.

<sup>162</sup> McAdam (2009), p. 30.

<sup>163</sup> Climate-change displaced people and Housing, Land and Property Rights. Preliminary Strategies for Rights-Based Planning and Programming to Resolve Climate-Induced Displacement. Report by Displacement Solutions 2009 p. 21.

<sup>164</sup> McAdam (2009), p. 30.

<sup>165</sup> Williams (2008), p. 519 The UNFCCC states in Art. 19(b) that all parties shall agree to "formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change and measures to facilitate adequate adaptation to climate change".



## 7.6 Soft Law

Soft law refers to non-legally binding documents signed by States, which have the possibility of eventually developing into something legally binding. Such documents serve as a guide for States when they are willing to follow it, though if they do not comply it does not constitute a violation of international law.

Soft law is a paradoxical term for defining an ambiguous phenomenon. Paradoxical because, from a general and classical point of view, the rule of law is usually considered “hard,” i.e., compulsory, or it simply does not exist.<sup>166</sup>

Although “soft law” is not legally binding, most of them are written based on principles and norms established in international instruments, such as the International Covenant on Civil and Political Rights (ICCPR), the International Covenant on Economic, Social and Cultural Rights (ICESCR), the Declaration on the Elimination of Violence against Women (1993), or the Declaration on the Right and Responsibility of Individuals, Groups and Organs of Society to Promote and Protect Universally Recognized Human Rights and Fundamental Freedoms (Declaration on Human Rights Defenders, 1999).<sup>167</sup> There are some “soft law” instruments which have also acquired authority over time, such as the 1948 Universal Declaration of Human Rights, which has some articles that are currently considered as customary law. Documents which were signed by States and do not satisfy the requirements of a treaty, informal exchanges of promises through diplomatic correspondence, or votes in international organizations are some other examples of soft law.<sup>168</sup>

The political climate for negotiations to a Convention to address climate change displaced people show that it is unlikely that an agreement will be reached in the near future. Moreover, there has so far been a lack of success to obtain commitments to binding obligations under either the Kyoto Protocol or the UNFCCC, which demonstrates a trend away from legally binding obligations in the climate change regime.<sup>169</sup> Hence, it cannot be expected that an entirely new, climate-related treaty with binding obligations is feasible.<sup>170</sup>

The reasons why States prefer to use soft law instead of hard law in some situations relate to how soft law has lower contracting costs and does not implicate a loss of sovereignty, i.e., it does not restrict their freedom of action and it is a good alternative to deal with uncertainty.<sup>171</sup> A soft law commitment is also easier and faster to achieve since it does not have to undergo a long ratification process as in the case of hard law. Furthermore, some legally binding treaties do not even enter

<sup>166</sup> Dupuy (1991), p. 420.

<sup>167</sup> International Council on Human Rights Policy (2006), p. 16.

<sup>168</sup> Guzman and Meyer (2010), p. 173.

<sup>169</sup> McAnaney (2012), p. 1202.

<sup>170</sup> McAnaney (2012), p. 1202.

<sup>171</sup> Abbot and Snidal (2000), pp 434-444.

into force or only have a limited number of parties. Soft law allows governments to make more ambitious commitments than they would do in a binding treaty.<sup>172</sup> In the case of climate change displaced people, since it seems difficult that States would agree in making a Convention that encompasses their protection, the application of soft law could bridge the formalities of law-making and the needs of international life.<sup>173</sup> Soft law has been used when there is a clear deadlock in negotiations where disparities in wealth, power, and interests make binding agreement impossible.<sup>174</sup>

However, climate change displaced people are not the only who suffer from the lack of a legally binding instrument. There are other categories of people who also need protection, such as the economic migrants and people who flee due to natural disasters.<sup>175</sup> The major example of soft law in the field of human displacement is the framework to the Guiding Principles on Internal Displacement. These guidelines do not require States to take more obligations, but rather facilitate the implementation of such norms into domestic law. The merit of using a Guideline for climate change displacement would be that States would choose when and in what conditions they might turn such guidelines into hard law in their domestic legislation. They would be free to interpret and implement norms and comply or not with their interpretation of the guideline.<sup>176</sup>

A suggestion of a guideline in the field of climate change was sent to 145 governments at UNHCR's high-level Ministerial Meeting in December 2011, but only four countries demonstrated interest in order to assess protection gaps for environmental displacement. In addition, UNHCR's Standing Committee, comprised of States, turned down a proposal for a pilot scheme in which UNHCR would become the lead agency for the protection of those affected by natural disasters.<sup>177</sup>

In a different effort, after the Nansen Conference on Climate Change and Displacement, in June 2011, the "Nansen Principles"<sup>178</sup> were adopted. However, these principles were defined not as a soft law, but rather a "policy framework for addressing disaster-induced displacement by identifying key actors and relevant areas of activity".<sup>179</sup>

Currently, the Convention on the Protection and Assistance of Internally Displaced Persons (IDP) in Africa, adopted in October 2009, in Kampala by the African Union, is the only instrument which deals with the climate change displacement in its Art. 5(4) and sets forth that State Parties "shall take measures to

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<sup>172</sup> Köppel (2009), p. 824.

<sup>173</sup> Abe (2005), p. 233.

<sup>174</sup> Chinkin (2000), p. 41.

<sup>175</sup> UN High Commissioner for Refugees (2008), p. 2.

<sup>176</sup> UN High Commissioner for Refugees (2008), p. 14.

<sup>177</sup> McAdam (2012a), p. 4.

<sup>178</sup> Kälin (2012), p. 48.

<sup>179</sup> Kälin (2012), p. 48.

protect and assist persons who have been internally displaced due to natural or human made disasters, including climate change”.

## 7.7 Statelessness

If Atolls Island States physically disappear and there is a lack of State continuity (as discussed in Chap. 6) or the government becomes ineffective it has been argued that their inhabitants could lose their citizenship. In order to demonstrate whether the concept of statelessness can be applied to this situation, the stateless legal regime and its application to the case of Atoll Island States will be discussed in the following pages.

### 7.7.1 *Statelessness and Atoll Island States*

In the case of an environmental disaster, a host country or region can give environmentally displaced people temporary protection, allowing them to eventually return to their countries or regions when the situation is stabilized, as explained previously in this chapter. However, people that are displaced by sea level rise and/or erosion of coastal areas, such as the inhabitants of Atoll Island States, could eventually find themselves in the “Permanent Climate-Change Displaced Persons” category (see Fig. 7.1).

Concerning the uncertain situation of the inhabitants of Atoll Island States UNHCR submitted a note on the need for early action to prevent statelessness.<sup>180</sup> Funding should be made available for adaptation, the implementation of the Bali Action Plan<sup>181</sup> and the prevention of stateless, as this is a principle recognized in international law.<sup>182</sup> UNHCR also organized expert roundtables on displacements related to climate change in Bellagio in February 2011,<sup>183</sup> where the situation of “sinking islands” was also discussed.<sup>184</sup>

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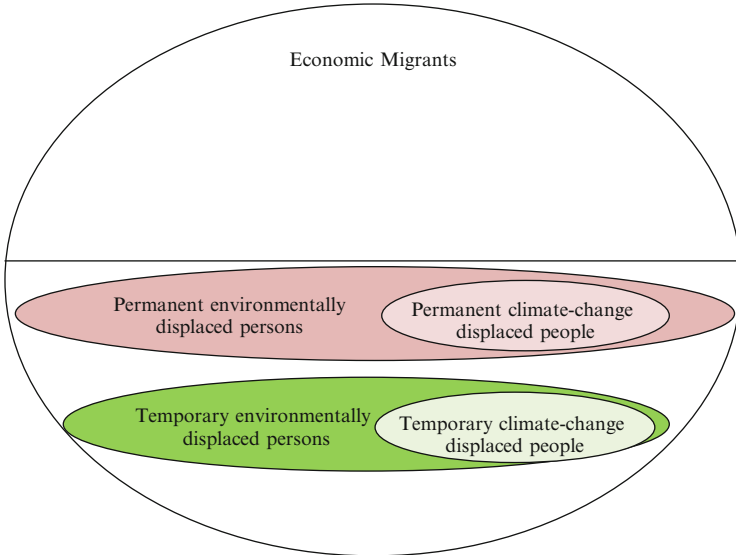
<sup>180</sup> The difficult situation of stateless people relates to the problem that international law is based on legal instruments which establish relations between States. If the individual does not have a nationality, i.e., the element that connects her/him to the State, it means that this person will not enjoy any international rights before international law. See Batchelor (1995), p. 233.

<sup>181</sup> UNHCR (2009).

<sup>182</sup> The prevention of statelessness is connected to the right to nationality provided by the Universal Declaration of Human Rights in its Art. 15.

<sup>183</sup> Celebrating the 60<sup>th</sup> anniversary of the 1951 Geneva Convention and the 40<sup>th</sup> anniversary of the 1961 Convention on the Status of Stateless Persons.

<sup>184</sup> The papers of this roundtable are available at <http://www.unhcr.org/cgi-bin/texis/vtx/search?page=&comid=4e01e63f2&keywords=Bellagio-meeting>.



**Fig. 7.1** Classification of migrants into those seeking better fortunes (economic migrants) and environmentally displaced people. Part of these environmentally displaced people would also be affected by climate change, while for others the displacement would be due to a deterioration in their local environment (such as due to volcanoes or local industrial pollution). Environmentally displaced persons can be permanent or temporary, depending on whether they can eventually go back to their lands or not. The inhabitants of Atoll Island States could eventually find themselves in the “Permanent climate-change displaced people” category

Stateless individuals have a twofold protection under international instruments, namely through the Convention Relating to the Status of Stateless Persons (1954) and the Convention on the Reduction of Statelessness (1961). Art. 1 of the 1954 Convention Relating to the Status of Stateless Persons defines a stateless individual as “a person who is not considered a national by any State under the operation of its law”. Unlike refugees, however, stateless persons in most countries are not registered or granted legal status and documentation.<sup>185</sup> The international treaties on statelessness do not consider the physical disappearance of the land on which a State is located. For this unprecedented situation, the prevention of statelessness through the succession of States has been mentioned,<sup>186</sup> as it provides guidance on the acquisition of nationality after the political disappearance of a State. A traditional view of succession of States would provide that the nationality of individuals affected by a change of sovereignty is to be determined by the domestic law of the

<sup>185</sup> According to the UNHCR 2010, 2009 Global Trends. Refugees, Asylum-seekers, Returnees, Internally Displaced and Stateless Persons. <http://www.unhcr.org/statistics> Accessed 24th December 2011. In 2009 there were almost 6.6 million stateless persons in the world, though the real number worldwide was estimated to be around 12 million people.

<sup>186</sup> McAdam (2012a), p. 140.

States concerned.<sup>187</sup> Therefore, in the event of the political disappearance of a country the States involved should apply their own domestic law to resolve the situation. However, neither statelessness treaties nor the domestic laws of States provide solutions for the physical disappearance of the land on which these States are based.

In fact, statelessness is usually classified into two categories, which adds an important nuance to the discussion at hand:

- Statelessness *de jure*, which is the situation of a person who is not considered as a national by any State under the operation of its law.
- Statelessness *de facto*, when a person has a nationality which is not effective.<sup>188</sup>

Usually, statelessness results from a legal dispute between several countries that prohibits the obtainment of a nationality either by *jus soli* (territorial criteria) or by *jus sanguinis* (blood criteria), a loss of nationality; or an administrative error.<sup>189</sup> The usual ways of not being considered a citizen by any country therefore do encompass the case of Atoll Island States. Situations that might cause statelessness (linked to succession of States) include:

- When a State becomes independent from a colonial power, after its dissolution
- When a new State succeeds a dissolved State
- When a State is restored after a period of dissolution<sup>190</sup>

Blitz classifies the sources of statelessness into primary and secondary. The primary sources are:

- (a) denial and deprivation of citizenship;
- (b) withdrawal and loss of citizenship.

As for the secondary sources he enumerates:

- (c) political restructuring and environmental displacement;
- (d) practical barriers which prevent people from accessing their rights to nationality<sup>191</sup>

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<sup>187</sup> Bustamante Code Art. 13 states that “In collective naturalizations, in case of the independence of a State, the law of the acquiring or new State shall apply, if it has established in the territory an effective sovereignty which has been recognized by the State trying the issue, and in the absence thereof that of the old State, all without prejudice to the contractual stipulations between the two interested States, which shall always have preference”. See Blackman (1997–1998), p. 1152.

