

IN THE EYE OF THE STORM
REFLECTIONS FROM THE SECOND
PACIFIC CLIMATE CHANGE CONFERENCE



EDITED BY **ALBERTO COSTI** AND **JAMES RENWICK**

FOREWORD BY
HON LUAMANUVAO DAME **WINNIE LABAN** AND LEOTA **KOSI LATU**

FEATURING THE OPENING ADDRESS BY
HONOURABLE PRIME MINISTER OF SAMOA TUILAEPA DR **SAILELE MALIELEGAOI**

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Foreword by

Hon Luamanuvao Dame Winnie Laban and Leota Kosi Latu

Featuring the Opening Address by

Honourable Prime Minister of Samoa Tuilaepa Dr Sailele Malielegaoi

SPREP, Te Herenga Waka—Victoria University of Wellington and NZACL

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NOTES ON THE CONTRIBUTORS

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Alberto Costi is a Professor of Law at Te Herenga Waka—Victoria University of Wellington. He has published extensively in international law. Recent publications include the general editorship of the first ever textbook on international law from a New Zealand angle (*Public International Law: A New Zealand Perspective* (LexisNexis, 2020)). Alberto is a Co-Director of the New Zealand Centre of International Economic Law, the President of the New Zealand Association for Comparative Law and the Secretary-General of the International Law Association New Zealand Branch, and sits on various editorial committees and scientific associations in New Zealand and overseas, including the *Asia Pacific Journal of International Humanitarian Law* and the *Comparative Law Journal of the Pacific*. Alberto currently works on a monograph (funded by the New Zealand Law Foundation) examining whether the rise in sea level and related climate change events may impose obligations on neighbouring states to assist Pacific Island nations in retaining rights and duties under international law, or in ensuring the protection of their populations.

James Renwick

Professor James Renwick is Head of the School of Geography, Environment and Earth Sciences at Te Herenga Waka—Victoria University of Wellington. He is a climate researcher with a background in atmospheric science and statistics. His main areas of interest are atmospheric teleconnections between the tropics and the higher latitudes of the Southern Hemisphere, the mid-latitude westerly circulation, and the effects of climate change on New Zealand and Antarctica. James has served as an author of the Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC) for the past twenty years and is currently a co-chair of the World Climate Research Programme Project on Climate and Cryosphere. He is involved in a lot of public speaking and media interactions and was awarded the 2018 Prime Minister's Prize for Science Communication. James was also a member of the "Melting Ice and Rising Seas" team awarded the 2019 Prime Minister's Science Prize.

Contributors

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Dr Patila Amosa is the Dean, Faculty of Science at the National University of Samoa. She holds an MSc (Environmental Science) and PhD (Chemistry) from the University of Otago, New Zealand. Her research interests include physico-chemical and microbial assessment of water resources, climate change impacts, ocean acidification and science education. She facilitates faculty research development and is a key member in international collaborative projects such as Edulink, PACENet plus, Samoa Knowledge Society Initiative: Open Access Research and the UNITWIN Project for water quality research. Patila is a member of the University Council and represents the University in national environment committees. She teaches postgraduate courses in Climate Change and Disaster

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Paul Blaschke

Dr Paul Blaschke is an independent environmental consultant and Honorary Fellow at Te Herenga Waka—Victoria University of Wellington and University of Otago, Wellington. With a background in landscape ecology and environmental policy work, Paul has recently been most active in applied urban ecology, particularly work on urban green spaces and urban nature-based adaptation to climate change. He has professional experience in many New Zealand regions and Pacific Island nations.

Nicola Gaston

Nicola Gaston is Co-Director of the MacDiarmid Institute and an Associate Professor of Physics at the University of Auckland. She is interested in understanding the development and variation of physical properties in materials as a function of size, from clusters of a few atoms, to large nanoparticles and bulk materials. Her current research is focused on understanding the relationship between electronic structure and properties such as catalytic activity, chemical reactivity, conductivity and thermodynamic stability, and how this relates to the underlying structure (size, shape, composition) of the material.

Tim Grafton

Tim Grafton is the Chief Executive of the Insurance Council of New Zealand (ICNZ). He has extensive experience in providing strategic, policy and communications advice to public and private sector leaders. He was an executive director of a leading market research company prior to taking up his position with ICNZ. Tim has a strong understanding of the machinery of government, having been an adviser to former Prime Ministers and Ministers of Finance as well as leading private companies. He has extensive knowledge of post-disaster recovery issues and insurance regulation. He is a Chartered Member of the Institute of Directors and holds several governance roles. He is on the Executive Committee of the Global Federation of Insurance Associations, chairs the Code Compliance Committee of the Fair Insurance Code, chairs the Representative Users Group of the Deep South Science Challenge which focuses on research to adapt to climate change, and is on the New Zealand Advisory Board of the Australian and New Zealand Institute of Insurance and Finance and the Advisory Board of Te Herenga Waka—Victoria University of Wellington's Chair in the Economics of Disaster.

Justin Hodgkiss

Justin Hodgkiss is Co-Director of the MacDiarmid Institute and a Professor in Physical Chemistry at Te Herenga Waka—Victoria University of Wellington. His research group has pioneered ways of manipulating laser pulses to understand, for example, how solar photovoltaic cells convert light into electricity, or how the skin pigment melanin protects us from UV light – processes which occur on picosecond timescales or faster. Justin is a founding inventor of early stage biosensor startup, AuramerBio Ltd, which is now commercialising laser instrumentation that his group invented. Justin completed his undergraduate studies at the University of Otago, before undertaking his PhD at MIT

in the United States of America, postdoctoral research in Cambridge, and returning to New Zealand in 2009.

John Howell

Since retiring from Parish Ministry seven years ago, John Howell focuses on writing poetry and the ethics of Climate Change. He was a joint contributor to a paper at the Second Pacific Climate Change Conference. He has authored two books of prayers: *Sighs Too Deep for Words: Prayers and images from Taupo* (St Paul's Union Church, Taupo, 2007) and *Longings for the Eternal – Prayers for spirit, community and sustainability* (St Paul's Union Church, Taupo, 2009). A book of poems, *Homeless*, was published in 2017 by Makaro Press. From 1975-85, John was a member of the Environmental Council, a 15-member body advising the Minister for the Environment in the New Zealand government. He edited the book *Environment and Ethics – A New Zealand Contribution* published by the Centre for Resource Management, Lincoln College and the University of Canterbury.

Judy Lawrence

Dr Judy Lawrence is Senior Research Fellow at the New Zealand Climate Change Research Institute, Te Herenga Waka—Victoria University of Wellington and Director of PS Consulting Ltd. Judy contributes to climate change policy and practice in New Zealand and internationally, pioneering the development and use of decision tools for addressing climate uncertainty and change. Her current research focuses on adaptation decision making for sea level rise. Judy co-authored the *Coastal Hazards and Climate Change: Guidance for Local Government* (2017), is currently a Coordinating Lead Author for the Intergovernmental Panel on Climate Change Sixth Assessment, a New Zealand Climate Change Commissioner and a recipient of the 2019 Prime Minister's Science Prize.

Adrian Macey

Adrian Macey is an Adjunct Professor, New Zealand Climate Change Research Institute (School of Geography, Environment and Earth Sciences) and a Senior Associate of the Institute for Governance and Policy Studies at Te Herenga Waka—Victoria University of Wellington. He is also a Fellow of the Institute of Advanced Studies, Nantes (France). He previously served in various positions in the New Zealand Ministry of Foreign Affairs and Trade, including Chief Trade Negotiator, Ambassador to France, and as New Zealand's first climate change ambassador. He was Vice-Chair, then Chair of the United Nations Framework Convention on Climate Change Kyoto Protocol negotiations in 2010-2011. Adrian's research interests include climate change policy, the science-policy connections, international governance, and trade.

Jamie Morton

Jamie Morton is the *New Zealand Herald's* science reporter. He has been a newspaper journalist for more than 15 years – most of which he has been covering science and environment issues for New Zealand's largest circulating daily newspaper. Over that time, Jamie has travelled to international disaster zones, the landmark 2015 UN COP21 Climate Change Conference in Paris and twice to Antarctica. Jamie has won several major media awards for science and environment reporting, and for coverage of natural hazards.

Geoffrey Palmer

Sir Geoffrey Palmer QC was a law professor in the United States and New Zealand before entering New Zealand politics as the MP for Christchurch Central in 1979. In Parliament, he held the offices of Attorney-General, Minister of Justice, Leader of the House, Minister for the Environment, Deputy Prime Minister and Prime Minister. Sir Geoffrey is a Distinguished Fellow of the New Zealand Centre for Public Law and the Faculty of Law at Te Herenga Waka—Victoria University of Wellington. He has an extensive list of publications in legal periodicals and is the author or co-author of over a dozen books.

Shenuka de Sylva

Shenuka de Sylva is an academic at the School of Architecture, Te Herenga Waka—Victoria University of Wellington, an architect and urban designer. Her research and design interests are on resilience and water, and on identifying adaptation opportunities to the effects of climate change, sea level rise and floods. She studies the compatibility of traditional, indigenous, vernacular and modern systems and solutions to environmental hazards, to culture and context. Of particular interest is the psychology of adaptation. She has professional experience in south and east Asia, New Zealand, several small island nations of the Pacific and some regions of Europe's North Sea coast.

Shane Telfer

Shane Telfer leads a team of researchers who make contributions to the design, synthesis and applications of functional materials. His research encompasses synthetic chemistry, X-ray crystallography, catalysis and gas adsorption. The cornerstone of this research is the chemistry of metal-organic frameworks (MOFs), crystalline sponge-like materials that have applications arising from their porosity and structural diversity. This is a deeply collaborative research area, which benefits from partnerships with a diverse range of local and international scientists.

Celia Wade-Brown

Celia Wade-Brown QSO was Mayor of Wellington from 2010-2016 and previously an elected Councillor, a teacher and IT analyst. Mayor Wade-Brown's vision of a smart, green capital increased the biodiversity budget, signed off the Predator Free Wellington programme and challenged the primacy of cars in the city. After standing down as Mayor, Celia has been appointed to Biophilic Cities Network Advisory Board, Walk21 Foundation, Living Streets Aotearoa, Te Araroa Trust, Walking Access Commission, Commonwealth Foundation and Predator Free Wellington. She is currently Biodiversity Manager at Duntulm Carbon Farm and a candidate for the Green Party.

Christopher Wright

Christopher Wright is Professor of Organisational Studies at the University of Sydney Business School, where he teaches and researches organisational change, management innovation, sustainability and critical understandings of capitalism and political economy. His current research explores organisational and societal responses to climate change, with a particular focus on how managers and business organisations interpret and respond to the climate crisis. He has published on this topic in relation to issues of corporate environmentalism, corporate citizenship, organisational

justification and compromise, risk, identity and future imaginings. His research on climate change and business is internationally recognised and he has developed research collaborations with leading international climate scientists and global environmental organisations. He is a key researcher at the Sydney Environment Institute, where he heads up a group examining corporate climate transition. His research has appeared in a broad range of leading journals and in addition to numerous chapters in edited collections, he is the author of several monographs, including *Climate Change, Capitalism and Corporations: Processes of Creative Self-destruction* (Cambridge University Press, 2015).

FOREWORD

Kia Ora, Ni Sa Bula Vinaka, Fakaalofa Lahi Atu, Kia Orana, Mauri, Ia Orana, Taloha Ni, Mālō e Lelei, Fakatalofa atu, Kam na mauri, Kaselehlie, Halo Olgeta, Noa'ia, Aloha mai e, Talofa lava and Warm Pacific Greetings.

Thirty years ago, concerns about climate change were only nascent. Yet, the impacts of rising sea levels in the Pacific region were already visible. Saltwater was seeping into the "pulaka" (taro) pits where the staple food was grown and into the freshwater wells. Seawalls were being constructed to reduce erosion. Bikenibea Paeniu, then Prime Minister of Tuvalu, told of the challenges he faced and the disbelief he encountered when raising the issues of climate change and rising sea level with the President of the United States of America, at the United Nations and in other international fora.

Thirty years on, the science of anthropomorphic climate change is well established, the impacts are clear, and the solutions generally accepted, though some are still in denial. The voices of small island states have been listened to at the United Nations and the Paris Agreement, within the United Nations Framework Convention on Climate Change, was adopted in 2015 and signed in 2016. The central aim of the Agreement is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below two degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

The growth in understanding of the causes and impact of climate change has come from the work of a wide range of scientists, activists, politicians, academics and concerned citizens. Governments, regional and international institutions, indigenous communities, universities and other civil society actors, including faith-based organisations, have sponsored meetings, conferences and publications dealing with the causes of greenhouse gas emissions and strategies for mitigation and adaptation.

In the region, the Secretariat of the Pacific Regional Environment Programme (SPREP) with Te Herenga Waka—Victoria University of Wellington and other partners have led a series of conferences on climate change with a Pacific Island focus.

This publication, *In the Eye of the Storm – Reflections from the Second Climate Change Conference*, edited by Professors Alberto Costi and James Renwick, is the product of our second biennial Pacific Climate Change Conference held in Wellington in 2018. A diverse range of experts have addressed the current state of the Pacific, researching and writing chapters on: the physical science of climate change; impacts and adaptation; mitigation techniques; politics and security; international cooperation; domestic and international legal issues; economics and business; communication through the arts and media; and matters of faith and spirituality. We trust you will find the content presented here interesting, informative and a spur to action.

The theme for our third biennial conference is "Blue Pacific, Climate Action for Climate Resilience". It is organised jointly by National University of Samoa, SPREP and Te Herenga Waka—Victoria University of Wellington and will be held online from 27 to 30 October 2020. The conference will explore the science, the impacts, the solutions and the enablers and expand the Pacific

conversation on how island countries are responding to the challenges of the Paris Agreement and the impacts of climate change felt by people in the Pacific.

Ia manuia.

Hon Luamanuvao Dame Winnie Laban, DNZM
Associate Professor and Assistant Vice-Chancellor (Pasifika)
Te Herenga Waka—Victoria University of Wellington

Leota Kosi Latu
Director-General
SPREP

*Wellington and Apia
15 October 2020*

WELCOMING REMARKS
SECOND PACIFIC CLIMATE CHANGE CONFERENCE
TE HERENGA WAKA—VICTORIA UNIVERSITY OF WELLINGTON

*Professor Grant Guilford, Vice-Chancellor
Te Herenga Waka—Victoria University of Wellington*

Tena koutou, talofa lava, and warm Pacific greetings to you all. It is my great privilege to welcome you here on behalf of Te Herenga Waka—Victoria University of Wellington.

Two years ago, I was standing in front of a similar crowd at the very first Pacific Climate Change Conference, hosted by this University. At that time, I referred to the breath-taking ignorance, complacency and self-interest that surrounded the twin global challenges of climate change and ocean acidification.

Two years on, much has changed. The Paris Agreement has been signed – signifying the commitment of world leaders to address climate change. This new found resolve of world leaders was tested a little over one year later when President Donald Trump announced his intention to withdraw the United States of America from the Paris Agreement. Yet, world leaders showed the foresight, intelligence and moral courage to remain committed to the Paris Agreement. And of course – here in New Zealand – a new government has been swept to power on the back of our nation's concerns about inequality and environmental degradation and we find ourselves with the previously unthinkable – a Minister for Climate Change, who not only understands the gravity of the issue, but also has a mandate to act.

Yet time is no longer on our side.

The consequences to life as we know it are grave and will be irreversibly set in motion unless we rapidly decarbonize the world's energy supply.

And, of course, as you are all aware, the people of the Pacific are on the frontline of climate change. At our first biennial Pacific Climate Change Conference in 2016, the then President of Kiribati, Anote Tong, described the desperation he felt in seeing the Kiribati people threatened by having their low-lying island nation lost to rising sea levels. This is not just the loss of land, but their livelihood and identity as a culture.

He spoke of his first-hand experience watching extreme high tides and more severe storms damage homes, erode the coastline and destroy vital food crops.

He spoke of his sense of urgency – urgency which we all must feel if we are to head off the looming catastrophe that faces us and our fellow travellers over evolutionary time with which we share our one and only precious planet.

So thank you for being here.

It is heartening to see so many leaders and dignitaries in attendance. I would like to personally acknowledge our opening keynote speaker, the distinguished Prime Minister of Samoa and Chair of the Pacific Islands Forum, the Honourable Tuilaepa Dr Sailele Malielegaoi, who has long been an advocate of climate change action. Thank you to mana whenua Te Ati Awa for welcoming us here today. As well as Cardinal John Dew; the Minister for Climate Change, the Honourable James Shaw; the Wellington Mayor Justin Lester; the Minister of Pacific Peoples, the Honourable Aupito William Sio; and former Governor-General Sir Anand Satyanand. We also welcome Members of the Diplomatic Corps, our speakers – in particular, our international speakers who have travelled so far to be with us – and of course all our conference delegates, including those representing 13 Pacific Island nations.

This conference is jointly hosted by SPREP – the Secretariat of the Pacific Regional Environment Programme, based in Samoa. So before I close, I would like to offer my thanks to SPREP Director-General, Kosi Latu, who has worked closely with Professor James Renwick, Associate Professor Luamanuvao Winnie Laban and Dr Pala Molisa from Te Herenga Waka—Victoria University of Wellington to organise this conference.

Thank you again – and please enjoy the discussion and debate ... and the exchange of knowledge and differing world views that the next three days will offer you.

Ngā mihi and all the best.

*Museum Te Papa Tongarewa
Wellington
21 February 2018*

OPENING ADDRESS
SECOND PACIFIC CLIMATE CHANGE CONFERENCE
TE HERENGA WAKA—VICTORIA UNIVERSITY OF WELLINGTON

Honourable Tuilaepa Dr Sailele Malielegaoi, Prime Minister of Samoa

Excellencies, Distinguished Participants, Ladies and Gentlemen,

I am honoured to be invited to provide the opening address for this Conference under the auspices of Te Herenga Waka—Victoria University of Wellington and the Secretariat of the Pacific Regional Environment Programme (SPREP). I note that the focus is on issues related to climate change and the Pacific Ocean, as they affect our region. And so, I will share the Government of Samoa's responses, in line with our commitment to the Paris Agreement to mitigate and adapt to climate change, particularly through the increased use of renewable energy and reduction in our dependence on fossil fuels; as well as the Call for Action on Oceans through voluntary commitments and the Sustainable Development Goals (SDGs) for both SDG13 and SDG14, under Agenda 2030.

Climate change is a reality that we in the Pacific Island Countries are facing every day. It is certainly a global reality even for developed countries such as New Zealand, with increasing incidents of extreme weather events in 2017, and the flash flooding in Auckland in January 2018. In February 2018, Tropical Cyclone Gita in the course of three days, wreaked havoc on four countries in the region, bringing with it record rainfall and unprecedented flooding. Fortunately, there was minimal loss of life. Notable was the rapid speed with which it passed through Samoa initially as a Category 2 cyclone, though still leaving a significant trail of damage through flooding as well as massive landslides never seen before. Cyclone Gita was not as kind to our neighbours, Tonga and the southern group of the Fiji islands, as it gained strength in its circuitous path. With the climatic changes we are experiencing, it is not surprising to find Cyclone Gita over New Zealand, unexhausted.

For Pacific Island Countries, climate change is an existential threat. Low-lying atolls are only a couple of metres above sea level. Predictions from the scientific community put these under water by the end of 2100, if ambitious efforts at emission reductions are not made and innovative solutions to adapt to sea level rise are not realised. The displacement of people will be a norm aggravated by more severe natural disasters. The reality of climate change and increased severity of disasters mean many communities are at risk of losing traditional homelands as tides wash away the shoreline; sea levels continue to rise; and inland communities experience landslides, leaving communities devoid of safer and more disaster resilient land. Added to that, are the challenges of relocation.

Pacific Island Countries need emission reduction targets consistent with "1.5 degree Celsius" of global warming to safeguard our people's well-being and livelihood. Unfortunately, our countries are already experiencing more intense and frequent disasters, higher storm surges, changes in rainfall and weather patterns, the prospect of ocean acidification, all of which will impact on food and water security and our people's livelihoods and well-being. There is a prospect for a region where less land

and diminishing opportunities will create unsustainable economies and create uncertainty and hardship for thousands and thousands of its communities.

The situation includes higher island countries like Samoa, where we would face challenges given that almost our entire infrastructure is located on the coastline, as well as most of our population. Therefore, timely and simplified access to international climate change and disaster risk finance is a priority if we are to adapt to, and mitigate, climate change.

In 2015, the Pacific Island Countries, being the frontline states in the fight against climate change, were instrumental in concluding one of the toughest ever global negotiations for the Paris Agreement. Collectively, the Pacific Leaders and their delegations doggedly pursued our region's priorities until we were able to make the world see climate change through our eyes, as the most vulnerable communities to climate change impacts.

Entry into force of the Paris Agreement in November 2016 set the world on an ambitious and critical path towards resilient and low carbon development. Climate action contributes directly to SDG13 and addresses other SDGs such as SDG14. For small island developing states, the implementation of the SAMOA Pathway 2014 represents an integrated approach to meeting commitments to the Paris Agreement and the 2030 Agenda and SDGs.

Reflecting the region's commitment to the Paris Agreement, Pacific Islands Forum Leaders in 2016 endorsed the Framework for Resilient Development in the Pacific. It is a global first where the Pacific region seeks to prevent and reduce its exposure to risk from climate change and natural hazards risk; achieve low carbon development; and improve disaster preparedness, response, recovery and reconstruction.

In June 2017, the Pacific Leaders again rallied to support and influence the outcomes of the inaugural United Nations Oceans Conference, which was co-chaired by Fiji and Sweden. Similarly, Leaders also committed their support to Fiji's Presidency of the 23rd Conference of the Parties to the United Nations Framework Convention on Climate Change (COP23), held in November 2017 in Bonn, Germany. A key focus was on the close links between Ocean and Climate and the need for oceans to become an integral part of the continuing climate change agenda. Pacific Leaders thence launched the Oceans Pathway at COP23 that seeks to address and strengthen actions related to the ocean-climate nexus.

The World's oceans definitely play a key role in regulating the climate and they buffer among many things the damaging effects of climate change. Ocean research should, therefore, be at the heart of the global response to climate change. There are also very practical steps we can take to protect our oceans and coastal ecosystems. For example, we can reduce other local stressors such as destructive fishing and reduce land-based sources of pollution. We must see mangroves and wetlands as our carbon allies, as they take up carbon dioxide and store it in their biomass and soils. So let us agree today to put a stop to the increasing destruction of coastal wetlands. For when we make the right choices to support our ecosystems, we invariably create positive growth for our Ocean, our health, and our industries.

Politically, it is extremely important that the momentum built in Paris be maintained. Keeping global temperature increases below 1.5 degrees Celsius is not a choice, but an absolute necessity. Yet, the most recent analysis suggests the collective Nationally Determined Contributions (NDCs) are leading us towards a world that by 2100, will be hotter by three to four degrees Celsius.

This shows that climate change is something that we are completely unable to tackle on our own, by ourselves. We recognise that all countries must determine their level of commitment through their NDCs. At the same time, we all have a role to play in seeking the greatest level of ambition from all Parties to the Paris Agreement. We understand that there are challenges for all countries, but through cooperation in good faith we can overcome these. But promises are not enough, now is the time for action and we must all act now.

The need to work together on key challenges facing the Pacific region is emphasised in the Pacific Islands Forum Leaders' endorsement of the "Blue Pacific" identity. The Blue Pacific identity reinforces the potential of shared ownership of the Pacific Ocean and reaffirms the connection of Pacific peoples with their natural resources, environment and livelihoods. Therefore, securing the well-being and potential of the Blue Pacific is at the centre of the Forum agenda.

At the top of its sustainable development priorities, are climate change and resilience, as well as fisheries. Among the security priorities for the region are: human security, prioritising environmental security and building resilience to climate change and natural disasters, as well as environment contamination, including impacts on the health of our Ocean and seas that we recognise as our main means and source of our livelihoods and well-being. To successfully meet the challenge of securing the well-being and potential of the Blue Pacific requires that we maintain a strong and collective voice, a regional position and action, and a common foreign policy on priority issues vital to our development as one Blue Pacific continent.

Though the Pacific Islands, as a group, may be the planet's most vulnerable nations to the effects of climate change, this has not detracted the attention of the Leaders from moving forward with plans aimed at adapting and creating greater resilience to climate change and also from natural hazards. This was showcased with the Forum Leaders' endorsement of the governance arrangements for the Pacific Resilience Partnership in 2017 in Apia, to support the implementation of the Framework for Resilient Development in the Pacific. Following COP 21, state parties announced NDCs post-2020 and we in Samoa, like our friends and neighbours across the region, are taking decisive action, as exemplified below.

Samoa has demonstrated significant commitment to addressing climate change, both in adapting to its impacts and mitigating – or reducing – greenhouse gas emissions that contribute to global warming by establishing a target of generating 100 per cent of its electricity from renewable energy sources and then to maintain this 100 per cent contribution through to 2025, in anticipation of the increasing electricity demand. Renewable energy options operational in Samoa through government include a wind farm, nine mini hydro schemes, and five solar power plants which are supplemented by four solar private partnerships. To date, renewable energy penetration is 81 per cent of the total generation capacity. Our target capability for solar power is 28 kilowatt hours. While we are only at

the 50 per cent mark, I wish to note that over weekends we are able to achieve 100 per cent generation from solar power.

Similarly, at the United Nations Oceans Conference, Samoa submitted 13 voluntary contributions – and I share with you brief outlines of a few of these, as follows.

The Sa Moana Folauga is a voyage to build capacity and awareness on environment and natural resource management and to revive our voyaging heritage in communities in Samoa. This is to ensure communities are better ocean stewards through establishing marine protected areas and sustainable use of marine resources as well as switching to renewable energy alternatives to reduce carbon emissions.

Samoa was one of the first Pacific Island Countries to declare its waters a sanctuary for sharks, whales, dolphins and turtles in 2003. These highly migratory charismatic species form an important part of our heritage and biodiversity, however, as you all know, these species are increasingly becoming threatened. The Aleipata and Safata Districts are important marine protected areas of Samoa.

Scientific research, monitoring and education programmes were created to promote public awareness and to foster a marine ethic of conservation and stewardship.

Support for the marine protected areas are provided through the National Ocean & Marine Committee (NOMC) which oversees our Ocean and marine development activities and help to ensure a better understanding of the costs and benefits of national marine protected areas and the Marine Sanctuary.

