Technical Paper: The risk of disaster-induced displacement

South Pacific island states

iDMC internal displacement monitoring centre

NRC NORWEGIAN REFUGEE COUNCIL

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Cover photo: Western Division, Fiji: In December 2012, Tropical Cyclone Evan left a trail of destruction across Samoa, Wallis and Futuna, and Fiji. Evan was the worst cyclone to hit Fiji in 20 years. It forced the government to declare a state of emergency and request international assistance. Credit: OCHA/Masaki Watabe, December 2012

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Acronyms

AAL	Average Annual Loss
CAPRA	Probabilistic Risk Assessment Initiative (of ERN-AL)
CCA	Climate Change Adaptation
CRED	Centre for Research on the Epidemiology of Disasters
DARA	Development Assistance Research Associates
DESINVENTAR	Disaster Inventory Management System
DiDD	Disaster-induced Displacement Database (of IDMC)
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EM-DAT	Emergency Events Database (of CRED)
ENSO	El Niño Southern Oscillation
ERN-AL	Evaluación de Riesgos Naturales – América Latina
GAR	Global Assessment Report
GFDRR	Global Facility for Disaster Reduction and Recovery
GPID	Guiding Principles on Internal Displacement
GRID	Global Resource Information Database (of UNEP)
HFA	Hyogo Framework for Action
IDMC	Internal Displacement Monitoring Centre
ICCRR	Indicator of Conditions and Capacities for Risk Reduction
IPCC	Intergovernmental Panel on Climate Change
IRR	Indicator of Conditions and Capacities for Risk Reduction (of DARA)
LAC	Latin America and the Caribbean
PCRAFI	Pacific Catastrophe Risk Assessment and Financing Initiative
PNG	Papua New Guinea
PREVIEW	UNEP/GRID Project for Risk Evaluation, Information and Early Warning - Commonly known as 'Global Risk Data Platform'
SOPAC	South Pacific Applied Geoscience Commission
SPREP	Secretariat of the Pacific Regional Environment Programme
UNEP	United Nations Environment Programme
UNISDR	United Nations International Strategy for Disaster Reduction

Preface

This technical paper represents an initial attempt to assess the risk of disaster-induced displacement in 21 island states in the South Pacific. It presents results from the second of five planned analyses[1] which correspond with the regional consultations of the Nansen Initiative, a state-led process that brings together representatives from governments, international organisations, civil society, think tanks and other key actors to develop a protection agenda for people displaced across state borders by disasters and the effects of climate change.[2] Preliminary results of this analysis were presented at the Nansen Initiative consultation in the Cook Islands in May 2013.

The primary intended audience for this paper are those in national and regional governments responsible for reducing and managing disaster risks and for protecting the rights of internally displaced persons (IDPs). Given that displacement risk is largely influenced by human decisions, final outputs of the process discussed in this paper could potentially inform development decisions and reduce or avoid the risk of displacement. Humanitarian actors may also use this analysis to inform preparedness planning for disaster-induced displacement. For example, the paper could help determine evacuation centre capacity, temporary shelter needs or funding needed for activities to reduce displacement risk in particular countries.

Findings from the five regional analyses will inform a consolidated report on the risk of disaster-induced displacement. Drawing on IDMC's *Global Estimates*[3] and other relevant data on previously reported disaster-induced displacement, this report and the five regional analyses will provide evidence-based estimates and scenarios concerning the likelihood of future displacement—and how it can be mitigated.

The following analysis is based on probabilistic risk. It models a methodology that has been widely used to assess the likelihood of disaster-related economic losses and fatalities. IDMC is testing this methodology to assess the likelihood of displacement, having already published an assessment of displacement risk in Central America.[4] This methodology will be refined and expanded in 2014 in regional analyses focusing on South Asia and Southeast Asia. A fifth technical paper, focusing on drought-induced displacement in the Horn of Africa, will expand the analysis by employing a methodology based on system dynamics modelling due to the difficulty of estimating drought-related displacement using existing methodologies. An initial analysis based on the system dynamics model, which accounts for drought impacts on the natural resources, livelihoods and displacement, will be published in early 2014. The aim of each report is to provide the best possible estimates of displacement risk given the available data. In this spirit of continuous improvement, IDMC invites relevant experts and interested readers to comment on and contribute to this innovative area of work.[5]

Executive Summary

This technical paper provides evidence-based estimates of the likelihood of disaster-induced displacement in the South Pacific island states of American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, Wallis and Futuna. It represents a first attempt to better quantify human displacement risk. It brings together data from several sources – notably the *Global Assessment Reports* (GARs) of the United Nations International Strategy for Disaster Reduction (UNISDR), national disaster loss inventory databases (DesInventar) and the Internal Displacement Monitoring Centre's (IDMC) *Global Estimates* – in order to better quantify human displacement risk. Applying a probabilistic risk model, it is one of the first attempts to assess how many people are at risk of being displaced by natural hazard-related disasters.

A new way of thinking

The study reflects emerging awareness of the need to see disasters as primarily social, rather than natural, phenomena. This acknowledges the fact that humans can act and take decisions to reduce the likelihood of a disaster occurring or, at the very least, to reduce their impacts and the levels of loss and damage associated with them. Disasters are thus no longer being perceived as 'acts of God' but instead as something over which humans exert influence and can therefore prevent.

This reconceptualisation of disasters signifies a shift from a retrospective, post-disaster approach to an anticipatory way of thinking about and confronting disasters. This conceptual development dates from the UN International Decade of Natural Disaster Reduction in the 1990s and is reflected in the 2005 Hyogo Framework for Action (HFA), a ten-year plan endorsed by the United Nations General Assembly which aims to reduce the risk of disasters globally. One important outcome of the HFA process is awareness that without ability to measure it is not possible to know if disaster risk has been reduced.

In the context of disasters, displacement includes all forced or obliged population movements resulting from the immediate threat of, or actual, disaster situation regardless of length of time displaced, distance moved from place of origin and subsequent patterns of movement, including back to place of origin or re-settlement elsewhere. Based upon existing information and notwithstanding some notable exceptions, the vast majority of people displaced by disasters are assumed to remain within their own country rather than to cross internationally recognised borders to find refuge.

Displacement is a disaster impact that is largely determined by the underlying vulnerability of people to shocks or stresses that compel them to leave their homes and livelihoods just to survive. The number of people displaced is, of course, related to the magnitude and frequency of extreme hazard events or processes. The most significant factors are those that leave exposed and vulnerable communities without the means to be resilient in the face of such hazards.

Informed by this anticipatory way of thinking about disasters, the approach used in this study departs from most existing analyses in two ways.

First, while the efforts of many governments and other actors continue to emphasise post-disaster and post-displacement response and recovery the following analysis is based on probabilistic risk modelling. This uses historical information available about past disasters to provide estimates that may inform policy and action to ideally prevent, or at least to prepare, for displacement before a disaster occurs.

Second, while displacement and disasters have traditionally been associated with humanitarian relief and human rights protection this study analyses disaster-induced displacement in the language of the disaster risk reduction and disaster risk management communities. In sum, this study attempts to provide entry points for humanitarian and protection actors while presenting information aimed at those responsible for disaster risk reduction and risk management and development.

Regional context

With the exception of Papua New Guinea, the region consists of small to very small island states whose populations are exposed not only to significant tropical cyclone activity but also to the effects of climate change such as sea-level rise, increased storm surges, ocean acidification and changes to historic precipitation patterns that can lead to increased risk of drought. In addition, due to the

Destruction caused by the tsunami that hit Samoa in 2009. Credit: OCHA ROP

volcanic nature of much of the region, earthquake, tsunami and volcano risk also contribute to the risk pattern many must live with. Public resources to address substantial disaster-driven displacement events are often limited, potentially exceeding national capabilities to respond adequately, thus leaving many of those displaced, or at risk of being displaced, with little choice other than to fend for themselves or survive on foreign aid and remittances.

IDMC research has found that at least 80 per cent of the world's disaster-driven displacement in the past five years has been triggered by hydro-meteorological events.[6] The South Pacific region is no exception to this trend. Beyond the extremely high exposure levels that are endemic to the location and nature of these territories, extremely high vulnerability levels complete the picture in terms of displacement risk. Some states' high vulnerability levels are derived from their extremely low elevation (several countries have high points under five metres above sea level), while others have seen their highest ground decimated by extractive mining during the 20th century (as is the case with Kiribati's Banaba island and Nauru).

These are just two of the factors that drive disaster and climate-change induced displacement risk in a region where both endogenous and exogenous development processes lead to heightened exposure and vulnerability levels. Endogenous causes include disasters such as landslides affecting informal settlements at the base of steep slopes and downstream flooding caused by development-driven changes in upstream land use such as reductions in permeable surface area. Exogenous causes include all of the effects of climate change, from rising sea levels and water temperatures to increased extremes, such as the recent Typhoon Haiyan and its record-setting 310 kilometre per hour sustained winds that led to a large disaster and displacement in the Philippines.

The region has a mixture of both internal and external human displacement that is largely driven by access to livelihoods. The region has a very large range of income levels with many still practicing subsistence farming and fishing activities. On extremely small island states, and in particular on those consisting of only low-lying atolls, Polynesian navigators served a historic role not just as 'captains' of their vessels, but also as 'displacement leaders' who often helped move populations from one island to another following storms that left their territories temporarily inhabitable.

Larger territories, for example those with a major principal island, have seen migration patterns toward urban centres or more developed rural areas due to the lack of infrastructure and employment in more remote areas. There is an ongoing pattern of migration away from areas where the only economic option is subsistence fishing and farming and toward areas where more promising livelihoods can be found. After disaster hits, this may take place in the form of internal displacement and other times in the form of external displacement, all dependent on where new livelihoods may be found.

Preliminary results and findings

In this paper, human displacement risk due to disasters and climate change has been estimated as a 'magnitude' index expressed as the number of persons expected to be displaced on average per year. Results are provided in both absolute and relative number of displaced. A separate qualitative 'amplitude' measure expresses the general duration, distance and severity of the potential displacement.

The initial modelled displacement estimates were found to be line with expected results. The risk displacement estimates were generated without knowledge of the methodology used by IDMC's Disaster-induced Displacement Database (DiDD) or its estimates over the past five years, yet the preliminary results of this risk assessment process are largely in line with DiDD figures. Countries with higher Human Development Indexes, better governance indicators and higher per capita incomes also had better (that is, lower) relative displacement estimates. Countries with higher intrinsic hazard, exposure and vulnerability levels generally saw these factors reflected in higher estimated displacement. Both of these patterns are in line with findings of studies on vulnerability, exposure and resilience indicators in the context of disaster risk.

Key Findings:

1. The South Pacific island states reviewed for this study offer a wide range of hazard, exposure and resilience configurations, making the region a unique example of risk heterogeneity in a comparatively small land mass area over a very wide ocean area.

2. Based on evidence related to past disaster-induced displacement events in the 21 countries and territories included in this analysis, approximately 13,000 people in the South Pacific are at risk of being displaced each year.

3. Normalising by the region's population, we estimate that approximately 2,900 people per million are at risk of being displaced annually. This regional figure is below the global average of 4,000 displaced per million per year due to the fact that there are relatively fewer vulnerable and exposed populations in the South Pacific than in the more populous South and Southeast Asia.

4. Historical displacement patterns are very hard to detect in the South Pacific due to the nature of global-level data collection and how it relates to states with small populations. For example, it is difficult to assess the likelihood and return-periods for events occurring in very small territories. As we project into the future, this uncertainty is compounded by climate change impacts on storm frequency and intensity, sea-level rise and other slow-onset processes such as coastal erosion and ocean acidification. This uncertainty should not, however, be an excuse for inaction.

5. Civil strife and poor governance contribute substantially to displacement risk in the South Pacific. Several states have free association or protectorate arrangements with developed countries, principally New Zealand, the USA and France, which help improve governance and result in lower levels of displacement risk. Several other states have yet to establish legitimate and effective enough governance structures to be able to ensure the absence of civil strife, or to effectively manage disaster and climate change risks.

6. Within the region, the risk of displacement in lowest in countries and territories with high resilience and low vulnerability, such as French Polynesia and Guam. On the other hand, people in countries with low resilience and high vulnerability, such as Kiribati, Solomon Islands and Vanuatu, are at relatively higher risk of displacement.

7. Countries with high levels of exposure to one or more hazards can often effectively reduce displacement risk by adopting and enforcing building codes, land use plans and development strategies that manage natural resources sustainably.

8. Initial estimates demonstrate the need for improvement in data sources and data quality in order to properly assess displacement risk. Regional data collection approaches with broad inclusion criteria and standard methodologies can help improve understanding by painting a more accurate and detailed picture of disaster-related losses at the local level.

9. Data on displacement relating to high-frequency, low-intensity hazards and slow-onset hazards is particularly sparse. This paucity of data means it is difficult to infer past patterns or quantify displacement risk associated with these types of hazards. Furthermore, displacement data linked to slow-onset climate change impacts is even scarcer, compounding the challenge of producing precise estimates about the future. Consequently, additional studies of these small-scale, recurring events and future climate change impacts are needed. Insights from these studies could lead to a greater understanding of displacement risk, and potentially require us to revise upward the initial estimates of displacement risk within the region included in this paper.

Table 1: Disaster displacement estimates- preliminary results

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
American Samoa	56,000	134.0	10	2,397.6	11	Medium
Cook Islands	20,000	182.0	8	9,120.4	3	High
Federated States of Micronesia	104,000	91.0	11	875.0	15	High
Fiji	861,000	4,608.0	2	5,351.5	7	Medium
French Polynesia	258,000	25.0	14	98.3	19	High
Guam	159,000	467.0	7	2,937.9	10	Medium
Kiribati	98,000	53.0	12	545.5	16	Very high
Marshall Islands	52,000	171.0	9	3,287.3	9	Very high
Nauru*	10,000	1.0	20	50.0	20	Very high
New Caledonia	246,000	34.0	13	138.1	18	Medium
Niue*	1,000	14.0	16	13,797.5	2	High
Northern Mariana Islands	54,000	9.0	18	163.0	17	High
Palau	20,000	1.0	20	44.5	21	High
Papua New Guinea	6,859,000	7,019.0	1	1,023.3	14	Medium
Samoa	186,000	1,402.0	6	7,535.6	6	Medium
Solomon Islands	526,000	2,483.0	3	4,719.6	8	High
Tokelau*	1,000	8.0	19	8,489.5	4	Very high
Tonga	104,000	1,745.0	5	16,777.6	1	High
Tuvalu*	10,000	17.0	15	1,708.9	12	Very high
Vanuatu	236,000	1,832.0	4	7,763.6	5	High
Wallis and Futuna Islands*	14,000	14.0	16	1,028.9	13	High
TOTAL	9,875,000	20,310		4,184		High

* Countries whose physical and population size is below the necessary level to generate sufficient disaster loss figures for a statistically valid analysis.

4,184 per 1m is the average of each country's relative displacement risk (to eliminate disproportionate influence by largest states). Relative displacement using regional totals 2,056 per 1 million inhabitants.

1 Introduction

> *To understand disasters we must not only know about the types of hazards that might affect people, but also the different levels of vulnerability of different groups of people. This vulnerability is determined by social systems and power, not by natural forces. It needs to be understood in the context of political and economic systems that operate on national and even international scales: it is these which decide how groups of people vary in relation to health, income, building safety, location of work and home, and so on.*[7]

This technical paper provides evidence-based estimates of the likelihood of disaster-induced displacement in South Pacific island states. Applying a probabilistic risk model, it begins to project how many people are at risk of being displaced by disasters by using evidence from reported situations of disaster-induced displacement. It builds upon the existing evidence base concerning disaster risk and disaster-induced displacement, particularly that which has been consolidated in the United Nations International Strategy for Disaster Reduction's (UNISDR) three *Global Assessment Reports* (GARs)[8] and IDMC's *Global Estimates*.[9] It provides forward-looking estimates, a spatial scale that we hope will be useful for planning and decision-making. For example, the amount of displacement risk in a particular area could determine evacuation centre capacity or temporary shelter needs.

This paper is primarily intended for those in national and regional government responsible for reducing and managing disaster risks or protecting the rights of internally displaced persons (IDPs). The study is particularly intended to inform the multi-lateral consultations of the Nansen Initiative,[10] a state-led process that focuses on cross-border displacement related to disasters and climate change. Given that displacement risk is largely influenced by human decisions – as opposed to natural hazards – the study may also be useful for informing development investment decisions that could reduce or avoid the risk of displacement. Humanitarian actors may also be interested in the findings as a means of informing preparedness planning for disaster-induced displacement.

This paper covers human displacement risk in the South Pacific island states of American Samoa, the Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, the Marshall Islands, Nauru, New Caledonia, Niue, the Northern Mariana Islands, Palau, Papua New Guinea (PNG), Samoa, the Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu and Wallis and Futuna. It represents a first attempt to better quantify human displacement risk. With the exception of PNG, the region consists of small to very small island states whose populations are exposed not only to significant tropical cyclone activity but also such effects of climate change as sea-level rise, increased storm surges, ocean acidification and changes to historic precipitation patterns that can lead to increased risk of drought. Due to the volcanic nature of much of the region, earthquake, tsunami and volcano risk also contribute to the risk pattern many must live with. National resources to address substantial disaster-driven displacement events are often limited, potentially exceeding national capabilities to respond adequately, thus leaving many of those displaced with little choice other than to fend for themselves or survive on foreign aid and remittances.

IDMC research has found that at least 80 per cent of the world's disaster-driven displacement in the past five years has been triggered by hydro-meteorological events.[11] The South Pacific region is no exception. Extremely high exposure levels and high vulnerability levels are endemic to the location and nature of these territories. Some states' high vulnerability levels are derived from their extremely low elevation. Several countries have high points less than five metres above sea level), while others have seen their highest ground decimated by extractive mining during the 20th century (as is the case with Kiribati's Banaba island and Nauru).

These are just two of the factors that drive disaster and climate-change induced displacement risk in a region in which both endogenous and exogenous development processes lead to heightened exposure and vulnerability levels. Endogenous causes include disasters such as landslides affecting informal settlements at the base of steep slopes and downstream flooding caused by development-driven changes in upstream land use such as reductions in permeable surface area. The compounding effect of hydro-meteorological events occurring together with geophysical events, such as a period of high rainfall preceding an earthquake, frequently lead to much higher levels of damage and displacement. Exogenous causes include all of the effects of climate change, from rising sea levels and water temperatures to increased extremes. This is exemplified by the November 2013 Typhoon Haiyan and its unprecedented 310 kilometre per hour sustained winds that led to a large disaster and displacement in the Philippines.