<sup>188</sup> UNHCR organized a meeting to discuss the concept of stateless persons under international law, Expert meeting organized by the Office of the United Nations High Commissioner for Refugees, Prato, Italy, 27-28 May 2010, summary is available at <http://www.unhcr.org/cgi-bin/texis/vtx/home/opendocPDFViewer.html?docid=4cb2fe326&query=prato>.

<sup>189</sup> Cournil (2011), p. 367.

<sup>190</sup> UNHCR (2005), p. 34.

<sup>191</sup> Blitz (2009), p. 9.

Thus, the population of Atoll Island States would fall under the secondary sources of statelessness proposed by Blitz,<sup>192</sup> i.e. under both items c and d shown above. An important consideration in this case would be whether other States and the UN continue to recognize the continued international personality of Atoll Island States or not (as discussed in Chap. 6).

In order to avoid statelessness, the principle of the prevention of statelessness has been developed and recognised in international law and specific instruments have addressed the prevention and reduction of this problem, including the 1961 Convention on the Reduction of Statelessness.<sup>193</sup>

Art. 10 of the 1961 Convention on the Reduction of Statelessness provides that States parties should ensure that statelessness does not occur as a result of a transfer of territory. To this avail States should sign bilateral or multilateral treaties that ensure that statelessness does not take place when the ownership of a territory changes hands. However there is no provision for the event of the disappearance of a State, and this situation would require new solutions to be sought between the various parties. UNHCR suggests the creation of multilateral comprehensive agreements which would provide where and on what legal basis the inhabitants of Atoll Island States would be allowed to move elsewhere.<sup>194</sup>

If the Atoll Island State government was still recognised and operated, individuals who depart to foreign lands to escape the submersion of certain islands would not be considered as stateless. However, gradually as the Atoll Island State loses more islands and becomes unable to provide services to its citizens, those displaced could become *de facto* stateless. In other words these individuals would still theoretically belong to a State, but if their government was unable to issue them with passports or other documents, for all practical purposes they would be stateless. Problems of application of the stateless regime to the case of the Atoll Island States start from the fact that the main point of discussions of climate caused displacement is to protect and extend State links, whereas in this case Atoll Island States could lose their entire territory<sup>195</sup> and cease to exist (as discussed in more detail in Chap. 6).

An example of a State with a government that had limited functions (if any) and therefore was not operating as such is that of Somalia during the end of the twentieth and beginning of the twenty-first century.<sup>196</sup> In this case the State ceased to function in 1991 following the dictatorship of Siade Barre, and it was impossible for many of its inhabitants to obtain documents that could be recognised by a foreign government, as stated by the New Zealand government:

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<sup>192</sup> Blitz (2009), p. 9.

<sup>193</sup> UNHCR (2009), p. 2.

<sup>194</sup> UNHCR (2009), p. 3.

<sup>195</sup> Cournil (2011), p. 368.

<sup>196</sup> At the time of writing this book Somalia was still in civil war, and even now it is unclear how much functions the internationally recognised government can provide, as it is restricted to the capital and some narrow areas of land.

There is currently no authority in Somalia that is recognised by the New Zealand Government as being competent to issue passports on behalf of Somalia. As a result Somali passports are not acceptable travel documents for travel to New Zealand and visas or permits must not be endorsed in them. Endorsement should be made in a NZIS Certificate of Identity, or another acceptable travel document.<sup>197</sup>

According to some scholars, there is actually some uncertainty regarding the possibility of applying the statelessness regime to the case of Atoll States. McAdam and Saul point out that citizens of Atoll Island States would not be protected due to the fact that the definition of statelessness is premised on the denial of nationality through the operation of the law of a particular State, rather than through the State disappearing.<sup>198</sup> Moreover, it is hard to distinguish if these people will be considered as migrants or forcedly displaced, as sea level rise is a gradual process.<sup>199</sup>

There are other authors who claim that according to the presumption of continuity of States, the use of terms such as “disappearance” or “sinking” of the islands should be avoided.<sup>200</sup> However, it is also unclear that even under this presumption of continuity they would be able to ensure the rights which flow from citizenship.<sup>201</sup> It is likely that such governments would face some restrictions to their activities, and their citizens could find themselves in a situation similar to or the same as if the State had ceased to exist, becoming *de facto* stateless.<sup>202</sup> This category of individuals do not find protection under the Convention of Stateless people although the Final Act of the 1961 Convention “recommends that persons who are stateless *de facto* should as far as possible be treated as stateless *de jure* to enable them to acquire an effective nationality”.

### ***7.7.2 The Right to a Nationality to Prevent the Statelessness of the Inhabitants of Atoll Island States***

The prevention of statelessness is also based on the various human rights instruments that provide for the right to a nationality. The Universal Declaration of Human Rights in its Art. 15 states that “no one should arbitrarily be deprived of his nationality nor the right to change his nationality”.

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<sup>197</sup> New Zealand Immigration (2010).

<sup>198</sup> McAdam and Saul (2008), p. 9.

<sup>199</sup> Kolmannskog and Trebbi (2010), p. 6.

<sup>200</sup> UNHCR (22-25 February 2011) Summary of Deliberations of the expert meeting on Climate Change and Displacement, p. 2, available on the internet at <http://www.unhcr.org/4da2b5e19.html>, para.30.

<sup>201</sup> United Nations General Assembly, A/64/350, 11<sup>th</sup> Sept 2009, sixty-fourth session, item 114 of the provisional agenda.

<sup>202</sup> UNHCR (2009), Climate Change and Statelessness: An Overview. 6<sup>th</sup> session of the Ad Hoc Working Group on Long-Term Cooperative Action (AWG-LCA 6) under the UNFCCC, 1-12 June 2009, Bonn, Germany.

Nationality was for the first time set forth in the 1930 Convention on Certain Questions Relating to the Conflict of Nationality Law. Art. 1 provides that

it is for each State to determine under its own law who are its nationals. This law shall be recognized by other States in so far as it is consistent with international conventions, international custom, and the principles of law generally recognized with regard to nationality.<sup>203</sup>

The meaning of nationality under traditional international law was that of ‘excluding others’ and to defend the territory if the nation was under external aggression. That has gradually changed to the status of a membership of a community based upon a common history, culture, ethnicity and/or common political convictions and values.<sup>204</sup> Nationality is traditionally a matter for each State, but that does not mean that governments can act completely freely in this matter, as the Inter-American Court has ruled that

despite the fact that it is traditionally accepted that the conferral and recognition of nationality are matters of each State to deal, contemporary developments indicate that international law does impose certain limits on the broad powers enjoyed by the States in that area and that the manner in which States regulate matters bearing on nationality cannot today be deemed to be within their sole jurisdiction.<sup>205</sup>

The characteristics of nationality were stated in the Nottebohm case, in which the International Court of Justice provided that:

According to the practice of States, to arbitral and judicial decisions and to the opinion of writers, nationality is a legal bond having as its basis a social fact of attachment, a genuine connection of existence, interest and sentiments, together with the existence of reciprocal rights and duties.<sup>206</sup>

It could be argued that citizens of Atoll Island States could lack the genuine connection of existence, interest and sentiments to acquire the nationality of the State they would be moving to. However, depending on the legislation of each State, sometimes mere birth on a territory has been considered sufficient to grant nationality (*jus soli*), which does not require to prove any cultural links with the country.<sup>207</sup> Unfortunately, such a system would solve only the situation of the second generation of climate-change displaced people, and not those of the first

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<sup>203</sup> League of Nations, Convention on Certain Questions Relating to the Conflict of Nationality Law, 13 April 1930, League of Nations, Treaty Series, vol. 179, p. 89, No. 4137, available at: <http://www.unhcr.org/refworld/docid/3ae6b3b00.html>.

<sup>204</sup> Hailbronner (2006), p. 37.

<sup>205</sup> Advisory Opinion on Proposed Amendments to the Naturalization Provision of the Constitution of Costa Rica, OC-4/84, Inter-American Court of Human Rights (IACrHR), 19 January 1984, available at: <http://www.unhcr.org/refworld/docid/44e492b74.html>, paragraphs 32-34.

<sup>206</sup> Nottebohm Case (Liechtenstein v. Guatemala); Second Phase, International Court of Justice (ICJ), 6 April 1955, available at: <http://www.unhcr.org/refworld/docid/3ae6b7248.html>.

<sup>207</sup> See Hailbronner (2006), p. 59. As Hailbronner notes the *jus soli* principle might have had its justification in the nineteenth century and first half of the twentieth century since most of people who were travelling abroad intended to emigrate, which does not occur nowadays.



generation.<sup>208</sup> This would be the case, for example, if they were to relocate to the Americas, where most of States operate on the *jus soli* system.<sup>209</sup> Nevertheless, in the Pacific there are also a number of islands<sup>210</sup> that operate under *jus soli law*. Conversely, if they were to go to countries where the *jus sanguinis* system operates then statelessness could affect not only the first generation but also subsequent generations.<sup>211</sup> In order to prevent the possible statelessness of inhabitants of Atolls Island States measures should ideally be taken, such as allowing dual citizenship during the transitional period.<sup>212</sup> However, it is unclear if many States would agree to such arrangements.

Nevertheless, second and third generations of migrants are likely to integrate into the country where they are displaced to, as it is often possible for the migrants themselves or their descendants to somehow obtain the nationality of the country in which they reside. In this respect each country has different rules regarding when an individual can become a citizen and whether his or her's nationality of origin can be retained (and thus have dual nationality). There is the possibility that not all countries will recognise the continuing existence of a State that has no territory (as explained in Chap. 6), and would therefore only recognise one nationality (its own) to those who managed to acquire it. In this case, could these second and subsequent generation migrants continue to claim to be descendants of an Atoll Island State? If they did not maintain or were forced to relinquish their nationality would they be able to continue to claim any potential benefits from it? At present it is of course difficult to see what these potential benefits might be, though they could include revenues from the continued exploitation of the EEZ (if this proves possible) or a claim to the islands if they were to re-surface at some point in the future. The legal possibilities are of course quite complex, though it is possible that the claims could be made through blood-lines (*jus sanguinis*), rather than by nationality.<sup>213</sup>

The right to nationality has also been set forth in many universal and regional human rights instruments.<sup>214</sup> The European Convention on Nationality and the

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<sup>208</sup> Unless of course they could naturalize through some other process.

<sup>209</sup> Refugee Studies Centre (2009), p. 41.

<sup>210</sup> Such as Hawaii, which is part of the US.

<sup>211</sup> One example of how birth in a given State does not guarantee nationality is that of Koreans in Japan. Resident Koreans are not considered stateless because they are covered by nationality laws of Republic of Korea and Democratic People's Republic of Korea. See UNHCR (2010), p. 57.

<sup>212</sup> UNHCR (2011a), p. 19.

<sup>213</sup> There are a number of examples for this. Descendants of Japanese people in Brazil are able, for example, to obtain work visas in Japan with relative ease, as compared to other Brazilians not of Japanese descent.

<sup>214</sup> The Convention on the Rights of the Child, Art. 7(1) states that "national governments must register children immediately after birth, and children enjoy the right from birth to acquire a nationality." Art. 24 of the 1966 International Covenant on Civil and Political rights states that "every child shall be registered immediately after birth and shall have a name," and that "every child has the right to acquire a nationality." The International Convention on the Rights of

Convention on the Avoidance of Statelessness in relation to State Succession adopt the principles found in the 1961 Convention and on the International Law Commission draft articles. Moreover, the Annex of the United Nations General Assembly Resolution 55/153 sets forth the “Nationality of Natural Persons in relation to the Succession of States” which in its Art. 21 (Attribution of the Nationality of the Successor State) states how:

Subject to the provisions of Art. 8, when two or more States unite and so form one successor State, irrespective of whether the successor State is a new State or whether its personality is identical to that of one of the States which have united, the successor State shall attribute its nationality to all persons who, on the date of succession of States had the nationality of a predecessor State.<sup>215</sup>

In an overview of climate change and statelessness UNHCR argued that since the situation of populations that can suffer the consequences of climate change is predictable, preventive action should be taken. UNHCR has also outlined possible solutions to solve these problems, such as the cession of territory (i.e. where one State would cede part of its territory to the disappearing State) and the union with another State, emphasizing that in this case the 1961 Convention and the Draft Articles on the Nationality of Natural Persons in relation to Succession of States would establish specific safeguards to prevent statelessness. Furthermore, UNHCR indicated that in order to prevent temporary statelessness, the acquisition of an effective new nationality should happen before the dissolution of the affected State. In this way, having dual nationality should be permitted for the transitional period.<sup>216</sup>

Although the regime of succession of States<sup>217</sup> does not apply to the case when all the islands that form Atoll Island States disappear (as the territory would not be transferred) the principles found in it to avoid statelessness could nevertheless be applied. However the problem in this case is that there is no clear responsibility for one particular State to accept the displaced populations, as there would be no State taking over the former land of the Atoll Island State (unless some sort of agreement could be reached with a host State, as described previously in this chapter and in Chap. 6). If these territories were to revert to the status of high seas it could be argued that they would in fact be owned by the entire global community and hence that all the States in the planet would be successor States. This could provide a case

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All Migrant Workers and Members of their Families (Migrant Convention) also provides in its Art. 29 that “every child of a migrant worker shall have the right to a name, to registration of birth and to a nationality.”, the Convention on the Elimination of Discrimination Against Women, Article the International Convention on the Elimination of All Forms of Racial Discrimination, the Convention on the Nationality of Married Women.