The significance of oceanic fisheries to the Pacific Island Countries is manifested not only in economic growth, but also in the food security of their populations. License fees for distant-water fishing nations contribute up to 40 per cent of government revenue for seven Pacific Island Countries. The effects of climate change on tuna are that it determines where national and foreign fishing fleets will have to go, as well as who will receive the total license fees from the distant-water fishing nations. Projected changes in the tropical Pacific Ocean are likely in the future, which means that tuna spawning grounds will be affected and that tuna movements will likely occur towards the eastern Pacific. This is already evident during El Niño Southern Oscillation events.

Some adaptation measures in place include good fish management practices such as maintaining fish stocks at healthy levels.

Samoa has enacted legislation that prohibits the use of destructive fishing methods, including explosives, some traditional fishing methods and driftnet fishing activities in Samoa's waters. This will ensure the preservation of marine habitats to support the population and recruitment of fisheries resources.

Similarly, coastal fisheries will also be affected by climate change. Impacts will likely result in the reduction of availability of food and livelihood opportunities for coastal communities due to the losses of coral reef, mangrove, seagrass and other intertidal habitats that provide food and shelter for coastal fish and shellfish.

Some of the adaptation measures put in place by Samoa include the restoration of vegetation in catchments and care for coastal fish habitats.

Samoa is looking more to enhancing management of its fisheries through improved scientific information and knowledge. The objective is to increase knowledge on stock status of highly migratory fish stocks in the western and central Pacific Ocean for sound management decisions.

In that connection, Samoa works with the Secretariat of the Pacific Community (SPC) in extracting biological samples from tuna species harvested by fishing vessels operating in Samoa's exclusive economic zone for analysis by SPC's Oceanic Fisheries Programme. The results will increase knowledge on the movement of tuna species in the western and central Pacific Ocean and will help us understand further biological characteristics of tuna species that are very important for stock assessment work. It will also help countries make informed decisions so as not to risk breaching their limit reference points.

Additionally, Samoa has implemented measures to minimize the accidental catch of non-targeted species in its commercial fishery, so it would have a minimal impact on the wider ecosystem. This includes measures such as the use of circle hooks for the longline fishery to minimize incidental catches of sea turtles and the use of devices to aid in the live release of sea turtles when accidentally caught.

We are committed to ensure that mangroves, as important marine ecosystems which provide social, economic and cultural benefits for many Pacific Island communities, coastal protection and ocean biodiversity, are protected and conserved.

Mangroves are recognised as flagship ecosystems for livelihoods, climate change adaptation and biodiversity. However, they are threatened from over-harvesting, removal in favour of other developments, pollution, use as wastelands, natural phenomena and other activities.

Awareness, capacity building, research, legislation and the establishment of mangrove marine protected areas inside communities will ensure that mangroves can be rehabilitated and protected for climate change adaptation, livelihoods and biodiversity.

On waste management, the Government of Samoa has enacted the Waste Management Act 2010 as well as the Plastic Bag Prohibition on Importation Regulations 2013 that provide a formal legal framework for the management of waste.

By doing so, Samoa commits to keep its waters clean and healthy from land-based pollution via river and coastal ecosystems. Given that around 80 per cent of marine debris is from land-based sources – and that marine litter is a key environmental challenge for Samoa with around 70 per cent of all litter in Samoa's urban coastal waters comprising plastics (such as packages, containers, bottles and nappies) and most of these being single-use items – cumulatively, they present an enormous threat to Samoa's marine wildlife.

A pilot project is continuing, which offers an opportunity to highlight the issue of marine debris as well as to demonstrate best practice measures for effective waste management, and minimization

of marine debris via the use of marine litter booms and development of waste management infrastructure.

The Samoa Ocean Health Network Initiative provides coordination for oceans and marine work involving all stakeholders to share information and advance Samoa's work on ocean conservation and the sustainable management of ocean resources. The Initiative connects the country mechanism to the regional Pacific Ocean Alliance, under the Forum Leaders' endorsed Framework for a Pacific Oceanscape that considers the sustainable development, management and conservation of the Pacific Ocean and its resources and requires regular reports to Forum Leaders.

Ladies and gentlemen,

As small island developing states and being the most vulnerable countries to the effects of climate change whether from sea level rise, ocean acidification, coral bleaching, overfishing and marine pollution, our voices and interests should be the basis for global action.

As we strive to address the impacts of climate change, we must at the same time ensure that we invest in the livelihoods of our people. Such challenges and our diversity should be our strength to assist each other in learning from each other's experiences, and best practices. It is in this same spirit of collaboration to address similar challenges that Samoa signed up to the Marine Arctic Peace Sanctuary Treaty in November 2017 that will ensure preserving the unique arctic flora and fauna and thus helping to slow down climate change at this critical time. Pacific Island Countries face numerous challenges with sustainable development. We are small in size and population. We have small markets and limited trade. We are remote and our resource bases are limited. Yet, we have so much to be proud of. Pacific Island Countries have made significant steps forward, and despite our challenges, our economies are growing. We are implementing innovative adaptation measures against climate change impacts. We made considerable progress in moving our economies towards renewable energy, despite being responsible for a tiny proportion of greenhouse gas emissions. COP23 and the United Nations Conference on Oceans demonstrated the importance of the collective support of the Pacific towards the implementation of the Paris Agreement and Call for Action.

But all of our efforts will be meaningless unless there is a concerted and more ambitious effort by all countries to reduce emissions and scale up financial support for adaptation in the most vulnerable countries.

Such a future for our generations to come is avoidable – but by building on the strengths of collective collaboration of the Blue Pacific identity that we have embraced, our smallness will have an expanded outreach, and our collective voice will soar above the roar of the angry tides. The recognition of our "earth without borders" resonates with the need for a global outlook, international cooperation and solidarity, and a shared strategy, to address the challenges we face. After all, as the Honourable Prime Minister of Tuvalu always ardently advocates – "Save Tuvalu and you will save the world".

*Museum Te Papa Tongarewa
Wellington
21 February 2018*

1

THE THREAT OF CLIMATE CHANGE TO THE PACIFIC REGION:
PROBLEMS, SOLUTIONS AND PROSPECTS

*Alberto Costi and James Renwick**

1.1 In the eye of the storm

This volume is a record of the Second Pacific Climate Change Conference hosted by Te Herenga Waka—Victoria University of Wellington and the Secretariat of the Pacific Regional Environment Programme (SPREP) at the Museum of New Zealand Te Papa Tongarewa in Wellington on 21-23 February 2018. One of the main strengths of the conference series is that it brings together perspectives from across all sectors of society, from science to policy; engages community activism; and highlights the role of the arts and of faith communities. Hence, this book is a collection of disparate voices, representing the diverse participants to the conference.

There is a wide range of styles and substantive content, but there is a strong common theme: climate change affects us all, and a successful response involves all sectors of society. To adapt to changes that are already under way, a concerted effort is required to protect communities from changing hazards associated with sea level rise, increasing extremes of rainfall, more violent cyclones, and the inevitable impacts on food and water security. To bring climate change to a halt, the whole of the global community must reduce emissions of greenhouse gases to zero as soon as possible, ideally by 2050.¹

The risks and the challenges of climate change are huge, and no more so than across the Pacific. This book is titled "In the Eye of the Storm" because the Pacific, especially the western Pacific, is at the front lines of the changing climate; the title also pays tribute to the theme of the inaugural Pacific Climate Change Conference held in Wellington in 2016. Sea level rise is higher than the global average, rainfall variability is set to increase dramatically, the tropical cyclone season is lengthening and the most powerful storms are becoming more frequent. Many communities live on low-lying clusters of islands, especially prone to the effects of sea level rise. While Pacific nations have done very little to cause the climate change problem, they are very much at the forefront of suffering the consequences.

* Book editors.

1 Nicolas Stern "We must reduce greenhouse gas emissions to net zero or face more floods" *The Guardian* (online ed, 8 October 2018) <<https://www.theguardian.com/environment/2018/oct/08/we-must-reduce-greenhouse-gas-emissions-to-net-zero-or-face-more-floods>>.

After having briefly raised some of the key issues facing the region, we introduce below the core chapters in this book, before concluding with some prospects about the efforts of the Pacific region to tackle climate change.

1.2 Ongoing problems

The foreword to the book, written jointly by Hon Luamanuvao Dame Winnie Laban and Leota Kosi Latu, points out that the problem is not new. Yet, for a long time, climate change failed to gain traction with those states most responsible for greenhouse gas emissions, as illustrated by the many difficulties with the implementation of the Kyoto Protocol,² despite the fact that already in 1988, the World Meteorological Organization was devoting resources to the issue.³

Moving forward three decades to the Second Pacific Climate Change Conference, the welcoming remarks by the Vice-Chancellor of Te Herenga Waka—Victoria University of Wellington, Professor Grant Guilford, reminded us that by 2018, climate change had grown into a central concern of the international community, even more so in the Pacific region. Resilience building has gained resonance throughout the region as a call for Pacific Islands to control their destiny by staking their claims to their existing maritime zones and embarking on large and small adaptation projects, thus ensuring that they will continue to prosper in their ancestral lands and harvest the goods from the sea and soil of the place to which they belong.

Although there might sometimes be differences of views among them, the fight against climate change unites Pacific peoples. The Prime Minister of Samoa, Honourable Tuilaepa Dr Sailele Malielegaoi, in his opening address, canvasses the role of regional organisations in tackling climate change and highlights some of the initiatives at the national level in Samoa to illustrate the leading role governments must play in tackling this multifaceted problem. Equally, he informs us about the work of regional organisations such as the Pacific Islands Forum, the Secretariat of the Pacific Community and SPREP in building home-grown capacity for tackling environmental challenges.

Besides state-led programmes and policies, we must not forget the role played by non-governmental organisations and other civil society actors. Whether they be part of global networks or emerging from grassroots movements, it is often through their hard work that innovative solutions may be found to address climate change while governments argue and timidly iron out their differences in order to reverse current trends. No doubt more efforts are needed to find sustainable solutions.

2 Kyoto Protocol to the United Nations Framework Convention on Climate Change 2303 UNTS 162 (opened for signature 16 March 1998, entered into force 16 February 2005).

3 Intergovernmental Panel on Climate Change *Report of the First Session of the WMO/UNEP Intergovernmental Panel on Climate Change GE (IPCC) (World Meteorological Organization, Geneva, 9 - 11 November 1988 IPCC-1)* (World Meteorological Organization, 1988). Only four years later was adopted the United Nations Framework Convention on Climate Change 1771 UNTS 107 (opened for signature 4 June 1992, entered into force 21 March 1994).

The chapters in this volume detail the effects of climate change. These are felt not only through extreme weather events and sea level rise, but also in terms of growing pressure on limited resources, increased displacement within and across borders. Addressing these effects necessitates legal measures and enlightened policies, bold initiatives, from the local to the global and from the global to the local. The timid steps taken at the international level to successfully work out mitigation goals and the equally tepid efforts at long-term adaptation strategies are in part the result of the international community producing environmental agreements with weak legal obligations, too often wrapped in aspirational goals without sufficiently strict deadlines, despite the fact that the clock is ticking.

1.3 Some suggested solutions

This book covers many of the important topics around the most pressing of issues that is addressing climate change and its effects. All the contributors have one aim – to present the problem, highlight possible ways forward, and ensure we prevent rather than wait. The book is divided into three informal clusters.

First, a number of contributors cover the science of climate change and the current state of the climate across the Pacific, while others look at adaptation responses. Chapter 2 sets the scene by outlining the current climate of the southwest tropical Pacific, and how it is likely to change through the rest of the 21st century. It is a scientific account of the concrete impacts of global warming on our oceans and its consequences, the rise in sea levels, the precipitation of extreme weather events and the recurrence of droughts as well as its impact on marine life, thus challenging the nations of the Pacific. Needless to say, this chapter testifies to the lack of success of mitigation strategies so far.

As mitigation has failed to materialise, even as a stop-gap against climate change, the focus has shifted towards adaptation strategies, very much strengthened by the adaptation mechanisms adopted in Paris in 2015.⁴ For Dr Judy Lawrence, Celia Wade-Brown QSO, Shenuka de Sylva and Dr Paul Blaschke, the authors of Chapter 3, there are several examples of innovative and integrated adaptations, but they require the involvement of communities to succeed. Although they acknowledge the fact that Pacific nations have been able to adapt in the past, their current predicaments require solutions that too often are challenged by governance, institutional and financial constraints and barriers. Through examples taken from New Zealand, they question current governance and institutional arrangements that tend to shift the burden on future generations. They argue that innovative solutions, to be optimal, require the active role of communities in addressing hazards and threats and find suitable options to adapt to climate change. Looking at Niue, they show that traditional architectural designs, building techniques and materials for dwellings and facilities may provide much better and more economical buffers to climate events than dependency on imported technologies and materials. Turning to Vanuatu and the Solomon Islands, they give examples of capacity development and working with nature in a way that builds multiple benefits and long-term solutions.

4 Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016).

In Chapter 4, Dr Patila Amosa discusses the current state of knowledge of climate change in the Pacific and how the region is addressing existing and projected impacts. She presents sobering statistics about climate patterns in the Pacific and the challenges that communities already face. Yet, the resilience of the region is exemplified by the examples the author gives about the various initiatives taken by Pacific Island nations at the regional level.

Chapter 5 by Associate Professor Nicola Gaston, Professor Justin Hodgkiss and Shane Telfer completes the first informal part of the book. The authors offer a fascinating account of attempts in materials science to reduce carbon emissions and avoid the worst scenarios of climate change, by making some of the required economic and behavioural adjustments easier. They introduce readers to several current and emerging technologies that could reduce emissions through either provision of carbon-free energy, materials-based energy conservation, or the use of advanced materials in energy hungry technologies, such as computing. They also look at the issue of carbon capture and storage, including a range of porous materials that show promise in negative emissions technologies and offer potential for productive repurposing of atmospheric carbon.

Following on, a number of chapters are dedicated to matters of law and policy, rather than science. Chapter 6 by Professor Christopher Wright explores the political and security implications of these unprecedented changes to our world within the context of Australia and the wider Pacific region. The chapter offers a stark contrast between the position taken by Australia – whose national interests have been tied to the global fossil fuel industry – and that of Pacific Islands. After an overview of the general political economy of the climate crisis, the author explores political responses taken by Australia, and then outlines the implications of these for politics and security in the Asia-Pacific region.

In Chapter 7, Adrian Macey, a seasoned diplomat, asks the question whether climate change negotiations and programmes are fit for the Pacific. Although small developing island states nowadays voice their concerns and participate more actively in international negotiations, there is still a sentiment that international fora remain under the control of economic powers and that better strategies are required, with the need for building capacity in the region.

The next two chapters offer legal perspectives and highlight the fact that at the heart of decisions on both mitigation of, and adaptation to, climate change lies political decision making. In Chapter 8, Sir Geoffrey Palmer QC stresses the importance for international norms to be translated into domestic law in order to have "bite". The making and enforcement of domestic environmental law and policies may take time to design and to enact; they may be subjected to judicial review; and statutes are subject to interpretation by courts. Focusing on New Zealand law, he examines the degree to which judicial decisions and other processes (such as the Waitangi Tribunal and the Parliamentary Commissioner for the Environment) can correct and encourage government policies on climate change and give them a "nudge" towards making them effective.

Chapter 9 examines the current state of international law with regard to legal personality, especially where sea level rise threatens low-lying Pacific Island nations and their very existence. The chapter argues against loss of status through a narrow reading of the criteria of statehood, favouring instead strategies that strengthen their right to existence. The chapter then considers whether there

could be a future basis for action to protect low-lying states. Canvassing existing norms of international law and emerging trends, the chapter makes a case for the future of those states through the principle of respect for the right of peoples to self-determination; the concept of an international or regional "duty of assistance"; or even "a responsibility to protect" nations at risk and their populations. The chapter sketches the nature of such a "duty" and "responsibility": what these terms entail, and whether they translate into legal or political obligations to ensure low-lying nations can put in motion adaptation strategies that protect the state in the long term.

The last cluster of chapters examines climate change through other, diverse viewpoints. In Chapter 10, Tim Grafton from the Insurance Council of New Zealand suggests that much can be learned from the risk analysis and management techniques of the insurance sector. As insurance cannot cover certain and expected events like sea level rise, reliance has to be on adaptation measures. Insurance against the risk of loss from other natural hazards may help countries to reduce the total costs of disasters for their economies.

Jamie Morton, science reporter at the *New Zealand Herald*, looks at the coverage of climate change in the media. One of a breed of media people devoting time to climate change reporting, he shows how the issue has shifted from fringe news towards headlines, and the difficulties in balancing the reporting of scientific certainty with coverage of the views of climate sceptics. He also illustrates that beyond the media, other means of communication make climate change centre-fold, with an energetic arts scene using creative talent to make people aware of climate change, whether it be through dance, theatre, painting and so on.

Finally, Chapter 12 looks at climate change through a faith perspective. In his unique way, Rev John Howell offers a refreshing take on the need for action to combat climate change. He proposes an approach shared across religious beliefs and value systems. He finds in various texts and cultures a similar call for action to protect our environment and change our habits to ensure a better future for the next generations.

1.4 Prospects

Through the work of regional and international organisations, Pacific Island nations have integrated climate adaptation approaches into national strategies. Numerous adaptation measures have been carried out with the involvement of the Secretariat of the Pacific Community, SPREP, the United Nations Development Programme as well as many other organisations, states and civil society actors. It is refreshing to see grassroots movements play a crucial role at the community level and there is increasing awareness of the topic among many decision-makers. All are debating climate change issues and seeking appropriate solutions.

It would be easy to be negative about the future. Yet, as the Prime Minister of Samoa reminded us at the opening of the 2018 conference, Pacific Islands have taken a pro-active role to secure their future. The wise words of the Prime Minister of Tuvalu, the Right Honourable Enele Sopoaga, that to

save Tuvalu is to save the Pacific,⁵ underlines the importance of the choices that must be made today in the interest of future generations.

We hope that the reflections emanating from this multidisciplinary volume generate new conversations and inspire further initiatives to better adapt to the changes we see around us, and most importantly, to redouble efforts to move the world towards the zero-carbon future we all deserve.

5 "Save Tuvalu; save the world"; UN chief echoes rallying cry from front lines of global climate emergency" (29 May 2019) UN News <<https://news.un.org/en/story/2019/05/1039431#:~:text=On%20his%20recent%20Pacific%20tour,warming%20temperatures%20threaten%20the%20region>>.

2

PHYSICAL SCIENCE

*James Renwick**

2.1 Introduction

Island nations in the tropical western Pacific are truly "in the eye of the storm" in terms of climate change. The oceans are acidifying, temperature extremes are going off the scale, rainfall variability is increasing, sea level rise is occurring faster than the global average in a region where many populations live close to sea level, and tropical cyclones are becoming more intense. All these factors raise the likelihood of damaging extreme events, from coastal inundation to drought and crop failures, to unprecedented storm damage and torrential rains. This chapter outlines the current climate of the southwest tropical Pacific, and how it is likely to change through the rest of the 21st century.

2.2 Current climate

The average climate of the southwest Pacific is dominated by the trade wind circulation, combined with intrusions of cooler air from the middle latitudes. Average daytime temperatures across the region range from the mid-20s to the low 30s (degrees) Celsius, with small seasonal or interannual variability. Precipitation in most parts of the region can be divided into a dry season from May to October and a wet season from November to April. During the wet season, much of the precipitation is associated with the South Pacific Convergence Zone (SPCZ), the core of which on average lies from the Solomon Islands to French Polynesia, as shown in Figure 1.

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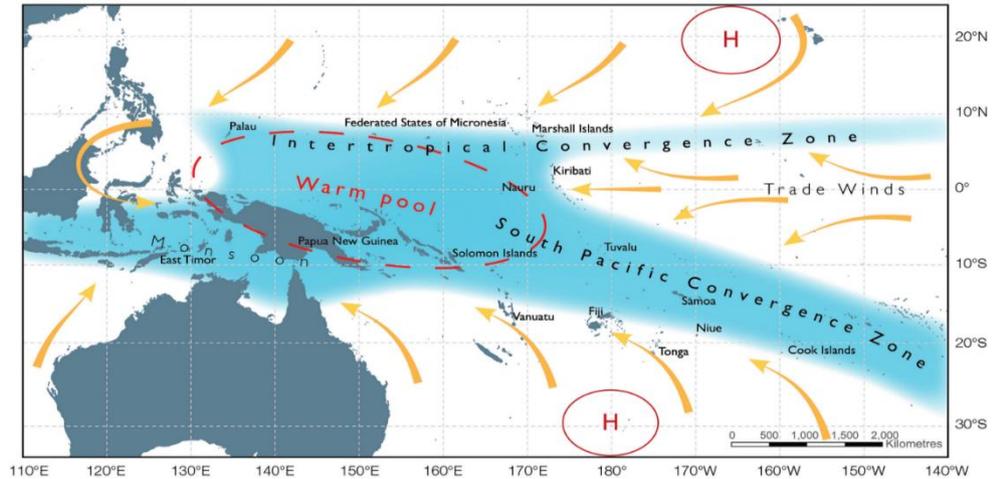


Figure 1: schematic of the factors controlling the climate of the tropical southwest Pacific. Source: CSIRO.

Annual mean precipitation for the period 1979-2018 is shown in Figure 2, from the Global Precipitation Climatology Project (Adler et al, 2003), version 2.3.¹ The SPCZ is clearly visible south of the Equator, with the Intertropical Convergence Zone to the north. Average rainfalls in the core of the SPCZ region reach around 3,000 mm per year. The subtropical region south of about 20°S and west of the Date Line is relatively dry, with average rainfall amounts of 1,000 mm or less.

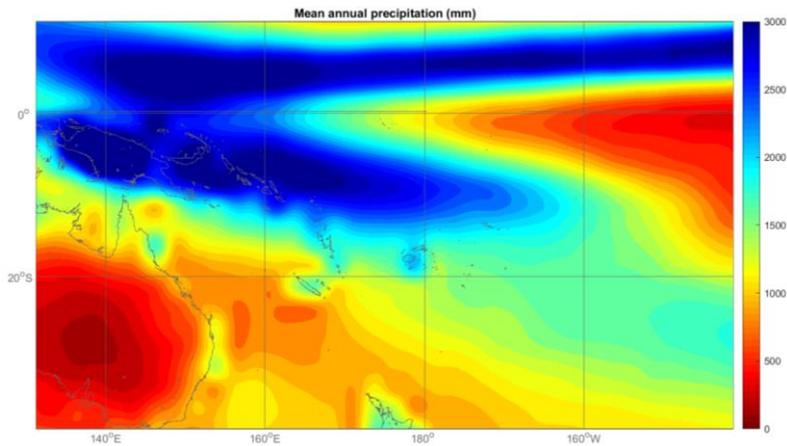


Figure 2: mean annual precipitation (mm) across the western Pacific. Source: based on Global Precipitation Climatology Project (GPCP) data for the 40-year period 1979-2018.

¹ Global Precipitation Climatology Project (GPCP) precipitation data provided by the NOAA/OAR/ESRL PSD, Boulder, Colorado <<https://psl.noaa.gov>>.

There is considerable interannual variability in southwest Pacific precipitation, largely driven by the El Niño-Southern Oscillation (ENSO) phenomenon (Wallace et al, 1998) and its effects on the location and intensity of the SPCZ (Folland, Renwick, Salinger and Mullan, 2002; Harvey, Renwick, Lorrey and Ngari, 2019). During El Niño conditions, the SPCZ moves northeast, increasing the likelihood of high precipitation and flooding in the northeast of the region, and increasing the chances of drought in the southwest of the region. The opposite occurs during La Niña, when the SPCZ moves southwest. During El Niño conditions, tropical cyclones are more likely to occur and move farther east (Diamond, Lorrey and Renwick, 2013), while they tend to be confined to the western part of the tropical southwest Pacific during La Niña conditions. During very strong El Niño conditions, such as in 1982-83 and 1997-98, the SPCZ can move far to the northeast of its average location and lie almost along a latitude line, well to the north of most Pacific Island nations. In these conditions, rainfall shortages and drought can be widespread across most of the region, while tropical cyclones roam freely from west to east. Since sea surface temperatures rise in many parts of the tropical Pacific in an El Niño, there also tend to be more tropical cyclones in total during very strong El Niños (Diamond, Lorrey and Renwick, 2013).

As a percentage of mean precipitation, year-to-year variability is largest northeast of the average location of the SPCZ, and near the Equator in eastern parts of the region, where the interannual standard deviation exceeds the mean (the ratio is greater than 100 per cent, Figure 3). There is a secondary maximum in variability southwest of the SPCZ over the Coral Sea, where the interannual standard deviation reaches between 30 and 40 per cent of mean precipitation. Along the SPCZ itself, precipitation is more reliable, with the ratio of standard deviation to the mean of between 10 and 20 per cent, as is seen at New Zealand latitudes.

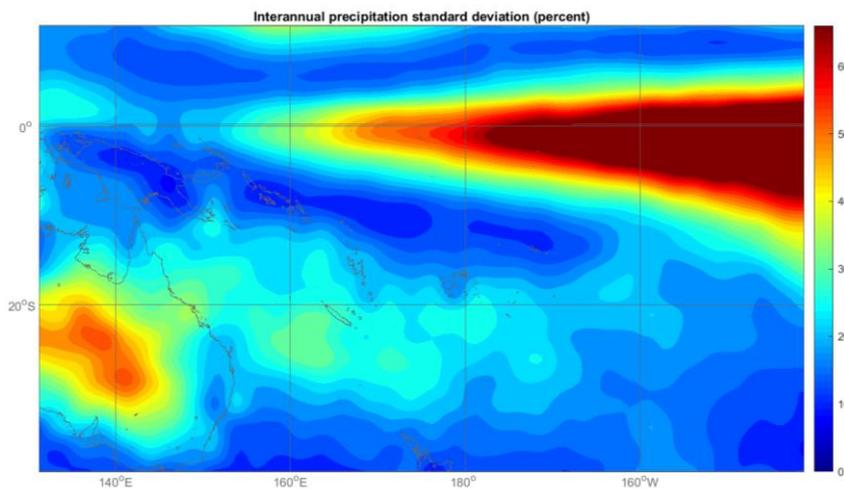


Figure 3: the standard deviation of annual precipitation as a fraction of long-term mean precipitation, as a percentage. Source: based on GPCP data for the 40-year period 1979-2018.

Tropical cyclone activity occurs during the wet season (November to May), to the south of the SPCZ. The most common location for tropical cyclone occurrence is over the Coral Sea, between Vanuatu and the Queensland (Australia) coast, although cyclones can occur across a wide swath of the tropical southwest Pacific (Figure 4).