Palau's Kayangel state was completely inundated and homes across the island were destroyed. Credit: Office of the President, Republic of Palau, November 2013

Different economic activities help contribute to total displacement risk. Tourism often tends to drive development in highly exposed coastal areas where events with shorter and shorter return periods are increasingly leading to damaging events and more frequently recurring losses. Losses incurred by large tourism operators are usually covered by insurance companies while tourist industry employees are left to fend for themselves, often suffering loss of shelter and/or livelihoods. Agricultural activities are highly subject to changes in climatological patterns, fresh-water reserves and erosion of high-quality soils. With increasing stress placed on water sources, fisheries and habitable land, those with a limited resource base may have no choice but to move to seek alternative short- or long-term livelihoods.

The region has a mixture of both internal and external human displacement that is largely driven by access to livelihoods. There are marked regional differences in income levels. Many people still practice subsistence farming and fishing activities. On extremely small island states, and in particular on those consisting of only low-lying atolls, Polynesian navigators served a historic role not just as 'captains' of their vessels, but also as 'displacement leaders' who often helped move populations from one island to another following storms that left their territories temporarily uninhabitable. Larger territories, for example those with a major principal island, have seen migration patterns toward urban centres or more developed rural areas due to the lack of infrastructure and employment in more remote areas. In both of these cases, we see an on-going pattern of migration from areas where the only economic option is subsistence fishing and farming toward areas where more promising livelihoods can be found. After disaster hits, this may take place in the form of internal displacement and other times in the form of external displacement, all dependent on where new livelihoods may be found.

2 Displacement and disaster risk

2.1 Approaching displacement from the perspective of disaster risk

This paper brings together data from several disparate sources in order to better quantify human displacement risk in island states in the South Pacific. The goal is to look beyond historic displacement figures towards future displacement risks awaiting different regions, countries and communities. As the second of five regional analyses based on a displacement risk methodology under development by IDMC, it:

- advances several considerations for modelling of displacement risk
- elaborates a new assessment methodology which will be refined and formalised in 2014
- seeks to yield results that are as accurate and certain as possible with available data
- informs continuing policy discussions relevant to the Nansen Initiative consultation on cross-border displacement related to disasters and climate change.

The findings presented here are the result of a pilot study and use the best available spatial and temporal evidence to generate displacement risk estimates. In the light of climate change related pressures, these displacement risk estimates provide a look at potential, rather than historic, displacement in order to help bring to light the implications of disaster-induced human displacement trends. As a pilot, results contained in this paper should be considered provisional as the methodology is improved and expanded. A complete explanation of the methodology used in the analysis will be published once the methodology is finalised in 2014. A draft version of the methodology document is available and the authors are keen to receive feedback on it.[12]

2.2 Strengths and weaknesses of the 'risk' approach

The objective of this project is to generate probabilistic risk information that quantifies expected human displacement based on both annual averages as well as the effect of disaster events of different return periods (for example, the expected number of displaced based on a 100-year return period flooding event). At this point, such a model is not possible due to various data limitations. These include the level of capture of loss events within differing databases, differences in methodologies between national databases and exceedingly short sample periods for modelling longer return period events. The study thus focuses on providing an empirical assessment of displacement risk, utilising primarily quantitative sources but also relying on qualitative input to help fill the gaps. The study identifies principal sources of bias and error involved in the initial quantitative measures.

The strength of the approach is to use high-quality disaster loss data that is most relevant to displacement risk, that which specifically relates to those left homeless after disasters. This is also relevant in relation to the study's principal methodological constraint, its application to disasters that do not destroy homes but which do lead to displacement: these are necessarily under-represented. For a similar reason, it is also exceedingly difficult to quantify displacement due to drought.[13] A further challenge is determination of the distance and duration of displacement, both of which are hard to quantify using purely loss data. Developing proxies to measure the impact of loss of livelihoods will be necessary at some point. This is also true of attempts to quantify risks that loss data has not yet captured (such as sea-level rise or ocean acidification) which will also require a different approach.

For these reasons, this paper focuses principally on generating displacement estimates related to the number of people expected to be displaced using data relating to homelessness. It also uses other peripheral types of loss data beyond homeless figures, including the number of people affected and the number of people killed in each event to help fill in some of the gaps in loss reporting. It is hoped that as the methodology is advanced a more complex approach will help increase the predictive capacity of modelling displacement risk as well as reduce sources of uncertainty.

Glossary of Key Terms[14]

Climate change is a change in the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external pressures, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.[15]

Disaster is "a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources."[16] Disasters result from a combination of risk factors: the exposure of people and critical assets to single or multiple hazards together with existing conditions of vulnerability, including insufficient capacity or measures to reduce or cope with potential negative consequences.

Disaster risk is normally expressed as the probability of an outcome (e.g., the loss of life, injury or destroyed or damaged capital stock) resulting from a disaster during a given period of time. In this study, the disaster outcome in question is displacement. Disaster risk is considered to be a function of **hazard**, **exposure** and **vulnerability**.

Exposure refers to the location and number of people, critical infrastructure, homes and other assets in hazard-prone areas.

Vulnerability is the degree of susceptibility of these assets to suffer damage and loss due to inadequate design and construction, lack of maintenance, unsafe and precarious living conditions and lack of access to emergency services.[17]

'Natural' hazards are events or conditions originating in the natural environment that may affect people and critical assets located in exposed areas. The nature of these hazards is often strongly influenced by human actions, including urban development, deforestation, dam-building, release of flood waters and high carbon emissions that contribute to long-term changes in the global climate. Thus, their causes are often less than 'natural'.

The United Nations' *Guiding Principles on Internal Displacement* observe that displacement may occur as a result of, or in order to avoid the effects of, disasters.[18] Displacement includes all forced movements regardless of length of time displaced, distance moved from place of origin and subsequent patterns of movement, including back to place of origin or re-settlement elsewhere. This definition also encompasses anticipatory evacuations.

People are considered displaced when they have been forced to leave their homes or places of residence and the possibility of return is not permissible, feasible or cannot be reasonably required of them. Voluntary migration is at the other end of the spectrum of population mobility. 'Voluntary' does not necessarily imply complete freedom of choice, but merely that "voluntariness exists where space to choose between realistic options still exists."[19]

A key tool under development for the next stage of this methodology is a human displacement analogue for the Hybrid Loss Curve approach pioneered by Evaluación de Riesgos Naturales – América Latina (ERN-AL), a Latin-American research organisation. This seeks to better quantify disaster risk (or, in this case, displacement risk) by joining empirical loss data for more frequently recurring events with modelled results for expected losses in the case of infrequently recurring events. The loss/return period graphs for both of these datasets can then be expressed as a single continuous curve.

2.3 'Natural' disasters?

The standard nomenclature for calculating disaster risk is as a convolution[20] of hazard, exposure and vulnerability (see figure 2.1).

Figure 2.1: Commonly used elements and equation for disaster risk. The exact relationship is defined differently in varying models.

Risk = Hazard X Exposure X Vulnerability

It is widely considered that disaster risk is generally increasing due to increases in exposure. For example, populations continue to grow in coastal areas regardless of the fact that they are subject to hurricanes, storm flooding, tsunami risk and sea-level rise. The problem is not only that development patterns area leading to more humans settling in exposed areas but also that those that are living in these exposed areas often do so in a highly vulnerable fashion that can be a recipe of disaster. Examples include the use of inadequate masonry techniques in earthquake-prone areas and the settlement of unstable hillsides surrounding coastal cities with high precipitation levels. This leads to landslides affecting extra-legal settlements and downstream flooding caused by development-driven reductions in permeable land upstream.

Climate change and other anthropogenic causes increase hazard levels. These increases are not just through increases in magnitude and frequency of extreme (or intensive) events[21] but also due to the changing averages that may significantly increase the number of non-extreme (or extensive) events that together lead to substantial aggregate losses.

Vulnerability levels are generally considered to be slowly declining on a global level, although not at a sufficient pace to keep increases in exposure in check. When looked at from the local level, this may not be the case as vulnerability levels vary widely with some communities locked into cycles of extreme vulnerability, such as those facing flooding from sea-level rise. Disaster loss databases report increasing losses due, in particular, to hydro-meteorological events. Considering all three of these variables together – sustained high vulnerability levels with increasing exposure and hazard levels – helps put these increases into clearer context.

2.4 The displacement dimension: manifestation of extreme disaster risk

A disaster has historically been quantified in terms of the direct loss of life and capital stock that is depleted with the occurrence of the given natural event. Recently there has been greater focus on the secondary effects of disasters, which comes closer towards capturing the important component of livelihoods in the disaster risk equation. However, even this newer focus has trouble capturing the plight of those most drastically affected by the consequences of these disasters: those that must leave their communities and livelihoods in exchange for an otherwise intolerable level of uncertainty in an attempt to survive, and eventually to hopefully find a new home and livelihood until they can return (if that is possible).

Displacement itself is a driver of future disaster risks and it places people at a higher risk of impoverishment and human rights abuses while exacerbating any pre-existing vulnerability.[22] This is especially true where homes and livelihoods are destroyed and where displacement is recurrent or remains unresolved for prolonged periods. Forced from their homes or places of residence, people often face heightened or particular protection risks such as family separation and sexual and gender-based violence, particularly affecting women and children.[23]

People displaced by naturally triggered disasters are thus often among the most vulnerable populations. Their only form of resilience is to leave home to seek a new living and/or to become dependent on assistance. Thus, those displaced by disasters are the proverbial 'canary in the coal mine' in terms of manifest levels of disaster risk: these are the people most impacted on an on-going basis by the effects of a disaster. Greater visibility of the problem could deliver aid and, more importantly, reduce or better mitigate this source of displacement risk for those most vulnerable.

The study reflects emerging awareness of the need to see disasters as primarily social, not natural, phenomena. This implies that humans can act and take decisions to reduce the likelihood of a disaster occurring or, at the very least, to reduce their impacts and associated levels of loss and damage. Disasters are thus no longer being perceived as 'acts of God' but, instead, as something over which humans exert influence. Displacement is seen

Water rations in Tuvalu during the drought emergency in September 2011. Credit: OCHA ROP

as an extreme manifestation of disaster risk in which vulnerability levels and lack of resilience are so high that natural events (both extreme and non-extreme) compel people to leave their homes and livelihoods just to survive.

The magnitude of displacement is, of course, related to the magnitude and frequency of extreme as well as non-extreme natural events. However, the social variables are what allow the construction and configuration of risk in a form that leaves those most exposed and vulnerable with few tools with which to improve their resilience levels when faced with potentially damaging natural events.

Thus, the total number of people displaced by such events, both in relative and absolute terms, provides an important quantitative measure of their underlying vulnerability. The distance of the displacement, whether to another part of the same community or to a completely different nation/state, is also an important gauge of the level of vulnerability and/or lack of resilience of the affected communities.

2.5 Risk: Shifting the focus from the past to the present and future

This paper contributes to a large body of existing research that has reframed the way people and states have thought about disasters.[24] This has recognised that disasters are the result of both human and natural factors and that humans can act and take decisions to reduce the likelihood of a disaster occurring (Figure 2.2).

The reconceptualisation of disasters signifies a shift from a retrospective (i.e., post-disaster) approach to an anticipatory way of thinking about and confronting disasters. This conceptual development dates from the UN International Decade of Natural Disaster Reduction in the 1990s – the precursor to the current UN International Strategy for Disaster Reduction (UNISDR) – to the adoption in 2005 of the *Hyogo Framework for Action* (HFA) which aims by 2015 to achieve "the substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries."[25]

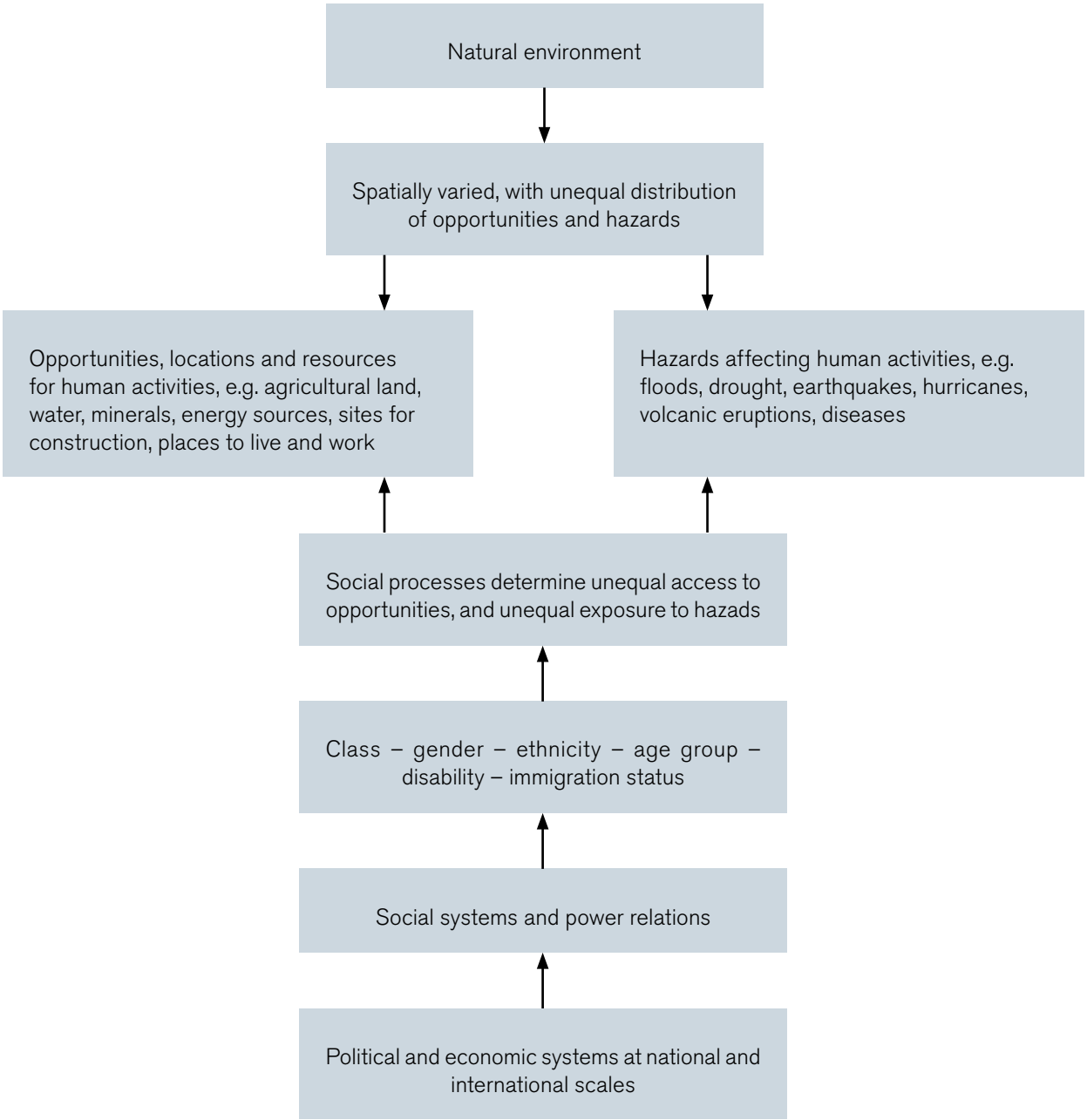
An important outcome of the HFA process is awareness that without the ability to measure, it is not possible to know if disaster risk has been reduced. Measuring disaster risk (especially the risk of economic losses) is the core business of insurance and reinsurance companies. The HFA has made it a public responsibility, and one that includes more than just economic losses. UNISDR has consolidated much information and research on disaster risks in its biennial Global Assessment Reports (GARs), making economic risk information more transparent and raising awareness of disaster mortality risk. We are augmenting this with a new methodology for enabling governments and others to more effectively assess, reduce and manage disaster displacement risk.

Disaster displacement risk has been poorly understood and neglected, particularly in light of the fact that disaster-induced displacement has been increasing and is likely to continue to do so. As noted in IDMC's *Global Estimates 2012*, the trend is driven by three factors:

- population growth and increased concentration of people and economic activities in hazard-prone areas such as coastlines and river deltas are increasing the number of number of people exposed to natural hazards
- improvements in life-saving early warning systems and evacuation planning means that more people are expected to survive disasters even as their homes are destroyed
- climate change may increase the frequency and/or severity of some hazards (hydro-meteorological hazards account for 83 per cent of all disaster-induced displacements observed during the last five years).[26]

As with mortality and economic loss risks, it is beyond the ability of any government to eliminate disaster risks entirely. Is it thus important to know which displacement risks can be reduced so that resources can be allocated most effectively.

Figure 2.2: Factors and relationships that influence disaster risk



Source: Wisner et al., 2003

3 Displacement risk in South Pacific island states

3.1 Measuring displacement risk

In this paper human displacement risk due to disasters and climate change has been estimated as an index expressed as the number of persons expected to be displaced on average per year. Results are provided in both absolute and relative numbers of displaced. A separate qualitative measure expresses the general distance and duration of the typical displacement. The terms magnitude and amplitude are used to convey these two dimensions of disaster induced displacement.

Magnitude refers to the total number of people expected to be displaced by natural disasters and climate change. The absolute magnitude measure provides the estimated number of people displaced per country while the relative measure provides the estimated number of people displaced per million inhabitants. Rankings between the 21 studied countries and territories in terms of absolute and relative expected displacement are also provided. Colour-coded representations are used in which green equals least modelled displacement risk and red the most (see figure 3.1).

In order to properly configure displacement risk, beyond the number of people expected to be displaced, it is also important to determine for how long those affected may be displaced. In an initial attempt to measure this variable this paper refers to the difficulty and duration of displacement as the amplitude of the displacement and represents the difficulty in livelihood generation together with the expected duration of displacement (from short-term to protracted to situations in which safe return is not possible). This 'amplitude' of displacement is expressed on a scale from 'low' to 'very high'.