<sup>215</sup> General Assembly Resolution 55/153. A/55/PV.84, GA/9845. 12 December 2000 available on the internet: <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N00/568/57/PDF/N0056857.pdf?OpenElement>.

<sup>216</sup> UN High Commissioner for Refugees (2011a), p. 19.

<sup>217</sup> Example of such cases include Yemen, Serbia, Slovenia, Bosnia-Herzegovina, Croatia, USSR, Estonia, Ethiopia, Eritrea, Latvia, Lithuania or the former Yugoslav Republic.

for the inhabitants of Atoll Island States to obtain the nationality of any country they were to choose, under a very wide interpretation of this regime of succession of States. Nevertheless, it is not clear if this would be accepted by many States since there is no obligation for any State to accept the inhabitants of disappearing Atoll Island States and thus such an argument in fact appears unrealistic.

## 7.8 Human Rights of Climate-Change Displaced People

Growing concerns regarding the future existence of Atoll Island States have led the UN General Assembly to approve several resolutions dealing with the possibility that the inhabitants of these countries could find protection under human rights instruments.<sup>218</sup> If people are displaced to a foreign State as a consequence of climate, human rights law demands that minimum standards are provided to them by the host State.<sup>219</sup>

These concerns regarding the influence of climate change on the enjoyment of human rights resulted in the Male' Declaration on the Human Dimension of Climate Change,<sup>220</sup> which expressed a fundamental right to an environment capable of supporting a society, though the Declaration is non-binding and limited only to the States that were present at the meeting.<sup>221</sup> In 2008, the UN Human Rights Council passed Resolution 7/23, introduced by the Government of the Maldives, which instructed the UN Office of the High Commissioner for Human Rights (OHCHR) to conduct a study on human rights and climate change.<sup>222</sup> The January 2009 OHCHR report<sup>223</sup> addressed three main questions:

1. Is there a relationship between climate change and human rights, and if so, what is the nature of that relationship?
2. Does climate change constitute a violation of human rights, especially the rights of vulnerable people?
3. Irrespective of whether climate change represents a human rights violation, what are States' national-level and international-level human rights obligations pertaining to climate change?

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<sup>218</sup> Protection of global climate for present and future generations of mankind, UN General Assembly resolution 43/53 of 6 December 1988, 54/222 of 22 December 1999, 62/86 of 10 December 2007, 63/32 of 26 November 2008 and 64/73 of 7 December 2009, 65/159.

<sup>219</sup> McAdam (2009), p. 14.

<sup>220</sup> 14<sup>th</sup> of November 2007. Available on the internet at [http://www.ciel.org/Publications/Male\\_Declaration\\_Nov07.pdf](http://www.ciel.org/Publications/Male_Declaration_Nov07.pdf).

<sup>221</sup> Söderbergh (2011), p. 20.

<sup>222</sup> Söderbergh (2011), p. 3.

<sup>223</sup> Limon (2010), p. 551.

The General Assembly of the United Nations also passed a resolution (63/281) on 3 June 2009 in which it urged the relevant organs of the United Nations to intensify their efforts to tackle climate change. The Secretary-General of the General Assembly launched a report on climate change and its possible security implications,<sup>224</sup> which also discusses the main challenges facing the inhabitants of Atoll Island States.

Regarding regional level organizations, the Organization of American States approved resolution 2429 on June 3, 2008<sup>225</sup> on Human Rights and climate change in the Americas and stressed the fact that climate change will impact Small Island States.<sup>226</sup> This resolution recognizes

the possible existence of a link between adverse effects of climate change and the full enjoyment of human rights, seeking coordination to that end with the United Nations Human Rights Council and the Office of the United Nations High Commissioner for Human Rights, and in consultation with the member states, the Intergovernmental Panel on Climate Change (IPCC), and the OAS Department of Sustainable Development.<sup>227</sup>

However, not only human rights law, but also international environmental law could partly come into this discussion. There are several basic differences between these two fields of law, which will be discussed below in order to demonstrate what are the obstacles to create a connection between human rights law and climate change. International environmental law relies on reciprocity while human rights law does not, as its obligations are towards States in order to protect individuals. International environmental law requires that States act together, for problems that cannot be solved solely by one State.<sup>228</sup> Also there is the point that one of the characteristics of human rights organizations is that they do not work on “hypothetical” or scenario-based issues, which means that future situations are not part of human rights research.

### ***7.8.1 Is There a Relationship Between Climate Change and Human Rights?***

Regarding the first question, OHCHR clearly listed the rights that are likely to be severely affected by climate change: the right to adequate food, water, health, adequate housing, and self-determination. The report also points out that the effects of climate change will affect disproportionately poorer areas of the planet, which

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<sup>224</sup> UN General Assembly, *Climate change and its possible security implications: report of the Secretary-General*, 11 September 2009, A/64/350, available at: <http://www.unhcr.org/refworld/docid/4ad5e6380.html> [accessed 15 August 2012].

<sup>225</sup> OAS, Resolution 2619, 7 June 2009.

<sup>226</sup> OAS, Resolution 2619, 7 June 2009, para.2, p. 18.

<sup>227</sup> Para.4 the Resolution.

<sup>228</sup> Bodansky (2010), p. 516.

would probably cause large-scale human rights crises due to mass displacements. It also warns that some measures to mitigate and adapt to climate change will cause secondary effects on human rights. It gives as an example biofuel production, which as a mitigation measure can cause harm to the right to food.<sup>229</sup>

Interestingly, one of the outcome documents of the UNFCCC COP16 in Cancun (see Chap. 4 for more details on Climate Change Negotiations) actually cites the Human Rights Council resolution 10/4 and recognises that:

The adverse effects of climate change have a range of direct and indirect implications for the effective enjoyment of human rights and that the effects of climate change will be felt most acutely by those segments of the population that are already vulnerable owing to geography, gender, age, indigenous or minority status and disability.<sup>230</sup>

Therefore, it seems that there is widespread agreement that climate change will affect the enjoyment of human rights of the inhabitants of a variety of countries around the world.

### ***7.8.2 Does Climate Change Constitute a Violation of Human Rights?***

In answering question two, OHCHR recognised that climate change would have “implications for the enjoyment of human rights”, but refrained from recognising that this would constitute human rights violations due to a variety of factors. Firstly, because it is virtually impossible to disentangle the complex causal relationship that would link the greenhouse gas emissions of a particular country to a specific effect. Knox suggests that since greenhouse gases are contributing to climate change, the share of responsibility could be allocated according to which States are the major emitters. Among those, the United States and China contribute to more than one-third and together with the European Union are responsible for more than half.<sup>231</sup> Knox states that responsibility should be shared, but according to the proportion of emissions by each State.<sup>232</sup> However, in fact, it can be difficult to clearly distinguish who are the duty bearers, as major emitters of greenhouse gases are often not willing to recognise their own responsibility in causing climate change.

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<sup>229</sup> Biofuels from food crops such as maize, sugarcane, soybeans, palm oil and others have been identified as potentially important mitigation strategies. However biofuel production and use can have significant negative social impacts affecting, for example, food security and land rights. See Gasparatos and Stromberg (2012) or Gasparatos et al. (2011), p. 111.

<sup>230</sup> Outcome of the work of the Ad Hoc Working Group on long-term Cooperative Action under the Convention, Draft Decision, CP. 16 preamble (2010). As cited by Söderbergh (2011), p. 3.

<sup>231</sup> Knox (2009), p. 489.

<sup>232</sup> Knox (2009), p. 489.

Secondly because global warming is one of several contributing factors to climate related disasters such as tropical cyclones (as explained in more detail earlier in this chapter and in Chap. 3), and it is difficult to establish which proportion of a certain environmental phenomena is attributable to global warming. Tropical cyclones, for example, are believed by some to have multi-decadal variability (meaning that they could follow natural cycles, due to variations in the ENSO El Niño-Southern Oscillation perhaps) and therefore it is difficult to attribute any one event to climate change. In fact, if it is difficult to establish if anthropogenic influences have or will increase the intensity of natural disasters, and thus it is challenging to identify a duty-holder. This rationale is summarized by Bodansky:

Legally, climate change no more violates human rights than does a hurricane, earthquake, volcanic eruption, or meteor impact. Human rights are “human” by virtue of not only their victims but also their perpetrators. And they represent human rights “violations” only if there is some identifiable duty that some identifiable duty-holder has breached<sup>233</sup>

Moreover, scientists argue that the frequency of a given level of natural hazards will increase in many areas in the planet due to climate change, but the event *per se* will not change.<sup>234</sup> This essentially means that a natural disaster and a climate change exacerbated disaster would have the same characteristics (though not the same intensity or frequency). In this sense, and if such arguments are accepted, the available protection framework (complementary protection) for natural disasters that already exists would be enough to protect the populations at risk. The main issue is that the States which are going to be most affected (i.e. the poorest ones) are often the ones least able to provide adequate responses to natural disasters, relying on international assistance after the most extreme events. Thus, instead of attempting to use an approach that differentiates between climate change exacerbated events and those which are not, the framework of protection against environmental disaster could be extended to those that are displaced by climate change.

Thirdly because the adverse effects of global warming are often projections about future impacts whereas human rights violations are established after the harm has occurred.<sup>235</sup> Despite this last point,<sup>236</sup> OHCHR prefers not to take into consideration preventive action, or the risk that a violation occurs. The report refers to jurisprudence related to an environmental case, in which the Committee clarified that for a person to claim to be a victim of a violation of a right, “he or she must show either that an act or an omission of a State party has already adversely affected his or her enjoyment of such a right, or that such an effect is imminent...”.<sup>237</sup>

<sup>233</sup> Bodansky (2010), p. 519.

<sup>234</sup> This is discussed in more detail in Chaps. 2 and 3 of this book and in the IPCC 4AR.

<sup>235</sup> UN High Commissioner for Refugees (2011b).

<sup>236</sup> That is that human rights violations are established after harm takes place.

<sup>237</sup> Human Rights Committee, *Mrs. Vaihere Bordes v. Mr. John Temeharo v. France*, Communication No.645, para.5., *Aalbersberg and 2,084 other Dutch citizens v. Netherlands*, Communication No. 1440/2005, para. 6.3.

In several cases concerning environmental harms the Committee has found that the authors of the communication did not meet the criteria to be considered as victims of human right violations. For example, in the case of *S. Aumeeruddy-Cziffa and 19 Other Mauritian Women vs. Mauritius* the Committee wrote how,

In the first place, a distinction has to be made between the different groups of the authors of the present communication. A person can only claim to be a victim in the sense of article 1 of the Optional Protocol if he or she is actually affected. It is a matter of degree how concretely this requirement should be taken. However, no individual can in the abstract, by way of an action popularis, challenge a law of practice claimed to be contrary to the Covenant. If the law or practice has not already been concretely applied to the detriment of that individual, it must in any event be applicable in such a way that the alleged **victim's risk of being affected is more than a theoretical possibility.** (emphasis added)<sup>238</sup>

Therefore, if the author of a communication is able to demonstrate that there is a real risk that his or her rights are affected a violation could be considered to occur.

The Committee also did not take into consideration the precautionary principle, a concept established in para. 13 and 14 of the Maastricht Principle on Extraterritorial Obligations of States in the area of Economic, Social and Cultural Rights<sup>239</sup> and other international environmental instruments such as the Rio Declaration adopted at the United Nations Conference on Environment and Development, the Bamako Convention, the Montreal Protocol to the Vienna Convention for the Protection of the Ozone Layer, and the Second North Sea Declaration. The precautionary principle shows that science does not always provide the insights needed to effectively protect the environment, and places emphasis on the fact that the environment is vulnerable and science has limitations to predict threats.<sup>240</sup> The United Nations Framework on Climate Change incorporates a version of the precautionary principle in Art. 3, providing that:

the Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures...<sup>241</sup>

<sup>238</sup> Human Rights Committee, *S. Aumeeruddy-Cziffa and 19 Other Mauritian Women v. Mauritius*, Communication No. 35/1978, para.9.1.