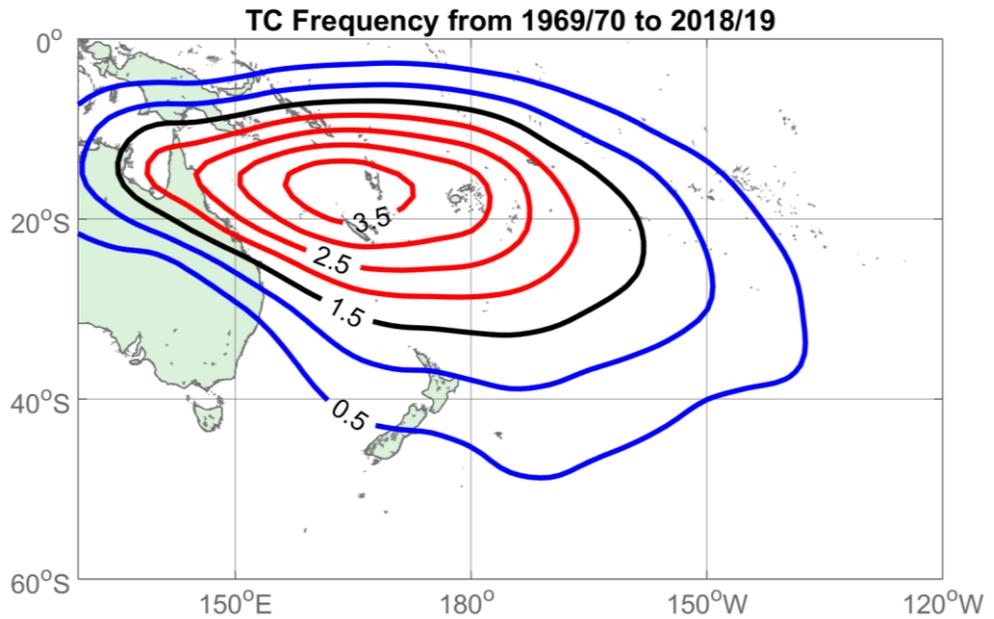


Figure 4: spatial distribution and average number of tropical cyclones per season across the southwest Pacific (during November to April) for the period 1969-1970 to 2018-2019. Source: updated from Diamond et al, 2013.

As noted above, annual average temperatures are in the mid-20s (degrees Celsius) across the region with a strong latitudinal gradient southward of around 20°S, as shown in Figure 5.

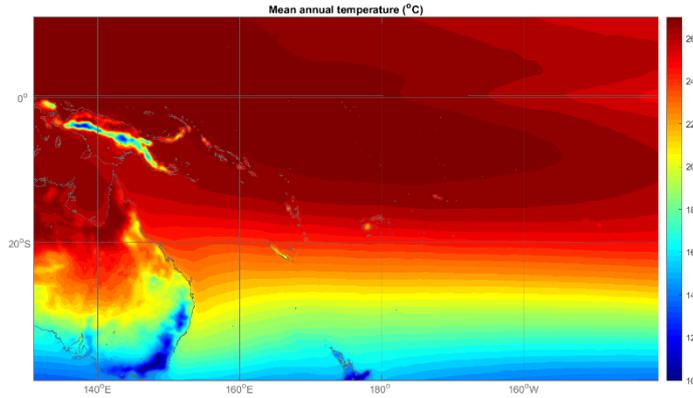


Figure 5: mean annual surface (two-metre) temperatures. Source: from the ERA5 data set for the 40-year period 1979-2018.²

In contrast to precipitation, interannual variability in temperature is relatively small. From one year to the next, the standard deviation of annual mean temperatures is typically less than 0.5 degrees Celsius (Figure 6), and between 0.2 and 0.3 degree Celsius in the SPCZ region. The ENSO cycle and movement of the SPCZ play a role in seasonal to interannual variability in southwest Pacific temperature variations. For most of the region, cooler conditions are experienced during El Niño events and warmer conditions during La Niña events, although this relationship reverses in the northeast of the region (Salinger et al, 1995).

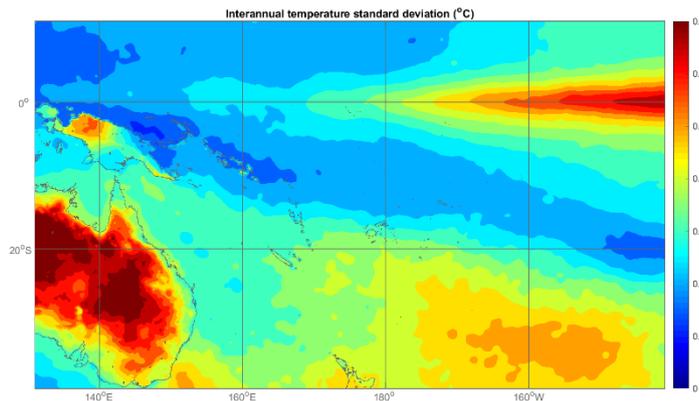


Figure 6: the standard deviation of annual mean temperature, in degrees Celsius. Source: based on ERA5 data for the 40-year period 1979-2018.

2 Copernicus Climate Change Service (C3S) *ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate* (Copernicus Climate Change Service Climate Data Store (CDS), 2017) <<https://cds.climate.copernicus.eu/cdsapp#!/home>>.

The small magnitude of natural temperature variability across the tropical southwest Pacific implies that temperature rises associated with climate change are felt more rapidly than they would be in a region that experiences large temperature variability. As global warming continues, temperatures move outside the previously observed range more quickly than they would in a more variable climate such as that of New Zealand.

2.3 Climate change

The changing climate, brought about by human-induced greenhouse gas emissions, is affecting all aspects of the climate across the southwest Pacific and the globe. The oceans are soaking up the bulk of the heating (at least 90 per cent (IPCC, 2019)) and around a third of the carbon dioxide emitted from fossil fuel burning. Consequently, sea levels are rising and the pH of ocean waters is decreasing (known as "ocean acidification").

Climate futures are based on the climate change scenarios considered in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). The various scenarios are known as Representative Concentration Pathways (RCPs) (van Vuuren et al, 2011) and range from RCP2.6 (broadly consistent with Paris Agreement goals³) to RCP8.5 (broadly consistent with a continuation of recent rates of increases in emissions continuing through the rest of this century). RCP4.5, illustrated in Figure 7 below, is a mid-range scenario associated with emissions peaking before 2050 and declining rapidly through the rest of the 21st century, under which global average temperatures are projected to rise by between two and three degrees Celsius by 2100, compared to pre-industrial values.

Consistent with global trends, temperatures across the southwest Pacific have risen approximately one degree Celsius since the mid-20th century (Hartmann et al, 2013) while precipitation has shown no significant trends in recent decades. Sea levels in the western tropical Pacific have risen at around 4-5 mm per year over the past 20 years,⁴ faster than the global mean rate of 3.3 mm per year.

2.3.1 Precipitation

Average precipitation change is on average expected to be small across most of the southwest Pacific through the rest of the 21st century, but variability is expected to increase. Figure 7(a) shows median projected changes in wet season precipitation for the region, under a mid-range emissions scenario (RCP4.5; van Vuuren et al, 2011). Hatching indicates that average changes are projected to be smaller than typical year-to-year variability, which is the case for almost the entire region (average changes less than about 20 per cent of the late 20th century average). The exception is the Equatorial strip, east of the Date Line, where average precipitation is expected to increase significantly.

Figures 7(b) and 7(c) show how year-to-year variability is projected to change through the rest of the 21st century, for a range of emissions scenarios. In both regions shown, variability increases over

3 Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016).

4 See "Historical Sea Level Changes" CSIRO <www.cmar.csiro.au/sealevel/sl_hist_last_decades.html>.

time. In the southern region, which encompasses much of the tropical southwest Pacific, the occurrence of dry years (more than a 20 per cent reduction) increases even though median precipitation decreases only slightly. In the Equatorial region, precipitation variability increases sharply, with a large increase in the occurrence of very wet years (more than five times the current average) under the higher emissions scenarios.

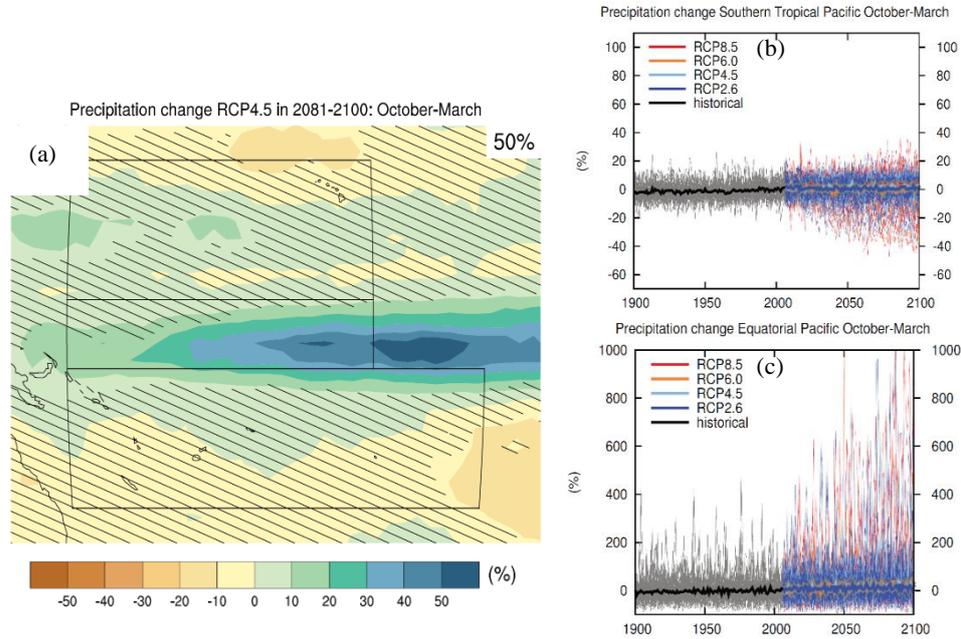


Figure 7: projected changes in precipitation for the tropical Pacific, based on CMIP5 models: (a) median change in precipitation, 20-year average 2081-2100 divided by 1981-2000 (per cent change) for the RCP4.5 scenario; (b) time series of yearly variations in precipitation in the lower box outlined in (a), for the historical period and four future scenarios (per cent differences from 1981-2000); and (c) as in (b), but for the middle box outlined in (a). Note the different vertical scales in (b) and (c). Source: IPCC, 2013.

Increasing precipitation variability is a consequence of a moister atmosphere combined with circulation changes. For many regions of the globe, this translates to the rule of thumb "the wet get wetter and the dry get drier". This applies to individual events (storms deliver more rain, droughts are more intense), seasons and years. The SPCZ is expected to become more variable in its movements in the future (for instance, Cai et al, 2012) and the ENSO cycle is expected to be associated with more intense precipitation extremes as the planet continues to warm (Power et al, 2013; Cai et al, 2014; Wang et al, 2017), as discussed below.

2.3.2 Temperature

The future magnitude of climate change impacts for the southwest Pacific depends strongly on how global greenhouse gas emissions reduction policy and technology develop. At the low end of the

scale, if the most stringent goals of the Paris Agreement⁵ are met, global temperatures would rise around 0.5 degrees Celsius from the present day (approximately 1.5 degrees Celsius above pre-industrial temperatures) by 2100. At the high end, if emissions of greenhouse gases continue as they have done over the past 20 years, global temperatures would rise by at least another three degrees Celsius from the present day (four degrees Celsius above pre-industrial levels) by 2100. Whatever the future of emissions, global temperatures are virtually certain to rise another 0.2-0.3 degrees Celsius above present-day levels over the coming 30 years (IPCC 2013).

Future temperature rise across the southwest Pacific is expected to be somewhat slower than the global average rate, but all future scenarios show temperatures rising significantly above what has been observed in recent decades. Figure 8 shows projected temperature change during December-February for the range of RCPs considered in the AR5 (IPCC, 2013). Even with moderate warming scenarios, the occurrence of extreme events increases rapidly (Frame et al, 2017).

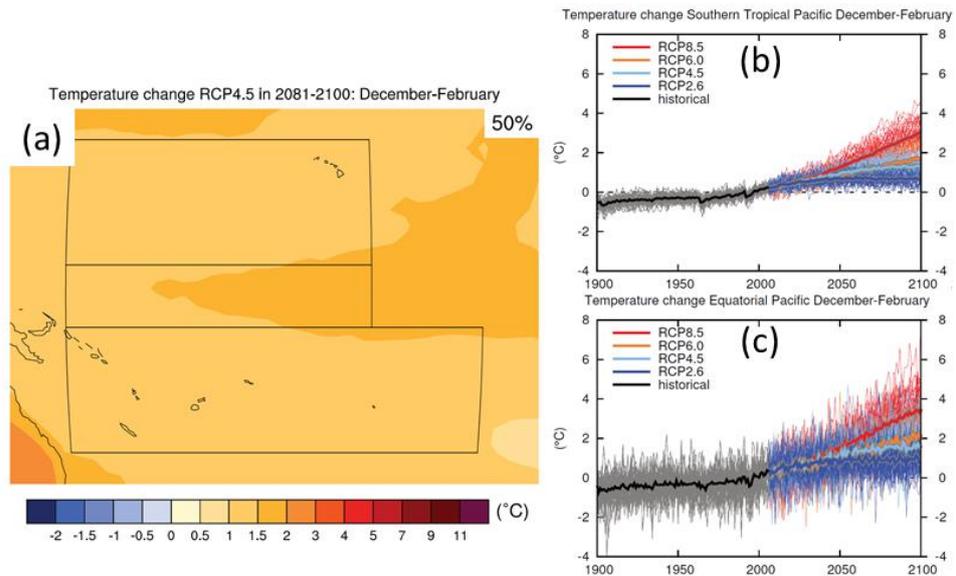


Figure 8: projected changes in temperature for the tropical Pacific, based on CMIP5 models – (a) median change in temperature, 20-year average 2081-2100 minus the 1981-2000 average for the RCP4.5 scenario; (b) time series of yearly variations in precipitation in the lower box outlined in (a), for the historical period and four future scenarios (differences from 1981-2000); and (c) as in (b), but for the middle box outlined in (a). Source: IPCC, 2013.

2.3.3 ENSO, the SPCZ and tropical cyclones

The spatial pattern of temperature change shows greater warming in the eastern Equatorial region than in the west and southwest, reminiscent of the pattern of sea surface temperature change associated

⁵ Paris Agreement, above n 3. See Chapter 7 and 9 in this book.

with El Niño events (Wallace et al, 1998). While such a change in sea surface temperatures across the tropical Pacific may facilitate the occurrence of El Niño events in the future, there is no clear signal from climate models about the future of the ENSO cycle. The majority of models included in the AR5 show future conditions that are relatively El Niño-like, although some models show a more La Niña-like average future. The magnitude of future events is also uncertain, with roughly half of models suggesting larger amplitude El Niño and La Niña events, while the other half suggests weaker amplitude events in future (Christensen et al, 2013).

Research over the past few years does suggest that very strong El Niño events may become more common in the future, although they will remain relatively rare (Cai et al, 2012; Cai et al, 2014). Such extreme El Niño events lead to more variability in the location of the SPCZ, as strong El Niño events have in the past been associated with extreme northward swings of the SPCZ (Cai et al, 2012). Such movements expose many south Pacific nations to greater risk of drought, and in part contribute to the very large variability in rainfall seen in future scenarios for the region (see Figure 7).

Since tropical cyclones form and move only to the south of the SPCZ, significant northward swings of the SPCZ expose eastern parts of the region to much increased tropical cyclone risk, on a seasonal basis (Basher and Zheng, 1995; Diamond, Lorrey and Renwick, 2013).

On average, tropical cyclone behaviour over the southwest Pacific is expected to change relatively gradually. As shown in Figure 9, both the incidence of very strong cyclones (categories 4-5) and the lifetime of cyclones at their maximum intensity are expected to remain about the same as they have been over recent decades. The total number of tropical cyclones over the southwest Pacific is expected to decrease by around 20 per cent on average (around two less named cyclones per year) by the end of this century. The amount of precipitation in southwest Pacific tropical cyclones is, however, projected to increase significantly, associated with the general increase in atmospheric moisture in a warmer climate (Christensen et al, 2013).

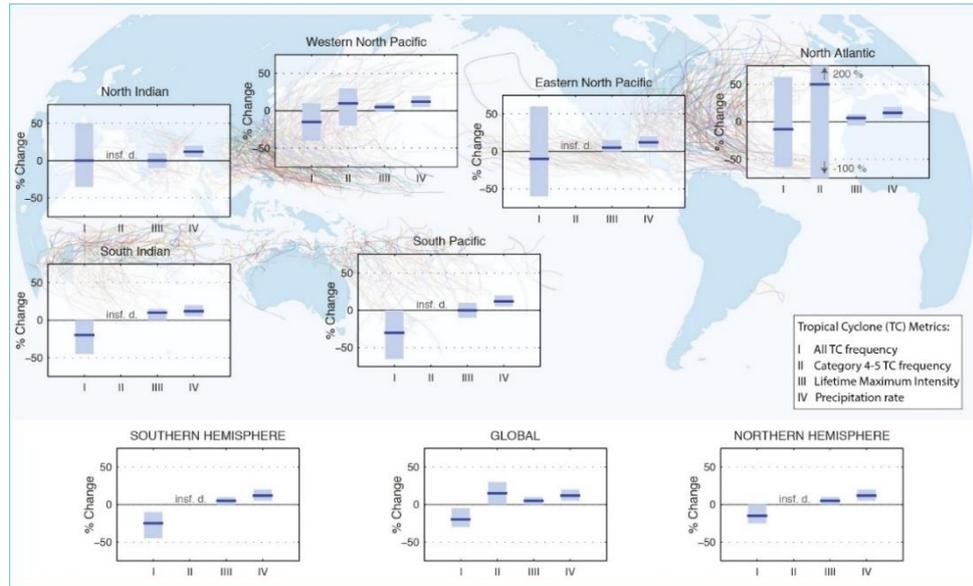


Figure 9: projected percentage changes in tropical cyclone behaviour across all global basins for the period 2081-2100, compared to 2000-2019. Statistics reported are (I) frequency of occurrence of all tropical cyclones, (II) frequency of category 4-5 cyclones, (III) cyclone lifetime at maximum intensity, and (IV) precipitation rate. Source: sourced after Figure 14.17 in Christensen et al, 2013.

2.3.4 Ocean change

Sea level rise in the southwest Pacific is projected to continue at a rate a few per cent greater than the global average. Globally, sea levels are projected to rise by between ~ 50 cm and ~ 80 cm by the end of the century, depending on emissions scenario. Should warming reach two degrees Celsius or more globally before 2100, there is the possibility that parts of the West Antarctic Ice Sheet may start melting irreversibly before the end of the century. This could result in up to 1.5 m of sea level rise (global average) by 2100 and several metres more in the centuries beyond that (Golledge et al, 2015; DeConto and Pollard, 2016).

For all scenarios, sea levels keep rising for centuries, with an eventual rise of around one metre for the lowest warming scenario (RCP2.6 in Figure 8) and possibly tens of metres for the highest warming scenario (after several centuries, RCP8.5). For all scenarios, around 20 cm further rise (compared to the present day) is projected by mid-century.

Absorption of carbon dioxide by the oceans lowers the pH of ocean water (making it more acidic) and reduces the availability of calcium carbonate in the water column, interfering with coral growth and shell formation (from micro-organisms to shellfish). Average surface pH has fallen around 0.1 unit over the past century. Under RCP2.6 (close to the Paris Agreement), pH would fall less than one more point and would start to recover by 2100. Under RCP8.5, ocean surface pH would keep falling through this century and beyond, going down by around another 0.3 points by 2100. Such conditions,

combined with decreased oxygen levels and changes in nutrient cycles, would pose major risks for many marine ecosystems (Bindoff et al, 2019).

2.4 Summary

The southwest Pacific faces a wide range of challenges as a result of the changing climate. Temperatures are rising rapidly, and will move outside of observed ranges more rapidly than in many other parts of the world. Precipitation variability is increasing, with a tendency towards more frequent dry conditions in the southwest of the region and more frequent heavy rainfall and flooding in the northeast of the region. Tropical cyclones will bring more heavy rain in future and may travel much farther east than normal, more often. Sea levels have been rising for a century and more and will rise at least another half a metre this century, and may rise well over a metre if global warming passes two degrees Celsius. Ocean waters are becoming warmer and more acidic, affecting all marine life.

All the current and projected changes put stresses on water availability, food security and habitability. In the lowest-lying nations, sea level rise (and the associated salination of ground waters) may make some areas uninhabitable well before the end of the century. Across the whole region, high temperature extremes and more erratic rainfall patterns are likely to lead to major challenges for agriculture and food security, challenging populations across the board.

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3

THE ADAPTATION GAP

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3.1 Introduction¹

The climate change adaptation challenge for Pacific nations is profound. We have not yet fully witnessed the impacts of the anthropogenic emissions burden already in the atmosphere. Whatever we do to reduce emissions now will not affect what is yet to come in the next few decades; it will affect the longer-term prospects which are dependent on nations globally all playing their part to reduce emissions as soon as possible.

We have had a taste of things to come: successive ex-tropical cyclones like Gita; the frequent flooding of major access routes within Auckland, New Zealand's most populous city; prolonged droughts affecting our agricultural way of life and income; rising seas and cyclones affecting Pacific Island life and livelihoods and properties on the west and east coasts of New Zealand. Island communities have relocated as a response to past climate impacts. Increasingly, Pacific communities have widely dispersed diaspora in neighbouring New Zealand and Australia as well as the west coast of North America. This will continue.

The climate changes we face now come on top of many other hazards that challenge the ability of our Pacific region to adapt, including cyclones, coastal flooding, drought, tsunamis, earthquakes, habitat loss and volcanic hazards. Climate change compounds these hazards and introduces new sources of impact, like accelerating sea level rise due to the rapid melting of the polar ice sheets. Impacts are not just these familiar and direct impacts. We are increasingly understanding the interdependence between our natural and human systems. Impacts flow across the natural

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environment, our social systems, our physical assets, challenging the capacity of our human systems to respond, in particular our communities, our financial and governance systems (Lawrence, Blackett, Cradock-Henry and Nistor, 2018).

Our natural instinct is to "protect" ourselves and our families and assets in situ. This is what we have always done. Most of our institutions are geared to this – we are myopic by nature and have an "emergency" response culture. We solve problems as they arise, rather than anticipate what we know is coming to reduce the damage and losses. This predisposition places us in a very vulnerable space. What is to come will stretch our institutions, because the residual risk is increasing – that from which we cannot protect ourselves. This arises because we continue to entrench our exposure in harm's way, creating a legacy of vulnerability that will compound as the climate change impacts continue to change the risk profiles for some time to come.

The emergency culture and current planning law and its practice encourage building back in the same climate change exposed locations, rather than building back better or somewhere else. We assume that the social safety nets that we are used to, will come to our rescue. This assumption is reinforced by governments' recovery packages and our high dependence on insurance or on overseas aid. We demand compensation for past decisions when planning rules are enforced or land uses denied. But the world is changing. We cannot assume that help will be there. Already, we are seeing insurance premium hikes or withdrawal in some places. We need to be much savvier about where we live and work and how we provide network services – roads, underground water services, gas and electricity utilities. The present and future are not like the past. We are operating outside the range of experienced risk which will widen for some time to come, until we can stabilise greenhouse gas emissions. We have an adaptation gap that needs to be filled with some urgency.

We examine these themes to provide a context for thinking about the adaptation gap and how we can address it: what are we adapting to; the call for adaptation action; the risk transfer; and a new way (examples from positive action taking place in the Pacific region: in New Zealand, learning from national policy and community action; in Niue, learning from traditional values and practice; and in Vanuatu and the Solomon Islands, learning from ecosystems).

3.2 What are we adapting to?

Not all climate change impacts are the same. Some are acute and some are chronic. Acute impacts occur as events, like cyclones and intense rainfall events and storm waves on top of king tides, for example. Chronic impacts are less visible until they start to be a nuisance or when they are beyond our coping capacities. This type of climate change impact includes sea level rise and associated groundwater rising, heat and drought. These impacts can compound and have wide cascading impacts for our natural, cultural, social and economic systems. The frequency of the impacts is critical to our ability to respond and in some areas, mainly coastal, will render habitation very difficult well before the more dramatic sea levels projected. Sea level rise is, however, ongoing for centuries and is creeping up on us.

These impacts are all foreseeable and we can reduce their impact by adapting now – where we live and work, how we use the land, how we design our infrastructure, and importantly, how we

respond to the acute climate change impacts and interact with mitigation of emissions. This involves avoiding and reducing the impact of the foreseeable and managing the unavoidable.

Another twist to the problem to which we are adapting, is that many of the impacts will be occurring concurrently within nations and across Pacific nations. Adapting requires a long-term view, especially for investments being made today that have long lifetimes. This means we need to be transitioning now to more adaptive and flexible design, planning and investment of resources and avoiding development of areas highly exposed to the impacts of climate change.

To date, we have been responding to "one-off" events like the aftermath of an ex-tropical cyclone. Increasingly, as heavy rainfall events and coastal inundation become more frequent, we need to be thinking about the flow-on impacts of our current response paradigm. This means thinking of our places of settlement and our natural environment as part of a wider natural and economic system. Impacts on transport infrastructure, for example, influence our value chains by disrupting access to ports and supermarkets and to our telecommunications.²

Stormwater and sewerage services that become overwhelmed can lead to public health alerts, and if water supplies become contaminated, whole towns can be affected.³ Increasingly, fire will become an issue in the east of New Zealand, as it already has in Australia. Competition for water resources becomes critical as drought scenarios play out and irrigation is used as an adaptation. This has already emerged in the Murray-Darling Basin in Australia where governance has been insufficient to manage water sustainably (Bouckaert et al, 2018). The land and water use nexus and the coastal flooding problem have profound and long-lasting effects on people and productive, cultural and natural systems – at Edgecumbe, a coastal town in the Bay of Plenty (New Zealand), when a flood levee failed during a large flood event (Rangitāiki River Scheme Review Panel, 2017); or the Pacific Islands, when more frequent tropical cyclones occur, are other examples where governance becomes a critical issue. This includes how we make decisions as the risk increases, and how we make the transition to new land uses and new ways of living and governing.