The displacement risk estimates were produced by using a combination of national-level disaster loss data from two of the principal loss databases combined with hazard, exposure, vulnerability and resilience proxies from several sources[27] to produce estimates of annual average displacement risk for each of the 21 reviewed countries. For loss data, EM-DAT[28] and the database of the South Pacific Applied Geoscience Commission (SOPAC)[29] were used primarily for their homeless data (or 'homes destroyed') as the primary proxy for displacement. Other disaster metrics, such as number of people affected, were also used to estimate displacement risk as often these entries were more consistent than homeless data in both databases.

The displacement risk estimates described in this section are the result of the first prototype iteration of the model and, as such, all results should be considered purely as preliminary and very likely subject to change. Normalisation, as well as final ranks and scores, are currently only based on the 21 countries and territories that form the basis for this study. Since this process involves standardising components of the results into a scale from 0-1 based on all possible countries' values, the results will need to be re-calibrated once a more extensive global analysis is done. This could lead to significant changes in final figures. The amplitude measure is provided solely as an example of how the final index may display results; calculation for this prototype is only handled in a very basic fashion.

All of these variables must be kept in mind when considering the necessarily coarse nature of using an index to quantify something as complex as displacement risk. Displacement risk estimates are necessarily limited in their ability to capture the true complexity of risk scenarios that can lead to displacement. For this reason, the country reports provide additional information with which to further dimension displacement risk at national and sub-national levels.

Generally, modelled displacement patterns were found to be line with expected results on two fronts. The risk displacement estimates were generated without knowledge of the methodology used by IDMC's Disaster-induced Displacement Database (DiDD), yet the preliminary results are largely in line with DiDD figures. Secondly, countries with higher Human Development Indexes and governance indicators also had better (that is, lower) relative displacement estimates. Countries with higher intrinsic hazard, exposure and vulnerability levels generally saw these factors reflected in higher estimated displacement. This meshes with findings from disaster risk studies focusing on vulnerability, exposure and resilience indicators.

3.2 Annual displacement risk magnitude estimates

KEY FINDING #1: The South Pacific island states and territories reviewed for this study offer a wide range of hazard, exposure and resilience configurations, making the region a unique example of risk heterogeneity in a comparatively small land mass area over a very wide ocean area. A large variety of hazards, from seismic, and

its related tsunami, risk to winds, rain, flooding and landslides, and the harder to quantify drought risk, make the region a good case study for learning to manage complex risk configurations. Combined with its wide variety of socio-economic conditions, the region offers a complex array of potential development and risk management problems and potential solutions.

Due to a combination of rugged topography, high population densities, social inequality and haphazard enforcement of land-use regulations, many of the region's losses can be directly related to development processes. These include landslides affecting extra-legal settlements and downstream flooding caused by development-driven reductions in permeable land upstream. Tourism often tends to drive development in highly exposed coastal areas where more frequent damaging events lead to recurring losses. In areas that have suffered from a long series of disasters associated with both natural and man-made hazards, the resultant long-term erosion of livelihoods has left many of those displaced by disasters with little choice other than on-going displacement or seeking

Figure 3.1: Disaster displacement estimates- preliminary results

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
American Samoa	56,000	134.0	10	2,397.6	11	Medium
Cook Islands	20,000	182.0	8	9,120.4	3	High
Federated States of Micronesia	104,000	91.0	11	875.0	15	High
Fiji	861,000	4,608.0	2	5,351.5	7	Medium
French Polynesia	258,000	25.0	14	98.3	19	High
Guam	159,000	467.0	7	2,937.9	10	Medium
Kiribati	98,000	53.0	12	545.5	16	Very high
Marshall Islands	52,000	171.0	9	3,287.3	9	Very high
Nauru*	10,000	1.0	20	50.0	20	Very high
New Caledonia	246,000	34.0	13	138.1	18	Medium
Niue*	1,000	14.0	16	13,797.5	2	High
Northern Mariana Islands	54,000	9.0	18	163.0	17	High
Palau	20,000	1.0	20	44.5	21	High
Papua New Guinea	6,859,000	7,019.0	1	1,023.3	14	Medium
Samoa	186,000	1,402.0	6	7,535.6	6	Medium
Solomon Islands	526,000	2,483.0	3	4,719.6	8	High
Tokelau*	1,000	8.0	19	8,489.5	4	Very high
Tonga	104,000	1,745.0	5	16,777.6	1	High
Tuvalu*	10,000	17.0	15	1,708.9	12	Very high
Vanuatu	236,000	1,832.0	4	7,763.6	5	High
Wallis and Futuna Islands*	14,000	14.0	16	1,028.9	13	High
TOTAL	9,875,000	20,310		**4,184		High

* Countries whose physical and population size is below the necessary level to generate sufficient disaster loss figures for a statistically valid analysis.
** 4,184 per 1m is the average of each country's relative displacement risk (to eliminate disproportionate influence by largest states). Relative displacement using regional totals 2,056 per 1 million inhabitants.

extra-legal migration to more prosperous neighbouring states. These highly vulnerable groups often settle in low-cost, high-risk areas, often putting themselves at further risk of displacement.

KEY FINDING #2: Based on the probabilistic model and using evidence of historic displacement patterns, we estimate that approximately 20,300 people are at risk of being displaced per year in the 21 countries and territories included in this study. Territories with relatively larger populations, such as PNG and Fiji – which together account for 70 per cent of the estimated displacement risk – make up the majority of the absolute displacement risk. Conversely, states with extremely small populations, such as Niue and Tokelau, contribute only a fraction of a percentage to the total displacement within the region.

KEY FINDING #3: With a total population of approximately ten million among the 21 studied countries, there are expected to be about 2,000 people displaced annually per million people. The country by country average is around 4,200 displaced per million. This per capita meas-

Figure 3.2: Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
American Samoa	77,386.00	*4.00	5.75	0.54	0.07	125.2	2,236
Cook Islands	55,078.00	*6.00	5.49	0.60	0.08	169.6	8,482
Federated States of Micronesia	40,026.00	*6.00	5.21	0.46	0.07	85.1	819
Fiji	176,930.00	**4.00	4.78	1.48	0.12	4,131.1	4,798
French Polynesia	120,564.00	**6.00	6.59	1.10	0.10	23.1	90
Guam	556,548.00	**4.00	6.84	3.25	0.20	390.4	2,456
Kiribati	*207,260.00	**8.00	4.65	3.57	0.21	44.2	451
Marshall Islands	3,422.00	**8.00	5.58	0.05	0.05	162.8	3,131
Nauru	*207,260.00	**8.00	5.47	3.03	0.19	0.4	42
New Caledonia	302,297.00	**4.00	5.38	2.25	0.15	29.5	120
Niue	98,490.00	**6.00	***5.52	1.07	0.10	12.6	12,581
Northern Mariana Islands	439,666.00	**4.00	6.46	2.72	0.17	7.5	139
Palau	25,438.00	**4.00	6.48	0.16	0.05	0.8	42
Papua New Guinea	184,570.00	**4.00	4.09	1.80	0.13	6,210.3	905
Samoa	95,823.00	**4.00	5.13	0.75	0.08	1,295.6	6,965
Solomon Islands	372,903.00	**4.00	4.18	3.57	0.21	2,050.5	3,898
Tokelau	*207,260.00	**4.00	***5.52	1.50	0.12	7.6	7,605
Tonga	314,333.00	**4.00	5.06	2.49	0.16	1,502.5	14,447
Tuvalu	4,892.00	**8.00	7.37	0.05	0.05	16.3	1,627
Vanuatu	806,946.00	**4.00	4.88	6.62	0.35	1,357.2	5,751
Wallis and Futuna Islands	55,366.00	**4.00	***5.52	0.40	0.07	13.5	965
TOTAL	*207,260	5.1	***5.52	1.78	0.13		

* Values use regional average due to lack of data for these countries.
** All values use the regional average, adjusted qualitatively, due to exceedingly low number of the region's countries being represented in the source data. Vulnerability +4 in 'very high' amplitude rated countries, and +2 in 'high' rated countries, baseline value for all others: 4.0.
*** Values use regional average due to lack of resilience figures for these countries.

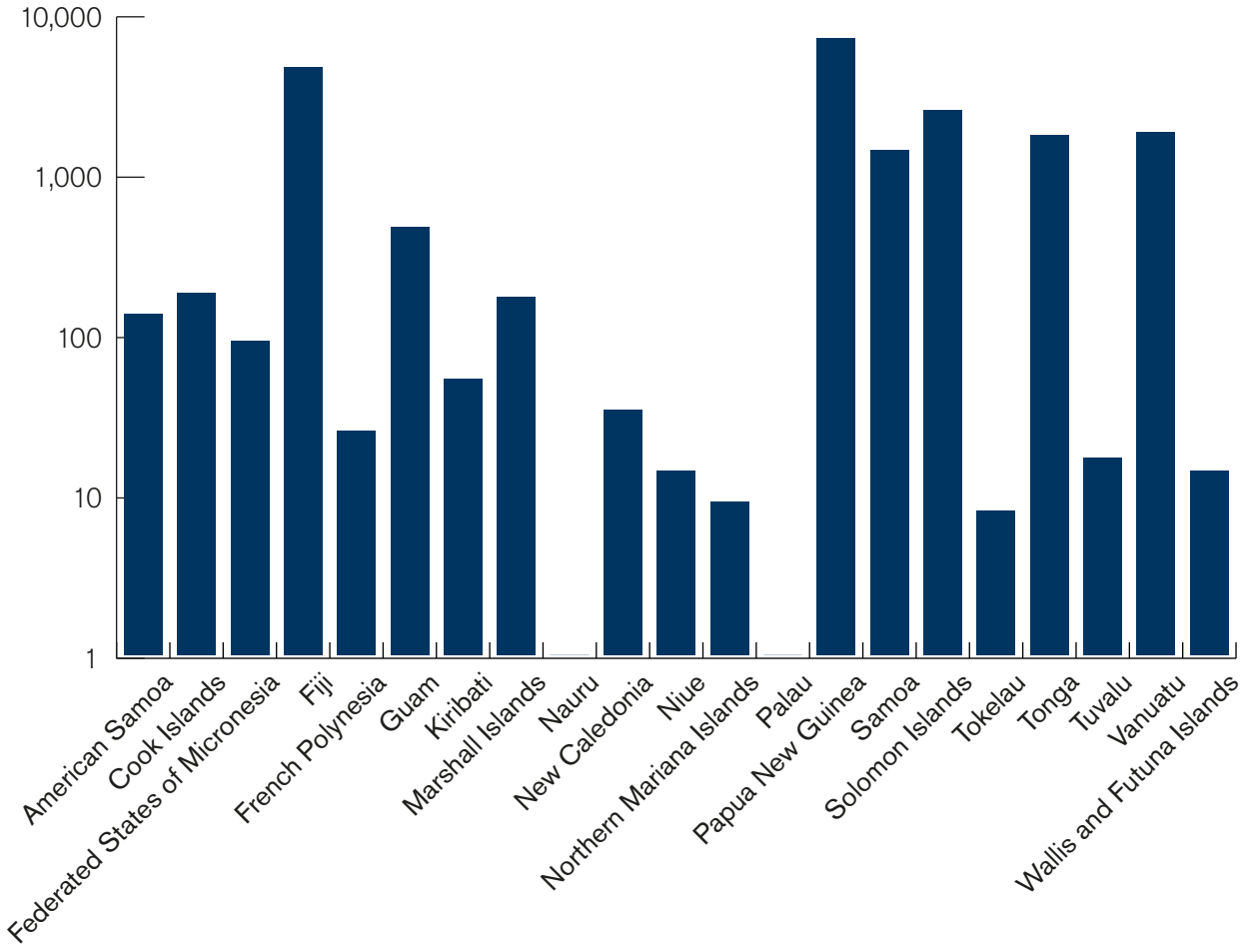
ure of the relative magnitude of displacement excludes each country's total population and allows one to better understand how much displacement affects people at the local level within different countries.

Compared to the global average of approximately 4,000 displaced per million annually, the regional figures are considered below average. However, on a county by country basis it is right around the global average. Per capita displacement risk is much lower than in South and South East Asia, where much of the world's displacement risk is concentrated, but it remains higher than the average for developed countries. Considering important man-made components that influence disaster risks and displacement outcomes, these risk estimates can be a valuable indicator of how well different levels of government and civil society, both national and international, are reducing displacement risk.

KEY FINDING #4: Historical disaster-induced displacement patterns are very hard to detect for this due to the nature of global-level data collection in exceedingly small states, especially those below 50,000 residents. In addition, there is difficulty in establishing likelihood and return-periods for events crossing very small territories, especially those that may only consist of 20 square kilometres. When these factors are combined with high levels of uncertainty related to changing future hazard, especially those related to climate change, quantitative methodologies of the kind employed in this study may struggle to create reasonable risk estimates. This is borne out in the results for the six smallest states (the Cook Islands, Nauru, Niue, Tokelau, Tuvalu and Wallis and Futuna), which together account for less than 60,000 of the region's population (about 0.5 per cent of the total). Enough is known about long-term climate change impacts such that this uncertainty should not be used as an excuse for inaction. This is relevant given that only two of the 19 DRR and CCA plans and policies from 15 countries in the region that IDMC analysed mention displacement.[30]

KEY FINDING #5: Countries and territories with high resilience scores and low vulnerability levels, such as French Polynesia and Guam, have substantially lower displacement risk estimates. Those with low resilience and high vulnerability scores, such as Kiribati, the Solomon Islands and Vanuatu, are expected to have higher

Figure 3.4: Table: Absolute disaster-induced displacement risk estimates (log scale)



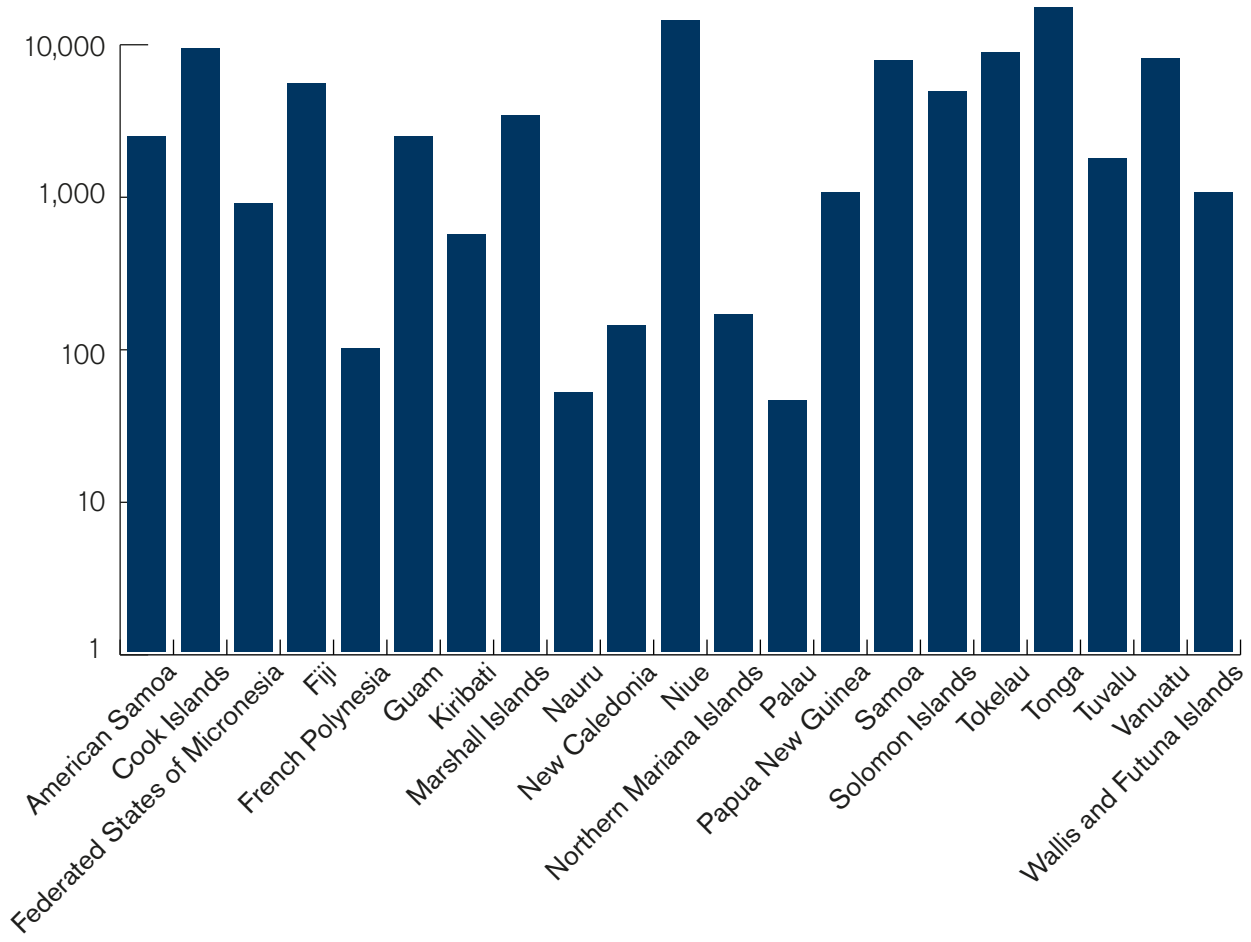
displacement risk. Reported loss figures can be misleading in countries with poor disaster reporting mechanisms – often the case in countries with low governance and resilience levels – since many events tend to go unseen by either central authorities or organisations tracking data.

KEY FINDING #6: Countries with high levels of exposure to one or more hazards can often effectively reduce displacement risk by adopting and enforcing building codes, land use plans and development strategies that manage natural resources sustainably. Examples of mismanagement of resources include the phosphate-rich islands of Banaba (in Kiribati) and Nauru. Growth has been poorly managed in Kiribati's South Tarawa Island. On-going emigration from such territories indicate the latent displacement risk which can lead to a large displacement should a significant damaging event occur. At the same time, it must also be noted that migration can also potentially reduce the likelihood of future disaster-related displacement by decreasing the number of people exposed to hazards and by those who have migrated and are sending remittances to family and friends in places of origin.

KEY FINDING #7: Extensive and slow-onset risk patterns are highly relevant to quantifying displacement risk, but difficult to extract from available data. Preliminary studies show that better analysis of these small-scale, recurring events could make this extensive risk more visible and known, thus requiring us to significantly revise upward the reported number of displaced persons in the past and the risk of disaster-induced displacement in the future. If island states with limited inhabitable land and ocean-based natural resources continue to see increases in their populations, either through internal or migratory driven growth, more people may be forced to live in more vulnerable locations, deriving livelihoods from more precarious sources than those already living in more desirable locations.