<sup>239</sup> 13. Obligation to avoid causing harm. States must desist from acts and omissions that create real risk of nullifying or impairing the enjoyment of economic, social and cultural rights extraterritorially. The responsibility of States is engaged where such nullification or impairment is a foreseeable result of their conduct. Uncertainty about potential impacts does not constitute justification for such conduct. 14. Impact assessment and prevention. States must conduct prior assessment, with public participation, of the risks and potential extraterritorial impacts of their laws, policies and practices on the enjoyment of economic, social and cultural rights. The results of the assessment must be made public. The assessment must also be undertaken to inform the measures that States must adopt to prevent violations or ensure their cessation as well as to ensure effective remedies.

<sup>240</sup> Burns (1997), p. 163.

<sup>241</sup> Burns (1997), p. 165.

In addition, the European human rights system developed a notion of “potential victims” under the European Convention on Human Rights<sup>242</sup> which could also apply to the situation of climate-change displaced people. An example for this can be found in the case of *J. Soering v. the United Kingdom*.<sup>243</sup> In this case, the applicant (who was a citizen of United Kingdom) claimed that if he was extradited to the United States he could face the death penalty since he was being accused of capital murder. The Court decided that if the author was extradited to the USA to face charges of capital murder it would amount to a violation of Art. 3 which guarantees the right against inhuman and degrading treatment.<sup>244</sup> Therefore, it cannot be argued that violations are exclusively for past situations if there is a real risk of becoming a potential victim due to a specific situation. In the case of climate change based claims this real risk standard could also be applied, since in the future there could be a real risk of inhabitants of Atoll Island States suffering the consequences of sea level rise (once the environment in the atolls has degraded sufficiently, as explained in Chap. 3).

Furthermore, in environmental law the principle of prevention is well acknowledged, which is related to potential victims and the possibility of harm that might occur in the future. Such ideas are stated clearly in the 1972 Stockholm Declaration on the Human Environment, which refers to the safeguard of the interests of present and future generations.<sup>245</sup> The Prevention principle is also present in three Conventions against Torture, such as 1985 Inter-American Convention to Prevent and Punish Torture and the 1987 European Convention for the Prevention of Torture and Inhuman or Degrading Treatment or Punishment. In addition, the 1984 United Nations Convention against Torture and Other Cruel, Inhuman, or Degrading Treatment or Punishment also has a preventive character.<sup>246</sup>

In environmental law the principle of “polluter pays” has also been recognised for some time, meaning that the party responsible for polluting is responsible for paying for the damage done to the natural environment.<sup>247</sup> This is mentioned in Principle 16 of the Rio Declaration on Environment and Development. Could this principle be used in the search for justice against the consequences of climate change? While the disappearance of atolls is not a source of pollution, the reason for it could be a consequence of the “pollution” of the oceans due to increased CO<sub>2</sub> concentrations in the atmosphere (though an increase in ocean acidification, as explained in Chap. 3).

Among the explanations given by the report, the second question is the most difficult to answer since it is, in fact, difficult to establish to what extent

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<sup>242</sup> Trindade (1992), p. 263.

<sup>243</sup> European Court of Human Rights, *Soering v. United Kingdom*, application no. 14038/88.

<sup>244</sup> Art. 3 of the European Convention of Human Rights “No one shall be subjected to torture or to inhuman or degrading treatment or punishment.”

<sup>245</sup> Trindade (1992), p. 257.

<sup>246</sup> Trindade (1992), pp. 261-262.

<sup>247</sup> Maclellan (2009).



environmental degradation and natural disasters would be attributable to climate change. Apart from these discussions, the UNFCCC is on the process of discussing a mechanism which would assist developing countries on establishing institutional arrangements to address loss and damage,<sup>248</sup> as explained in Chap. 4.

### ***7.8.3 What are States' National-Level and International-Level Human Rights Obligations Pertaining to Climate Change?***

Regarding question three, the report emphasizes that although climate related events might increase in intensity States remain under the obligation to ensure the widest possible enjoyment of economic, social and cultural rights. In addition, it adds that in order to have successfully addressed climate change, the affected populations must be allowed to participate in decision-making processes and be granted access to administrative and judicial remedies. Although the report did not establish the connection between human rights and violations, it proposes four kinds of international or extraterritorial human rights obligations, as listed below:

1. Refrain from interfering with the enjoyment of human rights in other countries
2. Take measures to prevent third parties (e.g., private companies) over which they hold influence from interfering with the enjoyment of human rights in other countries
3. Take steps through international assistance and cooperation, depending on the availability of resources, to facilitate fulfilment of human rights in other countries and
4. Ensure that human rights are given due attention in international agreements and that such agreements do not adversely impact upon human rights.

In its conclusions, the report points out that international human rights law complements the United Nations Framework of Convention on Climate Change.<sup>249</sup> However, The International Council on Human Rights Policy gives five main reasons why human rights would not assist the creation of policies to deal with climate change:

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<sup>248</sup> See Approaches to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change to enhance adaptive capacity, FCCC/CP/2012/L.4/Rev.1, available at <http://unfccc.int/resource/docs/2012/cop18/eng/104r01.pdf>.

<sup>249</sup> Office of the High Commissioner of Human Rights (2009) Report of the Office of the United Nations High Commissioner for human rights on the relationship between climate change and human rights.

1. The rights in question are not enforceable due to the weak enforcement mechanisms in the international law, in special socio-economic rights, or the rights of migrants.
2. Extraterritoriality issue. According to human rights law, a State which exerts jurisdiction over a person should take measures when there is a violation. In the case of climate change the responsibility for the impacts of climate change relies more on diffuse actors and not only on one State in particular.
3. Local accountability cannot be easily established since the countries which are going to be more burdened by the effects of climate change generally have less resources to adapt. These countries, who even under ordinary conditions cannot implement policies to ensure that socio-economic rights are enjoyed by their citizens will be unlikely to fulfil these rights if conditions worsen. Popovski and Mundy point out that the responsibility regarding the violation of human rights lies with the worst affected States, which would “lack preparedness” and capacity to respond to disasters. They further explain that not only “mother-nature” would be responsible for the victimization, but also negligence by the governments of the countries concerned.<sup>250</sup>
4. Some predicted impacts will suspend the application of human rights as in the case of drought, famine, floods, mass migration and wars. International human rights treaties and most national constitutions allow for suspension of many rights during an emergency.
5. Conflict of rights and interests: the public good resulting from climate change policies might find opposition by holders of property rights which sometimes have discretionary power to deal with their properties in a way that opposes climate change policy. Other rights are related to the right to culture, freedom or religion, can bring individuals into conflict with climate change policies.<sup>251</sup>

Although this report did not recognize that climate change may cause human rights violations, it sets standards of international cooperation and recommends that States give due attention to human rights when creating international instruments. Nevertheless, since they do not have a binding character the guarantee of human rights will depend on the goodwill of States to give priority to this important issue.

### ***7.8.4 Time, Climate-Change Displaced People, and the Case of the Atoll Island States***

When unexpected events occur concerned parties often attempt to seek solutions based on existing legal frameworks. When that does not seem feasible, one solution is to establish new legal instruments that deal with the latest situation. Governments

<sup>250</sup> Popovski and Mundy (2011), p. 10.

<sup>251</sup> The International Council on Human Rights Policy (2008), pp. 4–5.

and the international community tend to tackle policies of migration in a reactive rather than preventive way.<sup>252</sup> In most cases, an event which already took place will cause the establishment of a new treaty or mechanism of protection for those who are already suffering from the lack of international legal protection. Due to the relatively small number of people who at present unequivocally appear to be internationally displaced due to environmental and climate change factors<sup>253</sup> some authors have argued that it is unlikely that the international community would agree to a new framework to protect them, a conclusion that many intergovernmental bodies have also reached.<sup>254</sup> It is important to note that currently it is difficult to distinguish between those fleeing conflicts that are caused purely by political arguments and those due to degradation to the environment (either due to climate change or other local causes). In this sense various conflicts around the world, such as that in Sudan for example, have been attributed to underlying disputes for resources.

The issue of climate change involves temporal questions such as whether third States would have a moral and immediate obligation towards Atoll Island States, and if the answer is affirmative, towards whom and since when the major emitters should respond for that.

Byravan and Rajan argue that the starting point for counting greenhouse gas emissions should be the Industrial Revolution, and thus according to them emissions should be considered from the time industrialized countries started burning large quantities of fossil fuels, as the carbon dioxide emitted remains in the atmosphere to this day<sup>255</sup> or has been absorbed by the oceans (and thus is contributing to ocean acidification).

According to this line of argument the first stage of major emissions would have occurred around 250 years ago. However, the rate of emission has rapidly increased in the last four decades,<sup>256</sup> and thus from when exactly should emissions start to be counted in order to attribute blame can be controversial. According to Barnett and Campbell the measure of responsibility for the problem of climate change is an individual or group's share of the greenhouse gases currently in the atmosphere.<sup>257</sup> A number of other authors also support this view,<sup>258</sup> and generally speaking this

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<sup>252</sup> Refugee Studies Centre (2011), p. 6.

<sup>253</sup> Note that this number will probably dramatically increase in the future, as stated earlier. However, at present there are few people clearly displaced due to these reasons. Note also that those displaced are not only from Atoll Island States but from many other countries.

<sup>254</sup> Refugee Studies Centre (2011), p. 16.

<sup>255</sup> Of course it could be argued that not all of it remains there, as some has been re-absorbed by forests or the sea (contributing to ocean acidification, which nevertheless poses problems for the corals on which Atoll Islands rely for their survival). Nevertheless, since this time at least a fraction of these gases has contributed to the increase in greenhouse gas concentrations in the atmosphere.

<sup>256</sup> Byravan and Rajan (2010), p. 243.

<sup>257</sup> See discussion in Barnett and Campbell (2010), p. 10.

<sup>258</sup> Such as for example Burkett (2008), p. 169.

seems to be a well established ethical principle. However, it might be possible that if States that were aware of the consequences of climate change (such as sea-level rise and ocean acidification) failed to take action they could be held accountable over the consequences of these actions.<sup>259</sup>

International human rights lawyers face the same questions when analyzing situations which took place before the existence of a norm in international law or of the jurisdiction of a body to examine a case. In these cases, international human rights bodies have solved the problem by applying the concept of continuing violations of human rights. For example, in the case of a violation of human rights these violations could linger on time. A typical case is that of forced disappearances, common in many countries in Latin America, where people would disappear before there was jurisdiction of a regional court over the State in question.<sup>260</sup> In this case, for example, the continuing nature of the violations could rely on the fact that the continuing emissions of greenhouse gases would not allow corals to keep up with the pace of sea level rise and negatively affect the environment of Atoll Island States, eventually leading to their disappearance.

Corals have adapted to past alterations in planetary conditions, but the current rapid pace of change might not allow them enough time to do so. The hurdle would be, however, to make a distinction between the greenhouse emissions that occurred before and after the knowledge of the effects of these emissions. In other words, much of the climate change that is taking place today is due to emissions in the past, and it is not clear from which point in time there is a scientific consensus on the consequences of these greenhouse gases in the atmosphere. Previous generations were not aware of the effect that greenhouse gas emissions were having on the planet, and thus it would be unfair to blame them for this. The consensus shown in the publication of the IPCC 4 AR clearly identifies that there is a wide consensus nowadays regarding its possible implications, and it could be argued that this goes much further back in time, to the beginning of the UNFCCC conferences. At that time, however, the scientific basis behind the consequences of climate change was still not well established. Nevertheless, it would be possible to argue that at some point between 1991 and 2004 humanity as a whole became aware of the dramatic consequences that can be brought about due to climate change.<sup>261</sup> Thus, in general

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<sup>259</sup> In criminal law the concept of *Mens rea* can take three forms: *dolus directus* (direct intent), where the consequences of an action were both foreseen and desired by the perpetrator. Here, for example, a perpetrator desires the death of a victim and foresees that a certain act will bring about the death of the victim;- *dolus indirectus* (indirect intent), where secondary consequences in addition to those desired by a perpetrator of an act were foreseen by the perpetrator as a certain result, although the perpetrator did not specifically desire these secondary consequences, he still committed the act with knowledge of them; and- *dolus eventualis*, where a perpetrator foresees consequences other than those directly desired as a possibility, and not necessarily a certainty, but nevertheless proceeds with a criminal act, see Vyver (1999), p. 307.

<sup>260</sup> Blake Case, Judgement on the Preliminary Objections of July 2, 1996 Inter-Am. Ct. H.R.