For many people, the impacts are beyond imagining and all too uncertain. This means that they focus on the present and think that others can address the impacts. Others know that there is a problem, but cannot act without systems being in place to facilitate solutions, so we make it up as we go along. Some others still deny that climate change is anything other than natural variability at work, while a few accept that there is change, but question its human cause. Adaptation takes foresight and a long-term joined-up commitment across the community and across all levels of government, with an eye on the consequences of our actions today for future generations. Anything less will fail to meet the challenge ahead of us.

2 For an analysis of cascades, see Judy Lawrence, Paula Blackett, Nicholas Cradock-Henry and Benjamin J Nistor *Climate Change: The cascade effect. Cascading impacts and implications for Aotearoa New Zealand* (Deep South Challenge, Wellington, 2018) at 4-5.

3 See Government Inquiry into Havelock North Drinking Water *Report of the Havelock North Drinking Water Inquiry: Stage 2* (Department of Internal Affairs, Auckland, December 2017).

Pacific nations are on the front line of climate change. Whether it is the impacts on the Great Barrier Reef, communities in Kiribati, Hawkes Bay or the west coast of New Zealand, the consequences are being felt now. The impacts also have wider consequences for how we prioritise actions regionally across Pacific Islands and within our nations to achieve equitable outcomes. The impacts affect funding and overseas aid flows and the nature of those flows. Who should pay and what do we spend our adaptation dollars on? Do we continue to entrench expenditure into "protection" by "holding the line" and the status quo knowing that will fail as a strategy, or do we start to transition ourselves away from "risky places" and "risky economic activities" that make us less sustainable?⁴ And at the same time, how do we avoid entrenching current vulnerabilities and capacities?

These are decisions that must be informed by an empowered society in a participatory way with the support of national, regional and local governments, as highlighted by the Intergovernmental Panel on Climate Change (IPCC)'s Special Report on 1.5 degrees Celsius (IPCC, 2018). Transformational change can only happen with such wide societal support.

3.3 The call for adaptation action

Tragically, the call for action is not new. Successive IPCC assessments have strengthened the evidence of the risks. The World Bank reported in 2012:⁵

... we're on track for a 4°C warmer world marked by extreme heat-waves, declining global food stocks, loss of ecosystems and biodiversity, and life-threatening sea level rise.

The Special Report on 1.5 degrees Celsius (IPCC, 2018) reiterated the urgency for action and in particular highlighted the close relationship between the choices and implementation of adaptation and mitigation options:⁶

A mix of adaptation and mitigation options to limit global warming to 1.5°C, implemented in a participatory and integrated manner, can enable rapid, systemic transitions in urban and rural areas (high confidence). These are most effective when aligned with economic and sustainable development, and when local and regional governments and decision makers are supported by national governments (medium confidence).

4 See Intergovernmental Panel on Climate Change "Summary for Policymakers" in Valérie Masson-Delmotte et al (eds) *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* (2018) <https://archive.ipcc.ch/pdf/special-reports/sr15/sr15_spm_final.pdf> [IPCC SR15].

5 World Bank "Climate Change Report Warns of Dramatically Warmer World This Century" (18 November 2012) <<https://www.worldbank.org>>.

6 IPCC SR15, above n 4, at D3.3.

Furthermore, how we adapt and mitigate has consequences that flow well beyond the immediately observed impacts:⁷

Adaptation options that also mitigate emissions can provide synergies and cost savings in most sectors and system transitions, such as when land management reduces emissions and disaster risk, or when low carbon buildings are also designed for efficient cooling. Trade-offs between mitigation and adaptation, when limiting global warming to 1.5°C, such as when bioenergy crops, reforestation or afforestation encroach on land needed for agricultural adaptation, can undermine food security, livelihoods, ecosystem functions and services and other aspects of sustainable development (high confidence).

At COP24 in 2018 in Katowice, Poland, the call for action came from Greta Thunberg, the Swedish school-girl who said:⁸

Until you start focusing on what needs to be done rather than what is politically possible, there is no hope. We can't solve a crisis without treating it as a crisis. We need to keep the fossil fuels in the ground, and we need to focus on equity. And if solutions within the system are so impossible to find, maybe we should change the system itself.

Sage words that apply equally to adaptation.⁹ Decisions made today without thinking about tomorrow will not address what is to come, because they will expose future generations to consequences that we know about already.

3.4 A massive risk transfer

We spend an awful lot of time talking about tweaking the current levers for hazard risk management. We have systems of dependency on government disaster relief and on insurance which the New Zealand government underwrites for some classes of damage and loss. Tied to this is the large devolution of powers to local government without the requisite funding needed to address the increasing climate change adaptation gap. We continue along in the belief that someone else will pick up the tab.

Contrary to popular belief, insurance does not reduce risk. It transfers risk from the insured to the insurer. Insurers, unsurprisingly, are shifting their cover away from places exposed to climate change impacts, because they are foreseeable risks.¹⁰ In New Zealand, this places pressure on the Earthquake Commission (EQC) system to deliver at a time when the Natural Disaster Fund is depleted from earthquakes claims. There are limits to this risk transfer.

The transfer of risk has primarily been to local government, which is required to have particular regard to the effects of climate change under the Resource Management Act 1991 (RMA). The

7 Id, at D3.4.

8 Greta Thunberg "Speech addressed to the COP24 Plenary Session" (Katowice, 12 December 2018).

9 See Glossary at the end of this chapter for a definition of adaptation and its various forms.

10 See Glossary for a definition of risk transfer. See also Chapter 10 in this book.

planning system under the RMA contains a hierarchy of regulatory provisions that should, if administered well, avoid future legacy effects. Addressing existing uses is somewhat more complicated. However, we see ongoing consenting of buildings and infrastructure in low-lying exposed areas around New Zealand off the back of inadequate plans to address the issue. There is a long time-lag between scientific evidence, central government leadership, updating of regional and district plans or land information memoranda (LIMs), consultation on the updates, and then applying them to new consent applications. This is far too long for the urgent change required to address the adaptation gap.

Furthermore, there have been examples where councils have tried to address the land use consequences of rising seas and which have been thwarted. For example, the Kāpiti Coast District Council was challenged in 2013 over its placing of hazard information on LIMs. It is a legal obligation to include information about hazards on LIM reports or in district plans.¹¹ Doing so enables potential buyers to consider relevant information held by councils about properties. In that case, the form of the information and its quality was questioned successfully.¹² The obligation on councils to place such information on LIMs was not. This highlighted that communities need to better understand councils' legal obligations, and that councils need to communicate the risks better. Plans will continue to be challenged unless that happens.

Successive governments have regarded it as a matter for councils to decide what areas can be built on and for insurers to assess the risks. However, this approach means that different rules are being applied in every council area. This stretches resources, especially of the smaller councils, as development pressures become more intense. In 2015, the Parliamentary Commissioner for the Environment highlighted the risk of rising seas in many towns and cities where there are whole suburbs, such as South Dunedin in Dunedin City, Petone in Hutt City, New Brighton in Christchurch City and Granity on the West Coast, that are particularly vulnerable.¹³

Reflecting the concerns expressed by local government, that there was a lack of clear guidance for addressing the coastal climate change risks highlighted by the Parliamentary Commissioner for the Environment, central government guidance was revised and is now available for councils' decision making on coastal hazards and climate change (Bell et al, 2017). At the same time, guidance was also issued on the implementation of the New Zealand Coastal Policy Statement (NZCPS). The NZCPS is a statutory policy statement which legally directs local government in its coastal hazard functions to take a precautionary approach to coastal hazards. The necessity for engagement with communities on what to do, and how fast, is a centre piece of the guidance along with how to apply sea level information for different types of development and on adaptive pathways planning for addressing changing risk over time.

11 *Weir v Kapiti Coast District Council* [2013] NZHC 3522 at [68].

12 *Id.*, at [70].

13 Parliamentary Commissioner for the Environment *Preparing New Zealand for rising seas: Certainty and uncertainty* (November 2015) at [5.2], [7.3] and [7.5].

The update of guidance on how to address extreme rainfall and a national policy on other hazard risks have also become urgent. Calls for a stronger alignment of the Building Act 2004 with the RMA and the NZCPS are now urgent to drive consistency across risk timeframes, extreme events and methodologies for identifying "climate change effects".¹⁴ A review of the RMA is currently underway providing an opportunity to address these issues.

There is also a transfer from insurers and local government to banks. This is a timeframe issue since insurance contracts are for one year, whereas bank mortgages are usually for several decades. We are seeing banks continuing to lend to the rural community for large infrastructure investments to manage existing land uses faced by drought conditions – the very locations where drought is likely to get worse. The risk of stranded assets is high within the payback period of those investments. Such areas also face the prospect of increased fire risk which will compound the impacts on rural communities. Perhaps this will change as insurance becomes unavailable or too expensive, government tightens its adverse effects policies and banks' self-interest kicks in.¹⁵

Released at the 2018 UNEP FI Conference in Sydney, co-hosted by IAG and NAB, the Joint Statement in Support of a Sustainable Financial System for Australia and New Zealand calls on organisations across the finance sector to support the development of Sustainable Finance Roadmaps for Australia and New Zealand.

A Sustainable Finance Roadmap is "a set of recommendations across policy, regulation and finance practices that helps the finance sector contribute systematically to a more resilient and sustainable economy."¹⁶

Insurance Council NZ CEO Tim Grafton has shown leadership in his assessment of the importance of adaptation:¹⁷

Adaptation and mitigation overlap with building designs that need to be more resilient and energy efficient, as they do when farm businesses seek to be more financially sustainable by substituting to more resilient crops. ... If risk is not reduced well, then insurance will become less affordable or even unavailable for some.

In the Pacific, we see foreign aid agencies investing large sums of money to shore up coastal areas and invest in infrastructure that may not last the test of time. This is also occurring in New Zealand

14 Department of Conservation *Review of the NZCPS 2010 on RMA decision-making: overview and key findings* (June 2017) at [29].

15 United Nations Environment Programme Finance Initiative "Finance Sector Commits to Working Together to Develop Sustainable Finance Roadmaps for Australia & New Zealand" (24 July 2018) <unepfi.org>.

16 Ibid.

17 Tim Grafton "Sustainable insurance in a sustainable world" (18 August 2018) Insurance Business Magazine <insurancebusinessmag.com>.

on the Coromandel coast road, a primary access road for communities and tourists alike. Planning for alternative adaptation options is urgently needed.

Biodiversity is at huge risk from the effects of climate change, such as the frightening decrease in insect life. Scientist Brad Lister comments about the Puerto Rican rainforest:¹⁸

The insect population that once provided plentiful food for birds throughout the mountainous national park had collapsed. On the ground, 98% had gone. Up in the leafy canopy, 80% had vanished. The most likely culprit by far is global warming.

Planting forests will certainly help mitigate greenhouse gas emissions and restoring wetlands will attenuate increased heavy rainfall and flood flows. What is often overlooked is how incorporating more nature in our cities can help adaptation. Professor Tim Beatley, populariser of the phrase "biophilic cities", says:¹⁹

... the green infrastructure of a city and region—rivers and riparian areas, floodplains and wetlands and large swaths of forested land—all provide essential services, that help cities and urban regions respond to and spring back from climatic and natural events. Cities with large natural wetland systems will be better able to absorb flood waters from hurricanes and storms, for instance.

Ultimately today's failures of governance, legislation and imagination are all massive transfers of risk to our younger generations and generations to come.

3.5 A new way

A new way is urgently needed. First, we need an aware public which can call decision-makers to account over a longer period than our three-year terms of office. Secondly, we need an effective decision framework for adaptation. Support across the political spectrum was given to the Climate Change Response (Zero Carbon) Amendment Act 2019 to provide for a National Climate Change Risk Assessment and National Adaptation Plan, and an independent Climate Change Commission to advise on mitigating climate change, adapting to the effects of climate change and monitoring and reviewing government's progress towards its emissions reduction and adaptation goals.²⁰

The public and our officials require the ability to navigate a changing and uncertain future and the ability to mediate difficult conversations with stakeholders and between experts. We need to deploy new tools that can give us confidence in making decisions in the present and to be flexible as the changes evolve. Fundamental to this new way of thinking about change and making decisions that are robust across many different possible future conditions, is attention to the many societal values and objectives. We can learn from others in building a common understanding of the nature of the

18 Cited in Damian Carrington "Insect Collapse: 'We are destroying our life support systems'" *The Guardian* (online ed, 15 January 2019) <www.theguardian.com>.

19 Timothy Beatley and Peter Newman "Biophilic Cities Are Sustainable, Resilient Cities" (2013) 5 *Sustainability* 3328 at 3333.

20 Climate Change Response Act 2002, sections 5A-5P, 5ZP-5ZX. See Chapter 8 in this book.

adaptation challenge, working with our elected officials to unblock the inertia in the system. We now illustrate some early attempts to build a more sustainable future from which we can learn.

3.5.1 New Zealand local government and communities

Local Government New Zealand (LGNZ), to which all New Zealand councils belong, has begun to undertake significant work on adaptation, starting with understanding the scale of assets exposed to sea level rise. The three waters (water supply, waste-water and stormwater) infrastructure has been a recent focus, due to pressure for new development on top of aging infrastructure in many areas. Councils manage water services for drinking water, stormwater management and sewage treatment and discharge which include using pipes, reservoirs, pumping stations and treatment facilities. These are all affected by climate change impacts:²¹

Our analysis reveals that more than \$4 billion of three waters infrastructure, roughly \$1.0 billion of roading infrastructure and \$1.2 billion of buildings and facilities is exposed at a 1.5-metre elevation increment of sea level rise. The total value of all infrastructure types exposed is estimated at approximately \$8.0 billion.

However, these costs reflect only replacement costs, associated with sea level rise. They do not include other drivers of coastal flooding or other climate change impacts such as storm events, high tides or land subsidence, which in the near-term may be more significant for coastal communities. From mid-century, however, permanent and ongoing coastal flooding will dominate.²² The study also does not include costs of other activities, such as temporary or permanent adaptation measures, planning activities and purchasing additional resources to ensure an acceptable level of service. There were gaps in data across councils and for some ports, roads and wastewater treatment plants. As well as councils, there are other major asset owners not included in these costs. The report noted that costs will go far beyond the tangible measures. Potential economic development and growth, community health and safety and social support systems will also entail large costs, some of which will arise from permanent coastal flooding and rising groundwater associated with sea level rise. The costs, therefore, will likely be orders of magnitude more.

21 Local Government New Zealand *Vulnerable: the quantum of local government infrastructure exposed to sea-level rise* (Local Government New Zealand, 31 January 2019) at 2. See also Local Government New Zealand "Climate Change Project" <www.lgnz.co.nz>.

22 Robert Bell et al *Coastal Hazards and Climate Change: Guidance for Local Government* (Ministry for the Environment, Wellington, 2017) at [6.4.1].

The report by LGNZ provides a starting point from which the community can identify and discuss their appetite for different adaptation options moving forward. Two recent examples follow, using processes for community participation for flood and coastal hazard impacts and options for reducing climate-related risks over long-term planning periods of 50 and 100 years respectively.

Waiōhine River Plan

The Waiōhine River Plan in the Wairarapa (New Zealand) considered climate change impacts within a flood risk management plan and successfully resolved council and community disagreements within the scope and cost of the plan with trigger points enabling decisions to account for changing flood risk profiles and other changes over the planning period. The community disagreement arose when in 2016, the Greater Wellington Regional Council (GWRC) published a draft Floodplain Management Plan setting out the flood plain risk and mitigation options in the Waiōhine River catchment. Concerns were expressed about the information on which the Plan was based that did not draw on local knowledge, the proposed costs, potential restrictions on property interests (land use controls, information on LIMs and building controls), and that local knowledge had not been properly accounted for. This led to a community devised and led process with participation by the GWRC and all other stakeholders, calling on independent experts to align the initial ground elevation light detection and ranging (LIDAR) information with local expert knowledge, including photographs of historic flood events (Waiōhine River Plan, 2020; see Figure 1).

After several months of open community-led engagement and study of updated catchment, rainfall, climate change and flood data, the community, council and experts chose to base their work on the climate impacts associated with the global Representative Concentration Pathway (RCP) RCP6.0 (moderate emissions reductions initially followed by a rise in emissions and population peaking at around 9-10 billion). This scenario generates 16 per cent extra water volume for the Waiōhine – 10 per cent by 2050 and a further six per cent by 2090. The detailed local knowledge of what had been flooded in the past was used to ground truth 24 different model runs. The costs of the options chosen were around 70 per cent lower than the original plan and the science was accepted. Several years on from the public contestation and denial of climate change related to a coastal plan in Kāpiti Coast district, no one in the Waiōhine denied climate change publicly, although some queried its anthropogenic causes. A positive outcome from the process was the community appetite for another community-led process for the Mangatāre River Plan without the acrimony experienced in the Waiōhine catchment. This provides a New Zealand-based example of a collaborative community-led process for designing adaptation options for the effects of climate change on river systems.



Figure 1: semi-braided channel form typical in the reach between the Rail Bridge and Fullers Bend upstream of the State Highway Bridge. Source: Waiōhine River Plan, 2020.

Clifton to Tangoio Coastal Hazards Strategy

In a coastal setting, three Hawkes Bay councils in New Zealand have developed a non-statutory coastal hazards and climate change strategy to 2120 (Clifton to Tangoio Coastal Hazards Strategy 2120, 2018). Coastal erosion and wave overtopping affecting beach settlements have a decades-long history. Numerous reports had not addressed the problem from the communities' perspective. The climate change imperative brought this to a head. Three district councils, the regional council and three iwi groups (Napier City, Hastings District and the Hawkes' Bay Regional Council, He Toa Takatini, Mana Ahuriri Incorporated and Maungaharuru Tangitu Trust Incorporated) came together in a governance arrangement with the affected community to assess the hazards and the implications of sea level rise on the risk exposure, and develop adaptive pathways to 2120. With the help of the research and the consultant community, a strategy was recommended to the councils' Joint Committee. The detailed planning of the implementation phase of the strategy is now underway. This was a ground-breaking process for local government and other councils are taking it up. Nevertheless, challenges remain in getting buy-in from the wider regional community on the question of who pays. The councils have developed a shared funding model for implementation.

Such adaptive planning methods have been used previously in New Zealand (Lawrence et al, 2013) and elsewhere (Haasnoot, Kwakkel, Walker and te Maat, 2013; Bloemen et al, 2018), for example the Hutt River Flood Risk Management plan motivated by use of a serious game – The NZ River Game developed with the assistance of Deltares, The Netherlands, a number of New Zealand councils and the Ministry for the Environment as part of research undertaken at Te Herenga Waka—Victoria University of Wellington (Lawrence and Haasnoot, 2017). These methods stress-test adaptation options for their performance under a range of future conditions over a 100-year period, using several scenarios to reflect the range of uncertainties about the future. Using a range of scenarios rather than one scenario of the future, enables communities to be fully aware of the uncertainties and that scenarios are not what *will* happen in the future, rather they are plausible outcomes that can inform choices. Further research to develop signals and triggers for monitoring different adaptive pathways (Lawrence, Bell and Stroombergen, 2019) is ongoing.

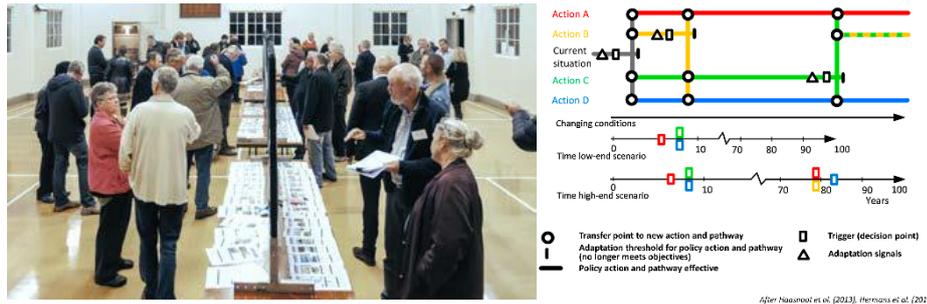


Figure 2: (left) community feedback. [Source:](#) Clifton to Tangoio Coastal Hazards Strategy 2120, 2018 at 43; (right) adaptation pathways. [Source:](#) after Haasnoot et al, 2013 at 488; and Hermans et al, 2017 at 30.

3.5.2 New Zealand central government addressing adaptation

3.5.2.1 National guidance

The Hawkes' Bay coastal strategy development process was assisted by the revised national Coastal Hazards and Climate Guidance (Bell et al, 2017). Such guidance informs decisions under the statutory NZCPS. The guidance is underpinned by a 10-step decision cycle grouped around five questions – What is happening? What matters most? What can we do about it? How can we implement the strategy? How is it working? Fundamental to the decision process is community engagement and addressing the drivers of climate, social, cultural and economic change, over at least 100 years – the statutory timeframe required of coastal risk management in the NZCPS. Embedded in the guidance is the underlying acknowledgement that decisions in a climate change context have to address dynamic change and uncertainty. Accordingly, guidance is given on the use of new approaches and tools to do this. For example, for coastal hazard assessments, a tiered approach is set out in which a high-level scoping of the problem can be done, and more focused attention given to hotspots. This addresses the resource constraints of many councils. For sea level rise considerations, statistical likelihoods cannot be assigned within the planning timeframe, due to uncertainties around the rate and magnitude of polar ice sheet melting, in which case scenarios can be used to stress-test a range of options for adaptation. Guidance is also given on how the transition from current exposures to how climate change impacts will evolve, can be made. For example, existing developments, changes in land use through intensification and new Greenfield developments can be addressed. To assist in these decisions, guidance is given on applying adaptive pathways planning by identifying options, assessing the options, developing alternative pathways, stress-testing the pathways and designing signals and triggers for monitoring change, so community objectives for the long term can be achieved. Other tools are set out for assessment and planning that can address the changing risk profiles over at least 100 years. For example, a range of economic assessment tools that can be used in situations of uncertainty and change without discounting the damages and losses and wider community benefits for future generations.

3.5.2.2 Climate Change Adaptation Technical Working Group recommendations

To address the growing concern in the community, and especially within local government, in late 2016, the New Zealand government set up a Climate Change Adaptation Technical Working Group (CCATWG) to advise it on adaptation progress to date in New Zealand, and on how New Zealand might adapt going forward. There was growing concern expressed by local government and in the community that local councils were on their own trying to adapt to climate change, especially the rising risk from coastal hazards and sea level rise, and from floods generated from extreme extra-tropical cyclones. The CCATWG reported that adaptation efforts across all sectors and levels of government needed to improve significantly; that there were gaps and lack of integration across legislation which required immediate attention; and that a new framework for adapting to climate change was needed because of the wide scale and scope of the impacts.²³ It also reported that New Zealanders were not sufficiently informed, and agencies not well organised or taking proactive and dynamic action. The elements of an effective adaptation framework were set out as an integrated strategy, to help transition to more effective adaptation across New Zealand. The key elements of the framework are:

- Understanding and assessing the risks;
- Developing a national adaptation plan integrated across national and local government; and
- Independently monitoring and reporting on the plan.

And to reflect the dependencies between these actions, the framework required:

- Accessible information to support decision making;
- Capacity and capability built to adapt;
- Funding the widening "adaptation gap" without creating moral hazard, by anticipating the known consequences and being able to transition before the changes occur; and
- Leadership (including cross-party beyond the three-year electoral cycle) through integrated governance to support long-term adaptation action.

This framework, recommended by the CCATWG, is partially reflected in the Climate Change Response Act 2002 alongside policy development for funding.

The funding remit is especially significant for successful adaptation since it is universally creating a barrier to starting adaptation (Boston and Lawrence, 2018). Understanding the potential costs is important and LGNZ has recently contributed to that (Local Government New Zealand, 2019). However, investments in developments in urban and rural locales are being made now which have the potential to lock-in a legacy of infrastructure, housing and rural activities affected by climate change impacts that will make future adjustments very costly due to the risk transfer to the next generation. Designing new sustainable funding mechanisms that do not create moral hazard and exacerbate

23 The Climate Change Adaptation Technical Working Group's two reports were: *Adapting to climate change in New Zealand: Stocktake report from the Climate Change Adaptation Technical Working Group* (Ministry for the Environment, December 2017); and *Adapting to climate change in New Zealand: Recommendations from the Climate Change Adaptation Technical Working Group* (Ministry for the Environment, May 2018).

inequities must start now, since institutional change takes time and some communities cannot wait because they are already threatened right now from rising seas, extreme rainfall, drought and fire. A national conversation about who pays and who should pay is the only way to avoid lengthy and ad hoc legal challenges to councils implementing their legal mandates around climate change adaptation. The community needs to be on board with the looming withdrawal of insurance cover and the risk that there will be no one to pick up the tab, leaving stranded communities and assets and potential widespread social and economic disruption. New Zealand does not have a good record in risk reduction and our institutions reinforce post hoc reaction to loss and damages (Boston and Lawrence, 2018). Now is the time to do better at it through anticipatory planning and flexible investments that can adjust in time to avert the worst impacts.

3.5.3 Niue – a new way by learning from traditional values and practices

Niue is already affected by devastating cyclones, exacerbated by a declining population base and a heavy reliance on recovery assistance from its near neighbours. This has affected adaptive capacity in a way that reduces, rather than exacerbates, exposure and ongoing risk to livelihoods and traditional ways of life in a changing climate. A project that sought to provide a contextual understanding of the Niuean environment and its people's response to past climate conditions, demonstrates a more sustainable and affordable adaptation approach than dependency on architectural and building methods imported from elsewhere (Freddie and de Sylva, 2018; Freddie, 2018).

Adaptation to the many cyclones and droughts over the generations has given Niueans an intimate understanding of their island home and how they can sustain themselves on it. However, western influences, modernisation, the importation of material resources and alien building technologies have undermined this self-reliance based on local knowledge, practices and traditional systems. Cyclone Heta in 2004 brought this into sharp focus. The modern centre of Aliluki (established on a highly exposed part of the island in the early 1900s by Christian missionaries), built with modern imported materials like concrete, timber and steel sheet roofing, was completely destroyed with the loss of Niue's only hospital, national museum, public library, hotel and a government-owned apartment complex. This led to a huge demoralising effect on the people and an exodus to New Zealand, which disrupted efforts that were beginning to stabilise population numbers.