The underlying source of risk – highly vulnerable populations living in exposed areas – is a common problem in many of the assessed countries. Better access to information on disasters at a sub-national level would greatly aid in the painting of a more complete disaster and climate induced displacement by driving past national averages to find specific pockets of high vulnerability and/or

Figure 3.5: Table: Relative disaster-induced displacement risk estimates (log scale)



high extensive risk, two factors that are often correlated.

Figure 3.6: Annual Disaster-induced displacement risk per hazard type

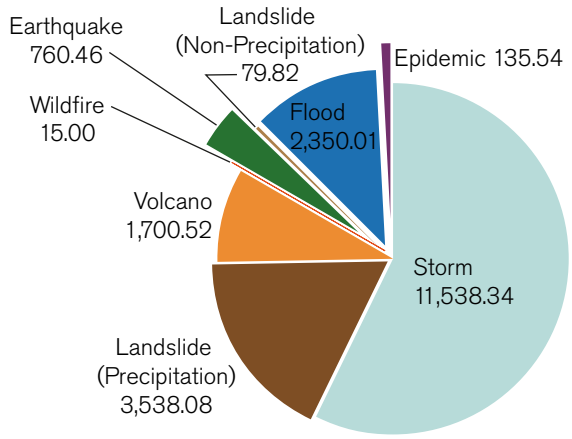


Figure 3.3: Disaster displacement totals per type of disaster (includes data for all 10 countries in the study). ???

KEY FINDING #8: Initial estimates demonstrate the need for improvement in data sources and data quality in order to properly assess displacement risk. Regional data collection approaches with broad inclusion criteria and standard methodologies could help improve understanding by providing a more accurate and detailed picture of disaster-related losses at the local level. This points to the importance of a parallel approach, such as one based on livelihoods, in order to compensate for lack of adequate loss data. Another important consideration is whether development parameters themselves may serve as better proxies for displacement risk than reliance on historic loss figures.

Each of the consulted datasets offered specific challenges for computing preliminary values within reasonable margins of error. Disaster loss data, unlike insurance loss data, is highly variable from region to region and country to country, in terms of the level of coverage, accuracy of data entry and lower thresholds for inclusion. Other components in the risk equation, such as vulnerability and resilience, do not lend themselves to simple, accurate quantification. Accurately compiled loss datasets have at most around 40 years of high quality data.[31] This is mostly far too short for assessing risk from lower recurrence events. Furthermore, these data sources often exhibit large variations in data collection methodologies, especially in terms of data regarding homeless figures.[32]

KEY FINDING #9: Civil strife and weak governance contribute substantially to displacement risk. Several states have free association or protectorate arrangements with developed countries – France, New Zealand and the USA – which can help improve governance and lead to lower levels of displacement risk. This can be as simple as providing diplomatic representation or other basic government functions that countries with less than ten thousand people would have difficulty affording by themselves. Having a larger country where residents of a small state may legally seek a wider range of livelihood options is a form of resilience.

Several states have yet to establish legitimate and effective governance structures that can reduce the likelihood of civil strife or effectively manage disaster and climate change risks. In these countries, low resilience levels resulting from the cumulative impacts of marginal livelihoods and few alternate sources of income often lead to both higher numbers of displaced persons and the recurrent displacement of marginalised groups as they seek sustainable livelihoods and shelter. This reality has led some to reconsider whether independence as a very small island state may indeed be a better option than continued association with a colonial power. This is exemplified by Tokelau where two separate proposals to achieve independence from New Zealand failed to secure majority support.

A prime example of failure of governance is the Solomon Islands. Home to one of the largest populations in the region (slightly over 500,000), it has not established effective governance since independence. A history of colonial domination, a large number of distinct cultural groups, poor education levels, challenging access to outlying areas and low levels of infrastructure development all pose challenges to improved governance.

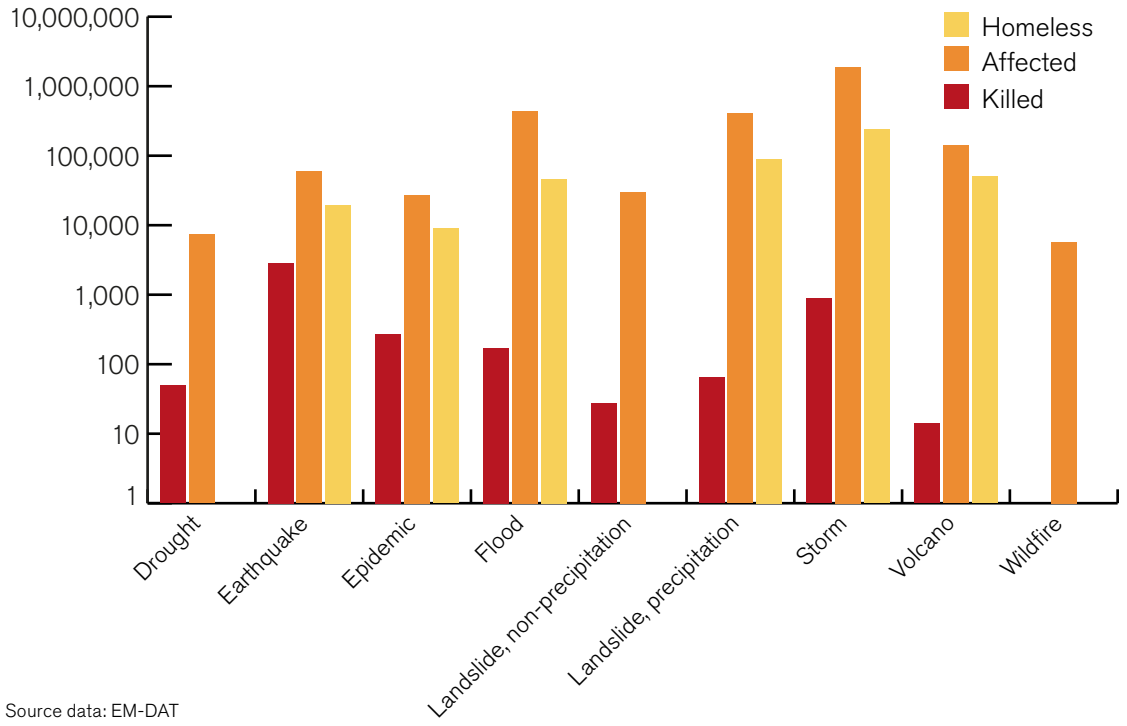
3.2.1 Displacement risk amplitude

Beyond displacement risk magnitude, that is the expected number of people that will be displaced per year, we have also included a qualitative measure to express the intensity of the displacement. That is, whether the displacement is of a short distance and duration (for example, if a home just needed repairing after a disaster) or whether it is longer distance and possibly permanent in duration (for example, if a small atoll-based state becomes fully submerged due to sea-level rise).

Qualitative displacement risk amplitude results will help progress towards a more complete picture of how displacement risk is configured in the region. Reliable qualitative displacement amplitude figures have been found to be most closely related to:

- country size in terms of population as well as total land mass
- median GDP per capita relative to neighbouring and regional values
- human development levels
- livelihood resilience – that is, prospects for restoration

Figure 3.7: Total disaster losses during the 43-year sample period, per hazard type. Log scale.



Source data: EM-DAT

of livelihoods after the disaster has occurred.

In addition, risk configurations among small island states, such as several of those reviewed in this region, are also closely related to the amount of arable and usable land that is significantly above level, distance from key infrastructure such as ports, education and medical services and long-term economic prospects in local areas.

In terms of the preliminary amplitude findings, the states with the highest levels of displacement risk amplitude are the four with both very small populations (under 25,000 between them) and very small land masses a significant level above sea level (just over 300 square kilometres between them): Nauru, Niue, Tokelau, Tuvalu. Kiribati and the Marshall Islands both have larger populations (about 100,000 and 50,000, accordingly) and are in a similar situation, but with much larger total potential displacement risk due to their larger populations. Displacement prospects for people in these six countries will probably require resettlement to another state thus requiring potentially challenging cultural adaptation.

3.2.2 Future estimates

For detailed displacement risk information, as well as loss and risk figures per hazard type, please refer to the national reports. Future methodological improvements, should data permit, include the disaggregation of displacement risk per hazard type. The preliminary disaster displacement numbers in figure 3.1 lists the number of people on average expected to be displaced per year and can be thought of as the actuarial analogue of the kind of average annual loss (AAL) calculation commonly used in the insurance industry. Eventually a probabilistic loss exceedance model such as ERN's Hybrid Loss Curves methodology will be adopted to complement these averages with probable maximum displacement figures. Another essential element of assessing displacement risk is to realistically portray uncertainty levels behind the estimates. This will be provided in a later version.

Within any risk model that utilises loss data available in disaster risk studies there is always a difficulty reducing uncertainty to acceptable levels. Just adding more datasets to an analysis where each dataset brings its own difficulties often compounds sources of error. An option is to utilise the additional data sources to create a separate model that either helps validate the first or else provides a complementary perspective. The level of convergence between results can serve as a rough indicator of the levels of uncertainty intrinsic to each model.

The end goal of this project is to also apply a probabilistic framework of specific types of natural event magnitudes and durations at specific locations (by using hazard, exposure and vulnerability proxies) with an index constructed from available development and extensive/intensive risk indicators. This will allow the calibration of the resulting curve using historic displacement data to establish 'tipping points' at which displacement would be expected to occur if different types, frequencies and magnitudes of events were to occur.

4 Country Reports

4.1 American Samoa

4.1.1 Displacement Risk Configuration

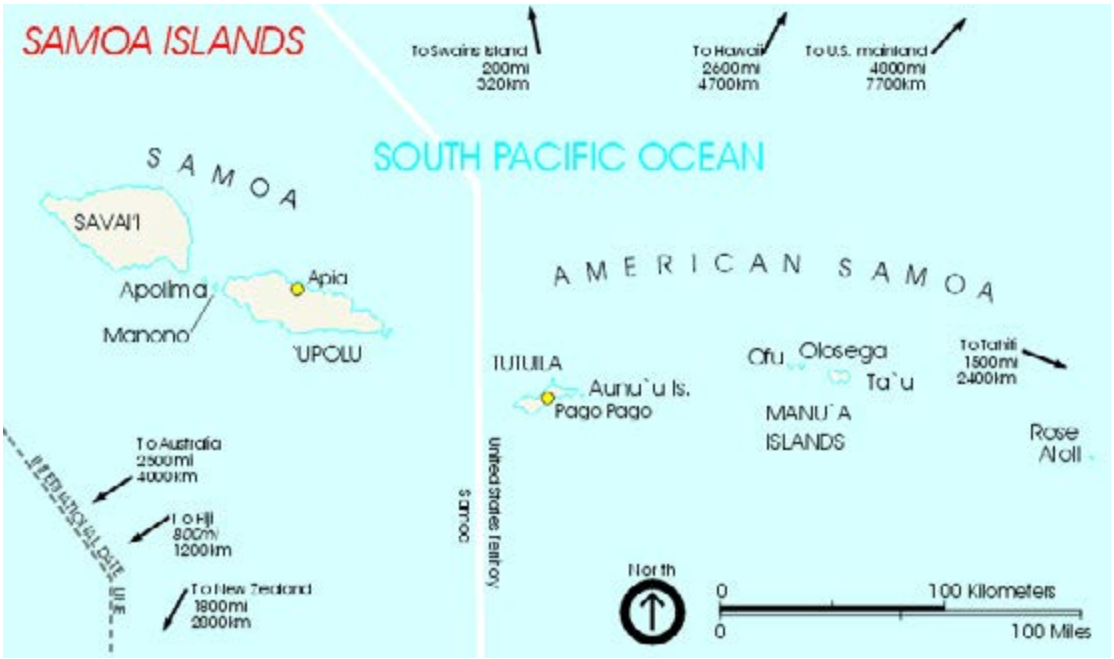
American Samoa is an unincorporated territory of the US that consists of five volcanic islands and two atolls with a total area of just under 200 square kilometres and a population of approximately 56,000. The largest island, Tutuila, is home to the capital of Pago Pago, as well as the largest village, Lafuna, with a population of approximately 8,000 inhabitants.

GDP per capita is approximately $8,000 and the main economic activity is tuna fishing. American Samoans are entitled to freely enter and work in the US and many have, primarily to Hawaii.

American Samoa is exposed to tropical cyclones which can lead to flooding, landslides, high winds and storm surges. An active underwater volcano and the volcanic nature of its islands explain earthquake and tsunami risks. As with all small Pacific islands, the chain is also highly vulnerable to sea-level rise and changes in fish populations related to ocean warming and acidification.

As an example of the historical relationship with hurricanes, an engagement in 1889 between US and German naval forces was averted when a typhoon destroyed both navies in Apia harbour. In September, 2009 an earthquake of magnitude 8.1 struck approximately 190 km. off the coast, generating a tsunami consisting of four waves of approximately 4.5-6 metres in height, which reached approximately 1.3 km. into the island of Tutuila. Thirty-four people were reported to have been killed and 2,500 affected. Storms have repeatedly affected the islands: some 90 people died in 1966, in 1989 there was over $5 million in damage and in 2004 over 23,000 people were affected and there was $150 million in damage. Flash floods and mudslides have also caused substantial damage. In May 2003, flooding caused approximately $50 million in damage, mostly to private homes, roads and public utilities.

Figure #4.1.1: Samoa & American Samoa



Source: US National Park Service

4.1.2 Displacement Risk Results

Figure #4.1.2: Disaster and climate change induced displacement risk estimates

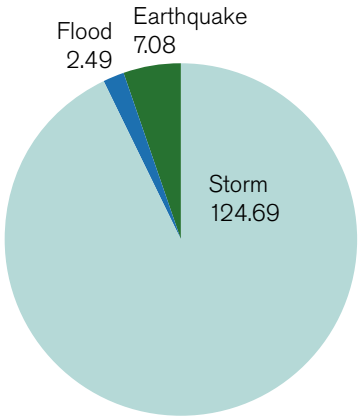
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
American Samoa	56,000	134.0	10	2,397.6	11	Medium

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
American Samoa	77,386.00	*4.00	5.75	0.54	0.07	125.2	2,236

Figure #4.1.3: Annual displacement estimates per hazard



4.2 Cook Islands

4.2.1 Displacement Risk Configuration

The Cook Islands are self-governed and in free association with New Zealand. Located northeast of New Zealand, it consists of 15 major islands divided into the Southern and Northern islands, the latter being coral atolls. Avarua, the capital, on the principal island of Rarotonga, has a high point of 652 metres. GDP per capita is estimated at between $9,000 and $10,000 and the principal economic activity is tourism. Cook Islanders are free to migrate to New Zealand and substantial numbers of people now live in Auckland.

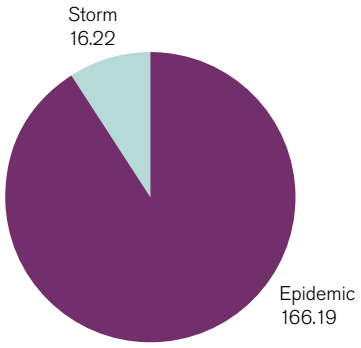
As with other islands in the region, the principal hazards are tsunamis, tropical cyclones and climate-change driven sea-level rise and ocean acidification. Many of the low-lying atolls are not only highly vulnerable to storm surges but their remoteness also complicates providing timely assistance.

Storms make up the vast majority of loss-causing events: in 2010 affecting 2,200 people, in 2005 600 people in, 2001 750 and two thousand in 1987. The other primary source of disruption is epidemics, affecting with 1,250 people in 2009 and 1,200 in 1990. Epidemics are among the lesser-considered problems potentially associated with climate change and are an important reminder that climate-change induced displacement involves more than impacts of sea level rise.

Figure #4.2.1: Cook Islands

Source: Lonelyplanet.com

Figure #4.2.3: Annual displacement estimates per hazard



4.2.2 Displacement Risk Results

Figure #4.2.2: Disaster and climate change induced displacement risk estimates

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Cook Islands	20,000	182.0	8	9,120.4	3	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Cook Islands	55,078.00	*6.00	5.49	0.60	0.08	169.6	8,482

4.3 Federated States of Micronesia

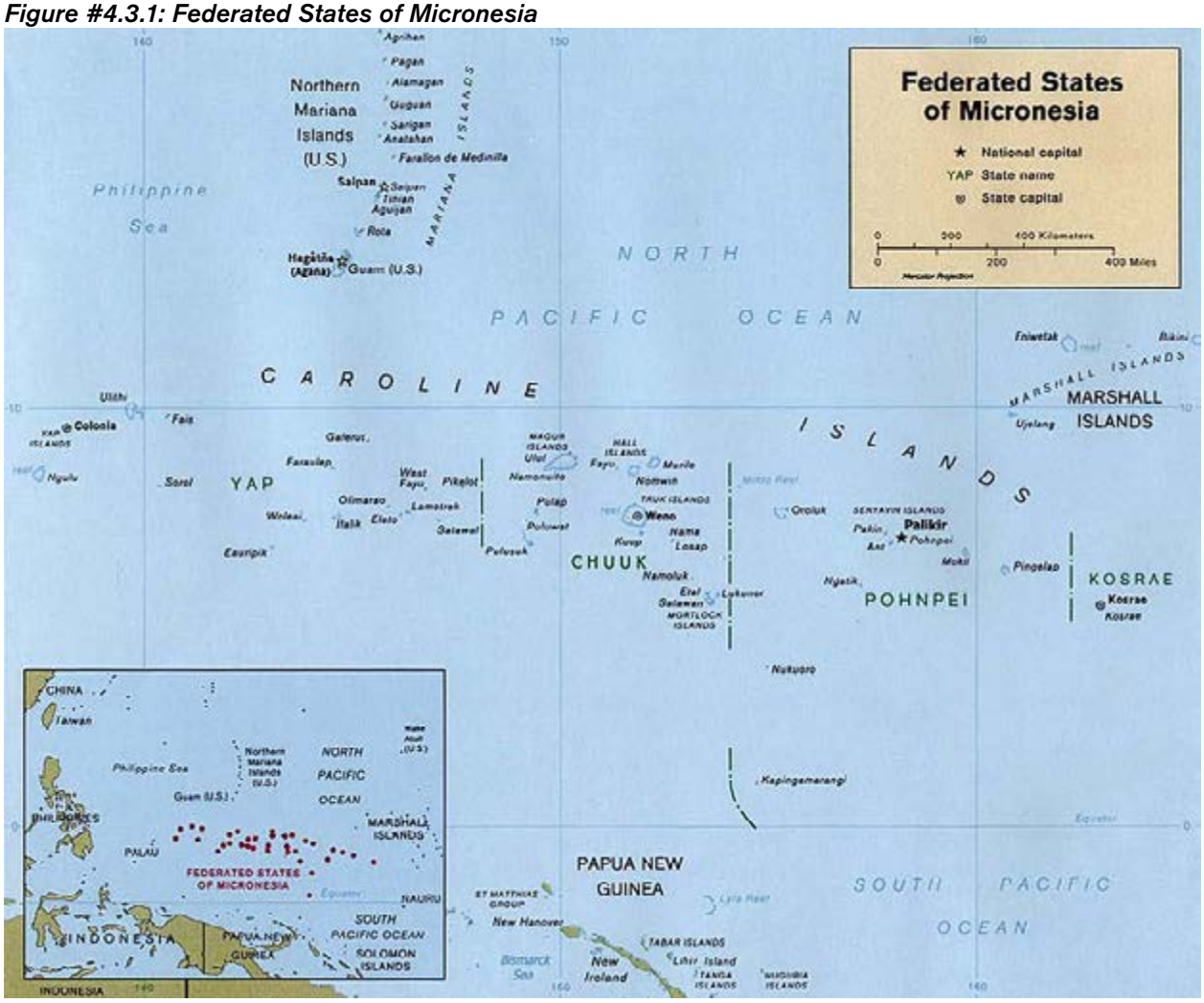
4.3.1 Displacement Risk Configuration

The Federated States of Micronesia is comprised of four states, each centred around one or more volcanic islands, three of which also include several outlying atolls. In total it has approximately 607 islands with a total surface area of 271 square kilometres and a high point of 791 metres. The island chains are located in an area of more than 2.6 million square kilometres, to the north and north-east of PNG. The nation has a population of approximately 104,000, with its largest city, Weno, located on Weno Island, home to just under 14,000 residents.