<sup>261</sup> Söderbergh argues that State responsibility regarding the human rights-related impact of climate change would have been triggered in the early 1990s with the first warnings issued by climatologists, though the first IPCC reports did not have the level of understanding regarding

it would be possible to say that at some point within this period different countries should have started to take action.

Human rights law and international criminal law mainly focus on past events, in questions regarding exceptions to the retroactive application of laws or until when international tribunals should go in order to examine past crimes. Conversely, environmental law emphasizes present and future situations, instead of the past events which are the object of examination by international human rights bodies. One such example is that sustainable development relies upon the commitment to equity with future generations.<sup>262</sup> Environmental protection had as its landmark the 1972 Stockholm Declaration on the Human Environment in which the responsibility to “protect and improve” the environment for present and future generations was recognized. In its preamble it states that

(...) to defend and improve the environment for present and future generations has become an imperative goal for mankind- a goal to be pursued together with, and in harmony with, the established and fundamental goals of peace and of world-wide economic and social development.<sup>263</sup>

Protection of the natural environment for future generations is also provided in the 1972 London Ocean Dumping Convention, the 1973 Convention on International Trade in Endangered Species, and the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage.<sup>264</sup> In fact, according to Söderbergh, more than 115 constitutions guarantee either a right to a clean and healthy environment, impose a duty on the State to prevent harm, or mention the protection of the environment or natural resources.<sup>265</sup>

Authors such as Burkett argue that “the right to a flourishing environment is a basic human right”.<sup>266</sup> However, it is not clear if the right to a healthy environment actually exists in international law, as it has so far been limited to non-binding declarations and regional instruments.<sup>267</sup> Notably, the US does not consider that such a right exists in international law, and a human rights approach to address climate change is likely to be ineffective, as those that have caused the climate change often seem unaware of the potentially negative impact of their actions.<sup>268</sup>

Territorial claims are also an issue for the intertemporal doctrine, such as in the Island of Palmas Arbitration, a dispute between the United States and Netherlands

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climate that exists in the IPCC 4AR. He draws also a parallel with tobacco litigation in the United States, were proof of the tobacco companies’ knowledge of the harm their products cause was critical in the outcome of the cases, in Söderbergh (2011), p. 21.

<sup>262</sup> Weiss (1992), p. 385.

<sup>263</sup> Sixth Proclamation in the preamble, Stockholm Declaration of the United Nations Conference on the Human Environment, U.N, Doc.A/Conf.48/14 (1972).

<sup>264</sup> Weiss (1992), p. 391.

<sup>265</sup> Söderbergh (2011), p. 20.

<sup>266</sup> Burkett (2008), p. 169.

<sup>267</sup> Söderbergh (2011), p. 20.

<sup>268</sup> Söderbergh (2011), p. 20.

over the sovereignty of a small Pacific island. Judge Huber stated that acts should be judged in light of the law at the time of its creation; and that rights acquired in a valid manner may be lost if not maintained in a manner consistent with the changes in international law.<sup>269</sup> That established principle was applied to other cases of the International Court of Justice such as *Minquiers and Ecrehos Case*, *The Western Sahara case*, *The North Sea Continental Shelf Case* and the *Aegean Sea Continental Shelf Case*.

The problem of climate-change displaced people encompasses both international human rights and environmental law, which means that from a temporal perspective it can focus on both past and future contexts. The past regards the harm caused by the accumulation of greenhouse gas concentration in previous centuries. Byravan and Rajan<sup>270</sup> highlight the delayed nature of the effects of greenhouse gases, since climate has a slow-onset character and it takes many decades for the impacts of past greenhouse gases<sup>271</sup> to be felt. Hence the effects that can be felt now are due to historical emissions at some point in the past, and emissions today will affect directly future generations,<sup>272</sup> so that future generations will thus receive the environment in a worse condition than that we enjoy today. Borrowing the theory of intergenerational equity might be useful for this discussion.<sup>273</sup> As Brown explains, intergenerational equity consists of the relationship we keep with other generations of our own species and that can be described as a partnership among all generations. Brown also states how “the ends of such a partnership cannot be obtained in many generations, it becomes a partnership not only between those who are living but between those who are living, those who are dead, and those who are to be born”.<sup>274</sup> The transgenerational perspective is based on the spectrum that the generation is placed somewhere in time and that it does not know in advance where.<sup>275</sup> That generation would like to receive the planet in at least as good a condition as every other generation receives it and to be able to use it. In order to be able to do that, it is necessary that each generation passes the planet in no worse condition than that in which it found it.<sup>276</sup> This is based on three principles:

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<sup>269</sup> Weiss (1992), p. 387.

<sup>270</sup> These points are discussed in the IPCC 4AR and in Byravan and Rajan (2010), p. 245.

<sup>271</sup> Such as the melting of ice caps, its consequent sea level rise, or increased ocean acidification, as outlined in Chap. 3.

<sup>272</sup> These points are discussed in the IPCC 4AR and in Byravan and Rajan (2010), p. 245.

<sup>273</sup> Rawls (1971).

<sup>274</sup> Weiss (1992), p. 396.

<sup>275</sup> The question of equity between generations is provided by Art. 3(1) of the United Nations Framework Convention on Climate Change: “The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.”

<sup>276</sup> Weiss (2008), p. 622.

1. Each generation should preserve the diversity of the natural and cultural base, so there is no restriction of options for subsequent generations, which is called the “conservation of options”;
2. Each generation should pass the planet in no worse condition than that in which it found it, which is called the “conservation of equality”;
3. “Conservation of access”: each generation should provide its members equitable rights of access to the legacy of past generations and guarantee access to future generations.<sup>277</sup>

Thus, the past temporal issue is related to until what point in the past should emissions be considered and regarding the future there is the need to preserve the planet for the next generations. However, an issue that links the past, present and future is whether emissions could be considered as a crime.

Therefore, the challenge is whether to consider the crime as a past issue (as the first emissions occurred long time ago) or to consider emissions as a continuing act. By considering the emissions a continuing act it could enable its future recognition as a crime. The emissions which have taken place since the Industrial Revolution would be emitting effects up to now and into the future. International human rights bodies have already considered the continuing violations as a type of crime that is within their competence *ratione temporis*.

Although the report by the Office of the High Commissioner of Human Rights notes that climate change poses threats to human rights, it refrains from recognizing it as a violation to human rights, as explained previously in this chapter.<sup>278</sup> Among the reasons<sup>279</sup> stated by the report, one of the points is that no harm has yet been proven to have occurred to people who would allegedly be affected by climate change related factors. Human rights violations are normally established after the harm has occurred. In general, facts which took place before the existence of a law cannot be analyzed by international bodies according to the well established principle of non-retroactivity in international law, as stated by Art. 28 of the Vienna Convention on the Law of Treaties, which provides that

unless a different intention appears from the treaty or is otherwise established, its provisions do not bind a party in relation to any act or fact which took place or any situation which ceased to exist before the date of the entry into force of the treaty with respect to that party.

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<sup>277</sup> Weiss (1992), p. 401.

<sup>278</sup> Office of the High Commissioner of Human Rights (2009) Report of the Office of the United Nations High Commissioner for human rights on the relationship between climate change and human rights.

<sup>279</sup> Other obstacles to the recognition of climate change as human rights violations are (1) “it is virtually impossible to disentangle the complex causal relationships” linking the emissions of a particular country to a specific effect; n42 (2) “global warming is often one of several contributing factors to climate change-related effects, such as hurricanes [or] environmental degradation” which makes it “often impossible” to establish how such an event is attributable to global warming; U.N. High Commissioner for Human Rights [OHCHR], *Report of the Office of the United Nations High Commissioner for Human Rights on the Relationship Between Climate Change and Human Rights*, U.N. Doc. A/HRC/10/61 (Jan. 15, 2009).

The consideration of the existence of “continuing violation of human rights” appeared after the Second World War when the international community started to deal with the promotion of common welfare by restricting the sovereign power of individual States, in an attempt to improve the position of individuals and establish rules of humanitarian interest.<sup>280</sup> In this context, regional human rights instruments and their bodies have been dealing with the issue of time and law regarding events which took place before the jurisdiction of the body entered into force in a given country. In the inter-American human rights system, for example, continuing violation cases refer to past violations committed by States against individuals primarily during the reigns of military dictatorships or newly established democracies. In many cases, the violations occurred before the State had ratified a Convention or recognized the jurisdiction of the Court, which in general would be a reason to consider these crimes as being outside the competence *ratione temporis* of the Commission or Court, if interpreted absolutely and without exceptions.<sup>281</sup>

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<sup>280</sup> Dissenting Opinion of Judges Guerrero, Sir Arnold McNair, Read, Hsu Mo relating to *Reservations to the Convention on the Prevention and Punishment of the Crime of Genocide to the Advisory Opinion*, ICJ, 28 May 1951, .p. 35, available at <http://www.icj-cij.org/docket/index.php?p1=3&p2=4&k=90&case=12&code=ppcg&p3=4> at 15 January 2010.

<sup>281</sup> One such example is the Moiwana Village case in which the question examined was that of a massacre of an ethnic group descending from “Bush Negroes” or “Maroons”, who fled enslavement and lived in independent communities. On 29 November 1986 a village belonging to the N’djuka community was surrounded, its property burned, and many members of the community were killed, causing the displacement of survivors to other regions. The American Convention on Human Rights entered into force for Suriname on November 12, 1987, and the jurisdiction of the Inter-American Court on Human Rights (IACtHR) was recognised on the same date. The Moiwana massacre occurred before the State of Suriname ratified the American Convention on Human Rights and accepted IACtHR’s jurisdiction, a fact which led the State of Suriname to question the competence *ratione temporis* of IACtHR. Suriname claimed that the Court lacked jurisdiction *ratione temporis* once IACHR treated it as a Convention State for the entire case, applying the Convention to the State *ex post facto*. Regarding the violations which occurred before the Convention entered into force for Suriname, IACHR recognized the violation of Arts. I, VII, IX, XXIII of the American Declaration of the Rights and Duties of Man and violations of a continuing nature, occurring after the Convention entered into force for the State. Suriname claimed that the only continuing violations IACtHR had recognized were forced disappearances, which were not at issue in the case. The IACHR replied to the State’s claims by stating that Suriname had been treated as a State party to the Convention with respect to the entirety of the claims once the claims directly connected to the attack and related violations were argued to be violations to the Declaration. The representatives then argued that the denial of justice in the case and omission had a continuing nature. The Court emphasized that in the case of a continuing or permanent violation, which begins before the acceptance and lasts till after the acceptance of the Court’s jurisdiction, the Tribunal is competent to examine the actions and omissions occurring after the recognition of jurisdiction. However, the Court admitted that it did not have jurisdiction to hear the facts related to the attack and death of the victims as they had occurred before the State of Suriname ratified the Convention. Nonetheless, the Court concluded that the failure to investigate, prosecute and punish those responsible for the massacre constituted ongoing violations to the Arts. 8 and 25 of the Convention, right to humane treatment (Art. 5), freedom of movement (Art. 22), and property (Art. 21). See also IACtHR, *Blake v. Guatemala* (Preliminary objections) 2 July 1996, IACHR, *Andres Aylwin Azocar and otros v. Chile* (Report No. 137/99, Case No.11.863).



In the context of climate change, the crime could be considered to be the ongoing emissions of greenhouse gases by various States (particularly industrialized developed countries) and their omission to control them. Omission to act was considered as a continuing violation when States failed to investigate, prosecute and punish human rights. Could then the omission of States to take measures to control the emissions also be considered as a failure to act?

## 7.9 Other Possible Alternative Status and Conclusions

At present there is “no major destination country that has a pro-active policy designed to resettle persons adversely affected by environmental hazards”.<sup>282</sup> However, it is clear that in the future displacement will take place due to the consequences of climate change, and it is necessary for the international community to establish some framework to guide this process. This legal vacuum should be addressed before the problem begins to grow in importance, especially before the numbers of people crossing international borders starts to increase.<sup>283</sup>

Despite the potential severity of the problem and some bold speeches and commitments, at present climate-change displaced people fall through the cracks of international refugee and immigration policy.<sup>284</sup> Hence many of these people, and especially the inhabitants of Atoll Island States, could eventually become *de facto* stateless. In order to prevent this and other problems, a number of initiatives and ideas around the world have been put forward on alternative possible status for future climate-change displaced people.

Some Bangladeshi NGOs have proposed the creation of a new status, a “Universal Natural Person”,<sup>285</sup> which could be accorded to climate-change displaced people and whom would be treated as permanent residents of the countries that would accept them.<sup>286</sup> This in a sense could be somehow similar to what happens to the inhabitants of EU countries when they travel to another country within the European Union. However, although it might be possible for countries to accept a few thousands or tens of thousands of immigrants under this accord, it appears more difficult to envisage the acceptance of millions of people.