Cyclone Heta showed that the range of ad hoc construction projects were exposed and vulnerable to natural weather events, but that in other parts of the island, where traditional architectural and construction practices had been used, similar damage was not sustained. Local communities had historically located themselves in naturally protected areas, using traditional low-built architectural styles which have protected the lives of people in severe cyclones. For example, by taking shelter amongst the many caves on the island or the above ground root networks of the "Ovava" tree, and by locating villages in sheltered parts of the island using vernacular building systems. This established the importance of privileging traditional knowledge, vernacular practices and local capacity in building and community development projects and its significance for nurturing pride and resilience amongst the locals.

A speculative design project was undertaken, focusing on sustainable architectural solutions to reduce the negative effects of climate change on Niue; the resilience of the Niuean people to the

damaging effects of ongoing natural weather events; and socio-economic development of Niue that could help reduce future population drain (Freddie and de Sylva, 2018). It did this by:

- Identifying, improving and building local capacity;
- Improving and diversifying livelihood sources;
- Safeguarding traditions and traditional knowledge;
- Utilising traditional knowledge effectively to improve living environments;
- Developing building technologies to suit local conditions, skills and capacity;
- Adapting modern and proven technologies, methods and systems to local conditions;
- Utilising traditional craft (for instance, weaving, lashing) to improve design and construction; and
- Growing and sourcing building materials locally.

A design for a community and cultural centre was undertaken, that could also serve as an educational facility for skill development, which is vital for community resilience, food sustenance and socio-economic well-being, and to support village based eco-tourism projects, at different scales and with available resources. In the event of an extreme weather event, the building is designed to serve as an evacuation centre. In a severe storm surge, the lower levels of the ground floor might be sacrificed to flood waters while the upper levels and floors provide safe shelter to the people. The multiple hazards affecting Niue were considered for the safety of the site and architectural solutions considered in response to site conditions. For example, the structural qualities of the Ovava tree were used to inform the building forms (Figure 3) and foundation were designed to wrap around and hug the hard limestone terrain and form protective cave-like spaces within the building. Planting heavily with native coastal trees and shrubs to help minimize wave damage from water surges and tsunamis at the island cliff edge was an alternative to the building of large seawalls and engineering projects. These were better suited to local capacity and context when combined with early warning systems.

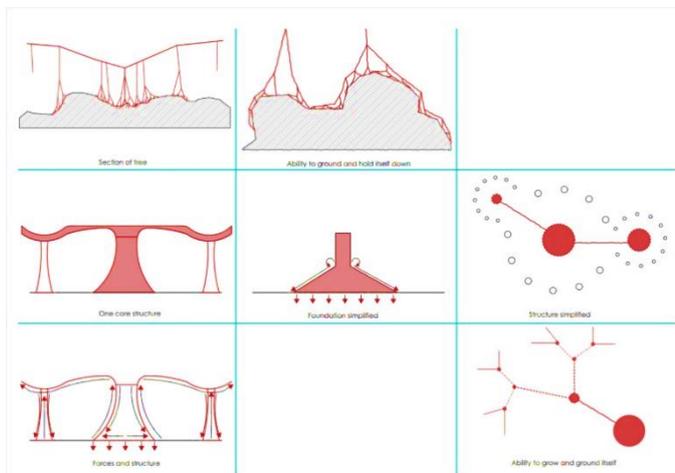


Figure 3: analysis of structural qualities of the Ovava tree. Source: Freddie, 2018.

Inspiration was drawn from:

- The native Ovava tree (Figure 4), which can be sustained through cyclonic weather conditions by its organically interconnected above and below ground structural system;
- Bamboo, as a suitable material for the structure which deflects with cyclonic force, can be grown sustainably; and
- Traditional tying and lashing techniques for securing the forms and shapes that allows the building to flex and move within acceptable limits in cyclonic conditions.



Figure 4: the Ovava tree. Source: Freddie, 2018.

A large central and several secondary structural cores were created (Figure 5) to act like the above ground root networks of the Ovava tree, while raised concrete foundation piles imitate its ground root network. The concrete foundations protect the bamboo and anchor the sub structure to the ground, while forming a circular maze of cave-like protective spaces. This structural system supports the building laterally and vertically when cyclonic forces are applied and form a barrier against tsunami waves that may reach the building. The roof, a diaphragm system inspired by traditional basket weaving techniques, acts like a lattice brace that links and structurally reinforces the whole building to resist lateral loads. Local traditions of thatching and local palm material resources were considered for roof coverings. The proposed building design is adaptable to domestic and public scale buildings and is a structurally safe, sophisticated and aesthetically beautiful response that is suited to the environment, local culture and local capacity.

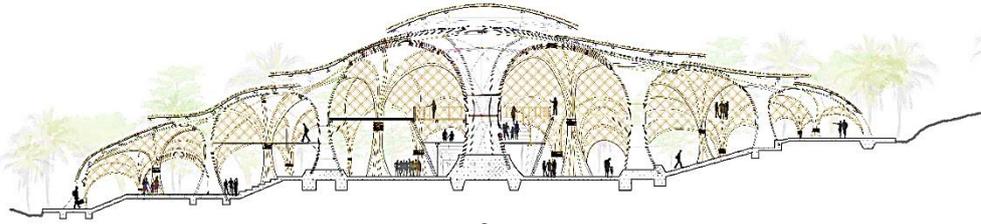


Figure 5: cross section of proposed community and cultural centre. Source: Freddie, 2018.

3.5.4 Vanuatu and the Solomon Islands – learning from ecosystems

Vanuatu and the Solomon Islands both experience urban resilience challenges. Both have rapidly growing urban populations in Honiara and Port Vila respectively (up to eight to nine per cent per annum), many households are largely subsistence-based and ecosystems are pressured by pollution, logging and development. On top of this, climate change is bringing sea level rise, rising air and ocean temperatures and greater rainfall variability that exacerbate existing pressures. Building on nature-based approaches to community resilience, the Pacific Ecosystems-based Adaptation (EbA) to Climate Change Project was set up as a five-year partnership project (2015-2020) between the Pacific Regional Environmental Programme (SPREP) and the governments of Fiji, the Solomon Islands and Vanuatu to demonstrate EbA as a low cost appropriate response to building resilience that can be embedded in policy and planning.²⁴ Using technical assessments and identification of options that can be used in demonstration activities, the results can be communicated for integration into policy and outreach programmes. Implementation addresses governance arrangements, contractual and funding models, partnerships and on-ground work. Examples include:

- Integrated catchment project for water security and riparian protection which has co-benefits for whole-of-catchment (including coastal areas) watershed protection using a ridge to reef corridor and strategic planting;
- Coastal ecosystem regeneration using strategic planting, traditional knowledge, and long-term funding for amenity, water quality, disaster mitigation and use of local raw materials;
- Intensified urban and peri-urban community gardens and agriculture using sustainable practices;
- Urban forests and agro-forestry encompassing community participation and training in nursery propagation, planting and monitoring; and

²⁴ See Secretariat of the Pacific Regional Environment Programme *Planning for ecosystem-based adaptation in Honiara, Solomon Islands* (Apia, 2018); Secretariat of the Pacific Regional Environment Programme *Planning for ecosystem-based adaptation in Port Vila, Vanuatu* (Apia, 2018); and Secretariat of the Pacific Regional Environment Programme *Planning for ecosystem-based adaptation in Taveuni, Fiji* (Apia, 2018).

- Sustainable integrated housing development encompassing integrated landscape and architecture in appropriate locations integrated with food, energy, water and waste management.



Figure 6: (left) mangrove replanting, Port Vila. Source: photograph courtesy of D Loubser; (right) peri-urban multi-layer bush garden, Port Vila. Source: P Blaschke.



Figure 7: (left) riparian protection, Honiara Botanical Gardens. Source: photograph by B Toki; (right) PEBACC workshop at Honiara. Source: B Toki.

3.6 Conclusions

There are similar themes emerging across the Pacific on climate change impacts and the ability to adapt. Natural hazards are not new. All nations have adapted in the past, but questions remain whether these approaches can cope with the increase in pace and severity of the changes, and to rising seas. It has been shown that strong communities can develop integrated adaptation that addresses a range of hazards, climate change and the changing demographics and external pressures that all nations experience. The spectre of relocation is high within and between Pacific nations. We see internal migration within countries and "squatter" settlements emerging on the urban margins dislocated from food production. International migration is constrained by immigration policies. We see increased anxiety in exposed communities in New Zealand as the frequency of storms affects small communities and drought affects rural areas. Climate change is raising moral and equity issues for the richer nations

in the Pacific, including for aid policies versus self-determination. There are also equity issues emerging between different groups in society in all nations in the Pacific – between young and old, men and women, urban and rural, rich and poor (Weir, Dovey and Orcherton, 2017).

Adaptation is universally challenged by governance, institutional and financial constraints and barriers (Boston, 2017; Boston and Lawrence, 2018). While there are several examples of innovative and integrated adaptations, their success and the ability to implement them will be fundamentally challenged by how wide and how fast the adaptation gap will grow and the adaptability of our institutions to make flexible decisions that are robust over time. This in turn relies upon all nations globally making the necessary shifts in development patterns to reduce emissions that can fundamentally move human endeavour to more sustainable lifestyles. In a microcosm, the Pacific represents what is happening globally. More appropriate development pathways that are attuned to nature's limits and work for people are essential.

We learn from New Zealand that our governance and institutional arrangements are far from fit for purpose, and have created inertia that has created a legacy of exposure that is hitting us now and which is shifting a huge burden onto future generations (Lawrence et al, 2013). Current generations are beginning to find that inequitable outcomes are unavoidable, unless we move faster to address their causes. But there is new learning emerging. It has been possible for some communities to come together in new governance arrangements to have those hard conversations about hazards, their threat and options for addressing them over time as the climate conspires. This has happened in New Zealand and in Pacific Island countries alike.

From Nuie, we learn that traditional architectural design, building and siting techniques, and materials for dwellings and community facilities, provided buffers to past climate changes at much less cost than dependency on imported technologies and materials. But can this strategy persist as the impacts of climate change become more intense?

The approach in Vanuatu and the Solomon Islands is providing a deep buffer for the climate changes to come by focusing on capacity development and working with nature in a way that builds multiple benefits.

However, at the heart of these initiatives being successful, is a new brand of leadership derived from the bottom-up which to thrive, requires the wilfully blind and the self-interested to be challenged more forcefully by the community to call our political leadership to account. In the end, our future relies upon it.

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3.8 Glossary²⁵

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process

25 Unless indicated otherwise, references are from IPCC SR15, above n 4.

of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

Incremental adaptation: Adaptation that maintains the essence and integrity of a system or process at a given scale. In some cases, incremental adaptation can accrue to result in transformational adaptation.

Transformational adaptation: Adaptation that changes the fundamental attributes of a socio-ecological system in anticipation of climate change and its impacts.

Adaptation limits: The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions:

- Hard adaptation limit: No adaptive actions are possible to avoid intolerable risks.
- Soft adaptation limit: Options are currently not available to avoid intolerable risks through adaptive action.

Governance: A comprehensive and inclusive concept of the full range of means for deciding, managing, implementing and monitoring policies and measures. Whereas government is defined strictly in terms of the nation-state, the more inclusive concept of governance recognises the contributions of various levels of government (global, international, regional, sub-national and local) and the contributing roles of the private sector, of nongovernmental actors, and of civil society to addressing the many types of issues facing the global community.

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. Here, the term hazard usually refers to climate-related physical events or trends or their physical impacts.

Likelihood: The chance of a specific outcome occurring, where this might be estimated probabilistically. Likelihood is expressed in this report using a standard terminology (Mastrandrea et al, 2010). See Section 1.6 for the list of likelihood qualifiers used.

Mitigation: A human intervention to reduce emissions or enhance the sinks of greenhouse gases.

Resilience: The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure while also maintaining the capacity for *adaptation*, learning and *transformation*.

Risk: The potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. In the context of the assessment of climate *impacts*, the term risk is often used to refer to the potential for adverse consequences of a climate-related *hazard*, or of *adaptation* or *mitigation* responses to such a hazard, on lives, *livelihoods*, health and *well-being*, *ecosystems* and species, economic, social and cultural assets, services (including *ecosystem services*), and infrastructure. Risk results from the interaction of *vulnerability* (of the

affected system), its *exposure* over time (to the hazard), as well as the (climate-related) hazard and the *likelihood* of its occurrence.

Risk transfer: The practice of formally or informally shifting the risk of financial consequences for particular negative events from one party to another (IPCC, 2014).

4

THE CURRENT STATE OF THE PACIFIC

*Patila Amosa**

4.1 Introduction

Climate change poses serious and considerable threats to the environment and livelihood of Small Island Developing States (SIDS), including the Pacific Island Countries and Territories (PICTs). It is expected to exacerbate the magnitude and intensity of natural hazards frequently experienced by the region. Hot temperatures and prolonged drought periods are felt throughout the region, threatening food security and reducing the availability of water resources. Intense rain events and severe flooding have resulted in environmental and ecosystem damage, population displacement both in-country and overseas as well as psychological stress to indigenous communities. Water-borne diseases are becoming more prevalent as vectors increase their habitat range due to warming. Low-lying atolls and coastal communities are already facing sea level rise with the possibility of being fully immersed if greenhouse gas emissions continue to be poorly controlled.

The future of the Pacific depends on how leaders and policy-makers, experts and local communities respond to these changes. This chapter discusses the current state of knowledge of climate change in the Pacific and how the region is addressing present and predicted impacts.

4.2 The Pacific

The Pacific Island region (Figure 1) extends from latitudes 70°W to 100°W and longitudes 66°N to 80°S. It covers an area of over 27 million km² with a landmass of about 551,312 km² and the rest being the ocean. The region includes 22 PICTs, with about 200 high islands of mostly volcanic origin and 2,500 low islands and atolls. Except for Papua New Guinea, land area is small with countries of Micronesia and 80 per cent of the countries in Polynesia having land areas of less than 1,000 km² and with some countries existing as coral atolls and with elevations of less than two metres above sea level. The population in 2016 was estimated to be about 11,328,400, which is about 0.15 per cent of the global population (Nunn, Kumar, Eliot and McLean, 2016) and with an estimated rural to urban distribution of 60 per cent and 40 per cent respectively. This number is projected to increase to over 15 million in the year 2035 and over 19 million in 2050 (SPC, 2016).

There is no doubt that climate conditions have changed since the pre-industrial period, are currently changing and will continue to change into the future. Global and regional assessments of climate conditions conducted by the Intergovernmental Panel on Climate Change (IPCC) over several decades have indicated a daunting future for the region (IPCC, 2018).

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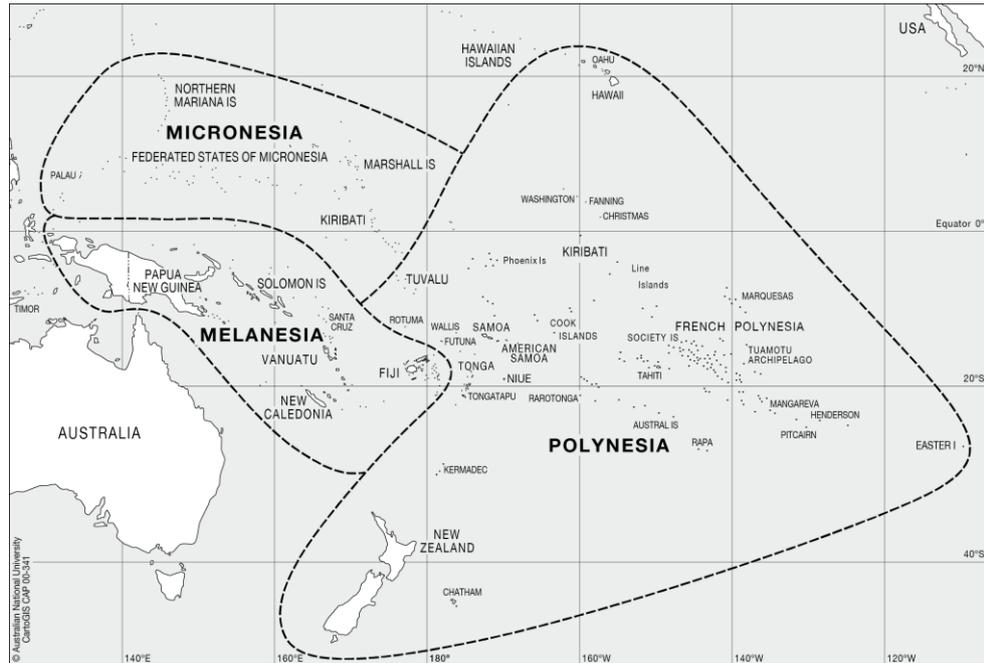


Figure 1: map of the southwest Pacific showing the location of PICTs. Source: <https://iusboverseas.files.wordpress.com/2015/06/00-341_micromela-polynesia.png>.

The leaders of the Pacific envision the region as a place of "peace, harmony, security, social inclusion, and prosperity, so that all Pacific people can lead free, healthy, and productive lives".¹ However, the environment and livelihood of the region and its people are threatened by the impacts of climate change despite its minute contribution of < 0.003 per cent to the global carbon budget (Betzold, 2015). PICTs share common characteristics and environmental challenges due to their size, geographical isolation and economic status, which contribute to their high vulnerability and low adaptive capacity to deal with the impacts of climate change. The Working Group II report on Small Islands (Nurse et al, 2014) forecasts continuing problems that were identified in previous reports, including sea level rise, rising temperatures and more hot days, changing rainfall patterns, ocean acidification, and less frequent but more intense cyclones. These impacts subsequently lead to indirect problems such as erosion, coastal inundation, contamination of freshwater and marine environments, food security, health and settlement patterns, to name a few. Climate change increasingly threatens the viability of agriculture and forestry sectors and food reserves may become inedible due to cyclones and hurricanes.

1 Pacific Islands Forum *The Framework for Pacific Regionalism* (Pacific Islands Forum Secretariat, Suva, 2014) at 3 [*Framework for Pacific Regionalism*].

4.3 Climate change trends in the Pacific

The Pacific currently faces climate-related challenges that are seen globally although the levels of exposure, vulnerability, impacts and coping capacities may vary across countries in the region. This section summarises trends that have been measured or estimated for the region as indicated in technical reports and previous research conducted in the region.

4.3.1 Temperatures

The Pacific is expected to face similar trends in atmospheric temperature as the global situation. Anthropogenic activities have contributed an estimated one degree Celsius increase above pre-industrial levels with global warming potentially raising temperatures by up to 1.5 degrees Celsius between the years 2030 and 2050 (IPCC, 2018) if current patterns of greenhouse gas emissions persist. This increase echoes similar predictions noted in previous IPCC reports (IPCC, 2007) for SIDS. Regional warming is projected to rise above to ~ 0.5-1.0 degree Celsius by 2030 and ~ 1.0-1.5 degrees Celsius by 2055 (Australian Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation (CSIRO), 2011). Land-surface temperatures in the region have increased slightly over the global level by about 0.17 degree Celsius per decade since the 1980s (State of Environmental Conditions in Hawaii and the US Affiliated Pacific Islands under a Changing Climate, 2017).

In an assessment of 15 countries in the western tropical Pacific using data as far back as the late 1800s and with available data up to 2011 (Australian Bureau of Meteorology and CSIRO, 2011), temperatures have increased in the range of + 0.08 to 0.22 degree Celsius per 10 years with projected increases in surface air temperature of 0.5-0.7 degree Celsius by the year 2030 under very low emission scenarios. Increased temperatures coincided with increased warm days and nights in all countries: with Palau showing the highest average number of warm days per decade at 21; and Tuvalu and the Solomon Islands with the highest number of warm nights per decade at about 12. The implications of these changes on the Pacific environment and its people tend to point to the negative end of the spectrum. Warmer temperatures increase evapotranspiration, broaden the habitat of vectors for water-borne diseases and can lead to the development of a tropical cyclone.

4.3.2 Rainfall

The equatorial Pacific is likely to experience an increase in annual mean precipitation by the end of this century (Nurse et al, 2014). Based on a 50-year record from 1951-2011, annual rainfall levels dropped in most countries by - 4.9 to - 77.4 mm/10 years (Australian Bureau of Meteorology and CSIRO, 2011). Palau, Papua New Guinea, Niue, Samoa and Vanuatu had increases in annual rainfall levels with estimates for the latter three countries based on at least a 100-year record. Figure 2 gives an outlook to the rainfall situation in the Pacific for the first three months of 2020. Of concern are countries that are expected to have below normal rainfall during this wet season. These changing rainfall patterns are attributed to climate change.

Severe flooding is occurring more frequently across the Pacific due to intense rainfall events brought about by tropical cyclones. Category 2 Tropical Cyclone Evan which struck Samoa in 2012 brought with it one of the highest rainfall levels ever recorded in Samoa, which caused massive

flooding and damage, including fatalities. The Solomon Islands up to the beginning of 2019 also faced life-threatening flooding associated with severe depressions and tropical cyclones which affected more parts of the country that did not usually flood. Fiji has faced similar devastations as has Vanuatu, resulting in mass relocation of flood-prone populations to safer grounds. In addition to intense rainfall, prolonged dry periods also affect the region as a consequence of climate change.

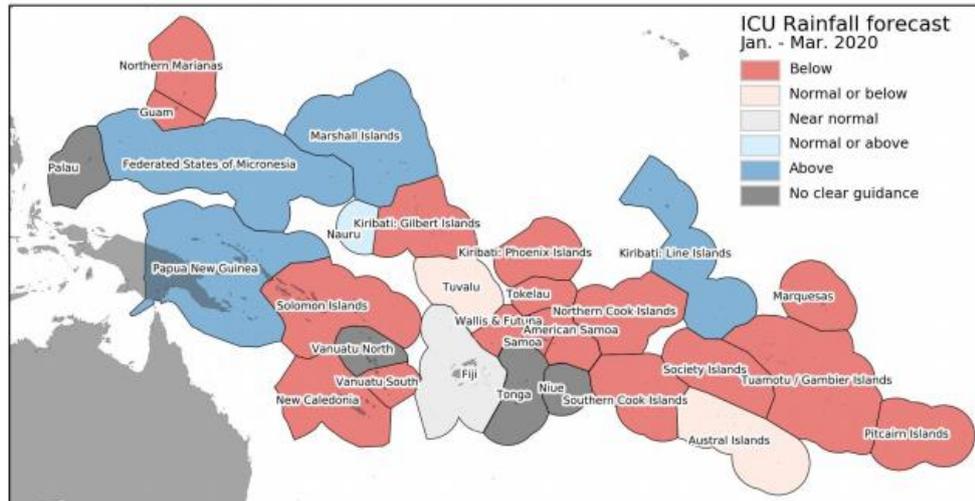


Figure 2: rainfall forecast for the Pacific for January-March 2020. Source: NIWA.²

4.3.3 Cyclones

The wet season running from November to April usually sees a spike in strong weather conditions which have included tropical cyclones normally at lower categories. However, the region was hit by two Category 5 cyclones, with Cyclone Pam generating massive destructions in Vanuatu in 2015, followed by Cyclone Winston in Fiji in 2016. Based on the IPCC AR5, intense tropical and subtropical cyclones are forecast for the region. This forecast has generated fears amongst the region with an estimated seven to eleven tropical cyclones predicted for the period November 2018 to April 2019 (SPREP, 2018). This estimate was quite close to an average of nine tropical cyclones per year for the 30-year period from 1977 to 2007 (Sinclair, 2002) with the peak of the cyclone season from January to March (Diamond, Lorrey, Knapp and Levinson, 2012). A tropical cyclone outlook for the 2019-2020 period (Figure 3) estimates a maximum of four events in the region with an intensity of as high as Category 3. Already, Fiji and Tonga were hit by Category 3 Cyclone Sarai in January 2020.

² "The Island Climate Update ENSO Watch January 2020" NIWA <<https://niwa.co.nz>>.

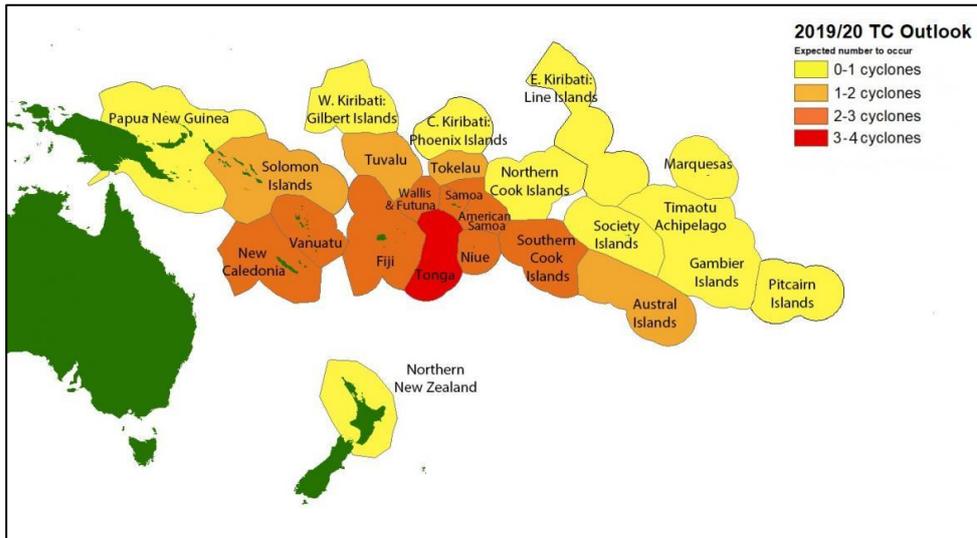


Figure 3: tropical cyclone outlook for the Pacific for 2019-20. Source: NIWA.³

4.3.4 Sea level rise

Global sea levels are rising now and are projected to continue to rise into the latter parts of the 21st century. Based on in situ data dating back to 1880, the rate of rising was estimated at 2.8 ± 0.8 mm year⁻¹ with a global average sea level rise of about 210 mm (Church and White, 2011). Since 1993, global mean sea level rose at a rate ranging from 2.8-3.6 mm year⁻¹ (Nurse et al, 2014). The rates of sea level rise can vary amongst regions and from the global mean sea level rise at different magnitudes, due to fluctuations in ocean circulation. Since 1993, the regional rates for the western Pacific are up to three times larger than the global mean, while those for much of the eastern Pacific are near zero or negative (Nurse et al, 2014). One of the highest recorded rates in the region, around Tuvalu, is about 5.1 mm per year (Connell, 2016).

Rising sea levels have critical direct impacts on the Pacific people as the majority of populations in the region live along the coast and for small atolls, the ocean is both their front and back yards.