Income per capita is approximately $3,000 on a purchasing-parity basis. Economic activity consists largely of subsistence farming and fishing, with some mining and fishing activity. US foreign aid is a primary source of revenue. There is tourism potential but remoteness and lack of facilities have inhibited the industry.

Like other islands in the region, hydro-meteorological events such as cyclones and storms, with their attendant flooding, storm surge and landslide related risks are the principal source of displacement risk. Since 2000, four such events have each triggered substantial numbers of affected people. Drought in 1998 affected almost 30,000 people, highlighting the problem with fresh water availability in the region during periods of limited rainfall. In terms of economic losses, the 1987 storm that affected the nation caused over $6 million in damage, a substantial figure for this relatively poor series of islands.

Figure #4.3.1: Federated States of Micronesia



Source: US Central Intelligence Agency, 1999

4.3.2 Displacement Risk Results

Figure #4.3.2: Disaster and climate change induced displacement risk estimates

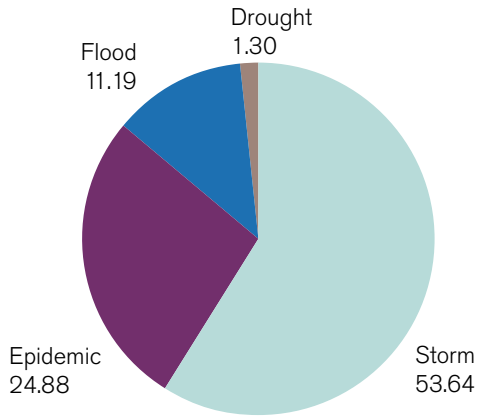
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Federated States of Micronesia	104,000	91.0	11	875.0	15	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
Federated States of Micronesia	40,026.00	*6.00	5.21	0.46	0.07	85.1	819

Figure #4.3.3: Annual displacement estimates per hazard.



4.4 Fiji

4.4.1 Displacement Risk Configuration

Fiji is a parliamentary republic dominated by the military. Located to the east of Australia and north of New Zealand, the archipelago has over 320 islands and 500 islets, of which just over 100 are populated. With a population of 861,000 and a total land mass of 18,274 square kilometres, it is one of the larger nations in the region. The capital, Suva, is on the island of Viti Levu, which is home to approximately three quarters of the population.

GDP per capita is between $4,000 and $5,000 with a large, developed economy due to its large natural resource base. Tourism also makes up a substantial portion of the economy as does agriculture, in particular sugar exports. The country has been destabilised by military coups in 1987, 2000 and 2006, leading to its suspension from the Commonwealth.

Fiji's principal disaster displacement risk comes from storms and tropical cyclones, with a similar pattern of risks, such as tsunamis, shared with other island states in the region. Internal displacement is likely to remain significant for quite some time as poorer, outlying islands lack viable livelihood options.

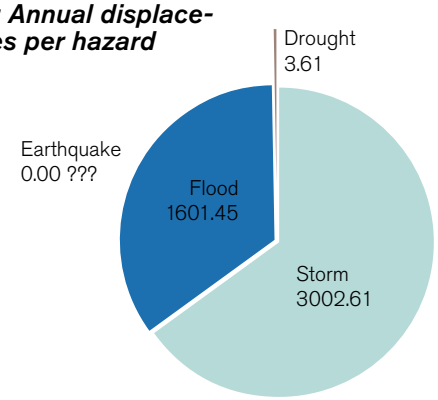
Fiji has a long history of storms and hurricanes causing damage and loss of life, with a string of events throughout the 70's, 80's and 90's. As with many other countries, a decline in disaster fatalities has coincided with increases in economic losses and total number of people affected: five of the most costly hydro-meteorological disasters in the 43-year sample period occurred in the past decade.

Drought in 1998 affected more than 260,000 people, a figure that is followed in magnitude by flooding that affected 215,000 in 1986 and a long string of storm-related losses throughout the sample period.

Figure #4.4.1: Fiji

Source: US Central Intelligence Agency World Factbook

Figure #4.4.3: Annual displacement estimates per hazard



4.4.2 Displacement Risk Results

Figure #4.4.2: Disaster and climate change induced displacement risk estimates

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Fiji	861,000	4,608.0	2	5,351.5	7	Medium

Disaster-induced displacement risk components

Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Fiji	176,930.00	**4.00	4.78	1.48	0.12	4,131.1	4,798

4.5 French Polynesia

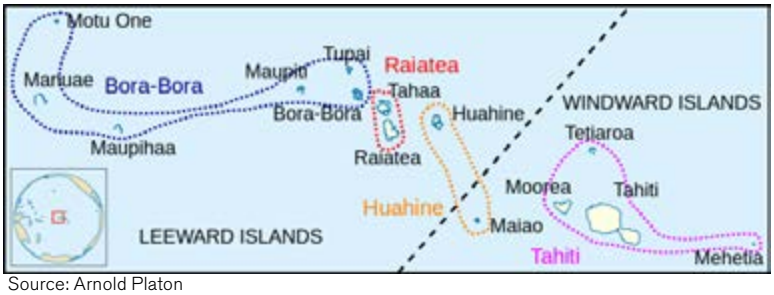
4.5.1 Displacement Risk Configuration

French Polynesia, administered by France since 1842 and a collectivité d'outre-mer since 2003, consists of several groups of islands with a total land mass of 4,167 square kilometres and almost 260,000 inhabitants scattered over about 130 islands..Unlike territories such as the Cook Islands or the Federated States of Micronesia(with free association agreements with New Zealand and the US respectively), French Polynesia continues to rely on France for such basic services as justice, education and security. With over 180,000 residents, Tahiti is not only the largest but also the most populous island in the chain. The capital, Papeete, located on the northwest coast of Tahiti, accounts for 133,000 of the island's inhabitants and also houses the only international airport.

Per capita GDP of approximately $27,000 is significantly higher than other island chains in the region. French Polynesia's economy relies principally on tourism, agriculture, natural resource extraction, the pearl industry and economic support from France. There is a substantial trade imbalance.

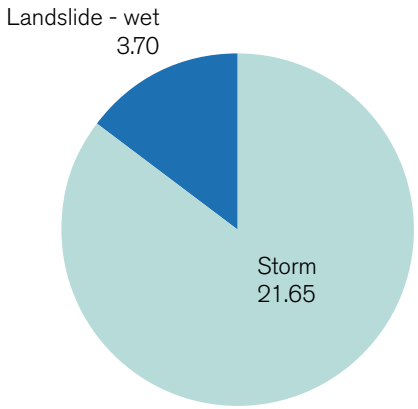
Two of the top loss-causing events in French Polynesia have been rainfall-triggered landslides in 1987 and 1998. Storms in 1983 and 2010 affected over 5,000 and 3,400 people and both caused economic losses in excess of $47 million.

Figure #4.5.1: French Polynesia



Source: Arnold Platon

Figure #4.5.3: Annual displacement estimates per hazard



4.5.2 Displacement Risk Results

Figure #4.5.2: Disaster and climate change induced displacement risk estimates

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
French Polynesia	258,000	25.0	14	98.3	19	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
French Polynesia	120,564.00	**6.00	6.59	1.10	0.10	23.1	90

4.6 Guam

4.6.1 Displacement Risk Configuration

Guam, an unincorporated territory of the US, is located north of PNG, and is one of the northern-most countries in the region. With a total area of approximately 540 square kilometres, it is the largest island between PNG and Japan. As the southern-most island in the Mariana island chain, it was formed by the collision of the Pacific and Philippine tectonic plates.

Guam has a population of just under 160,000, with main population centres consisting of the capital and historic centre, Hagatña (or Agaña in Spanish), and the northern village of Dededo (with just under 45,000 residents). Guam was the only Spanish outpost east of the Philippines and is currently the western-most territory of the US. The US assumed control of the island from Spain in 1898 and has subsequently administered the territory with the exception of the short period of Japanese occupation during World War II.

Per capita GDP, on a purchasing-parity basis is slightly over $15,000 and the island has one of the highest human development indexes in the region. Guam's economy is principally driven by tourism, US military operations and transfer payments from the US treasury.

Although not volcanically active, the island is subject to earthquake and attendant tsunami risk. Like other countries in the region, it is also highly exposed to the effects of tropical cyclones and climate change related hydro-meteorological hazards such as sea-level rise. It also has problems associated with limited fresh water resources, sewage related pollution and reef degradation. Although not reflected in historic loss figures, these factors contribute to risk configuration, especially in light of climate change related pressures.

Guam is located in the middle of what is aptly termed 'hurricane alley'. Most historic losses have been due to cyclones, resulting in over $630 million in losses and 25,000 people affected in the past two decades. An exception to the usual risk pattern was an earthquake in August 1993 which caused damage exceeding $120 million.

Figure #4.6.1: Guam

Source: US Central Intelligence Agency

4.6.2 Displacement Risk Results

Figure #4.6.2: Disaster and climate change induced displacement risk estimates

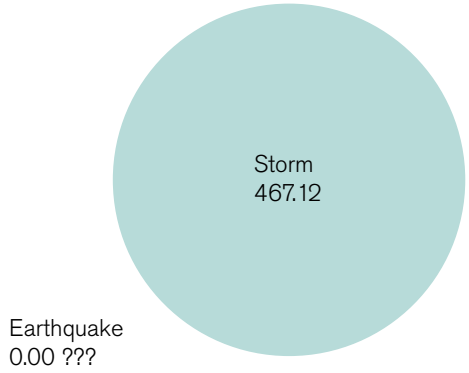
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Guam	159,000	467.0	7	2,937.9	10	Medium

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
Guam	556,548.00	**4.00	6.84	3.25	0.20	390.4	2,456

Figure #4.6.3: Annual displacement estimates per hazard.



4.7 Kiribati

4.7.1 Displacement Risk Configuration

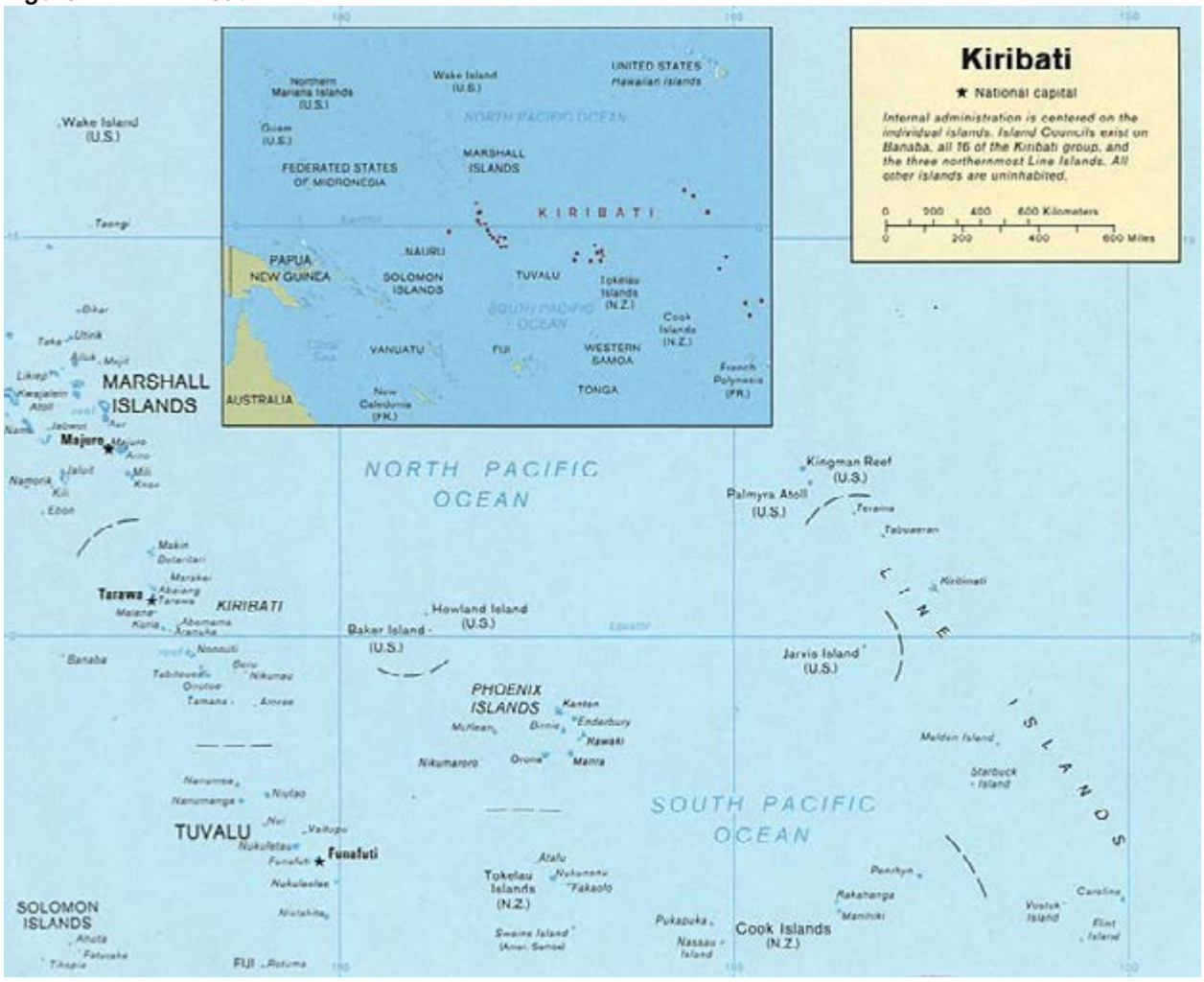
Kiribati is comprised of 32 atolls and one raised coral island, Banaba, with a total area of approximately 800 square kilometres spread over 3.5 million square kilometres. The republic has a population of just fewer than 100,000, half of whom live in the capital on the atoll of South Tarawa. With a total area of under 16 square kilometres, a high point of only three metres above sea level and a high population density, South Tarawa is among the most exposed and vulnerable of population groups anywhere in the world.

GDP per capita varies widely, from approximately $1,600 at a nominal level to $5,700 on a purchasing-parity level. Most residents practice subsistence livelihood activities, which are threatened by such unsustainable practices as using coral reefs for building material and the challenges associated with waste water treatment. As one of the internationally recognised least developed countries (LDCs), most of the country's income comes from development assistance, fishing licenses and remittances. Due to the lack of natural resources, the island chain must import almost all of its foodstuffs and manufactured products.

The only island with significant elevation is uninhabited Banaba. A British mining company stripped a large portion of the island's surface area, in the process forcibly relocating the native population. Kiribati nationals will be subject to displacement due to developed countries' economic activities, as is modelled to be the case with climate change related changes to hazard levels. The island may provide the only migration path within Kiribati for South Tarawans within their own national territory as sea-level rise and unsustainable development practices make life on South Tarawa increasingly tenuous.

Historic loss figures for Kiribati in databases are highly limited, with only four records in the past 43 years. By far the worst was the 1999 drought which affected over 85 per cent of Kiribati's population. Although there is no defined rainless season lack of fresh water reserves

Figure #4.7.1: Kiribati



Source: US Department of Congress

on all of its islands means that almost all of Kiribati's residents are subject to water shortages during periods of low rainfall.

The most recent hydro-meteorological event found in international databases was the December 2008 flood. Prior to that a tropical cyclone in 1972 which killed three people and affected 700 on Tarawa and Funafuti islands is the only other hydro-meteorological event recorded. Regional databases record several other entries although very little other data is available. According to the Secretariat of the Pacific Regional Environment Programme (SPREP) in 1999 two small islets, Tebua Tarawa and Abanuea, were among the first islands to have disappeared.