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<sup>282</sup> Martin (2010), p. 6.

<sup>283</sup> Atapattu (2009), p. 607.

<sup>284</sup> International Organization for Migration (2007).

<sup>285</sup> Shamsuddoha and Chowdhury (2009), <http://www.glogov.org/images/doc/equitybd.pdf>.

<sup>286</sup> Climate-change displaced people and Housing, Land and Property Rights. Preliminary Strategies for Rights-Based Planning and Programming to Resolve Climate-Induced Displacement. Report by Displacement Solutions, p. 22 [http://displacementsolutions.org/files/documents/DS\\_Climate\\_change\\_strategies.pdf](http://displacementsolutions.org/files/documents/DS_Climate_change_strategies.pdf).

Another proposal that has been made is that of a “climate refugee visa”, as suggested for example in Australia by the Green Party.<sup>287</sup> This would be available to individuals displaced by a “climate change induced environmental disaster”, which would include areas where people were “unable to lead safe or sustainable lives in their immediate environment” due to the effects of sea level rise, coastal erosion, fresh water contamination and increase in frequency in extreme weather events.<sup>288</sup>

The question that remains is whether any of these measures would be really effective to provide protection and avoid the possibility of the inhabitants of Atoll Island States becoming stateless after the disappearance of their islands. A “climate refugee visa” would imply that the problems faced are temporary, and that eventually the inhabitants would be able to return to their lands. A solution such as a “Universal Natural Person” appears far more adequate, though it is unlikely that many (if any) countries would support it, as the current framework for the movements of people around the planet tends to be restrictive, especially for the case of individuals from poorer countries (and especially those with a low skill base).

Therefore for the case of Atoll Island States that believe they could be forced to eventually evacuate their entire populations,<sup>289</sup> not ignoring the challenges that the protection of their citizens might face due to the lack of a Convention that encompasses their situation and due to characteristics that are peculiar to them and not to all other environmentally displaced people (such as the fact that temporary protection with a future return is not possible), the most feasible solution appears to be the establishment of bilateral agreements or the use of soft law.

In such bilateral agreements the terms of reception of the displaced people, respecting human rights standards, with the possible exchange of revenues of fisheries and funds from the EEZ as long as there is not complete submergence of at least some of the coral islands could be discussed, so that both countries can somehow benefit from the arrangements. This type of agreement would not solve the problems of environmentally displaced people in general, but for the case of Atoll Island States represents a feasible solution since at the moment there is not a concrete perspective for creating a specific Convention that would address climate change displacement. The relocation of inhabitants of Atoll Island Stations might make sense if it is considered in terms of the “equal citizenship” argument, where developing nations must receive compensation for the harm due to the actions of developed nations.<sup>290</sup> Under this logic, if they were granted citizenship of a developed nation, then an appropriate redistribution of benefit can be achieved.<sup>291</sup>

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<sup>287</sup> And eventually defeated in Parliament in 2007, see Martin (2010), p. 5.

<sup>288</sup> Martin (2010), p. 5.

<sup>289</sup> And it should be understood that it is possible that some of the Atoll Island States could actually engineer solutions to these problems, as highlighted in Chap. 5.

<sup>290</sup> Tsosie (2007), p. 1625.

<sup>291</sup> Tsosie (2007), p. 1625.

It is of course not possible to redress other cultural and psychological losses that would result as a consequence of the loss of their islands, but this would go some way to address the economic problems involved. These bilateral agreements could complement the use of soft law, which would allow States to introduce the climate change displacement at their own pace in their domestic legislations. Perhaps this could indeed be the best alternative to overcome the lack of will of many States in making a new Convention to address climate change displacement.

## References

- Abe K (2005) The new face of humanitarianism—The Internally displacement problem and the politics of law. In: Shimada Y (ed) *Internal displaced people and International law*. Shinzansha, pp 225–271. [阿部浩己 (2005) 新しい人道主義の相貌——国内避難民問題の法と政治。In 国内避難民と国際法、島田征夫、信山社]
- Abbot KW, Snidal D (2000) Hard and soft law in international governance. *Int Organ* 54(3):421–456
- Ammer M (2009) Climate change and human rights: the status of climate refugees in Europe, Swiss initiative to commemorate the 60th anniversary of the UDHR. Protecting dignity: an agenda for human rights, Ludwig Boltzmann Institute of Human Rights (BIM) <http://www.udhr60.ch/report/ClimateChange-paper0609.pdf>. Accessed 15 March 2013
- Anghie A (2006) The evolution of international law: colonial and postcolonial realities. *Third World Q* 27(5):739–753
- Atapattu S (2009) Climate change, human rights, and forced migration: implications for international law. *Wis Int Law J* 27:607
- Batchelor CA (1995) Stateless persons. Some gaps in international protection. *Int J Refug Law* 7(2):232–259
- Barnet J, Webber M (2009) Accommodating migration to promote adaptation to climate change. Commission on Climate Change and Development. <http://www.ccdcommission.org/Files/documents/Accommodating%20Migration.pdf>
- Barnett J, Campbell J (2010) Climate change and small island states. Earthscan Ltd, London
- Beyerlin U (2006) Bridging the north–south divide in international environmental law. *Z ausländisches öffentliches Recht Völkerrecht* 66:259–296
- Biermann F, Boas I (2008) Protecting climate refugees. The case for a global protocol. *Environment* 50(6):8–16, [http://oppenheimer.mcgill.ca/IMG/pdf/climate\\_change\\_refugees.pdf](http://oppenheimer.mcgill.ca/IMG/pdf/climate_change_refugees.pdf)
- Blackman J (1997–1998) State successions and statelessness: the emerging right to an effective nationality under international law. *Mich J Int Law* 19:1141–1194
- Blitz BK (2009) Statelessness, protection and equality. Forced migration policy briefing 3. <http://www.rsc.ox.ac.uk/publications/policy-briefings/RSCPB3-Statelessness.pdf>
- Bodansky D (2010) Symposium: international human rights and climate change, introduction: climate change and human rights: unpacking the issues. *Ga J Int Comp Law* 38(3):511
- Boege V (2010) Challenges and pitfalls of resettlement measures: experiences in the Pacific region. Paper presented at the ESF-UniBi-ZiF research conference on “environmental change and migration: from vulnerabilities to capabilities”, Bad Salzungen, Germany, 5–9 December 2010. COMCAD Working Papers No. 12
- Boswell C (2002) The liberal dilemma in the ethics of refugee policy. Available at <http://isanet.ccit.arizona.edu/noarchive/boswell.html>
- Büntgen et al (2011) 2500 years of European climate variability and human susceptibility. *Science* 4:578–582. doi:10.1126/science.1197175

- Burkett M (2008) Just solutions to climate change: a climate justice proposal for a domestic clean development mechanism. *Buffalo Law Rev* 56:169
- Burns WC (1997) Global warming - the United Nations Framework Convention on Climate Change and the future of small island states. *Dickinson J Environ Law Policy* 6:147–188
- Byravan S, Rajan SC (2010) The ethical implications of sea-level rise due to climate change. *Ethics Int Aff* 24(3):239–260
- Cartagena Declaration on Refugees, Colloquium on the International Protection of Refugees in Central America, Mexico and Panama (1984) 22 November 1984. <http://www.unhcr.org/refworld/docid/3ae6b36ec.html>
- Castles S (2002) Environmental change and forced migration-making sense of the debate working paper No.70. <http://www.unhcr.org/cgi-bin/texis/vtx/search?page=search&docid=3de344fd9&query=environmental%20refugees>
- Chimni BS (1998) The geopolitics of refugee studies: a view from the south. *J Refug Stud* 11(4):350–374
- Chinkin C (2000) Normative development in the international legal system. In: Shelton D (ed) *Commitment and compliance: the role of non-binding norms in the international legal system*. Oxford University Press, Oxford, pp 21–42
- Claro CAB (2012) *Refugiados ambientais: mudanças climáticas, migrações internacionais e governança global*, dissertação de mestrado. Universidade de Brasília
- Cournil C (2011) The protection of “environmental refugees” in international law. In: Piguet E, Pecoud A, Guchteneire P (eds) *Migration and climate change*. Cambridge University Press, Cambridge, pp 359–387
- Displacement Solutions (2009) Climate-change displaced people and housing, land and property rights. Preliminary strategies for rights-based planning and programming to resolve climate-induced displacement. [http://displacementsolutions.org/files/documents/DS\\_Climate\\_change\\_strategies.pdf](http://displacementsolutions.org/files/documents/DS_Climate_change_strategies.pdf). Accessed 15 Sept 2012
- Docherty B, Giannini T (2009) Confronting a rising tide: a proposal for a convention on climate change refugees. *Harv Environ Law Rev* 3:349–403
- Dupuy PM (1991) Soft law and the international law of the environment. *Mich J Int Law* 12:420–435
- Draft Convention on the international status of environmentally displaced persons. [http://www.cidce.org/pdf/Draft%20Convention%20on%20the%20International%20Status%20on%20environmentally%20displaced%20persons%20\(second%20version\).pdf](http://www.cidce.org/pdf/Draft%20Convention%20on%20the%20International%20Status%20on%20environmentally%20displaced%20persons%20(second%20version).pdf)
- Dun O et al (2007) Environmentally displaced persons, working definitions. Environmental migration theory seminar. [http://www.each-for.eu/documents/Environmentally\\_Displaced\\_Persons\\_-\\_Working\\_Definitions.pdf](http://www.each-for.eu/documents/Environmentally_Displaced_Persons_-_Working_Definitions.pdf)
- Duong T (2010) When islands drown: the plight of “climate change refugees” and recourse to international human rights law. *Univ Pa J Int Law* 31(4):1239–1266
- European Union: Council of the European Union (2001) Council Directive 2001/55/EC of 20 July 2001 on minimum standards for giving temporary protection in the event of a mass influx of displaced persons and on measures promoting a balance of efforts between Member States in receiving such persons and bearing the consequences thereof, 7 August 2001, OJ L.212-223 7.8.2001, 2001/55/EC. Available at <http://www.unhcr.org/refworld/docid/3ddcee2e4.html>
- European Union (2004) Number 6, European Union: Council of the European Union, Council Directive 2004/83/EC of 29 April 2004 on Minimum standards for the qualification and status of third country nationals or stateless persons as refugees or as persons who otherwise need international protection and the content of the protection granted, 19 May 2004, 2004/83/EC. Available at <http://www.unhcr.org/refworld/docid/4157e75e4.html>. Accessed 27 Feb 2012
- Falstrom DZ (2001) Stemming the flow of the environmental displacement: creating a convention to protect persons and preserve the environment. *Colo J Int Environ Law Policy* 13(1):15
- Farbotko C, Lazrus H (2011) The first climate refugees? Contesting global narratives of climate change in Tuvalu. *Glob Environ Chang* 22(2):382–390. doi:10.1016/j.gloenvcha.2011.11.014