Countries already impacted by sea level rise include Federated State of Micronesia, Kiribati and parts of Papua New Guinea and Vanuatu. In addition to sea level rise, king tides, associated with warm water mass and maybe as high as three metres (Lin, Ho and Cheng, 2013), are inundating further inland and saturating coastal aquifers, groundwater and freshwater springs with high salinity seawater. As recent as 2014 and 2019, king tides have struck the Kiribati islands resulting in damage to infrastructure and properties. In the latter year and despite coastal infrastructure developments, Samoa

3 "Southwest Pacific Tropical Cyclone Outlook - October 2019" NIWA <<https://niwa.co.nz>>.

was also struck by strong king tides on both big islands, an unusually obvious phenomenon in the country.

Sea level rise has also induced forced migration in the region, with residents either relocating to higher grounds or other parts of the country or migrating out of the country. Residents of Tuvalu, Tegua Island in Vanuatu and the Carteret Islands in Bougainville, Papua New Guinea were considered the first climate change refugees (Connell, 2016).

4.3.5 Ocean acidification

The ocean is the livelihood of the Pacific people, being the major source of food for indigenous communities and a source of income at both household and commercial levels. The release of anthropogenic CO₂ has increased atmospheric CO₂ by about 40 per cent since pre-industrial times (IPCC, 2013; Zeebe, 2012). The ocean is a major sink of anthropogenic CO₂ with an estimated 25 per cent capacity to absorb atmospheric emissions (Doney, Bopp and Long, 2014; IPCC, 2013). The uptake of CO₂ can alter the chemistry of seawater, leading to a drop in pH and availability of carbonate ions for skeletal formation. CO₂ uptake that is coupled with a temperature rise of 1.5 degrees Celsius is expected to magnify the adverse effects of warming and to threaten the functioning and survival of various marine species (IPCC, 2018), including algae, coral, fish and molluscs. Based on measurements for the 1950-1960 decade, sea surface temperature is expected to increase by up to 0.8 degree Celsius by 2035. Concurrently, pH is expected to drop from pH 8.08 to ~ 7.98 by 2035 (Bell et al, 2011). In the equatorial Pacific, where CO₂ uptake is coupled with deep water upwelling, pH declines of - 0.0018-0.0026 per year were measured for the period 1997-2011 (Sutton et al, 2014).

The saturation state of aragonite (Ω_a), the calcium carbonate morph that is essential for skeleton formation in many marine species including corals, needs to be above 3.5 for calcification. Aragonite saturation state was estimated at 3.9 relative to the 1950-1960 period and is expected drop to ~ 3.3 by 2035 and 2.4 by 2100 (Bell et al, 2011). An average aragonite saturation state of 3.8 was determined in 2000 for the Pacific region with all countries in the western tropical Pacific showing decreases from Ω_a of 4.5 in the late 18th century to $3.9-4.1 \pm 0.1$ (Kuchinke, Tilbrook and Lenton, 2014). Saturation states below 3.5 are projected to be more common in the region (Australian Bureau of Meteorology and CSIRO, 2011) with potential negative impacts not just on the skeletal organisms, but also at the ecosystem level.

Ocean acidification is a new concept in climate change dialogue in the Pacific and research by Pacific researchers in most of the region has been implemented in less than five years. This is a field of urgent need for capacity development in the Pacific region to enable its people to monitor their marine environment and resources as well as identifying potential strategies for an integrated approach to adaptation and resilience development to the acidification problem (Johnson, Bell and Gupta, 2016).

4.4 Challenges for the Pacific

The current challenges associated with climate change are expected to amplify or worsen, multiple stressors may interact to generate more harmful effects and new problems may emerge due to further changes in climate. There have been sporadic incidents of water-borne diseases such as cholera and

dengue fever in recent years as well as the emergence of the Zika virus and outbreaks of malaria. Increased sea surface temperatures, sea level rise and ocean acidification are changing the intrinsic characteristics of the marine environment that promote diverse and healthy ecosystems. Hot temperature extremes and marine heatwaves have resulted directly in coral bleaching events and fish mortality in parts of the region and indirectly on fisheries and marine biodiversity. Fisheries is a major income generating revenue not just at the local household level, but also at the national level. This is even more critical in small atolls like Kiribati and Tuvalu, with limited land for agriculture and huge exclusive economic zones for economic benefits.

Mangrove ecosystems are critical to the survival of marine species as habitats, sources of food and breeding grounds. They also function as carbon sinks to help in the removal of excess carbon dioxide from the atmosphere and as protective agents against storm surges and strong currents. When the rate of sea level rise exceeds the accumulation rate of fluvial sediment, mangroves may face substrate erosion, inundation stress and increased salinity.

The unprecedented rate of decrease in ocean pH and the high sensitivity of coastal ecosystems to such change (Ries, Cohen and McCorkle, 2009) raise serious concerns about the potential impacts of an increase in ocean acidity on the physico-chemical and biological characteristics of marine ecosystems. Currently, the open oceans are supersaturated ($\Omega > 1$) with respect to calcite and aragonite. However, greater reductions in saturation state are projected by the year 2100 in both low and high latitude regions, resulting in enhanced CaCO_3 dissolution (Gangstø et al, 2008). Further declines in saturation states in the low-latitude regions of the south Pacific, where saturation values below equilibrium have already been measured (Bostock et al, 2011), will be quite detrimental to the survival of marine organisms. IPCC assessments indicate that it is highly likely that ocean acidification will continue into the future with significant consequences for coastal ecosystems (IPCC, 2018). Ocean acidification is expected to have a negative effect on livelihood opportunities in the pearl farming and shrimp farming industries (Johnson, Bell and Gupta, 2016). There is a high risk of reduced growth and reproduction under acidified conditions in marine animals such as sea urchins, bivalves and gastropods (Hendriks, Duarte and Álvarez, 2010) as well as respiration and other physiological processes in fish (Guinotte and Fabry, 2008). Corals are prone to drops in the saturation state of aragonite which is critical for the formation of their skeletons. Changes in the distribution and abundance of tuna, plus a decline in coastal fisheries and coral reefs, have also been observed (Bell et al, 2011). These findings are of great concern as fish is a significant revenue-generating export for the region, vital to food security and livelihood of local communities. Pacific Island nations have been identified as the most vulnerable in the world to the health impacts of climate change due to their demographic and limited socioeconomic qualities (McIver et al, 2016).

4.5 The Pacific response

With all the challenges generated by changes in climate and the high vulnerability of the Pacific community, the region is at the forefront of climate change (Lazrus, 2012) and should play a critical role in the dialogue and advocacy on strategies to adapt to, or mitigate impacts of, climate change. The Pacific is in the "eye of the storm", disproportionately facing the impacts of climate change that are generated mostly by factors outside its realm.

The Pacific countries have not only ratified international climate change conventions, protocols and agreement such as the United Nations Framework Convention on Climate Change (UNFCCC),⁴ the Kyoto Protocol to the Framework Convention on Climate Change⁵ and the Paris Agreement,⁶ but they have also adopted laws and instruments to guide and prioritize regional attempts to address climate change with regard to reducing the vulnerability of countries through climate change resilience, mitigation and adaptation strategies and concurrently developing a resilient Pacific. This section summarizes some of these climate-related instruments that have been developed by the Pacific leaders.

4.5.1 The Framework for Pacific Regionalism

The Framework for Pacific Regionalism (FPR) was endorsed by the Pacific Islands Forum leaders in July 2014 and sets out a robust process to identify and implement regional priorities. The FPR outlined four major objectives, which focus on:⁷

- Sustainable development that combines economic, social, and cultural development in ways that improve livelihoods and well-being and use the environment sustainably;
- Economic growth that is inclusive and equitable;
- Strengthened governance, legal, financial, and administrative systems; and,
- Security that ensures stable and safe human, environmental and political conditions for all.

In the Pacific context, regionalism refers to:⁸

The expression of a common sense of identity and purpose, leading progressively to the sharing of institutions, resources, and markets, with the purpose of complementing national efforts, overcoming common constraints, and enhancing sustainable and inclusive development within Pacific countries and territories and for the Pacific region as a whole.

This definition focuses on regional integration and collective action to gauge the contribution of more stakeholders from civil society, private sector and government to policy development at the national and regional levels to achieve the stated goals. The FPR thus provides a forum for coordinated advocacy and negotiations by Pacific Island countries on global climate policies. However, it is a process-focused document with narrowing priority issues for leaders' consideration (Slatter, 2015). The success of the FPR has been challenged through barriers to achieve its objectives, including

4 United Nations Framework Convention on Climate Change 1771 UNTS 107 (opened for signature 4 June 1992, entered into force 21 March 1994).

5 Kyoto Protocol to the United Nations Framework Convention on Climate Change 2303 UNTS 162 (opened for signature 16 March 1998, entered into force 16 February 2005).

6 Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016).

7 *Framework for Pacific Regionalism*, above n 1, at 2.

8 *Ibid.* See Chapters 6 and 7 in this book.

different stages of country development, inclusion and exclusion of certain groups, geopolitics and encouraging member states to balance regional initiatives with their national priorities, particularly when a leader's national level political survival is at stake (Davidson, 2016). The importance of unified efforts was further captured in the Pacific Islands Forum leaders' endorsement in 2017 of the region's identity as the "Blue Pacific".⁹ The "Blue Pacific" connotes the shared values and identities of Pacific people and their relationship with their natural resources, environment, culture and livelihoods.¹⁰

4.5.2 Declaration on Climate Change Action

During the 46th Pacific Islands Forum leaders' meeting held in Port Moresby, Papua New Guinea in September 2015, the Pacific leaders established the Declaration on Climate Change Action (DCCA) to pave the way forward for the region in advocating for a global agreement to limit warming to below 1.5 degrees Celsius above pre-industrial levels.¹¹ The DCCA stressed grave concerns on the adverse effects of a temperature increase above this value on the PICTs and climate change in its entirety, and spelt out 11 points that PICTs call for as part of the outcome of the Paris Climate Change Summit (Conference of the Parties to the UNFCCC (COP21)) in December of the same year.¹² These points include the disproportionate impacts on vulnerable and marginalized groups in the region including gendered impacts and gender-sensitive responses, the commitment of the region in reducing greenhouse emissions and the region's support on international efforts to develop and implement appropriate adaptation and mitigation actions. The concerns of this Declaration are still valid today as activities that contribute to global warming continue, especially the major contributors from industrial nations who, after the Conference of the Parties in Spain (COP25), have still not fully or only partially honoured the commitments stipulated in the Paris Agreement.

4.5.3 Framework for Resilient Development in the Pacific: 2017-2030

The Framework for Resilient Development in the Pacific (FRDP), aimed at addressing climate change challenges in the Pacific, was endorsed by the Pacific Islands Forum leaders in 2016. In contrast to the Pacific Islands Framework for Action on Climate Change (SPREP, 2011) which expired in 2015, the FRDP recognises the overlapping and common risks and threats posed by both climate change and disasters (SPC, 2017). Encompassing sustainable development needs in the Pacific, the FRDP stipulates an integrated approach to mitigation and adaptation strategies to build community resilience against climate change and disaster challenges.

The FRDP specifies three interrelated goals: (1) strengthening integrated adaptation and risk reduction to enhance resilience to climate change and disasters; (2) low-carbon development; and (3)

9 Pacific Islands Forum "Forty-Eight Pacific Islands Forum Communiqué" PIF(17)10, Apia, Samoa, 5-8 September 2017.

10 Id, at [4]-[7].

11 Pacific Islands Forum "Pacific Islands Forum Leaders Declaration on Climate Change Action" (Annex 1 to the "Forty-Sixth Pacific Islands Forum Communiqué" PIF(15)7, Port Moresby, Papua New Guinea, 8-10 September 2015) at [6].

12 Id, at [3] and [11].

strengthening disaster preparedness, response and recovery. The implementation of actions and success in achieving these goals requires collaboration and partnerships amongst various stakeholders from the grassroots communities all the way up to the national government level. Concurrently, the efforts of each Pacific Island nation will also contribute to the implementation of global frameworks such as the Agenda for Sustainable Development 2015-2030, the Paris Agreement, the Sendai Framework for Disaster Risk Reduction 2015–2030 and the Small Islands Developing States Accelerated Modalities of Action (SAMOA) Pathway.¹³

4.5.4 The Kainaki II Declaration for Urgent Climate Change Action Now

The latest Pacific Islands Forum leaders' meeting in Tuvalu in 2019 gave an opportunity for all participants to observe first-hand the reality of the devastating effects of climate change on small island atolls and led to the establishment of the Kainaki II Declaration for Urgent Climate Change Action Now. A significant feature of this Declaration was the unanimous agreement of all members of the Pacific Islands Forum on the existence of a "climate change crisis" in the region.¹⁴ The region continues to advocate for limiting the global average temperature rise to below 1.5 degrees Celsius above pre-industrial levels and with a long-term goal of "achieving net zero carbon by 2050".¹⁵ It also reiterates the need for all state parties to the Paris Agreement to update and report by the end of 2020 on their efforts to reduce national emissions and adapt to the impacts of climate change or their Nationally Determined Contributions (NDCs).¹⁶

Additionally, the Declaration highlights the importance of the climate-ocean nexus and echoes the intricate value of an integrated approach to international negotiations for both climate and ocean challenges to maintain our "Blue Pacific".

4.6 Conclusion

The impacts of climate change have been increasingly felt by many communities in Pacific Island countries where adaptive capacities are mostly inadequate. These impacts are caused by either rapid-onset events such as tropical cyclones and heavy rainfall or slow-onset events like sea level rise and ocean acidification. The Pacific leaders have been pro-active in developing legislations and strategies to mitigate against, and adapt to, climate change as well as advocating and negotiating for climate challenges at the national, regional and international platforms.

Through an integrated and participatory approach, climate change principles are mainstreamed into national legislation and developments to ensure communities are well-protected against the

13 Secretariat of the Pacific Community *Framework for Resilient Development in the Pacific: An Integrated Approach to Address Climate Change and Disaster Risk Management (FRDP) 2017-2030* (SPC, Suva, 2017) at 10-11.

14 Pacific Islands Forum "Kainaki II Declaration for Urgent Climate Change Action Now" (Attachment to the "Fiftieth Pacific Islands Forum Communiqué" PIF(19)14, Funafuti, Tuvalu, 13-16 August 2019) at [1].

15 Id, at [19].

16 Ibid.

impacts of climate change. Mitigation and adaptation projects are implemented across the region at various levels and climate change training and education programmes have been conducted to raise community awareness on impacts, mitigation and adaptation mechanisms. The current laws guiding the development of climate change initiatives acknowledge the importance of an all-inclusive sectoral approach to addressing climate change challenges which were not strongly highlighted in previous legislative measures. For example, health and gender are now recognised as important climate issues.

It is important to stress that Pacific people are extremely concerned about the consequences of climate change. The possibility of high category cyclones in the region, loss of land to sea level rise and potential submergence of small islands are terrifying. The aspirations of the region to combat climate change come with huge financial implications as structural and non-structural capacities are limited. Governments must continue to strengthen collaboration with development partners to secure funds for implementation of climate change adaptation programmes or projects and to build the capacity of Pacific people to continue to advocate for climate change issues.

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5

MATERIALS FOR A LOW CARBON FUTURE

Nicola Gaston, * *Justin Hodgkiss*** and *Shane Telfer****

[T]his refined, minute, and quick-witted chemistry was "invented" two or three billion years ago by our silent sisters, the plants, which do not experiment, and do not discuss, and whose temperature is identical to that of the environment in which they live.

Primo Levi "Carbon" in *The Periodic Table*¹

5.1 Introduction

The world has changed since Primo Levi famously wrote his essay on the life of an atom of carbon, first published in 1975. Then, he could claim that "every element says something to someone", but that carbon was unique in that it says "everything to everyone",² and, therefore, lacks the specificity of other elements. Now, this otherwise mundane element has become highly specific in common usage, synonymous with climate change, in a way that is hard to imagine being the case for any other atom.

It is instructive, however, to recognise that the significance of the concept of the carbon cycle has led to a similar recognition of the need for material sustainability in the use of other elements. The nitrogen cycle relies on atmospheric nitrogen being fixed by plants. In the last century, it has been disrupted to the extent that now, half of the food grown on Earth relies on the synthesis of ammonia from nitrogen. While nitrogen is abundant enough in the atmosphere that this seems unproblematic, the overuse of nitrogen in farming has become an issue of real concern; less well known is that the chemical synthesis of ammonia accounts for two per cent of global energy use. Moreover, other fertilisers, such as those based on phosphorus, come from sources that are not inherently so sustainable.

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1 Primo Levi "Carbon" in *The Periodic Table* (Raymond Rosenthal (translator), Schocken Books, New York, 1984) 224 at 227.

2 Id, at 225.

It has gradually, therefore, become a central theme of modern materials science to consider our work as being about the smart use of natural resources, which might mean replacing the use of scarce elements with earth-abundant ones, or considering the whole life cycle of a material, from synthesis to disposal, as part of the research and development process. These considerations are particularly important in the context of negative emissions technologies, as we shall see, as the question arises: what should be done with the carbon, after it is captured?

The reduction of carbon emissions must be the central goal for efforts to avoid the worst scenarios of climate change. Much of what can and will be done comes down to behavioural change; it is also true, however, that materials science has a role to play in making some of the required economic and behavioural adjustments easier. In this chapter, as we discuss several current and emerging technologies, we wish to present these simply as options that materials science is able to place on the table, rather than as magic solutions that will permit society to continue with business as usual. All of the technologies on offer have a cost; so too, however, does all the carbon-costly technology that is in current usage.

In this chapter, we first address the reduction of emissions through provision of carbon-free energy, in the form of photovoltaic (PV) cells, a relatively mature materials science technology, but with further optimisation and development still to be expected. Secondly, we address the reduction of emissions that is possible through materials-based energy conservation. Here, energy may be saved through the use of advanced materials in energy hungry technologies, such as computing, where energy is both lost through the generation of heat, and then doubly wasted as it is used to keep computer servers from overheating as a consequence of this waste heat. Thirdly, we will look at the issue of carbon capture and storage. Here, the spotlight is on a range of porous materials that show promise in negative emissions technologies; notably, these extend beyond simple capture and storage, to the potential for productive repurposing of atmospheric carbon. As Levi said: "The number of atoms is so great that one could always be found whose story coincides with any capriciously invented story".³ Our role as materials scientists and nanotechnologists is merely to support the more useful pathways; to find ways of saying yes, to each carbon atom: take this pathway, here, this one.

5.2 Clean energy generation via solar PV cells

Solar PV cells unlock access to an energy source that is essentially unlimited on the scale of our needs; the amount of solar energy that reaches the surface of the Earth in one hour is equivalent to global energy used in an entire year. Even when considering that solar PV panels could only cover a small fraction of the surface of the Earth, the scale of available solar energy is immense. Accessing this energy through PV cells has been, and will increasingly be, a significant contribution of materials science towards a low emissions economy.

The total installed PV capacity now exceeds 400 gigawatts and produces roughly two per cent of global electricity. Until very recently, the growth in PV capacity for over 20 years has been

³ Id, at 232.

approximately exponential – doubling approximately every two years (Kabir et al, 2018).⁴ Behind this growing capacity is an exponentially decaying price; costing USD 76 per watt in 1977 (that is, USD 760,000 for a large 10 kilowatts home installation), silicon PV cells now cost a few dollars per watt.

First observed by Becquerel in 1839, the PV effect is the light-induced generation of an electrical voltage across the bandgap of a semiconductor. This bandgap describes a gap of energies that electrons cannot exist in the material, meaning electrons store electric potential when they are excited to the higher energy band. By attaching electrical contacts to this semiconductor layer, a current flows, thereby generating electrical power from the incident (solar) light (Figure 1).

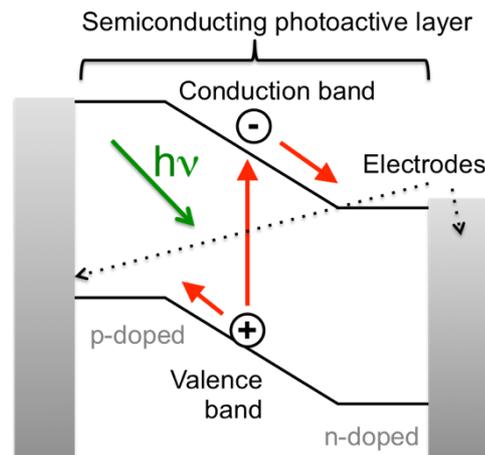


Figure 1: schematic illustration of a PV cell comprised of a semiconductor photoactive layer sandwiched between electrodes, where energy is the vertical axis.

5.2.1 Materials-driven growth of the PV industry

More than a century after this discovery, the first practical PV modules were manufactured by Bell Labs during the boom of the microelectronics industry in the 1950s. The pivotal role that materials science played in transforming that rudimentary device into the type of technology that can be installed on rooftops today is illustrated by the growth in materials diversity on which the silicon PV industry is built. Figure 2 shows the increasing utilisation of elements in silicon microelectronics industry over time. Whereas semiconducting silicon is the main constituent associated with solar PV panels, other elements and alloys are essential to optimising the PV function. For example, dopants are used to tune the energy levels inside the silicon layer and guide electrical current in the right direction. Additives are used to engineer the growth of large, pure crystals, with minimal defects at grain boundaries. Electrical contacts and interlayers are selected to extract current with minimal

⁴ See also International Energy Agency *Photovoltaic Power Systems Programme IEA-PVPS Annual Report 2017* (2018) at 21.

resistance, and with minimal shading of the active layer. Each of these material processing steps must be implemented with precision and at scale.

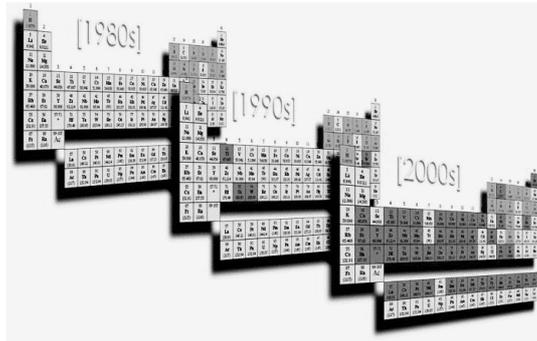


Figure 2: increasing utilisation of elements in the silicon microelectronics industry over time. Source: reproduced with permission from IBM Corporation.

The technical success of silicon PVs is tracked via their increasing power conversion efficiency over time (Figure 3). The efficiency of single junction polycrystalline silicon PV cells (comprising a single semiconductor layer) has approached saturation for the past two decades at around 26 per cent power conversion efficiency. This efficiency is approaching the thermodynamic limit of 31 per cent, the so-called Shockley-Queisser limit, which considers intrinsic losses through heat and transparency when a semiconductor is matched to the solar spectrum (Shockley and Queisser, 1961). The materials science and engineering of silicon PV cells was arguably near complete by the 1990s, and the 2000-fold surge in installed PV capacity since 1995 has been underpinned by falling prices as the scale of global PV manufacture has increased (Powell, Winkler, Goodrich and Buonassisi, 2013).

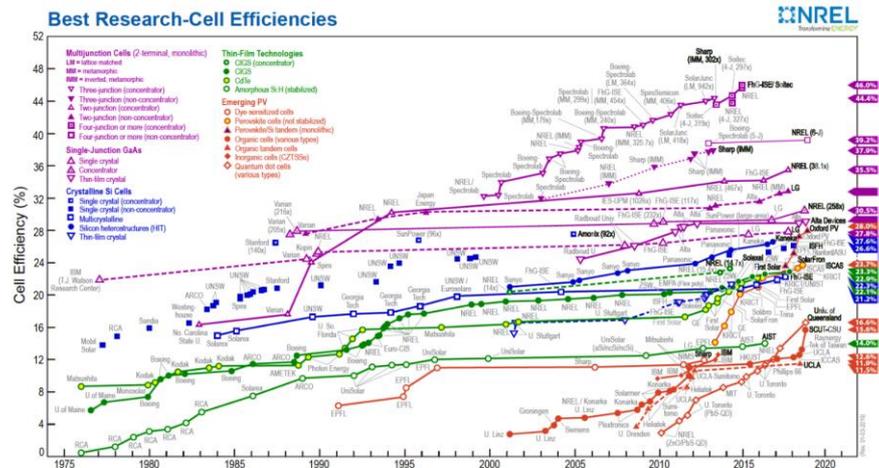


Figure 3: record-certified research PV cell efficiencies for different classes of PV cells over time. Source: reproduced with permission from the National Renewable Energy Laboratory of the United States of America.

Figure 3 also illustrates the remarkable rise of other classes of PV materials in recent years, including organic PVs (Brabec et al, 2010) and metal halide perovskites (MHP) (Stranks and Snaith, 2015). These emerging classes of PV materials offer numerous advantages over incumbent silicon technologies, and their development is even more dependent on materials discovery, design and development.

One important feature of both organic and MHP-based PVs is that they can be processed from solution at low temperature – the key benefit being that PV cells can then be printed roll-to-roll on lightweight, flexible substrates. In the future, when the optimum composition of these PV cells is settled and material production scaled up from current research levels to PV manufacturing levels, simple roll-to-roll production processes could substantially reduce the costs of PV technologies. Below, we describe some of the materials science that is rapidly boosting the efficiency of organic and perovskite PVs towards the Shockley-Queisser limit, and we highlight prospects for innovative materials that could circumvent this limit.

5.2.2 Printable organic PV cells

Organic PVs comprise organic molecules or polymers as semiconductors, rather than crystalline materials (Brabec et al, 2010). The optical and semiconducting properties of these materials are endowed by a so-called pi-conjugated structure – a pattern of alternating single- and double-chemical bonds. This pi-conjugated structure also governs the optical and electronic properties of natural organic compounds like those required for photosynthesis and vision.

In spite of possessing the requisite semiconducting properties to make PV cells, the function of organic PV cells is rather different to established inorganic silicon PV cells. One of the most consequential differences between organic and inorganic semiconductors is that the Coulomb attraction between photogenerated charge pairs is readily screened in inorganic semiconductors like silicon, allowing facile charge separation and photocurrent generation. On the other hand, light absorption in organic semiconductors leads to the formation of electrostatically bound charge pairs. This effect, along with the intrinsic disorder found in organic semiconductor films, means that organic semiconductors retain a strong molecular character that contrasts with the electronic band structure of their inorganic counterparts.

Overcoming the strong barrier towards charge separation in organic PV cells requires a mixture of at least two different materials in the active layer, as shown in Figure 4 (Yu et al, 1995). By matching materials with electronic energy levels to drive electrons into one phase and positively charged holes into the other, the Coulomb binding energy can be overcome to efficiently generate photocurrent. Understanding this key charge separation process has been a research priority in recent years in order to guide the design of better materials.