4.7.2 Displacement Risk Results

Figure #4.7.2: Disaster and climate change induced displacement risk estimates

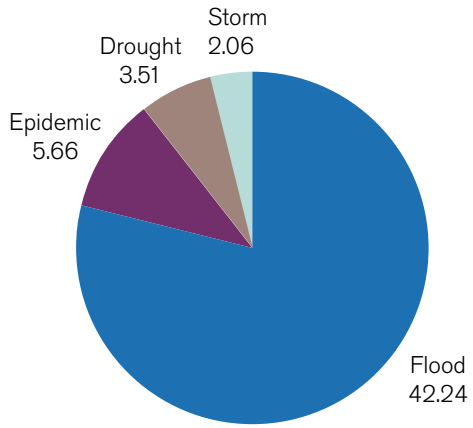
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Kiribati	98,000	53.0	12	545.5	16	Very high

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Kiribati	*207,260.00	**8.00	4.65	3.57	0.21	44.2	451

Figure #4.7.3: Annual displacement estimates per hazard.



4.8 The Marshall Islands

4.8.1 Displacement Risk Configuration

The country is located between the Federated States of Micronesia Kiribati and Nauru. With just over 50,000 residents living among 24 atolls made up of over 1,000 islands and islets and a highest elevation only eight metres above sea level, the Marshall Islands are an example of an exceedingly small country with very high vulnerability to sea-level rise and resultant storm surges, king tide flooding and salt water infiltration into fresh water aquifers. The capital and most populated atoll is Majuro, which is host to about one half of the nation's residents. After a history of foreign control and contestation between Spain, Germany and Japan the Marshall Islands achieved self-governance in 1979 and has been in a compact of Free Association with the US since 1986.

Per capita income, on purchasing parity basis, is around $3,000. There is a significant trade imbalance, like other small island states with few natural resources. The islands receive approximately $60 million per year in assistance from the US. Many residents work on the US military base on Kwajalein Atoll. Small-scale farming and tuna fishing also contribute to livelihoods.

As a small atoll-based country, resilience to climate extremes is highly limited. The islands have historically suffered disasters related to drought, storm surges, high winds and large waves. A tropical cyclone left approximately 6,000 affected residents in 1991. Floods in 2008 and 2013 caused damage to the capital which is only one metre above sea level. Drought in 2013 triggered a state of emergency, with many left to survive on less than one litre of water a day, crop losses and infectious diseases.

Figure #4.8.1: Marshall Islands

Source: Holger Behr

4.8.2 Displacement Risk Results

Figure #4.8.2: Disaster and climate change induced displacement risk estimates

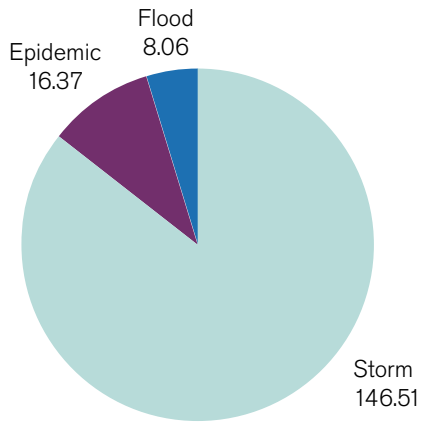
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Marshall Islands	52,000	171.0	9	3,287.3	9	Very high

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
Marshall Islands	3,422.00	**8.00	5.58	0.05	0.05	162.8	3,131

Figure #4.8.3: Annual displacement estimates per hazard



4.9 Nauru

4.9.1 Displacement Risk Configuration

The Republic of Nauru, formerly Pleasant Island, lies to the east of PNG, approximately 300 kilometres east of Banaba Island. Independence from a UN trusteeship, overseen by the UK, Australia and New Zealand, was attained in 1968. With just under 10,000 residents and a mere 21 square kilometres of land, it is one of the world's least populated independent countries. Like Banaba, its main natural resource is phosphate and most readily exploited material has already been mined, leaving the environment in a highly degraded state.

Phosphate was mined from the turn of the 20th century peaking in the 60's and 70's when Nauru boasted one of the world's highest per-capita incomes. A trust fund set up to handle profits has dropped in value and the highly degraded environment has made it impossible for residents to sustain the high income levels during this short period of extractive activity. Nauru is now highly dependent on Australian support for refugee processing facilities. The resident population, not counting refugees, has decreased substantially as downturn in phosphate mining has led to the return of workers who had migrated from other nearby island states. Unemployment now stands at about 90 per cent.

GDP, on a purchasing-parity basis, stood at $2,500 in 2006, half the value estimated in 2005. As with other small islands, fresh water is highly limited and several significant droughts have been recorded in past decades. Arable land is only found on the low-lying coastal areas while the higher elevation central plateau will remain uninhabitable without rehabilitation of phosphate mining areas. This combination makes Nauru one of the most vulnerable countries to the effects of global warming and sea-level rise. The country also has extremely high obesity rates, with about 95 per cent of the population either overweight or obese, thus resulting in the world's highest rate of type 2 diabetes.

The international disaster loss database utilised in this study, EM-DAT, does not include any records for Nauru, making displacement risk assessment challenging. The island has not been subject to a substantial cyclone in recent times. However, drought and sea-level rise related risks are substantial.

Figure #4.9.1: Nauru

Source: US Atmospheric Radiation Program, 2002

4.9.2 Displacement Risk Results

Figure #4.9.2: Disaster and climate change induced displacement risk estimates.
NOTE: This country did not produce statistically significant figures to properly calculate displacement risk.

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Nauru*	10,000	1.0	20	50.0	20	Very high

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Nauru	*207,260.00	**8.00	5.47	3.03	0.19	0.4	42

4.10 New Caledonia

4.10.1 Displacement Risk Configuration

New Caledonia, a large French dependent territory of 18,586 square kilometres, is located 1,200 kilometres east of north-central Australia. It is home to approximately 250,000 people, of whom 90 per cent live on the principal island, Grande Terre. The territory also includes the Loyalty Islands, Chesterfield Islands, the Belep archipelago, the Isle of Pines and a several small islets. The capital, Nouméa, located in the South Province of Grande Terre, has 183,000 residents. Annual population growth has averaged 1.7 per cent over the past two decades, with 15 per cent due to migration. The population has been growing on the main island, but decreasing in the Loyalty Islands (current population: about 17,000). It thus exhibits the same demographic trend as the other small island chains where residents also migrate to central islands with better livelihood options.

GDP per capita is approximately $39,000, second only to PNG among studied countries and territories. Nickel mining continues to constitute around three quarters of $2.1 billion total exports. Imports, as with many of the other territories in the region, are substantially higher than exports, totalling approximately $5.2 billion in 2011. With much of its territory unsuitable for agriculture, foodstuffs account for about 20 per cent of imports. Financial support from France accounts for approximately 15 per cent of GDP. Tourism is still small-scale, with substantially lower numbers of tourists than smaller territories such as the Cook Islands and Vanuatu.

The territory is subject to tropical cyclones and other hydro-meteorological and climatological events, with 16 recorded disasters in the past century. International databases contain sparse information on the total number of people affected, estimating only 3,500, far less than the reality. Fatality and economic cost figures are also equally poor, making displacement risk assessment susceptible to higher margins of error than other territories studied in this report. A 2003 storm caused over $40 million in damage and killed two people.

Figure #4.10.1: New Caledonia

Source: US Central Intelligence Agency

4.10.2 Displacement Risk Results

Figure #4.10.2: Disaster and climate change induced displacement risk estimates

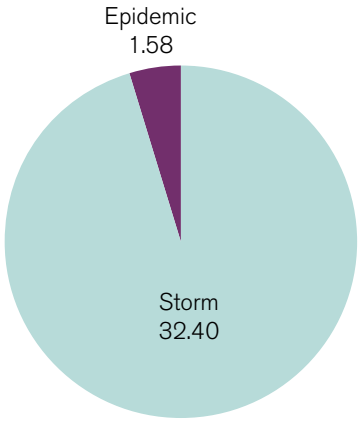
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
New Caledonia	246,000	34.0	13	138.1	18	Medium

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
New Caledonia	302,297.00	**4.00	5.38	2.25	0.15	29.5	120

Figure #4.10.3: Annual displacement estimates per hazard



4.11 Niue

4.11.1 Displacement Risk Configuration

Niue, a self-governing state with an area of 260 square kilometres and a population around 1,400, lies approximately 2,400 kilometres northeast of New Zealand. Due to its free association with New Zealand Niue nationals are entitled to New Zealand citizenship, where today some 90 per cent reside. The state has two outlying coral reefs and a submerged atoll, none of which have any land area above sea level. Geographically, Niue is one of the world's largest coral islands, with steep limestone cliffs along the coast and a central plateau about 60 metres above sea level.

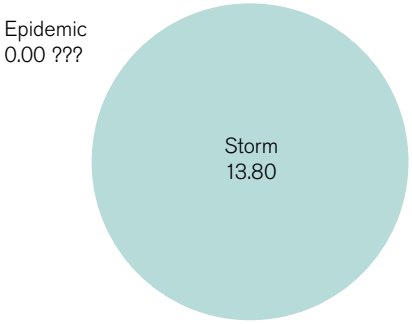
GDP, on purchasing-price parity, was estimated at $10 million in 2003. Foreign aid, largely from New Zealand, is the island's principal source of income. Remittances from Niueans living abroad were substantial in the 70's and 80's, but have decreased as more family members have joined those already living abroad. About 200 of the island's square kilometres have been dedicated to agriculture, mostly subsistence cultivation of taro root. Since 2003, the government in partnership with NZAID has attempted to expand vanilla production.

No disasters large enough to meet international database thresholds were recorded between 1961 and 1998. However, since then two cyclones and epidemic have affected a substantial portion of the island's population. Cyclone Heta in 2004 affected about half the population and caused substantial damage to agriculture. Niue alarmingly reports by far the highest level of skin cancer in the world, with 2,482 deaths reported per 100,000. Precipitation is rather light, with the driest period occurring during June and July when there is risk of drought.

Figure #4.11.1: Niue

Source: US Central Intelligence Agency

Figure #4.11.3: Annual displacement estimates per hazard.



4.11.2 Displacement Risk Results

Figure #4.11.2: Disaster and climate change induced displacement risk estimates

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Niue*	1,000	14.0	16	13,797.5	2	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Niue	98,490.00	**6.00	***5.52	1.07	0.10	12.6	12,581

4.12 Northern Mariana Islands

4.12.1 Displacement Risk Configuration

The Commonwealth of Northern Mariana Islands, a US territory since 1978, consists of fifteen islands with a total area of just under 463 square kilometres, and a total population of approximately 54,000. Over 90 per cent live on the island of Saipan, whose village of Capital Hill serves as the capital. Only two other islands are permanently inhabited.

As is the case with other island states in the region, population has been decreasing as residents migrate in search of better livelihoods: from 2000 to 2010 the population decreased by around 22 per cent due to declines in tourism and clothing production. Agricultural production, mainly for national consumption, adds a nominal amount to the territory's GDP.

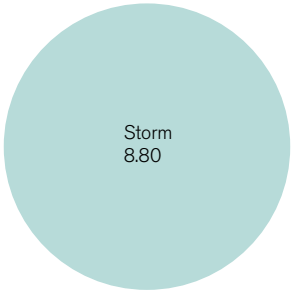
The northern islands in the archipelago are volcanic in nature, with Agrihan volcano on the island of Agrihan having the highest elevation at 965 metres. Ahatahan volcano on Ahatahan Island became active in 2003. The southern islands in the archipelago consist of limestone with surrounding coral reefs.

The international disaster loss database utilised in this study, EM-DAT, does not include any records for the country, thus making displacement risk assessment challenging. The archipelago is subject to tropical cyclones and the northern islands have been evacuated due to volcanic hazard.

Figure #4.12.1: Northern Mariana Islands

Source: US Central Intelligence Agency

Figure #4.12.3: Annual displacement estimates per hazard



4.12.2 Displacement Risk Results

Figure #4.12.2: Disaster and climate change induced displacement risk estimates.
NOTE: This country did not produce statistically significant figures to properly calculate displacement risk

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Northern Mariana Islands	54,000	9.0	18	163.0	17	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Northern Mariana Islands	439,666.00	**4.00	6.46	2.72	0.17	7.5	139

4.13 Palau

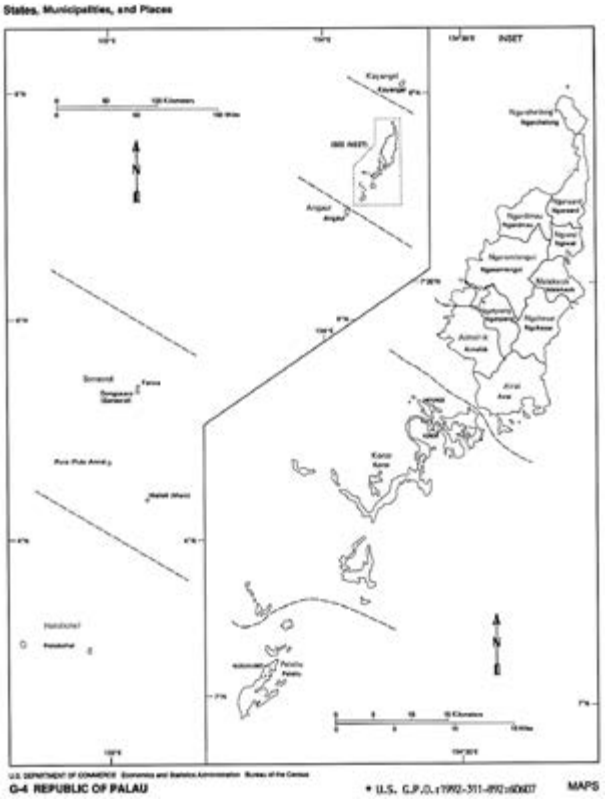
4.13.1 Displacement Risk Configuration

Palau, a republic in free association with the US, is home to approximately 21,000 residents spread over 250 islands with a total land mass of 459 square kilometres. Under Japanese control from World War I to World War II, in 1947 the islands passed to the US under a United Nations mandate as part of the Trust Territory of the Pacific Islands. In 1994, the islands gained full sovereignty, after having voted against joining the Federated States of Micronesia. About 60 per cent of the population lives on the island of Koror, 10 per cent on Airai and several hundred on each of 14 other islands.

GDP, on purchasing-power parity is slightly over $8,000, a large portion of which is derived from foreign aid. The government is the principal employer, other economic activity consisting of tourism, fishing and subsistence agriculture. Unlike some of the other very small states in the South Pacific, Palau's population has not seen emigration-based declines. It is hoped that with better air links tourism will contribute substantially more to the economy.

EM-DAT does not include any records for Palau, once again making displacement risk assessment challenging. Although the territory is outside of the highest risk areas for typhoons, the regional SOPAC database lists12 disasters in the past 43 years, including six typhoons, an earthquake and a tsunami. There is little environmental degradation but climate change, coral dredging and poor sewage treatment pose increasingly serious problems.

Figure #4.13.1: Palau



Source: US Department of Commerce

4.13.2 Displacement Risk Results

Figure #4.13.2: Disaster and climate change induced displacement risk estimates.
NOTE: This country did not produce statistically significant figures to properly calculate displacement risk

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Palau	20,000	1.0	20	44.5	21	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Palau	25,438.00	**4.00	6.48	0.16	0.05	0.8	42

4.14 Papua New Guinea

4.14.1 Displacement Risk Configuration

With a population of just under seven million and a total surface area of almost 463,000 square kilometres, PNG is by far the largest island state among the countries reviewed in this study. PNG is principally comprised of the eastern half of New Guinea island (the other being part of Indonesia), with several groups of smaller islands located to the east and north of the principal island. It is one of the most culturally diverse states in the world, with over 800 languages. After gaining independence from Australia in 1975 PNG became a member of the Commonwealth. The capital, and largest population centre, is Port Moresby

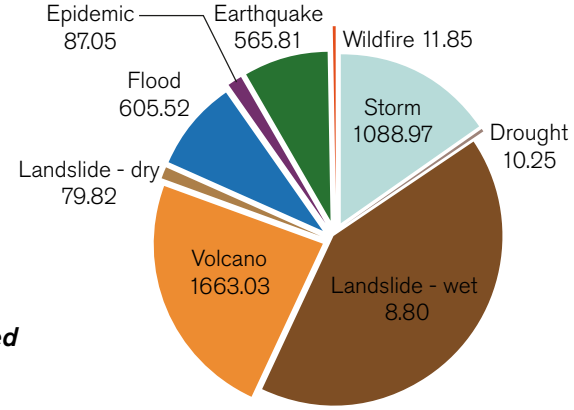
GDP per capita is estimated at between $2,500 and $3,000, depending upon the formula used. Despite its relatively fast growing economy, about a third of the population lives on $1.25 or less per day, relying on subsistence agriculture or cash crops. Chief exports include gold, copper, petroleum and palm oil. After a period of stagnation the economy has grown in recent years due to better fiscal management and higher global commodity prices.

PNG has an elevated malaria incidence which contributes a significant portion of the total mortality risk and has the highest incidence of AIDS in the Pacific region. A long list of varied hazards has contributed to the area's disaster risk. Volcanoes, earthquakes, landslides, storms and epidemics have all contributed significantly to loss of life. Drought (1997, 1980) and floods (2012, 2008, 1999, 1993 and 1992) have contributed the most significant quantities to the total number of people affected by disasters, while volcanoes, floods and earthquakes account for the majority of economic losses. EM-DAT also records five tropical cyclones affecting over 200,000 people in total: although significant in its own right, these losses are, nonetheless, dwarfed by other sources of disaster risk.

Figure #4.14.1: Papua New Guinea

Source: US Central Intelligence Agency's World Factbook

Figure #4.14.3: Annual displacement estimates per hazard



4.14.2 Displacement Risk Results

Figure #4.14.2: Disaster and climate change induced displacement risk estimates

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Papua New Guinea	6,859,000	7,019.0	1	1,023.3	14	Medium

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Papua New Guinea	184,570.00	**4.00	4.09	1.80	0.13	6,210.3	905

4.15 Samoa

4.15.1 Displacement Risk Configuration

The former Western Samoa, now known as the Independent State of Samoa, gained independence from New Zealand in 1962. There are 186,000 residents in its 2,831 square kilometres. Samoa includes one of the region's bigger islands, Savai'I. The capital, Apia, is located on the other main island, Upolu. Several small islands and islets make up around one per cent of the land area. GDP per capita is around $6,000 on a purchasing-parity basis and $3,500 on a nominal level. Just under 60 per cent of GDP is derived from industrial activity, largely comprised of automotive products. Tourism is expanding and accounts for around a quarter of GDP. Agriculture accounts for around 15 per cent.