- FIELD (2011) Receding maritime zones, uninhabitable states and climate exiles. How international law must adapt to climate change? Available at [http://www.field.org.uk/files/climate\\_exiles\\_dw.pdf](http://www.field.org.uk/files/climate_exiles_dw.pdf). Accessed 1 May 2012
- Gasparatos A, Stromberg P (eds) (2012) Socioeconomic and environmental impacts of biofuels: evidence from developing nations. Cambridge University Press, Cambridge
- Gasparatos A et al (2011) Biofuels, ecosystem services and human wellbeing: putting biofuels in the ecosystem services narrative. *Agric Ecosyst Environ* 142(3–4):111–128
- General Assembly Resolution 55/153. A/55/PV.84, GA/9845. 12 December 2000 Available on the internet. <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N00/568/57/PDF/N0056857.pdf?OpenElement>
- Grant H et al (2009) UK should open borders to climate refugees, says Bangladeshi minister. *The Guardian* (4 December 2009). <http://www.guardian.co.uk/environment/2009/nov/30/rich-west-climate-change>
- Guzman AT, Meyer TL (2010) International soft law. *J Leg Anal* 2(1):171–224
- Hailbronner K (2006) Nationality in public international law and European law. In: Bauböck et al (eds) *Acquisition and loss of nationality: policies and trends in 15 European countries*. Amsterdam University, Amsterdam, pp 38–104
- Havard B (2007) Seeking protection: recognition of environmentally displaced persons under international human rights law. *Villanova Environ Law J* 18:65–82
- Hodgkinson D, Burton T, Anderson H, and Young L (2010) The Hour When the Ship Comes in: A Convention for Persons Displaced By Climate Change. *Monash University Law Review* 36(1): 69–119
- Hong J (2001) Refugees of the 21st century: environmental injustice. *Cornell J Law Public Policy* 10(2):323–348
- International Council on Human Rights Policy (2006) Human rights standards: learning from experience. Available at [http://www.ichrp.org/files/reports/31/120b\\_report\\_en.pdf](http://www.ichrp.org/files/reports/31/120b_report_en.pdf). Accessed 20 December 2012
- International Council on Human Rights Policy (2008) *Climate change and human rights—a rough guide*, Atar Roto Press SA, Vernier
- International Organization for Migration (2007) Discussion note: migration and the environment. MC/INF/288. [http://www.iom.int/jahia/webdav/shared/shared/mainsite/about\\_iom/en/council/94/MC\\_INF\\_288.pdf](http://www.iom.int/jahia/webdav/shared/shared/mainsite/about_iom/en/council/94/MC_INF_288.pdf)
- Kälin W (2001) How hard is soft law? The guiding principles on internal displacement and the need for a normative framework. Presentation at Roundtable Meeting Ralph Bunche Institute for International Studies CUNY Graduate Center. December 19, 2001. <http://www.brookings.edu/fp/projects/idp/articles/Kaelin12-19-01.pdf>. Accessed 2 Feb 2013
- Kälin W (2012) From the Nansen principles to the Nansen initiative. *Forced Migr Rev* 41:48–49. Available at <http://www.fmreview.org/preventing/kalin>. Accessed 30 Dec 2012
- Kibreab G (1997) Environmental causes of impact of refugee movements: a critique of the current debate. *Disasters* 21(1):20–38
- Knox JH (2009) Linking human rights and climate change at the United Nations. *Harv Environ Law Rev* 33. Wake Forest University Legal Studies Paper No. 1457793. <http://ssrn.com/abstract=1457793>
- Kolmannskog V, Myrstad F (2009) Environmental displacement in European Asylum law. *Eur J Migr Law* (pre-printed version). [http://www.nrc.no/arch/\\_img/9429378.pdf](http://www.nrc.no/arch/_img/9429378.pdf)
- Kolmannskog V (2009) Climate change related displacement and the European response. Paper presented at SID Vijverberg Session on Climate Change and Migration, The Hague
- Kolmannskog V, and Trebbi L (2010) Climate change, natural disasters and displacement: a multi-track approach to filling the protection gaps, *International Review of the Red Cross*, No 879
- Köppel M (2009) The effectiveness of soft law: first insights from comparing legally binding agreements with flexible action programs. *Georget Int Environ Law Rev* 21:821–835

- League of Nations (1930) Convention on certain questions relating to the conflict of nationality law, 13 April 1930, League of Nations, Treaty Series, vol 179, p. 89, No. 4137. Available at <http://www.unhcr.org/refworld/docid/3ae6b3b00.html>
- Limón M (2010) Human rights obligations and accountability in the face of climate change. *Ga J Int Comp Law* 38(3):545–592
- Male' Declaration on the Human Dimension of Global Climate Change (2007). Available at [http://www.ciel.org/Publications/Male\\_Declaration\\_Nov07.pdf](http://www.ciel.org/Publications/Male_Declaration_Nov07.pdf). Accessed 16 Sept 2012
- Mandal R (2005) Protection mechanisms outside of the 1951 Convention (“Complementary Protection”). <http://www.unhcr.org/refworld/pdfid/435e198d4.pdf>
- Martin SF (2010) Climate change and international migration, by the German Marshall Fund of the United States
- McAdam J (2007) *Complementary protection in international refugee law*. Oxford University Press, Oxford
- McAdam J, Saul B (2008) An insecure climate for human security? Climate-induced displacement and international law. Working paper 4. Sidney Center for International Law
- McAdam J (2009) Environmental migration governance. Working paper 1. <http://law.bepress.com/cgi/viewcontent.cgi?article=1143&context=unswwps-flrps09>
- McAdam J (2011a) Swimming against the tide: why a climate change displacement treaty is not the answer. *Int J Refug Law* 23(1):2–27
- McAdam J (2011b) Refusing refuge in the Pacific: (de)constructing climate-induced displacement in international law. In: Pigué E, Pécoud A, de Guchteneire P (eds) *Migration, environment and climate change*. UNESCO, Paris, pp 102–37
- McAdam J (2012a) *Climate change, forced migration, and international law*. Oxford University Press, Oxford
- McAdam J (2012b) The normative framework of climate-change displacement, The Brookings Institution, 3 April 2012, for event. Addressing the legal gaps in climate change migration, displacement and resettlement: from sinking islands to flooded deltas. Available at [http://www.brookings.edu/~media/research/files/papers/2012/4/03%20cc%20migration%20mcadam/04032012\\_cc\\_paper\\_mcadamj.pdf](http://www.brookings.edu/~media/research/files/papers/2012/4/03%20cc%20migration%20mcadam/04032012_cc_paper_mcadamj.pdf). Accessed 15 Dec 2012
- McAnaney SC (2012) Sinking islands? Formulating a realistic solution to climate change displacement. *N Y Univ Law Rev* 87:1172–1209
- MacLellan N (2009) The future is here: climate change in the Pacific. Oxfam report. [www.oxfam.org.au/climate-change](http://www.oxfam.org.au/climate-change)
- McLeman RA (2011) Settlement abandonment in the context of global environmental change. *Global Environmental Change* 21(1):S108–S120. doi:10.1016/j.gloenvcha.2011.08.004
- McNamara KE, Gibson C (2009) We do not want to leave our land”: Pacific ambassadors at the United Nations resist the category of “climate refugees”. *Geoforum* 40(3):475–483. doi:10.1016/j.geoforum.2009.03.006
- Mikami T, Shibayama T, Matsumaru R, Takagi H, Faainuseiamalie L, Chanmow I (2011) Field survey and analysis of the Tsunami disaster in the Samoan Islands, 2009. In: *Proceedings of coastal structures 2011 conference*, Yokohama
- Mickelson K (2009) Beyond a politics of the possible? South–north relations and climate justice. *Melb J Int Law* 10(2):411
- Moberg K (2009) Extending refugee definitions to cover environmentally displaced persons displaces necessary protection. *Iowa Law Rev* 94:1107–1136
- Mutua M (2001) Savages, victims and saviours. A metaphor of human rights. *Harv Int Law J* 42(1):201–245
- Myers N (2001) Environmental refugees: a growing phenomenon of the 21st century. *Phil Trans R Soc Lond* 357(1420):609–613
- Najam A (2005) Developing countries and global environmental governance: from contestation and to participation to engagement. *Int Environ Agreements* 5(3):303–321
- New Zealand Immigration (2010) *New Zealand Operational Manual* <http://www.immigration.govt.nz/opsmanual/archive/4851.htm>. Accessed 2 February 2013

- Park CC (2001) *The environment: principles and applications*. Routledge, London
- Popovski V, Mundy KG (2011) Defining climate change victims. *Sustain Sci* 7(1):5–16
- Rakova U (2009) *How-to guide for environmental refugees*. OurWorld 2.0. <http://ourworld.unu.edu/en/how-to-guide-for-environmental-refugees/>
- Ramos EP (2011) *Refugiados ambientais-em busca de reconhecimento pelo direito internacional*, tese de doutorado-Universidade de São Paulo-Faculdade de Direito
- Rawls J (1971) *A theory of justice*. Harvard University Press, Cambridge
- Refugee Studies Centre (2011) Protecting environmentally displaced people: developing the capacity of legal and normative frameworks. <http://www.unhcr.org/refworld/docid/4da57972.htm>
- Refugee Studies Centre (2009) Statelessness, protection and equality. <http://www.unhcr.org/refworld/docid/4e5f3d572.html>
- Shamsuddoha M, Chowdhury RK (2009) Climate change induced forced migrants: in need of dignified recognition under a new Protocol. Available at <http://www.glogov.org/images/doc/equitybd.pdf>. Accessed 21 Mar 2012
- Söderbergh, C. (2011) Human rights in a warmer world: the case of climate change displacement. Lund University Working Paper. <http://lup.lub.lu.se/record/1774900>
- Suliman O, Osman M (2011) *The Darfur conflict: geography or institutions?* Routledge, New York
- Stern N (2007) *The economics of climate change: the Stern review*. Cambridge Press, Cambridge
- The Rasmussen report (2012) [http://www.rasmussenreports.com/public\\_content/politics/current\\_events/environment\\_energy/energy\\_update](http://www.rasmussenreports.com/public_content/politics/current_events/environment_energy/energy_update)
- Tsosis R (2007) The climate of environmental justice. *Univ Colo Law Rev* 78:1625
- UN General Assembly (2009) Climate change and its possible security implications : report of the Secretary-General, 11 September 2009, A/64/350. Available at <http://www.unhcr.org/refworld/docid/4ad5e6380.html>. Accessed 15 Aug 2012
- UNHCR (1950) Statute of the office of the United Nations High Commissioner for Refugees, General Assembly Resolution 428 (V) of 14 December 1950. Available at <http://www.unhcr.org/3b66c39e1.html>. Accessed 15 August 2013
- UNHCR (1998) Guiding principles on internal displacement, 22 July 1998, E/CN.4/1998/53/Add.2. Available at <http://www.unhcr.org/refworld/docid/3c3da07f7.html>
- UNHCR (2005) Nationality and statelessness: a handbook for parliamentarians. <http://www.unhcr.org/refworld/docid/436608b24.html>
- UNHCR (2008) Towards a 'soft law' framework for the protection of vulnerable migrants. Available at: <http://www.unhcr.org/refworld/docid/4c23256b0.html>. Accessed 4 Feb 2013. ISSN 1020-7473
- UNHCR (2009) Climate change and statelessness: an overview, submitted by United Nations High Commissioner for Refugees supported by the International Organization for Migration (IOM) and the Norwegian Refugee Council (NRC) to the 6th session of the Ad Hoc Working Group on Long-Term Cooperative Action (AWG-LCA 6) under the UN Framework Convention on Climate Change (UNFCCC) 1 to 12 June 2009, Bonn, Germany, p 3
- UNHCR (2010) Overview of statelessness: International and Japanese context <http://www.refworld.org/pdfid/4c344c252.pdf>. Accessed 10 January 2013
- UNHCR (2010) Expert meeting organized by the Office of the United Nations High Commissioner for Refugees, Prato, Italy, 27–28 May 2010, summary of the meeting. <http://www.unhcr.org/cgi-bin/texis/vtx/home/opendocPDFViewer.html?docid=4cb2fe326&query=prato>
- UNHCR (2010) 2009 Global trends. Refugees, asylum-seekers, returnees, internally displaced and stateless persons. <http://www.unhcr.org/statistics>. Accessed 24 Dec 2011
- UNHCR (2011) Climate change and the risk of statelessness: the situation of low-lying Island States, May 2011, PPLA/2011/04. Available at <http://www.unhcr.org/refworld/docid/4ed3268f2.html>
- UNHCR (2011) Climate change and risk of statelessness: the situation of low-lying island States. <http://www.unhcr.org/refworld/docid/4e09a4ba2.html>



- UNHCR (2011) Climate change displacement and international law: complementary protection standards. <http://www.unhcr.org/refworld/docid/4e09a3492.html>
- UNHCR (2011) Summary of deliberations on climate change and displacement, UNHCR expert meeting, 26–28 February. <http://www.unhcr.org/4da2b5e19.html>
- US (1965) Immigration and Nationality Act. <http://www.uscis.gov/portal/site/uscis/menuitem.f6da51a2342135be7e9d7a10e0dc91a0/?vgnextoid=fa7e539dc4bed010VgnVCM1000000ecd190aRCRD&vgnextchannel=fa7e539dc4bed010VgnVCM1000000ecd190aRCRD&CH=act>. Accessed 20 Feb 2012
- Trindade AAC (1992) The contribution of international human rights law to environmental protection, with special reference to global environmental change. In: Weiss EB (ed) Environmental change and international law-new challenges and dimensions. United Nations University, Tokyo, pp 244–312
- Vyver JD (1999) Prosecution and punishment of the crime of genocide. *Fordham Int Law J* 23(2):286–356
- Warmer et al (2009) In search of shelter: mapping the effects of climate change on human migration and displacement. Report for care. [http://www.care.org/getinvolved/advocacy/pdfs/Migration\\_Report.pdf](http://www.care.org/getinvolved/advocacy/pdfs/Migration_Report.pdf). Accessed 19 Sept 2012
- Weiss EB (1992) Intergenerational equity: a legal framework for global environmental change. In: Weiss EB (ed) Environmental change and international law-new challenges and dimensions. United Nations University Press, Tokyo
- Weiss EB (2008) Intergenerational equity, and international law. *Vt J Environ Law* 3:615–628
- Wei D et al (2011) Receding maritime zones, uninhabitable states and climate exiles. How international law must adapt to climate change? Foundation for International Environmental Law and Development (FIELD). [http://www.field.org.uk/files/climate\\_exiles\\_dw.pdf](http://www.field.org.uk/files/climate_exiles_dw.pdf)
- Williams A (2008) Turning the tide: recognizing climate change refugees in international law. *Law Policy* 30(4):502–529