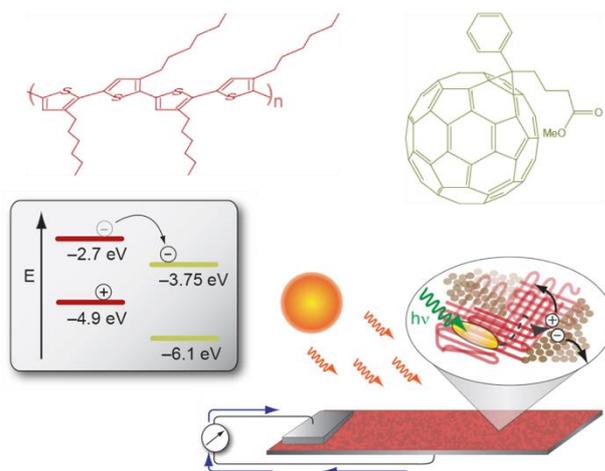


Figure 4: typical organic polymer (left) and fullerene (right) components of an organic PV cell, whereby the energy level offset drives interfacial charge separation in a nanostructured blend of the two.

The power conversion efficiency of organic PV cells has recently surged to over 15 per cent as a result of a global push to develop new active-layer materials. Until recently, soluble carbon fullerene derivatives (Figure 4) were the best performing electron acceptor materials in organic PVs.⁵ In spite of their weak optical absorption, carbon fullerenes perform well in organic PVs due to their excellent three-dimensional electron mobilities, and their ability to blend well with donor materials. Materials discovery and design focused largely on electron donor materials, and synthetic organic chemistry opens enormous possibilities of chemical structures with different optical absorption spectra, electronic conductivity, solubility, degree of structural order, mixing behaviour and stability – all critical parameters for organic PV cells. Understanding how to collectively optimize these parameters – even knowing what the optimum parameters are – has challenged the research community to work across research disciplines.

Understanding and controlling the nanostructured morphology of organic PV cells has been an important sub-discipline in the development of organic PV cells (Zhao, Wang and Zhan, 2018). The nanostructured donor-acceptor blend portrayed in Figure 4 is required to ensure that excitations created by light absorption are always close enough to reach a junction, while also ensuring that there is enough material in total to absorb all of the incident light. However, this morphology introduces a trade-off: if phase-separation is too fine-grained, charges do not flow freely and may recombine rather than being extracted from the active layer. On the other hand, too coarse phase separation reduces the probability that excitations will reach a charge-separating junction. The situation becomes more complex when considering that molecularly intermixed phases can also exist, and that molecular orientation can also be important. These factors have motivated significant research efforts to measure

5 Christoph J Brabec et al "Polymer–Fullerene Bulk-Heterojunction Solar Cells" (2010) 22(34) *Advanced Materials* 3839 at 3841.

the morphology of organic PV cells over different critical lengthscales, and also to control the resulting morphology. Some of the tools that materials scientists have developed to control morphology include adding different solubilising groups, employing solvent additives and using thermal annealing steps (Zhao, Wang and Zhan, 2018). The hundreds of publications that focus on a single material system alone is testament to the vast parameter space that materials scientists have explored (Dang, Hirsch and Wantz, 2011).

The field of organic PV cells has been buoyed by the recent emergence of non-fullerene electron acceptors, which now outperform fullerenes in record efficiency organic PV cells (Lin and Zhan, 2014). These new classes of molecular acceptors combine excellent electron mobility with strong optical absorption, and chemically tuneable energy levels. By tuning these parameters, materials scientists are discovering how to enhance the voltage, current and, ultimately, efficiency of this new sub-class of organic PV cells, stimulating rapid efficiency gains.

5.2.3 MHP PV cells

The search for solution-processable semiconductors with high PV power conversion efficiencies was considerably boosted with the discovery of MHP PV cells in 2012 (Lee et al, 2012; Stranks and Snaith, 2015). The active layer materials comprise metal halide (for instance, lead iodide) complexes and cations (for instance, methylammonium) that form a perovskite crystal structure (Figure 5) when deposited from solution, and they can now produce power conversion efficiencies over 23 per cent.

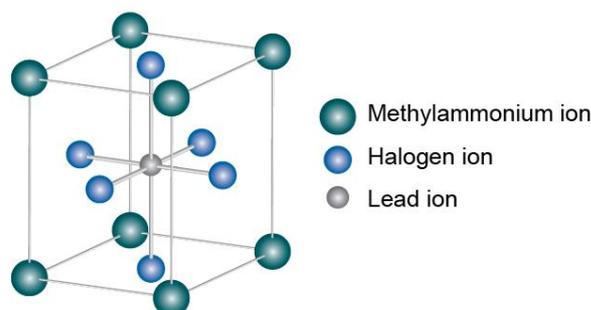


Figure 5: structure of the OMHP (CH_3NH_3) PbI_3 used in efficient PV devices.

Many of the same tools used to study organic PV cells have been applied to MHP PV cells in order to understand what makes them so efficient (Stranks and Snaith, 2015). They are a direct bandgap semiconductor, which means that only a thin layer is required to absorb all light. The bandgap of the most commonly used MHP materials is well matched to the solar spectrum, and is readily tuned by substituting the ions (for instance, using different halide ions, or mixtures thereof). Photoexcitation directly generates free charges, thus circumventing the charge separation problem that dominates organic PV cells, and the need for nanostructured junctions. Charges are long-lived and highly mobile, meaning that photocurrent is easily extracted before recombination occurs. The mobility of ions within MHP materials also appears to engender self-healing properties, meaning that defects are less detrimental to device function.

Aside from exploring the fascinating photophysical properties of MHP materials, significant research effort is now directed at understanding their stability (Niu, Guo and Wang, 2015). MHP-based PV cells generally suffer significantly poorer stability than organic PV devices, and early research efforts were plagued by hysteresis effects. As well as chemical degradation in the presence of moisture and oxygen, MHPs exhibit structural phase changes on account of the rotational freedom of methyl ammonium cations and migration of halide anions. The solution to this problem again appears to come from materials science, in the use of alloys of numerous anions and cations.

5.2.4 New paradigms for efficient PV cells

The Shockley-Queisser limit of around 30 per cent power conversion efficiency applies to single junction PV cells made from all classes of materials; photon energy absorbed above the bandgap is wasted as heat, and photons with lower energy than the bandgap are not absorbed at all (Shockley and Queisser, 1961). A frontier of PV materials research is in the development of materials that could circumvent this limit via two main approaches. One is to convert high energy photons into multiple lower energy excitations (Smith and Michl, 2010). In some organic materials with a particular electronic structure and packing arrangement, a photoexcitation can undergo a fission process that leaves a pair of excitations, each with half the original energy, on neighbouring molecules. When properly integrated into a PV cell, this means that high energy photons could produce twice the photocurrent that they otherwise would. The second approach to photon management is in "upconverting" multiple low energy photons into a photon with sufficiently high energy to be absorbed across the bandgap (Singh-Rachford and Castellano, 2010). Again, this idea does not violate conservation of energy because the energies of multiple photons are added together to give fewer higher energy photons. One implementation of this is through molecules whose photoexcited states can collide and react to produce higher energy excited states that emit higher energy photons. Materials scientists are developing design rules for both fission and upconversion, and creating materials with finely tuned energy levels, light absorption and emission spectra, and reaction kinetics.

In summary, solar PVs are already beginning to significantly impact global electricity production, and their importance as a carbon neutral energy supply will only continue to grow. Behind the evolution towards more efficient and lower cost solar PVs is a significant materials science effort, first in the development of industry standard silicon cells, and now in the rapid growth of a materially diverse set of next generation cells, including organic and MHP cells.

5.3 Energy conservation in computing and devices

One of the challenges in the public communication of the climate change crisis has been the essential invisibility of the key problem: human senses are not well-equipped to directly detect the relevant changes in atmospheric carbon. However, fossil fuels themselves are real and tangible, and the unpleasant emissions from a car exhaust are sufficient explanation of the basic problem for many people. Yet, the transition away from fossil fuel-based transport is one of the hardest forms of behavioural change that is needed: how much harder must the problem be, then, when the energy cost of a technology remains largely invisible?

This is the essential issue that underlies the importance of energy *conservation* in computing. The average consumer is aware of the energy that their mobile phone uses directly, of course, as their

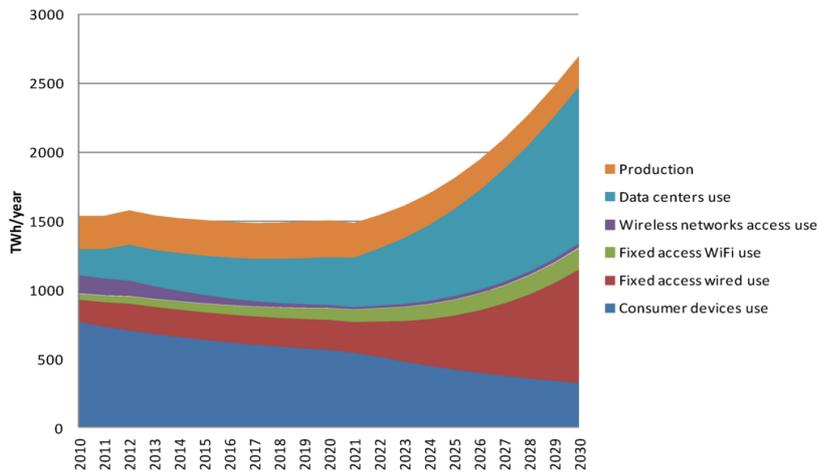
battery threatens to give out; very few have ever given any thought to the energy consumed by data servers on the other side of the world when they google the words "climate change". Nor when they use Facebook to organise an event to highlight climate change issues, nor when they store the photos from that event in the "cloud". Simply put: the cloud costs carbon.

Data centres use, as of 2018, around 200 terawatts (TWh) per year (Jones, 2018). The demand for data centre services is, of course, driven by the explosion of internet services, which are growing exponentially. This is, in some sense, the new Moore's Law, but one that is not so clearly bounded by an identifiable physical limit.

The carbon emissions from data centres alone sit at around 0.3 per cent of overall carbon emissions, but if the Information and Communications Technologies (ICT) ecosystem as a whole is taken into account (including personal digital devices), the value sits closer to two per cent. At this point, the carbon cost of computational technologies rivals that of air travel.

The comparison to the aviation industry is probably problematic enough to the average reader, but then again we have been told for a long time that aviation is an issue, and offsetting of carbon from flights is an idea that has had some, if limited, uptake from the public, with some associated behavioural change. A real concern around computing is that the invisibility of the carbon cost provides a real barrier to reduction through behavioural change, and some projections suggest that the ICT budget could grow to 20 per cent of global electricity use within not much more than a decade (Andrae and Edler, 2015). More optimistic projections reduce this to eight per cent, through enhanced energy efficiency of various parts of the system (Figure 6).

Best Case scenario CT electricity



(a)

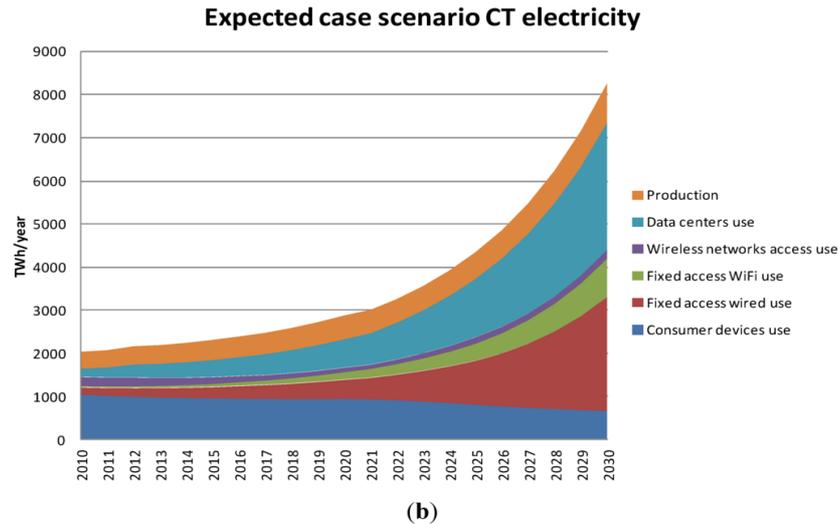


Figure 6: the expected growth in energy use by computing technology depends critically on technological advances to improve energy efficiency. Source: figure reproduced from Andrae and Edler, 2015 under a CCBY license.

5.3.1 Energy efficient computing paradigms

Novel materials that would enable computing paradigms that reduce energy usage, if realised in practical devices, include the following:

- *Superconductors.* Superconductors allow electrons to flow without the resistance that generates heat, a form of energy loss. This happens because electrons pair up – into so-called Cooper pairs – when a material becomes superconducting, at sufficiently low temperatures, and this pairing allows them to move without colliding within the superconductor. These collisions are what we normally refer to as resistance, which wastes energy (and produces heat). Superconducting computing components that are most promising include computer chips built from Josephson junctions, which consist of superconducting material separated by a very thin barrier that electrons can tunnel through. This creates the ability for current to be switched on and off, which is the basic ingredient necessary for information processing. However, all superconductors require very low temperatures, below a characteristic critical temperature for the material, in order to function, and there is an associated energy cost to cooling the material to such low temperatures.

- *Topological Insulators.* Topological insulators conduct electricity only along their surfaces and, therefore, a 2D topological insulator only conducts along its edges, and only in one direction, which eliminates resistance. The topological electronic state will not exist under all physical conditions; it can be switched on or off electrically, with a gate voltage, or even with the use of light.

- *Spintronic materials.* A spintronic material has an inherent magnetism due to the preferred orientation of the spin of some of its electrons. Instead of the electron charge needing to move through

the material to transfer information, the spin of the electron – its inherent magnetic dipole – can be used instead. This requires much lower energy input, as the spin can be transferred between electrons, much as a magnet can cause another magnet to rotate, without the electrons needing to move as far through the material. This relies on materials being found that have the necessary combination of semiconducting and magnetic properties; this can be achieved by using layers of semiconductors (for example, silicon) and magnetic metals (for example, iron), but also by designing new materials in which these properties co-exist (Granville et al, 2006). Spintronic materials also have some key advantages for memory storage – namely that the spin orientation is kept fixed when the computer is turned off, so no energy is needed to keep data in memory.

- *Neuromorphic computing.* A relatively new development, neuromorphic computing – or computers that "think like the brain" – use a range of different physical architectures of materials to process information. Instead of simple binary processing of zeroes and ones – whether by electron charge or spin – they process information in a more holistic way. The hardware varies, but requires a physical network consisting of many interacting parts – such as, for example, metal-based nanoparticles – which can be used to represent and optimize data. While this may not replace standard computational architectures for all problems, there are specific tasks – such as image recognition – that brains are more efficient at, as there is no efficient algebraic algorithm for finding the right answer. This is, of course, why images have long been used as CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) to identify human users of computers.

- *Quantum computing.* A variety of material systems are being developed for use in quantum computing: the key difference is that instead of the bits – coded 0 or 1 – used in classical computing, they require qubits, that can be in states 0, 1, or a superposition, or combination of the two. The qubit (or quantum unit) can be based on some of the above material systems – for example, superconducting circuits consisting of Josephson junctions, or the spin state of an electron in a quantum dot (nanoparticle); so long as the coding is done by a particle that itself behaves quantum mechanically, it can in principle behave as a qubit. As in the case of neuromorphic computing, quantum computing has particular potential to reduce computational cost and associated energy requirements, when applied to problems that it is particularly well suited to solve. A relevant example is computational materials science itself: calculating the electronic structure of a material currently requires that the wave function that contains all information about the electrons be broken into many pieces to be processed independently, and then put back together again. A quantum computer would be able to create a representation of the wave function itself, and from this extract any necessary data much more directly.

Of the possibilities listed above, we will discuss in more detail here those that have the most direct impact on energy usage without the need for considerable cooling – namely those computing components based on spintronics, and topological devices. However, it is also worth noting that many of these technologies are not advancing in isolation from, or in competition with, the others: for example, the provision of superconducting circuits has significance as an enabling technology for some forms of quantum computing.

5.3.2 Spintronics

The field of spintronics has the potential to contribute to computing technologies in a variety of ways (Sinova and Žutić, 2012): from tunnelling magnetoresistance (TMR) and giant magnetoresistance (GMR) components for hard-drives, to magnetic random access memories (mRAM) and high density memory devices. The spin Hall effect, which makes the electrons in an electric current move in a way determined by their spin, has enabled the creation of spin field-effect transistors (FETs). Spintronics has also been integrated with silicon electronics, through the injection of electron spin into the traditionally used semiconductor: this has promise for the integration of spintronics with currently dominant technologies.

In Figure 7, the materials architectures underlying some of the simplest devices are presented.

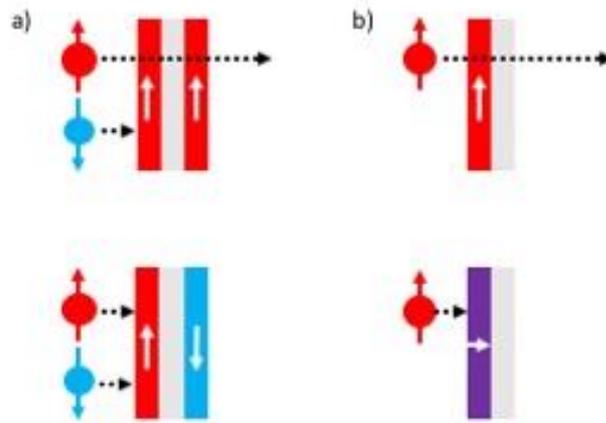


Figure 7: the alignment of electron spin within a device architecture has energetic consequences that allow for the processing, transmission and storage of information within computing hardware – (a) layers of ferromagnetic material, which can have a permanent magnetisation such as in a fridge magnet, can be placed either with their poles aligned (top) or in opposition (bottom); changing this alignment leads to a different flow of electrons of opposite spins; (b) Spin-orbit coupling, an effect that is important in heavy elements, makes it possible to align a single layer of material with the spin of electrons (top) or in a way that inhibits their flow (bottom).

Magnetoresistance – such as is created in the architectures shown in Figure 7, is what underlies the use of these materials in mRAM devices. The states are different when the magnetisation of the magnetic layers is changed; this provides a digital signal of "0" and "1" which is used to store information. The materials science challenge consists of finding materials that have a sufficiently high anisotropy, or resistance to switching orientation, so as to be stable under normal operating conditions – but not so high as to be difficult to switch at will.

5.3.3 Topological devices

Topological devices share considerable similarities with spintronics. The key difference is that the electrons are confined to the surface of a 3D material, or to the edge of a 2D material, as the

interior of the material remains insulating. This relies on a coupling of the electronic spin to the motion of the electron (spin-momentum locking), which means that these metallic surface states cannot be destroyed (unless, for example, a magnetic field is applied). Some of the excitement about the use of topological devices is due to the fact that materials with these properties have only been recently discovered: in 2007, for the 2D materials based on sandwiches of cadmium and mercury telluride (König et al, 2007); and in 2008, for 3D materials, in bismuth-antimony alloys (Hsieh et al, 2008). These materials are based on relatively heavy types of metals for the reason that these heavy atoms cause strong coupling of the spin of the electron to its momentum (spin-orbit coupling).

In summary, the discovery of new physics in new classes of materials has led to significant advances in computing technology over the last decades, beyond merely the increased computational power of an individual computer chip, to the development of smarter ways of computing, requiring new algorithmic paradigms which will be much more efficient for certain classes of computational problems. While these advances have been originally motivated by the concept of Moore's Law, that links increases in computational speed to reductions in chip size that are fundamentally limited by the number of atoms required to make the structures on a chip, it is increasingly recognised that computational efficiency is critical to reducing the carbon cost of our data hungry lives.

5.4 Negative emissions technologies: the role of materials science

There are two principal ways to reduce the levels of carbon dioxide in the atmosphere: lowering the release of new carbon dioxide; and capturing the gas that has been released historically. The latter process is termed the *negative emission* of carbon dioxide. It is much like a debt that needs to be repaid. We will discuss the need for negative emissions and the technologies that are available. The emphasis will be placed on the central role that fundamental research will play in developing sustainable porous materials for carbon dioxide capture.

Increasing levels of greenhouse gases in the atmosphere will result in a global temperature rise. The International Panel on Climate Change has projected the extent of this temperature rise based on various future greenhouse gas level. Even a temperature rise of 1.5 degrees Celsius above pre-industrial levels will require "rapid, far-reaching and unprecedented changes in all aspects of society".⁶

Mechanisms for pulling back on new carbon dioxide emissions are well established (Huisingh et al, 2015). Essentially, these hinge on reducing our combustion of coal, natural gas and petroleum. Reducing our reliance on these fossil fuels is likely to be a fairly gradual process, and the level of carbon dioxide in the atmosphere will continue to rise for the next several decades. This is because atmospheric carbon dioxide is long lived. It generally survives for around 50 years before it is consumed by photosynthesis, mixed into the ocean or destroyed by other processes. While cutting the emission of new carbon dioxide is essential, by itself it will not be sufficient to avoid dangerous temperature rises.

6 Intergovernmental Panel on Climate Change (IPCC) "Summary for Policymakers of IPCC Special Report on Global Warming of 1.5°C approved by governments" (press release, 8 October 2018) <<https://www.ipcc.ch>>.

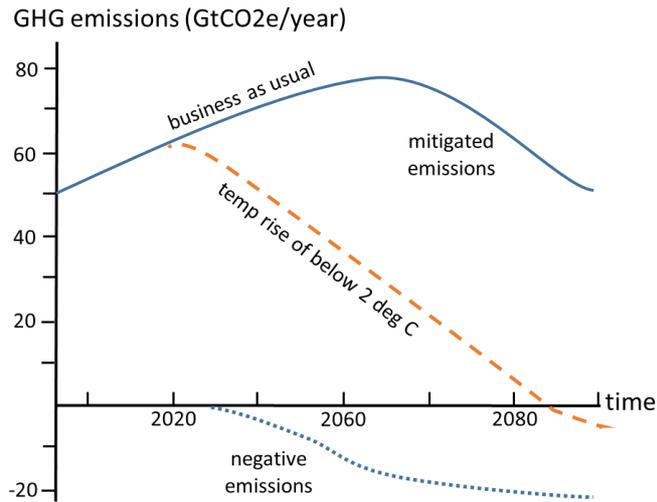


Figure 8: the central role of negative emissions in minimizing United Nations Environment Programme's projected temperature increases due to atmosphere greenhouse gases (GHGs). The y axis is in units of gigaton equivalents of carbon dioxide per year.

Negative emissions technologies must be deployed to augment the reduction of atmospheric carbon dioxide levels (Bui et al, 2018; Gasser et al, 2015). The Paris Agreement states that this should be carried out with haste: the large-scale capture of carbon dioxide should begin over the next decade.⁷ By 2050, an accumulated 40 billion tons of carbon dioxide will need to be extracted from the atmosphere. And to achieve net zero emissions, 20 billion tons will need to be captured annually.

These numbers are unfathomably vast. Do we have suitable technologies available to capture carbon dioxide on this scale? The simple answer is "No". Using current methods, we capture just 40 million tons of carbon dioxide per year. This needs to be scaled up a thousand-fold over the next decade. This will not be achievable simply by rolling out more of today's technology. We will need to develop new knowledge and processes, which in turn shall rest on advances made by fundamental research.

5.4.1 Strategies to capture carbon dioxide

Negative emissions technologies can be broken down into the following broad categories (Leung, Caramanna and Maroto-Valer, 2014; National Academies of Sciences, Engineering, and Medicine, 2018):

⁷ Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016), article 5. See Peter Christoff "The promissory note: COP 21 and the Paris Climate Agreement" (2016) 25(5) Environmental Politics 765.

- Blue carbon. Land use and management practices that increase the carbon stored in the open ocean or coastal ecosystems.
- Terrestrial carbon. Agricultural practices that enhance the storage of carbon dioxide in biological stocks such as woody biomass and soil, but is very land-intensive.
- Mineralization. Carbon dioxide is integrated into minerals, including mantle peridotite, basaltic lava, and to form limestone.
- Bioenergy with carbon capture and sequestration. Energy production in the form of electricity, liquid fuels and heat using plant biomass is combined with the capture of the emitted carbon dioxide (see next point), but is very land-intensive.
- Capture of carbon dioxide from point sources. Sequestration of carbon dioxide from streams where it is a significant component, such as flue gas, natural gas and geothermal vents.
- Capture of carbon dioxide directly from air.

The remainder of this discussion will focus on the latter two strategies for achieving negative emissions, with an emphasis on the role that fundamental research in materials science can play.

5.4.1.1 Point source carbon dioxide capture

A major benefit of point source carbon capture is that it allows for the interim use of fossil fuels while largely eliminating their emissions. This enables established industries to gradually transition to renewable energy sources while mitigating further adverse environmental impacts. The major users of this technology are coal- and gas-fired power plants, steel works, cement producers and natural gas providers, where it is often referred to as gas "sweetening".⁸ It is unsuitable for small-scale emissions involving liquid hydrocarbon fuels.

The conventional method for sequestering the carbon dioxide from point sources is to pass the gas streams through an aqueous solution of an amine such as ethanolamine. A chemical reaction takes place between the carbon dioxide and the amine. The reaction product remains in solution while the remaining components of the gas escape unimpeded. Upon saturation, the solution can no longer adsorb more carbon dioxide and it must be regenerated. This is an energy-intensive process since heating the solution, which is largely water, requires considerable thermal input. Moreover, the carbon dioxide is usually released into the atmosphere during this step. To achieve negative emissions, it should be captured and then stored or used (as discussed later). An additional drawback of amine solutions is their toxic and corrosive nature (Liang et al, 2015).

Solid adsorbents are alternatives to amine solutions. They operate by hosting the carbon dioxide in their networks of pores and channels (Oschatz and Antonietti, 2018). Since their interaction with the adsorbed carbon dioxide is relatively weak, they require minimal energy input in the regeneration step to drive the carbon dioxide out of their pores. Zeolites and activated carbons have traditionally

8 Mohammed Songolzadeh, Mansooreh Soleimani, Maryam T Ravanchi and Reza Songolzadeh "Carbon dioxide separation from flue gases: a technological review emphasizing reduction in greenhouse gas emissions" [2014] *The Scientific World Journal* 828131 at 25. See also Mohammed Songolzadeh, Maryam T Ravanchi and Mansooreh Soleimani "Carbon dioxide capture and storage: a general review on adsorbents" (2012) 6(10) *World Academy of Science, Engineering and Technology* 225.

dominated this area because they are inexpensive and available in bulk quantities. Membranes offer an alternative method of separating out the carbon dioxide while reducing the amount of material required to achieve an effective result. As outlined later, breakthroughs in materials science can underpin advances in this area to produce efficient and sustainable capture materials.