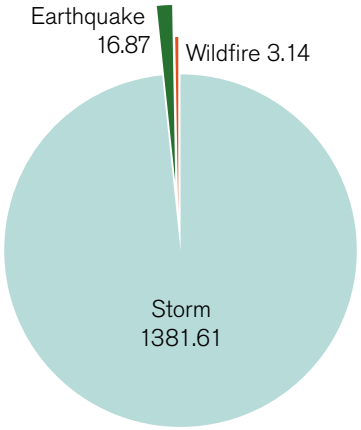
Cyclones form the vast majority of losses, with significant portions of the population affected by events in 2012, 1991, 1990 and 1983. A 2009 earthquake also led to significant fatalities, affected people and economic losses. Wildfire and floods are also among Samoa's diverse disaster risks.

The 1918-1919 influenza epidemic, which started when a New Zealand ship was allowed to berth in breach of quarantine rules, led to the death of approximately a fifth of the population. This was an important event in terms of Samoan's drive for independence from New Zealand and demonstrates the interrelationship between changing social and political trends and disasters in the region.

Figure #4.15.1: Samoa

Source: Wikipedia Commons

Figure #4.15.3: Annual displacement estimates per hazard



4.15.2 Displacement Risk Results

Figure #4.15.2: Disaster and climate change induced displacement risk estimates

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Samoa	186,000	1,402.0	6	7,535.6	6	Medium

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
Samoa	95,823.00	**4.00	5.13	0.75	0.08	1,295.6	6,965

4.16 Solomon Islands

4.16.1 Displacement Risk Configuration

The Solomon Islands lies to the east of PNG and consists of several distinct groups of islands with a population of just over half a million. The land area of the archipelago is approximately 28,400 square kilometres, much of it volcanic. There is a wide variety of ethno-linguistic diversity: there are over 70 indigenous languages.

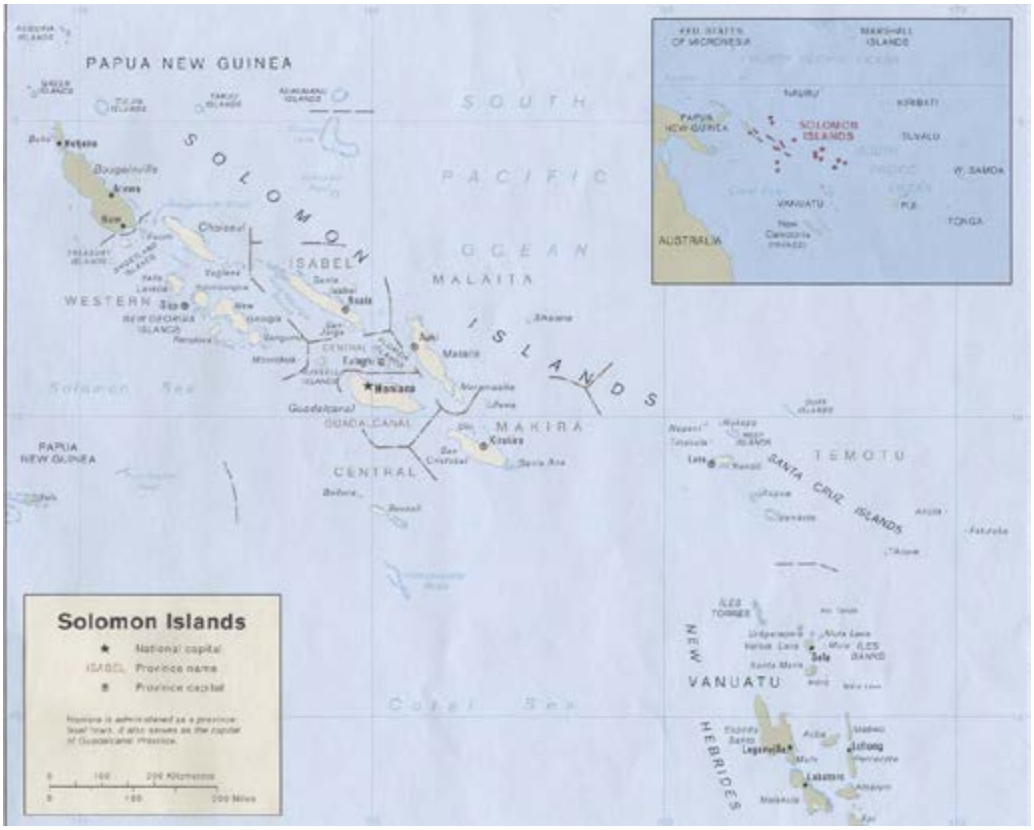
Since independence from the United Kingdom in 1978 there have been governance challenges. In 2003, with government in chaos and the country in financial difficulties, its parliament officially requested foreign assistance to help reduce problems with lawlessness, corruption and ineffective policing. Australia and New Zealand led the Regional Assistance Mission to Solomon Islands with a contingent of over 2,000 police and military personnel.

GDP per capita is estimated at slightly over $3,000 on a purchasing-parity basis and about one half on a nominal basis. The vast majority of exports in recent decades have consisted of timber products, leaving many forests in difficult conditions. The islands are rich in several minerals, including gold, lead, zinc and nickel. Mining remains substantially underdeveloped due to on-going political and social unrest. The other principal exports are palm oil, cocoa beans and fish. Tourism is still miniscule largely due to the lack of adequate infrastructure and transportation. Government insolvency in 2002 has contributed to extremely low levels of public infrastructure and institutional development.

In the past decade, earthquakes and tsunamis have played a prominent part in disaster loss patterns, with significant events in 2013 and 2007. During the sample period, a large number of total fatalities were due to seismic activity. Volcanic activity in 1971 affected a significant number of residents. Cyclones and storm-related floods have historically affected the greatest number of people, with significant events in 2012, 2010, 2009, 1993, 1986 and 1982.

International loss databases are necessarily light on entries due to the difficulty in obtaining accurate loss reports: only one recent event was given an estimated figure for economic losses. Due to the large variety of cultures and population groups, many smaller scale events go unreported. As with many other countries, landslide related losses are often local in nature. Although a single storm event may be responsible for triggering losses, the disperse nature of these damaging events hides their true level of devastation.

Figure #4.16.1: Solomon Islands



Source: US Central Intelligence Agency

4.16.2 Displacement Risk Results

Figure #4.16.2: Disaster and climate change induced displacement risk estimates

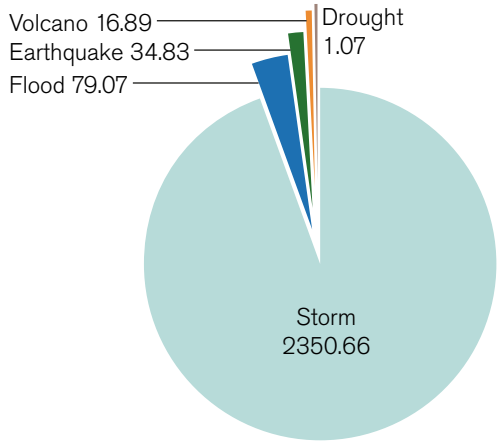
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Solomon Islands	526,000	2,483.0	3	4,719.6	8	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
Solomon Islands	372,903.00	**4.00	4.18	3.57	0.21	2,050.5	3,898

Figure #4.16.3: Annual displacement estimates per hazard



4.17 Tokelau

4.17.1 Displacement Risk Configuration

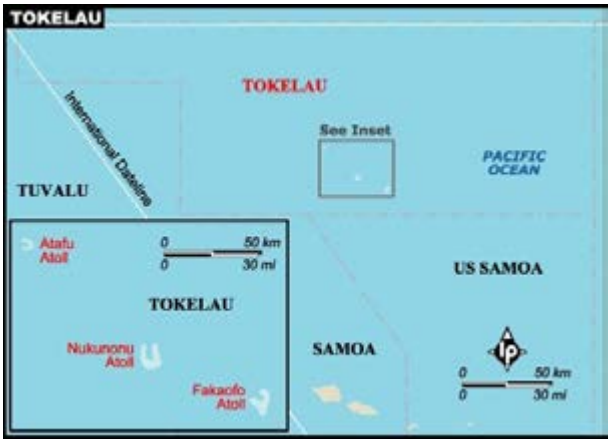
Tokelau is a non-self-governing territory with many governmental functions undertaken by New Zealand. With a population of just over a thousand, a land area of ten square kilometres and a high point only five metres above sea level the several atolls that comprise Tokelau are among the most vulnerable to the effects of sea-level rise and global warming.

As part of promoting decolonisation the United Nations has urged colonial powers to move remaining non-self-governing territories into self-governing states in free association. However, referenda in 2004 and 2006 both failed to obtain the necessary two thirds majorities, prompting some in New Zealand to question whether self-government is a viable option for such exceedingly small states.

GDP per capita, on a purchasing parity basis, was estimated in 1993 at just over $1,000. It is considered the world's smallest economy and has sparse available data. Tokelau is highly dependent on New Zealand for government funding, health and education As with many other very small island states, a substantial portion of the population has migrated to New Zealand and support family members on the atolls via remittances. In 2012, Tokelau became the first nation to meet all electricity needs via solar power.

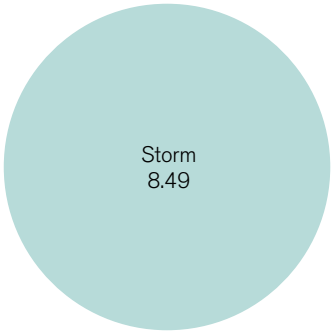
International loss database figures consist purely of cyclone-related losses. The 1990 event triggered losses of over $2.4 million, in excess of annual GDP. EM-DAT report cyclones in 2005 and 1987. Regional databases also include four other storm-related events between 1900 and 1970. The limited nature of data in such a small country necessarily means that estimating displacement risk using a probabilistic loss methodology is practically impossible.

Figure #4.17.1: Tokelau



Source: Bebo.com

Figure #4.17.3: Annual displacement estimates per hazard.



4.17.2 Displacement Risk Results

Figure #4.17.2: Disaster and climate change induced displacement risk estimates

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Tokelau*	1,000	8.0	19	8,489.5	4	Very high

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Tokelau	*207,260.00	**4.00	***5.52	1.50	0.12	7.6	7,605

4.18 Tonga

4.18.1 Displacement Risk Configuration

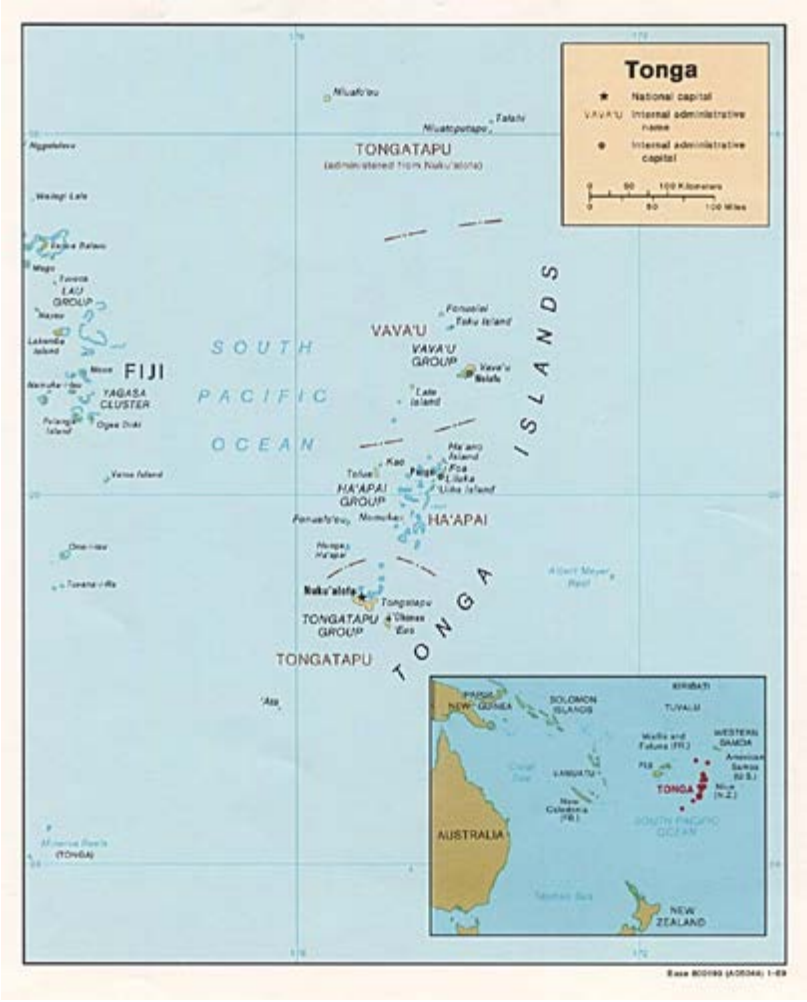
Tonga, which literally means "south", is the southern-most archipelago in central Polynesia. It has a land area of 748 square kilometres and a population of just over 100,000, seventy per cent of whom live on the main island, Tongatapu. Tonga's population has been growing slowly amid emigration from smaller islands to the principal urban centre. This is in contrast to nearby Nauru, where environmental degradation resulting from extractive mining has made emigration in search of livelihoods the only option for many. Together with nearby Nauru, Tonga has one of the world's highest levels of obesity.

Although a "protected state" under treaty with Great Britain since 1900, it is one of the only states in the region to have retained its indigenous system of governance. Joining the Commonwealth in 1970, it uniquely retained its own monarchy, instead of having the British monarch as head of state.

There is substantial income inequality but the state provides free compulsory education and health care. GDP per capita on a purchasing-parity basis is approximately $7,500, and on a nominal level around $4,200. The royal family and nobles are economically dominant and corruption is high by international measures. The poor largely depend on subsistence agriculture, the informal economy and remittances Tourism remains largely undeveloped.

Tonga has many recorded loss events, mostly related to hydro-meteorological conditions, but including both earthquake (the most recent large loss triggering event was in 1977) and volcanic activity (in 1946). The single largest cyclone-triggered event was in 1982, with events in 2001, 1998, 1997, 1990, 1977 and 1973 also contributing substantially to the total number of people affected. Unlike many of the other states in the region, economic loss figures have been extensively reported: over $51 million in damage from the December 2001 cyclone, over $21 million from the March 1982 event and over $3 million from the January 2011 event.

Figure #4.18.1: Tonga



Source: US Central Intelligence Agency

4.18.2 Displacement Risk Results

Figure #4.18.2: Disaster and climate change induced displacement risk estimates

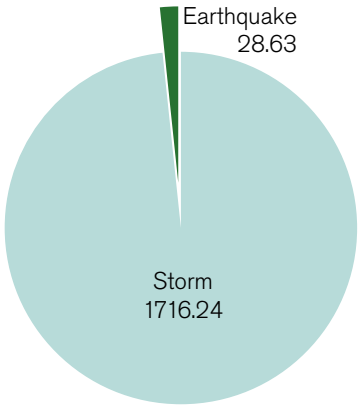
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Tonga	104,000	1,745.0	5	16,777.6	1	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
Tonga	314,333.00	**4.00	5.06	2.49	0.16	1,502.5	14,447

Figure #4.18.3: Annual displacement estimates per hazard.



4.19 Tuvalu

4.19.1 Displacement Risk Configuration

Comprised of three reef islands and six atolls, Tuvalu lies midway between Hawaii and Australia, with its closest neighbours being Kiribati and Samoa. With a population around 10,000 it is among the world's three least populous sovereign states. With only 26 square kilometres of land and a highest elevation of less than five metres it is among the states most highly vulnerable to the effects of climate change.

Tuvalu joined the Commonwealth on gaining independence from the UK in 1978. It is one of the strongest proponents for carbon emissions control due to its exceedingly high vulnerability to sea-level rise and other effects of climate change. Four fifths of reefs on the principal island, Funafuti, have suffered from coral bleaching as a result of warmer ocean temperatures triggered by El Niño events in 1998-2000 and 2000-2001. Tuvalu has declared an ambition to reach 100 per cent generation of power from renewable sources by 2020.

GDP per capita was estimated in 2010, on purchasing-parity basis, at $3,400. The public sector provides 65 per cent of employment. Fifteen per cent of adult males work on foreign-flagged merchant ships. The remainder of the population is typically involved in subsistence agriculture and fishing. Tuvalu's internet domain suffix, tv, has been commercialised and generates around $2.2 million per annum in royalties, around a tenth of state revenue. A trust fund recently valued at around $100 million was established by the UK, Australia and New Zealand in 1987. Several other countries also provide financial support.

Although severe tropical cyclones are rare, the low level of the islands makes them particularly vulnerable: Cyclone Bebe in 1972 overtopped the sand dunes forming the high point on Funafuti, submerging the entire island, destroying 90 per cent of structures and contaminating fresh water sources. Other historical cyclone events are recorded for 1883 and 1894. As is the case with other exceedingly small states, disaster loss records in international databases are necessarily highly limited. EM-DAT lists three cyclone-related events: Bebe in 1972, together with events in 1990 and 1993 each affecting a substantial portion of the population.

As with Kiribati, population growth on the small land mass has led to increased pressure on natural resources and food stocks as well as pollution due to inadequate sanitation systems. The use of coral as fill for the construction of the airport's runway during World War II resulted in seawater infiltration of fresh water aquifers due changes in patterns of sand migration, leading to beach erosion. Repeated attempts to mitigate this damage have not been successful.

Figure #4.19.1: Tuvalu

Source: US Central Intelligence Agency

4.19.2 Displacement Risk Results

Figure #4.19.2: Disaster and climate change induced displacement risk estimates

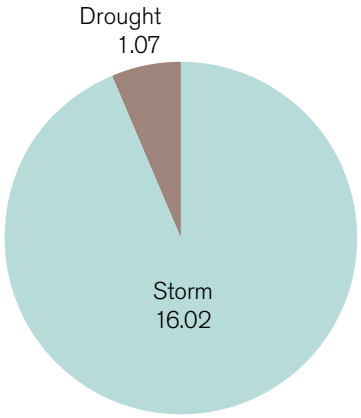
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Tuvalu*	10,000	17.0	15	1,708.9	12	Very high

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
Tuvalu	4,892.00	**8.00	7.37	0.05	0.05	16.3	1,627

Figure #4.19.3: Annual displacement estimates per hazard



4.20 Vanuatu

4.20.1 Displacement Risk Configuration

The Republic of Vanuatu consists of around 82 relatively small islands within an archipelago of volcanic origin, approximately 1,700 kilometres east of Australia. The country gained its independence in 1980 from France and the UK. It has a surface area of 12,190 square kilometres and a population of around 236,000, most living in rural areas. There is significant cultural diversity, with over 100 indigenous languages. Population growth is relatively high for the region, at 2.4 per cent per annum. Much of the landmass is unsuitable for agricultural use due to its steep, unstable soils and limited fresh water. Due to the volcanic nature of the archipelago, coastal areas quickly drop off to very deep levels.