## ***Cases/Communications***

- Advisory Opinion on Proposed Amendments to the Naturalization Provision of the Constitution of Costa Rica*, OC-4/84, Inter-American Court of Human Rights (IACtHR), 19 January 1984. Accessed 10 December 2012
- Dissenting Opinion of Judges Guerrero, Sir Arnold McNair, Read, Hsu Mo relating to *Reservations to the Convention on the Prevention and Punishment of the Crime of Genocide to the Advisory Opinion*, ICJ, 28 May 1951, <<http://www.icj-cij.org/docket/index.php?p1=3&p2=4&k=90&case=12&code=ppcg&p3=4>>
- European Court of Human Rights, Soering v. United Kingdom, application no. 14038/88
- Human Rights Committee, *Mrs. Vaihene Bordes v. Mr. John Temeharo v. France*, Communication No. 645, para. 5, *Aalbersberg and 2,084 other Dutch citizens v. Netherlands*, Communication No. 1440/2005
- Office of the High Commissioner of Human Rights (2009) Report of the Office of the United Nations High Commissioner for human rights on the relationship between climate change and human rights
- IACtHR, *Blake v. Guatemala* (Preliminary objections) 2 July 1996, IACHR, *Andres Aylwin Azocar and otros v. Chile* (Report No. 137/99, Case No. 11.863)
- IACtHR, *Moiwana village v. Suriname*, 15 June 2005 (Series C, No. 145)
- IACtHR, *Blake Case*, Judgement on the Preliminary Objections of July 2, 1996
- ICJ, *Nottebohm Case (Liechtenstein v. Guatemala)*; Second Phase, 6 April 1955. Available at <http://www.unhcr.org/refworld/docid/3ae6b7248.html>



## Chapter 8

# Concluding Remarks

Several Atoll Island States are potentially at risk of disappearing in the future due to the combined effects of sea level rise, an increase in ocean temperatures and acidity, the higher levels of coral mortality and the potential for stronger tropical cyclones. The present book has raised a number of important questions regarding the interpretation of the UNCLOS, climate change displacement, statelessness and statehood criteria. It is important that these questions are inserted into the current talks on climate change and that they should be given proper attention in the coming years, as they would have consequences not only for Atoll Island States but for many other countries that could eventually find themselves receiving the population from these islands, if they indeed disappear.

Possible future scenarios and adaptation strategies for Atoll Island States against climate change were discussed, together with the viability of these options from an economical, legal and engineering point of view. Adaptation to climate change is complex, and depends on a number of factors, such as the resilience, access to resources and the financial capacity of the communities involved. As such, it is unlikely that all Atoll Island States will be able to adapt in the same way. In particular, middle-income countries such as the Maldives are likely to be able to undertake more expensive adaptation strategies than poorer countries such as Tuvalu, by building coastal defences around the perimeter of key islands and gradually raising their elevation.

This issue of coastal defences could prove crucial to the economies of these countries, as the disappearance of the various coral islands would effectively cancel the maritime zones that can be derived from them. Several commentators have thus argued UNCLOS should be modified or that at least there should be a movement to a more progressive interpretation of some of its clauses. While we agree that such developments would be welcome, we argued that raising existing islands would be the most obvious and clear way of protecting the maritime zones that originate from them, and would not require any changes to UNCLOS. We emphasize once again that we are not arguing for the creation of artificial islands to preserve maritime zones or sovereignty, but rather for the raising of existing islands. This would be less costly than the creation of new islands—as it would involve far less materials

and would be technically simpler and in line with what many countries already do around their coastline (i.e. it would follow accepted State practice regarding the protection and management of coastlines around the world). As UNCLOS already allows the raising of existing naturally formed islands and the protection of their shoreline, and if the objective of the international community was to save the maritime zones of Atoll Island States, it would be more cost-effective to use any adaptation funds and resources that are available to elevate the most important coral islands than to reopen political negotiations around UNCLOS. The re-opening of political negotiations would involve protracted negotiations in various venues around the planet, with the associated consultancy fees (by each government) and travel fees, money that would arguably be better used creating an Atoll Island Defence Fund. This would not only allow their respective populations to stay in place, but in essence would nullify many of the problems that could potentially affect them, as we discussed throughout this book. Of course, this would not help with the problem that other low-lying regions of the world are facing, but these generally do not have associated with them as many sovereignty and UNCLOS issues as Atoll Island States.

The raising of coral islands could ensure the survival of at least some of them and prevent an Atoll Island State from losing its entire territory. However, poorer countries will arguably struggle finding solutions to the challenge of increasing levels of coral mortality and the consequences that this can have on atolls keeping pace with sea level rise, something that could lead to the eventual disappearance of all of their islands. In order to enable adaptation measures to be undertaken by the poorer countries the creation of a compensation mechanism would be essential. In fact, since the Bali Action Plan in 2007 there has been discussion regarding the creation of a “loss and damage” mechanism that could provide Atoll Island States with a way to seek some sort of compensation.

When thinking about these issues, it is important to keep in mind that International Law is dynamic, continuously adapting to new political demands and circumstances. Hence it is probable that it will eventually somehow adapt to the issues brought about by climate change,<sup>1</sup> though changes in law cannot have a retroactive effect, which would require that amendments to existent legal instruments or new instruments are created before Atoll Island States suffer from the complete loss of their territory. However, waiting for such changes in law is not a good prospect for Atoll Island States, who in the meantime should use all available diplomatic tools at their disposal (including their membership of AOSIS) to attempt to find a solution to these problems before they become more acute.

Despite the potential severity of the problem and some bold speeches and commitments, at present climate-change displaced people fall through the cracks of international refugee and immigration policy.<sup>2</sup> At present there is “no major destination country that has a pro-active policy designed to resettle persons

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<sup>1</sup> Wei (2011), p. 1.

<sup>2</sup> IOM (2008), p. 36.

adversely affected by environmental hazards”.<sup>3</sup> However, it is clear that in the future climate change could cause migration waves, making it necessary for the international community to establish some framework to guide this process. Nevertheless, the inhabitants of these countries could still suffer from the effects of the current legal vacuum, and therefore the potential problems highlighted in this book should be addressed before they start to grow in importance, especially before the numbers of people crossing international borders starts to increase.<sup>4</sup>

If these problems are not addressed then there is the possibility that many of the inhabitants of the poorer Atoll Island States could eventually become *de facto* stateless. In order to prevent this and other problems, a number of initiatives and ideas around the world have been put forward on alternative possible status for future climate-change displaced people. Temporary protection could, for example, be also applied to those who are displaced by climate-change. However, for the case of the inhabitants of Atoll Island States a temporary protection would not solve their problems since it is unlikely that they would be able to return to their homes as all of the coral islands which make up their archipelagos could eventually disappear.

It has also been proposed that a new Convention for climate change displaced people could be created. However, the creation of such a Convention involves overcoming various challenges, such as the fact that the movement of people in many countries would tend to be more internal than international, and that displacement is likely to be a complex process not only involving climate change itself but also other socio-economic factors. In this regard, the use of soft law or bilateral agreements could be a better alternative. Soft law would avoid a sense of caution due to its non-legally binding nature, thus enable it to be applied more easily. Bilateral agreement would involve only the interested parts that could discuss directly how the citizens migrate and what rights could be secured by them.

A key potential problem that Atoll Island States could face in the future is that after the last of their islands is eroded by the sea they could cease to be considered sovereign States. Despite this potential frightening prospect, it is actually unlikely that already recognized States can lose their status even if they lose one of the elements required by the 1933 Montevideo Convention (such as population, government or a defined territory). It appears that Atoll Island States can preserve their status by relying on the recognition of other States. This continuity of recognition by other States and international organizations would have a reparative effect to compensate for the lack of territory and/or population and would create a State *sui generis*. Conversely, if other States are no longer prepared to recognise Atolls Island States after they lose their territory, then this would in effect confirm that Montevideo criteria on territoriality is an absolute necessity for a State to be recognised as such. However, in this book we have argued against this outcome, by pointing out that there is a difference between the criteria for the initial recognition of statehood and the continuity of it. However, there is a common

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<sup>3</sup> Martin (2010), p. 6.

<sup>4</sup> Atapattu (2009), p. 607.

point between them in that the both rely on a blend of legal and political judgements. These judgements could ultimately determine whether statehood can be preserved, even after the last island in a given Atoll Island State disappears.

In fact there are subjects of international law which do not hold any territory, or did not hold this element during certain periods of time, and that was not an obstacle for them to be recognized as sovereign entities before international law. The international personality of these States could be preserved because sovereignty can be practiced in networks across space,<sup>5</sup> which would be equivalent to having a de-territorialized State (a concept which does not fit with the classical interpretation of statehood). This certainly poses some challenges since territoriality has long been emphasized as the almost exclusive way of exercising political power.

The issue of whether a de-territorialized State is possible draws attention to entities which are outside the rule of a “traditional State”, such as governments-in-exile and nomads, often overlooked by international law because they are not connected to the more traditional notions of prominent and powerful States. Atoll Island States are generally classified as “developing States”, and thus in this sense trying to secure an exception to established international practices could be challenging. The Vatican, SMOM, and the case of the Boers in the nineteenth century coincidentally or not belonged to that of western nations, and occurred when colonialism was still the rule throughout the world. They had their exceptions accepted because they were part of the club of States which could dictate international law. If Atoll Island States can preserve their statehood in a scenario in which one of the elements of statehood required by the Montevideo Convention is missing, it will demonstrate not only that the continuity of statehood does not necessarily rely on the existence of these elements, but that whether a State exists or not does not rely only on international law, but also on political relations. The survival of Atoll Island States in some form or another could be essential in order to preserve their inhabitant’s identity and culture, and we argue that major emitters of greenhouse gas could face a moral obligation to protect those communities as they are very likely to be the ones responsible for the increased pace in sea level rise.

Otherwise it has been suggested that Atoll Island States could preserve their sovereignty by acquiring some territory from another State. However the cession of territory was applied mainly in the past by Western countries to increase their colonial territories and thus its application appears misplaced. Anyhow, it is unlikely that this type of solution could be currently applied to the case of Atoll Island States since it is improbable that any sovereign State would be willing to cede a part of its own territory. Interestingly, if a cession of territory actually took place it would represent a change in the pattern of international relations, as Atoll Island States would be benefiting from an instrument that colonial powers frequently used in the past to further their territorial ambitions. Otherwise, poorer Atoll Island States could also attempt to merge with a bigger country, which would have the necessary financial resources to protect the coral islands in exchange for a

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<sup>5</sup> Agnew (2004), p. 441.

joint exploitation of their Exclusive Economic Zones (EEZs). However, such a measure also appears misplaced, as it would put these countries once again under the power of the States that were mostly responsible for the ultimate disappearance of their islands, and who would then profit from the exploitation of the resources in their EEZs. The ethical and moral implications of such a proposition thus appear flawed.

## References

- Agnew J (2004) Sovereignty regimes: territoriality and State authority in contemporary world politics. *Ann Assoc Am Geogr* 95(2):437–461
- Atapattu S (2009) Climate change, human rights, and forced migration: implications for international law. *Wis Int Law J* 27:607
- International Organization for Migration (IOM) (2008) Migration and climate change. IOM Migration Research Series No. 31. Available at [http://publications.iom.int/bookstore/free/MRS-31\\_EN.pdf](http://publications.iom.int/bookstore/free/MRS-31_EN.pdf). Accessed 16 Feb 2011
- Martin SF (2010) Climate change and international migration. German Marshall Fund of the United States, Washington, DC. <http://www.ehs.unu.edu/file/get/7103>. Accessed 15 Mar 2013
- Wei D (2011) Receding maritime zones, uninhabitable states and climate exiles, how international law must adapt to climate change. Foundation for International Environmental Law and Development (FIELD). [www.field.org.uk/files/climate\\_exiles\\_dw.pdf](http://www.field.org.uk/files/climate_exiles_dw.pdf). Accessed 17 Apr 2012

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