In recent decades Australia, the UK, France and New Zealand have provided most foreign development aid, with China a recent additional donor. The Millennium Challenge Account, a US bilateral foreign aid agency, announced in 2005 that Vanuatu would be one of the first countries to receive support and $65 million has been provided to upgrade essential infrastructure. Off-shore financial services also account for a substantial portion of revenues

GDP per capita ranges between $5,000 on a purchasing-parity basis and $3,000 on a nominal basis. A substantial portion of economic activity centres on fishing, either for export or subsistence. Agriculture and cattle rearing provide some 65 per cent of GDP and have led to substantial deforestation and soil erosion. Tourism has been growing fast, Vanuatu attracting around 200,000 tourists per year.

Vanuatu has a long history of losses attributed to disasters triggered by cyclones and volcanoes. Tropical cyclones in 2004, 1999, 1993, 1992, 1998, 1987, 1985 and many other less recent events affected over 240,000 people. Volcanic activity in 2008, 2005 and 2001 also affected a significant number of people. An earthquake in 1999 and a flooding in 2002 are also among the top disasters in terms of number of people affected. In terms of economic losses, the 1985 Cyclones Eric and Nigel alone led to over $173 million in losses.

Figure #4.20.1: Vanuatu

Source: US Central Intelligence Agency 's World Factbook

4.20.2 Displacement Risk Results

Figure #4.20.2: Disaster and climate change induced displacement risk estimates

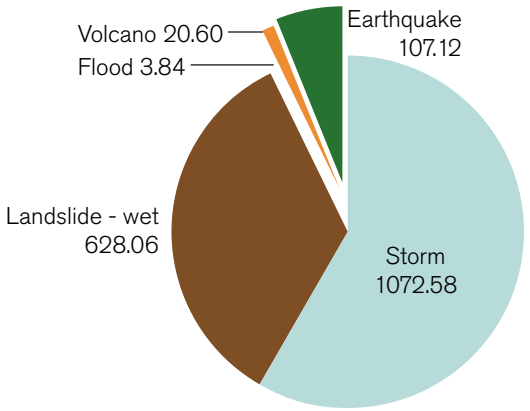
Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Vanuatu	236,000	1,832.0	4	7,763.6	5	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnera-bility	Resi-lience	Risk Confi-guration	Risk Configuration (Normalised)	Historic Absolute Displace-ment	Historic Relative Displacement (per 1M)
Vanuatu	806,946.00	**4.00	4.88	6.62	0.35	1,357.2	5,751

Figure #4.20.3: Annual displacement estimates per hazard



4.21 Wallis and Futuna

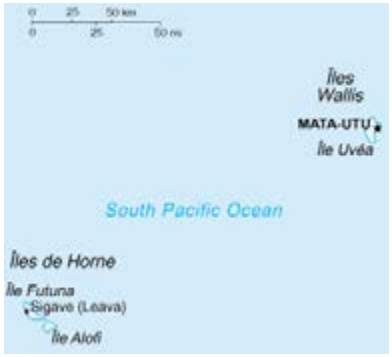
4.21.1 Displacement Risk Configuration

The Territory of the Wallis and Futuna Islands consists of three principal volcanic islands and around 20 uninhabited islets. Located in two groups about 200 kilometres apart, with a land area totalling 264 square kilometres the islands are about two thirds of the way from Hawaii to New Zealand, between Tuvalu, Fiji, Tonga and Samoa. Wallis and Futuna became a French protectorate in 1888, a French overseas territory in 1961 and a collectivité d'outre-mer in 2003. The territory consists of three traditional kingdoms, Uvea, Sigave and Alo. The capital, Mata'utu, is located on the most populous island, Wallis, where some 70 per cent of the population live. The island of Alofi has been uninhabited since the 19th century, largely due to lack of fresh water.

Per capita income, on a nominal basis, is approximately $13,000, among the highest averages in the region. Around four fifths of the population depend on agriculture and fishing, with a substantial portion doing so on a subsistence basis. Revenues principally come from foreign aid, licensing of fishing rights and remittances. There is only one bank in the nation and for several years from the late 1980s it had no banking services whatsoever. Around a quarter of the land area is used for agriculture. Long-term deforestation to meet demand for cooking fuel has left many areas subject to erosion, in particular on the island of Futuna.

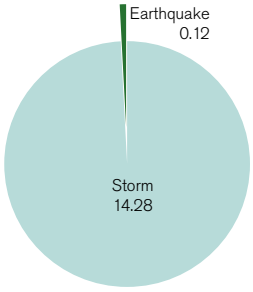
There are limited disaster loss records for Wallis and Futuna in international loss databases. The main loss-related events have been triggered by tropical cyclones, principally the December 1986 and December 2012. The regional SOPAC database includes five cyclones and three earthquakes from 1970-2012, with several of events below the threshold for inclusion in EM-DAT.

Figure #4.21.1: Wallis and Futuna



Source: US Central Intelligence Agency's World Factbook

Figure #4.21.3: Annual displacement estimates per hazard



4.21.2 Displacement Risk Results

Figure #4.21.2: Disaster and climate change induced displacement risk estimates

Disaster-induced displacement risk estimates

		Magnitude		Magnitude		Amplitude
Country	Population	ABSOLUTE – 2014-2018 Average Annual Displacement (Country total)	Regional Rank	RELATIVE – 2014-2018 Average Annual Displacement (per million inhabitants)	Regional Rank	Distance & Duration of Displacement (qualitative)
Wallis and Futuna Islands*	14,000	14.0	16	1,028.9	13	High

Disaster-induced displacement risk components

	DDI Absolute Magnitude					Historic Displacement	
Country	Total Relative Physical Exposure (per 100)	Vulnerability	Resilience	Risk Configuration	Risk Configuration (Normalised)	Historic Absolute Displacement	Historic Relative Displacement (per 1M)
Wallis and Futuna Islands	55,366.00	**4.00	***5.52	0.40	0.07	13.5	965

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United Nations Environment Programme (UNEP). 2011. GRID Physical Exposure Data. "*Physical exposition to tropical cyclone of Saffir-Simpson category 5 1970-2009*", "*Physical exposure to earthquakes of MMI categories higher than 9 1973-2007*" "*Physical exposition to flood*", "*Physical exposition to lanslides triggered by earthquakes*", "*Physical exposition to landslides triggered by precipitations*"," *Physical exposition to droughts events 1980-2001*" http://preview.grid.unep.ch

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6 Key Terminology

The following terms are all highly relevant for this paper. Definitions are provided for the benefit of those not already familiar with the common lexicon of disaster and climate change risk management. For further information on these terms and the underlying concepts, please refer to: UNISDR (2009) *Terminology on Disaster Risk Reduction*[33]; UNISDR (2013) *Global Assessment Report*[34]; IPCC (2012) *SREX*[35] and the *Hyogo Framework for Action* (2005).[36]

The following terminology lays out the basic framework for disaster risk, its human displacement component, the constituent elements of disaster risk assessment, analysis and reduction and human displacement risk:

Disaster

- *"A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources."* – ISDR (2009)
- This project uses the Disaster Typology used by IDMC to categorise disasters into 'rapid' and 'slow' onset; see figure #7.1.

Climate change

- *"A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use."* – IPCC (2012)
- *"The IPCC definition can be paraphrased for popular communications as 'A change in the climate that persists for decades or longer, arising from either natural causes or human activity.'"* – ISDR (2009)

Human Displacement

- *"Displacement addressed in this report is a result of the threat and impact of disasters. It also increases the risk of future disasters and further displacement. Being displaced puts people at a higher risk of impoverishment and human rights abuses, creating new concerns and exacerbating pre-existing vulnerability. This is especially true where homes and livelihoods are destroyed and where displacement is recurrent or remains unresolved for prolonged periods of time… The non-voluntary nature of the movement is central to the definition of displacement."* – IDMC (2013)

Risk

- *"The combination of the probability of an event and its negative consequences. This definition closely follows the definition of the ISO/IEC Guide 73. The word "risk" has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in "the risk of an accident"; whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period. It can be noted that people do not necessarily share the same perceptions of the significance and underlying causes of different risks."* – ISDR (2009)

Disaster risk

- *"The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period. The definition of disaster risk reflects the concept of disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least."* – ISDR (2009)

Probabilistic Risk Analysis

- *"In its simplest form, probabilistic risk analysis defines risk as the product of the probability that some event (or sequence) will occur and the adverse consequences of that event [i.e. expressed by the equation Risk = Probability x Consequence]. This likelihood is multiplied by the value people place on those casualties and economic disruption… [For Disaster Risk] All three factors – hazard, exposure, and vulnerability – contribute to 'consequences.' Hazard and vulnerability can both contribute to the 'probability': the former to the likelihood of the physical event (e.g., the river flooding the town) and the latter to the likelihood of the consequence resulting from the event (e.g., casualties and economic disruption).*
  In [disaster risk reduction] practice, probabilistic risk analysis is often not implemented in its pure form for reasons including data limitations; decision rules that yield satisfactory results with less effort than that required by a full probabilistic risk assessment; the irreducible imprecision of some estimates of important probabilities and consequences; and the need to address the wide range of factors that affect judgments about risk." – IPCC (2012).

Risk assessment

- *"A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend. Risk assessments (and associated risk mapping) include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process."* – ISDR (2009)

Hazard

- *"A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. The hazards of concern to disaster risk reduction as stated in footnote 3 of the Hyogo Framework are "… hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis."* – ISDR (2009)

Exposure

- *"People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest."* – ISDR (2009)

Vulnerability

- *"The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure."* – ISDR (2009)

Resilience

- *"The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions."* – ISDR (2009); IPCC (2012)
- *"Resilience means the ability to "resile from" or "spring back from" a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need."* – ISDR (2009)

Capacity

- *"Capacity refers to the combination of all the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to achieve established goals. This includes the conditions and characteristics that permit society at large (institutions, local groups, individuals, etc.) access to and use of social, economic, psychological, cultural, and livelihood-related natural resources, as well as access to the information and the institutions of governance necessary to reduce vulnerability and deal with the consequences of disaster. This definition extends the definition of capabilities referred to in Sen's 'capabilities approach to development' (Sen, 1983)."* – IPCC (2012)

Extensive Risk

- *"The widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts. Extensive risk is mainly a characteristic of rural areas and urban margins where communities are exposed to, and vulnerable to, recurring localised floods, landslides storms or drought. Extensive risk is often associated with poverty, urbanization and environmental degradation."* ISDR (2009)

Intensive Risk

- *"The risk associated with the exposure of large concentrations of people and economic activities to intense hazard events, which can lead to potentially catastrophic disaster impacts involving high mortality and asset loss. Intensive risk is mainly a characteristic of large cities or densely populated areas that are not only exposed to intense hazards such as strong earthquakes, active volcanoes, heavy floods, tsunamis, or major storms but also have high levels of vulnerability to these hazards."* ISDR (2009)

Notes

1. The five regions are Central America, the Pacific, the Horn of Africa, Southeast Asia and South Asia. The technical paper focusing on Central America was published in December 2013 and launched at the Nansen Initiative consultation in Costa Rica.

2. For more information, see http://www.nanseninitiative.org/

3. IDMC and Norwegian Refugee Council, 2013. *Global Estimates 2012: People displaced by disasters.* Geneva, IDMC. http://internal-displacement.org/publications/global-estimates-2012

4. IDMC, 2013. *Technical Paper: The risk of disaster-induced displacement – Central America and the Caribbean.* http://www.internal-displacement.org/idmc/website/resources.nsf/(httpPublications)/A6739FF3AF535330C1257C36005959BF?OpenDocument

5. To contact the authors, email: justin.ginnetti@nrc.ch

6. IDMC (2013) *Global Estimates 2012*, p.6.

7. Wisner, B., Blaikie,P., Cannon, T. and Davis, I. 2003. *At Risk* (2nd ed.), p.7. London: Routledge.

8. See http://www.unisdr.org/we/inform/gar

9. See http://www.internal-displacement.org/natural-disasters

10. See http://www.nanseninitiative.org/

11. IDMC, 2013. *Global Estimates 2012*, p.6.

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13. Due to the difficulty of estimating drought-related displacement using existing methodologies, IDMC is employing a new methodology, based on a system dynamics model, to estimate drought-related displacement. An initial analysis piloting this methodology in the Horn of Africa will be published in early 2014.

14. A more thorough glossary is included in Appendix I.

15. Adapted from Intergovernmental Panel on Climate Change (IPCC), 2012. *Managing the Risks of Extreme Events and disasters to Advance Climate Change Adaptation, Special Report of the Intergovernmental Panel on Climate Change*, Cambridge: Cambridge University Press, p.557. http://ipcc-wg2.gov/SREX/

16. UNISDR, 2009. *UNISDR Terminology on Disaster Risk Reduction*. Pg. 9. Geneva: UN Office for Disaster Risk Reduction. http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf

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18. United Nations, 1998. *Guiding Principles on Internal Displacement*. Geneva: United Nations. http://www.ohchr.org/EN/Issues/IDPersons/Pages/Standards.aspx

19. Kälin, W. 2013, "Changing climates, moving people: Distinguishing voluntary and forced movements of people". In *Changing climate, moving people: Framing migration, displacement and planned relocation*, pp.38-43 Warner, K., Afif, T.,Kälin, W., Leckie, S., Ferris,B., Martin, S. and Wrathall, D. (eds.)]. Bonn, Germany: United Nations University Institute for Environment and Human Security (UNU-EHS). http://www.ehs.unu.edu/article/read/changing-climate-moving-people-framing-migration-displacement

20. By convolution we here mean that each variable in the equation in Figure 2 may be expressed by a function (rather than say, a constant value). The relationship between each of these in turn may be expressed by another function obtained by integration that explains their relationship.

21. The term 'fat tailed distribution' is commonly used to describe the shape of a loss frequency curve where events on the end 'tails' of the distributions (that is, very low recurrence) are actually more probable than previously expected and/or related to more losses than previously expected.

22. UNISDR, 2013. Chair's Summary Fourth Session of the Global Platform for Disaster Risk Reduction Geneva, 21-23 May 2013. Geneva: UNISDR.

23. See the Guiding Principles on Internal Displacement, 1998 (http://www.idpguidingprinciples.org) and the IASC Operational Guidelines on the protection of persons in situations of natural disasters, 2011 (http://www.brookings.edu/research/reports/2011/01/06-operational-guidelines-nd). Also, Cernea's Impoverishment Risks and Reconstruction approach analyses forced resettlement in the context of large-scale development projects and outlines eight basic risks faced by displaced people, which are also common to disaster-induced displacement: landlessness; joblessness; homelessness, marginalisation, food insecurity, increased morbidity, loss of access to common property resources and social disarticulation. Cernea, M. 1999, "Why Economic Analysis is Essential to Resettlement: A Sociologist's View", in Cernea, M. (ed.), *The Economics of Involuntary Resettlement: Questions and Challenges*, Washington, DC: World Bank.

24. The history of this concept is summarised in Wisner et al. (2003), pp.10-11.

25. United Nations International Strategy for Disaster Reduction (UNISDR), 2005. *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*. Geneva: UNISDR. http://www.unisdr.org/we/inform/publications/1037. The HFA was endorsed by UN General Assembly Resolution A/RES/60/195 following the 2005 World Disaster Reduction Conference and adopted by 168 countries. A post-2015 agreement is currently being prepared for adoption at the Third UN Conference on Disaster Risk Reduction scheduled to take place in Sendai, Japan in 2015.

26. Internal Displacement Monitoring Centre (IDMC) and Norwegian Refugee Council, 2013. *Global Estimates 2012: People displaced by disasters.* Geneva, IDMC. http://internal-displacement.org/publications/global-estimates-2012

27. Physical exposure data which integrates hazard and exposure elements was used from UNEP's GRID PREVIEW model. Human vulnerability values from the same model were also used for each country. Resilience was measured using DARA's 2012 Index of Conditions and Capacities for Risk Reduction (IRR).

28. EM-DAT: The OFDA/CRED International Disaster Database – www.EM-DAT.be – Université catholique de Louvain, Belgium.

29. http://www.sopac.org/

30. IDMC (2013), Global Estimates 2012: People displaced by disasters

31. This paper used a 41-year period from 1970-2012 from EM-DAT and reliance on SOPAC's regional disaster loss database for additional events not tracked in EM-DAT.

32. For the displacement estimates produced in this paper, we used the principal international database for disaster losses, EM-DAT. It uses a threshold of ten fatalities, 100 people affected or a call for international aid. Generally, number of persons killed and number of persons affected values seem to take precedence over homeless figures whose entries can be less consistent. Future iterations of the model seek to integrate DesInventar databases – which contain much more granular loss data on many more events. These databases are maintained by each participating country, with the ability to apply the methodology for the database as each country sees fit. Since some countries report more detailed figures, and/or utilise lower thresholds than others, developing comparisons between countries is very challenging.

33. See: http://www.preventionweb.net/english/professional/publications/v.php?id=7817&utm_source=pw_search&utm_medium=search&utm_campaign=-search

34. See: http://www.preventionweb.net/english/hyogo/gar/2013/en/home/index.html

35. See: http://ipcc-wg2.gov/SREX/

36. See: http://www.unisdr.org/2005/wcdr/intergover/official-doc/L-docs/Hyogo-framework-for-action-english.pdf

About IDMC

The Internal Displacement Monitoring Centre (IDMC) is a world leader in the monitoring and analysis of the causes, effects and responses to internal displacement. For the millions worldwide forced to flee within their own country as a consequence of conflict, generalised violence, human rights violations, and natural hazards, IDMC advocates for better responses to internally displaced people, while promoting respect for their human rights.

IDMC is part of the Norwegian Refugee Council (NRC).

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