5.4.1.2 Direct air capture

Direct air capture is a process that sequesters carbon dioxide from ambient air and concentrates it in an adsorbent medium (Sanz-Perez et al, 2016). Once the adsorbent is saturated, the carbon dioxide is removed and the adsorbent recycled for a further round of capture (Figure 9). The concept of direct air capture was introduced in a formal way by Lackner in 1999 (Lackner, 2009). Initially deemed controversial, it is now seen as essential: negative emissions are baked into all climate change mitigation scenarios. Direct air capture is in an exciting phase from the viewpoint of materials science and technology. There are huge incentives, but large-scale operations are yet to be deployed.

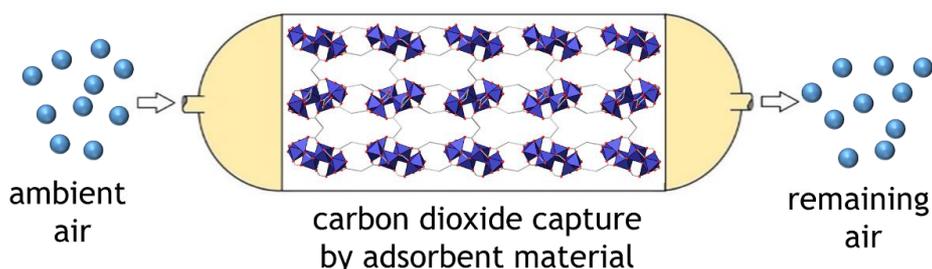


Figure 9: the direct capture of carbon dioxide by passing air through an adsorbent material that has a high affinity for carbon dioxide, but not the other components of air.

One of the biggest challenges that direct air capture faces is the low level of carbon dioxide in air. While it is too high for the global climate system, its concentration is 414 parts per million, which equates to 0.041 per cent. Just one out of every 2500 molecules in air is carbon dioxide, the remainder largely being nitrogen and oxygen. For direct air capture to be feasible, it, therefore, must be highly selective (Oschatz and Antonietti, 2018). The adsorbent must ignore the nitrogen and oxygen and bind only the carbon dioxide. Thankfully, this is feasible owing to the high reactivity and polarity of carbon dioxide relative to these other gases. It undergoes unique chemical reaction when bubbled through a solution containing an amine or other base. Or it can be more firmly caught in the pores of a solid adsorbent. The technical feasibility of scrubbing carbon dioxide from closed sources has been demonstrated in submarines and spaceships where it is employed to limit the build-up of carbon dioxide (Mattox, Knox and Bartot, 2013). As an interesting side-note, the rising levels of carbon dioxide onboard the crippled Apollo 13 spacecraft threatened the lives of the men on board until the lithium hydroxide filters designed for the command module could be adapted to the lunar module.

Commercially-available devices for the capture of carbon dioxide directly from air are emerging. Climeworks, a company based in Switzerland, offers a basic unit capable of capturing 135 kg of carbon dioxide per day (Bourzac, 2017). Multiple units can be run in parallel to eliminate five tons per day at an estimated cost of USD 600 per ton. Regeneration of the saturated adsorbent requires

temperatures of 100 degrees Celsius. This is a significant energy penalty and, naturally, the global analysis of the carbon-saving capabilities of these devices will be enhanced if they tap into renewable electricity sources. Renewable energy may also ameliorate concerns around devices that require the input air to be prepared or modified, for example by heating, cooling or pressurizing (all of which require energy).

5.4.2 The demand for new materials

The demand for technologies capable of capturing carbon dioxide from both point sources and directly from the atmosphere is compelling (Songolzadeh, Ravanchi and Soleimani, 2012). There is tremendous scope for fundamental research to identify and develop new ways of capturing carbon dioxide to discriminate it from other components in air in a sustainable way. Materials science will play a central role. Advances will come at the lab bench by designing, synthesizing and testing new porous materials. Ideally, these materials will be built up from earth-abundant and inexpensive precursors and they will be produced and recycled using energy-efficient protocols (Kumar et al, 2015).

Metal-organic frameworks (MOFs) feature prominently amongst the new generation of materials that will underpin advances in direct air capture (Furukawa, Cordova, O'Keefe and Yaghi, 2013). MOFs are crystalline porous materials that are built up using both metal and organic components. Unlike many other adsorbents, such as zeolites and silicas, the size, shape and chemical characteristics of their pores can be tuned by altering the building blocks. In this way, their affinity and selectivity for carbon dioxide can be optimized (Shalini et al, 2018; Sumida et al, 2012). A plethora of MOFs can be imagined, and the current challenge is translating structural blueprints into tangible materials. It is likely that fundamental research advances in this domain will produce adsorbents that meet the criteria for large-scale deployment at point sources or for atmospheric sequestration.

Looking ahead to the potential deployment of direct air capture, an ideal mass-produced device would be equivalent to a car in terms of weight and complexity and would capture one ton of carbon dioxide per day. Producing five million air capture units of this type could eliminate nearly two billion tons of carbon dioxide from the atmosphere per year. Given that more than 70 million cars are produced every year, deployment on this scale seems eminently achievable.

5.4.3 What to do with the captured carbon?

The negative emissions processes discussed thus far do not themselves convert the captured carbon dioxide into other compounds. Since carbon dioxide is a gas at room temperature, its direct release would see it enter the atmosphere and negate the negative emissions process. Storage of carbon dioxide in solid form, dry ice, is possible, but requires low temperatures (- 78 degrees Celsius), and, therefore, is not energy efficient. Moreover, to store 40 billion tons of carbon dioxide would require a storage reservoir equivalent to a mind-boggling 10 million Olympic-size swimming pools.

Using the captured carbon dioxide is difficult (Aresta, Dibenedetto and Angelini, 2014). Small quantities can be consumed in greenhouses, where it is converted to biomass by photosynthesis. It can be incorporated in polycarbonates, a family of tough polymers that are employed in the electronics

and construction industries. However, carbon dioxide used in these ways would rapidly saturate market demand.

The opportunity exists to initiate sequence of catch-convert-use (Figure 10). For example, if the captured carbon dioxide is converted to a liquid fuel such as methanol or gasoline, the fuels can then be used, releasing carbon dioxide which is subsequently captured to closed-cycle. This air-to-fuels cycle has numerous attractive features. Based in Squamish, British Columbia (Canada), Carbon Engineering captures carbon dioxide from air and, via calcium carbonate and calcium oxide intermediates, converts it to liquid fuels together with hydrogen from solar-powered water electrolysis (Keith, Holmes, Angelo and Heidel, 2018). Advances in fundamental research coupled with smart engineering are certain to further promote the efficiency of this process. Substantial recent investment in this firm by Chevron and BHP signals the perceived value of this approach.

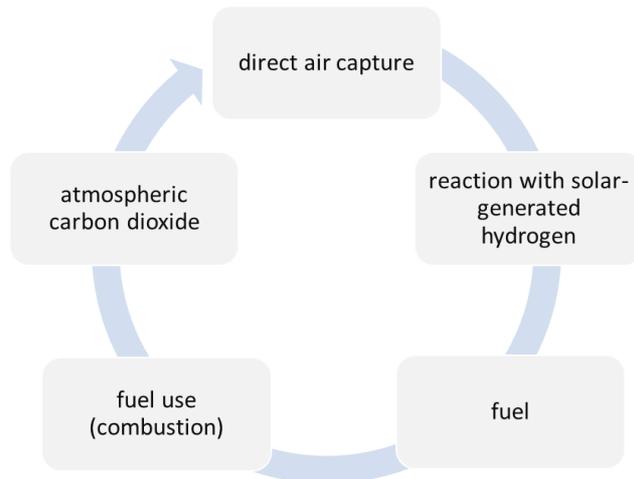


Figure 10: a closed loop involving direct air capture of carbon dioxide and its conversion to usable fuel.

In the context of research incentives, a broad group of benefactors is offering a USD 20 million prize, the so-called "Carbon XPRIZE", to the best new technology for converting carbon dioxide into valuable products and commodities. The finalists in this global competition present an insight into the activity and breadth of research in this domain, and include Breathe, an Indian enterprise that converts the carbon dioxide emitted from coal-fired power stations into methanol, and Carbon Cure, a Canadian company that converts carbon dioxide into advanced concrete products.

In addition to fuels, the conversion of the carbon dioxide to urea is another possibility. This occurs by the reaction with ammonia. Employing urea as a fertilizer results in its conversion back to carbon dioxide and ammonia, and capture of this carbon dioxide by direct air capture would close the cycle.

As an alternative to using the captured carbon dioxide, it can be permanently stored. One approach is to convert it to minerals such as calcium carbonate (limestone) or sequester it in peridotites. Alternatively, the carbon dioxide can be pumped into geological reservoirs that have been emptied, at least in part, by fossil fuel extraction. The injected carbon dioxide can lead to "enhanced oil

recovery", that is, recouping even more fossil fuels. This calls into question the sustainability of this solution. Nevertheless, it has been established that stable storage over long periods of time is possible while avoiding drawbacks such as the disturbance of underground sources of drinking water and the distances over which the carbon dioxide must be transported (Bui et al, 2018).

5.4.4 Pricing and timescales

A common refrain when discussing negative emission technologies is the question of how much it will cost to capture the carbon dioxide. The current benchmark for a process to be deemed economical is set at USD 100 per ton. Existing technologies for capturing flue gas meet this target and lie in the range of USD 30-100 per ton. The costs of direct air capture are highly debated, exacerbated by the absence of any commercial-scale deployments (Tollefson, 2018). The best guesses lie in the range of USD 60-1000 per ton, which is a wide range that will narrow as pilot-scale processes are initiated.

While the cost of carbon dioxide is a legitimate question, the current estimates do not include a price on carbon. They are simply generated using current taxation rates. However, it seems certain that governments will move to protocols whereby emitters shoulder their fair burden of costs, rather than externalizing them. This will raise the threshold for economical technologies, and allow those that draw on more expensive materials to become viable.

Significant costs are associated with new technologies such as fundamental research and prototyping, capital investment, energy for operating the process, including the need to regenerate the adsorbent, and maintenance. For point source capture, commercial enterprises will need to be convinced of the economic case of switching to new technologies so the overall profitability of their enterprises is not threatened. This economic case will be very sensitive to government policies. In the case of direct air capture, the lack of an established market may empower start-ups and newcomers with the commercial driver coming in the form of a high carbon price.

An interesting comparison can be made between the current state of carbon dioxide capture and the sequestration of sulfur dioxide and nitrogen oxides from the smokestacks of coal-fired power plants, which was implemented in the United States of America around 30 years ago. It has been noted that a timeframe of around 20 years was typically required to deliver a new process from the concept stage to commercial reality. Despite the clear environmental benefits, many processes were not commercially viable until a series of legislative measures were made (Joskow, Schmalensee and Bailey, 1998).

This is a common theme in the discussion of technological solutions to climate change. The science has been, and is still being, done, and the technologies are both available and continually improving. But implementation matters, and international experience to date has only reiterated the importance of the interplay between research advances, technological progress and the political measures needed to affect structural change. As Primo Levi suggested, the many possible pathways

for an atom of carbon have always existed – we just need to change our own behaviour to catch up with the plants, and their use of "refined, minute, and quick-witted"⁹ chemistry.

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9 Levi, above n 1, at 227.

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6

POLITICS AND SECURITIZATION: THE POLITICAL ECONOMY OF THE
CLIMATE CRISIS IN THE PACIFIC*Christopher Wright**

6.1 Introduction

The escalating use of fossil fuels, industrialization and deforestation have fundamentally transformed the chemistry of the atmosphere and oceans. This human disruption to the carbon cycle now threatens the life-support systems of the planet, evident in increasingly severe storms, droughts and heatwaves, the melting of glaciers and ice-shelves, a sixth mass extinction of animal and plant species, and escalating sea level rise (IPCC, 2013; Mann and Kump, 2015). On the current path of carbon emissions, projections suggest an average global temperature increase of as much as four degrees Celsius this century; a level incompatible with continued human civilization (IPCC, 2018; New, Liverman, Schroeder and Anderson, 2011). Responding to the climate crisis requires the radical decarbonization of global energy, transport and industrial systems, replacing coal, oil and gas with renewable energy technologies, and reinventing economic and political norms. Moreover, these changes need to occur as rapidly as possible in the face of opposition from the most powerful industry in the world: the fossil fuel sector (Klein, 2014; Wright and Nyberg, 2015).

This chapter explores the political and security implications of these unprecedented changes to our world within the context of Australia and the Pacific region. As one of the world's leading exporters of coal and natural gas and one of the largest per capita carbon emitters, Australia's national interests have historically been tied to the ongoing expansion of the global fossil fuel industry. However, its near neighbours in the Pacific are amongst the most exposed peoples in the world to climate change impacts. The chapter begins by outlining the general political economy of the climate crisis, before exploring the dominant political responses evident in Australia, and then outlining the implications of these for politics and security in the Pacific and Asian regions in coming decades.

6.2 The political economy of the climate crisis

Over the last 30 years, climate change has generated significant political activity. The United Nations' formation of the Intergovernmental Panel on Climate Change (IPCC) in 1988 signalled the beginning of an ongoing process of international negotiation over carbon emissions mitigation (Weart, 2003; Edwards, 2010). However, these negotiations also highlighted the fundamentally "wicked" political nature of this issue. Responding to the climate threat requires dramatic reductions in the global production of greenhouse gas emissions, which in turn demands government regulation of fossil fuel use. Thus, a classic "tragedy of the commons" dilemma has been revealed: economic

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development based on fossil fuel use benefits individual countries in the short term, at the cost of long-term environmental destruction for the global community and future generations.

Conscious of their individual economic interests, nations have divided over how best to respond to climate change. Early opponents of emissions reductions included: the world's foremost economy, the United States of America; the oil-rich kingdoms of the Middle East; and countries such as Australia, Canada and Russia, heavily reliant on fossil fuels as key sources of energy and export earnings. Divisions over decarbonization have continued to this day, with developing economies such as China and India, now among the world's largest carbon emitters, arguing that they should not be penalised in their drive for economic development. Indeed, despite the landmark 2015 Paris Agreement in which 195 signatory nations agreed to limit global warming to no more than two degrees Celsius,¹ tangible measures to implement such ambitions have remained illusory (Spash, 2016). Carbon emissions have continued to rise, exceeding levels not seen on this planet for millions of years. Recent studies demonstrate that the world has already warmed by as much as one degree Celsius above pre-industrial levels (Hawkins et al, 2017), and the heating of the planet and other physical impacts (for example, ocean acidification and sea level rise) will grow in intensity as greenhouse gas emissions continue to increase. As outlined in the most recent IPCC projections, limited change in emissions or a continuation of current levels would result in an estimated warming of three degrees Celsius or possibly even five degrees Celsius by 2100 and further increases thereafter (IPCC, 2013; Fuss et al, 2014). Climate change thus represents a fundamental challenge to the future of the global economy and the viability of human civilization.

6.3 Business as usual as the dominant political response

However, despite the drastic implications of climate science, the dominant political response to the climate crisis has involved a continued commitment to compound economic growth and the unending expansion of fossil fuel energy. This "business as usual" response rejects the threat posed by climate change and, as Levy and Spicer argue, represents a "fossil fuels forever" imaginary,² in which all sources of fossil fuels are exploited to ensure continued economic well-being.³ Such a response is based upon a founding ideology of the conquest of nature via industrial capitalism as central to human progress (Foster, Clark and York, 2010). The adoption of fossil fuels during the Industrial Revolution led to the belief that human society could free itself from the limits of natural laws (Klein, 2014; Malm, 2016). This focus on human progress over the natural environment underpinned the economic expansion of the 20th century and was celebrated in the ideology of "free-market capitalism" as a superior form of economic organisation. From the late 1970s, this view was

1 Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016), article 2(1)(a).

2 David L Levy and André Spicer "Contested Imaginaries and the Cultural Political Economy of Climate Change" (2013) 20(5) *Organization* 659 at 663.

3 See for example Alex Epstein *The Moral Case for Fossil Fuels* (Portfolio, New York, 2014).

reinforced through neoliberal commitments to free trade, reducing the role of government and the public sector, cutting corporate taxation and promoting corporate self-regulation (Harvey, 2007).

In regard to climate change, the "business as usual" response began soon after the political recognition of the issue in the late 1980s when proposals for government regulation of carbon emissions met with organised resistance from the fossil fuel sector (Levy and Egan, 1998). Over the following years, an increasingly powerful climate change denial movement developed in economies such as Australia, Canada, the United Kingdom and the United States of America, consisting of major fossil fuel corporations, industry groups, conservative think-tanks and politically-aligned media organisations (Oreskes and Conway, 2010; Dunlap and McCright, 2011). This political movement lobbied governments and sought to sway public opinion by questioning climate science, highlighting the economic costs of cutting emissions, and promoting the views of so-called "climate sceptics". Following the failure of the 2009 Copenhagen climate talks, right-wing politicians and media in the United States propagated a narrative of climate change as a "hoax" and conspiracy (Mann, 2012). This found political voice in industry-funded social movements such as the Tea Party in the United States, which gained increasing control over the Republican party (Dunlap and McCright, 2011; Brulle, 2014). With the election of Donald Trump in 2016 as President of the United States, the "business as usual" response to climate change became the official policy of the most powerful country in the world, evident in the United States withdrawal from the Paris Agreement, the expansion of coal, oil and gas extraction, removal of environmental regulations dating from the 1970s, and the promotion of prominent climate deniers to key government positions (De Pryck and Gemenne, 2017).

As Wright and Nyberg argue, this vision of economic development involves a form of "creative self-destruction" where "businesses are encouraged to further devour the very life-support systems of a habitable environment".⁴ Here, the climate crisis results not so much in attempts to reduce carbon emissions, but rather in a doubling down of the bet that we can harness technology to better master nature. In particular, technological innovation has been directed towards more efficient and effective ways of sourcing and extracting new, unconventional fossil fuel resources (Kitchen, 2014). This is evident in the significant government support and subsidies for the expansion of coal mining (Measham et al, 2013), the dramatic expansion of gas "fracking" around the world (de Rijke, 2013; Nyberg, Wright and Kirk, 2018), the emergence of the tar sands industry in Canada (Lê, 2013), and the growth of deep-water and Arctic oil drilling (Stephenson and Agnew, 2016).

In terms of politics and security, under the "business as usual" scenario, we can expect to see an exacerbation of what Klein has termed "disaster capitalism" (Klein, 2007), in which catastrophes are exploited by elites to push through further self-destructive policies of resource extraction. Carbon-intensive industries such as coal, oil and gas are likely to continue to thrive financially for the next decade despite a rapidly deteriorating climate, extreme weather events of growing ferocity and increased social and civil unrest. Under this scenario, governments would also take on an increasingly authoritarian role as guardians of fossil fuel and corporate interests and, through increased

4 Christopher Wright and Daniel Nyberg *Climate Change, Capitalism, and Corporations: Processes of Creative Self-Destruction* (Cambridge University Press, Cambridge, 2015) at 25.

securitization, seek to control and limit public unrest, as well as the growing waves of refugees and migrants fleeing the increasingly uninhabitable equatorial zones of the world (Dyer, 2010; Ghazi, Muniruzzaman and Singh, 2016). Indeed, there are already signs of such a movement towards authoritarianism evident in the use of police and security forces to uphold the interests of multinational corporations over those of local communities (Klein, 2014), and the categorisation of environmental activism as a threat to national security (Potter, 2011; Ahmed, 2014).

6.4 The climate crisis in the Pacific: fossil fuel expansion versus physical vulnerability

For Australia and the Pacific, the implications of this dominant political narrative are profound, in that Australia is one of the world's leading carbon exporters while low-lying Pacific Island nations are amongst the world's most vulnerable to climate change impacts. This contrast in positions highlights the fundamental conflict between continued fossil fuel use and the maintenance of a habitable climate.

Within the global debate over climate change, Australia has increasingly acted as a fossil fuel hegemon. Australia is one of the world's largest exporters of coal and natural gas and has among the highest levels of greenhouse gas emissions per capita among developed economies (Garnaut, 2011). Although an early leader in climate change negotiations in the early 1990s, under conservative government rule from 1996-2007, Australia reverted to a minimalist approach to climate change policy, viewing emissions mitigation as a threat to economic growth and fossil fuel exports (Pearse, 2007). This was evident internationally, in Australia's refusal (following the lead of the United States of America) to ratify the Kyoto Protocol.⁵

During the next decade, climate change became an increasingly partisan political issue in Australia. By 2005-2006, opinion polling revealed that climate change had become a growing area of public concern and political parties explored policy responses such as carbon pricing. A change in government in 2007 highlighted this policy shift, with the incoming Labor government led by Prime Minister Kevin Rudd finally ratifying the Kyoto Protocol and committing to the introduction of a carbon emissions trading scheme. This policy focus coincided with unprecedented extreme weather events, including the "Black Saturday" bushfires in Victoria in February 2009 in which 173 people perished (Head, Adams, McGregor and Toole, 2014).

However, movement towards domestic climate action became increasingly problematic following the failure to reach a global agreement at the 2009 Copenhagen climate talks, conservative political opposition, and growing resistance from industry to carbon pricing proposals. Narrowly holding on to power in the 2010 federal election, the minority Labor government under Prime Minister Julia Gillard announced the introduction of a fixed carbon price as a prelude to a carbon trading system (Commonwealth of Australia, 2011). The conservative opposition, with backing from the media, right-wing think-tanks and industry groups, launched a highly effective public campaign against what

5 Kyoto Protocol to the United Nations Framework Convention on Climate Change 2303 UNTS 162 (opened for signature 16 March 1998, entered into force 16 February 2005).

was dubbed a "toxic carbon tax" (Manne, 2011). This proved to be a key factor in the defeat of the Gillard government in the 2013 federal election. Under the new conservative leadership of Prime Minister Tony Abbott, climate policies were disbanded and Australia had the dubious honour of being the first nation on Earth to abolish a price on carbon emissions (Bogle and Oremus, 2014; Crowley, 2017). The promotion of fossil fuels was highlighted in late 2014 when, at the opening of a new export coal mine in Queensland, Prime Minister Abbott proclaimed that "coal is good for humanity" and the "foundation of prosperity ... for now and the foreseeable future".⁶ This statement duplicated the message promoted by United States coal giant Peabody Energy that coal exports helped to solve "energy poverty" in developing economies and were thus a moral rather than just an economic choice.⁷

For Pacific Island nations, the response to their larger neighbour's promotion of continued fossil fuel expansion has been one of increasing dismay and anger. Pacific Island countries are amongst the most vulnerable nations in the world to the impacts of climate change in the form of increasingly intense tropical cyclones, coral bleaching and accelerating sea level rise (Keener et al, 2013; Storlazzi, Elias and Berkowitz, 2015). Not surprisingly, Pacific Island governments have led international calls for strong global action on carbon emissions mitigation. For instance, in May 2015, Fiji's Prime Minister Voreqe Bainimarama explicitly criticised the Australian government's role in promoting the expansion of the coal industry, arguing that such self-interest endangered the future existence of Pacific Island nations. As he stated in a speech attended by the then Australian Foreign Minister Julie Bishop:⁸

Australia is siding with what I call the coalition of the selfish – those industrialised nations which are putting the welfare of their carbon-polluting industries and their workers before our welfare and survival as Pacific Islanders.

In the lead-up to the Paris climate talks in late 2015, Fiji's Prime Minister and leaders from other Pacific Islands such as Kiribati, the Marshall Islands and Vanuatu called for a "moratorium on the development of further reserves of Australian coal", an argument that newly anointed Australian Prime Minister Malcolm Turnbull dismissed, proclaiming that "coal is ... the largest single part in fact of the global energy mix, and likely to remain that way for a very long time".⁹ Moreover, utilising what critics termed the "drug dealer's defence", Turnbull argued that "if Australia stopped exporting coal, the countries to which we export it would buy it from somewhere else".¹⁰ Thus, while the 2015

6 Latika Bourke "Coal Is 'the Foundation of Prosperity' for Foreseeable Future, Says Prime Minister Tony Abbott" *Sydney Morning Herald* (online ed, 4 November 2014) <www.smh.com.au>.

7 Suzanne Goldenberg "The Truth Behind Peabody's Campaign to Rebrand Coal as a Poverty Cure" *The Guardian* (online ed, 19 May 2015) <www.theguardian.com>.

8 Rowan Callick "Fiji Blasts Australia's 'Coalition of the Selfish'" *The Australian* (online ed, 7 May 2015) <www.theaustralian.com.au>. See also Chapters 4 and 7 in this book.

9 Megan Darby "Australia PM Turnbull Stands by Coal Amid Moratorium Calls" (28 October 2015) Climate Home News <climatechangenews.com>.

10 Oliver Milman "Fiji PM Decries Australia's 'Climate Change Deniers' in Turnbull Cabinet" *The Guardian* (online ed, 28 October 2015) <www.theguardian.com>.

Paris Agreement resulted in state parties (including Australia) undertaking to take action to keep the global average temperature to well below two degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 degrees Celsius,¹¹ Australia's response focused solely on domestic carbon emissions and ignored the fact that if the world was to meet even a weak two degrees Celsius target, over 80 per cent of the world's coal reserves would need to stay in the ground (McGlade and Ekins, 2015).

In recent years, Australia's conservative political leadership has maintained an explicit policy of fossil fuel expansion both in terms of opening major new coal and gas export projects (including the politically controversial Adani Carmichael coal mine in Queensland), as well as undermining nascent renewable energy developments. Both federal and state governments have strongly promoted fossil fuel expansion via government funding of new rail lines, ports and water licenses for new export-oriented coal mines, the development of new gas extraction projects as well as proposals to finance new domestic coal-fired power stations. The Australian government's promotion of fossil fuels has also extended to the international political stage, with senior diplomats lobbying foreign financial investors to fund so-called "clean coal" power plants in Asia (Hutchens, 2016), and aligning itself with other fossil fuel boosters such as Russia, Saudi Arabia and the United States of America at recent international climate change fora (Doherty, 2018).

Against this, Pacific Island nations have continued to voice criticism of Australia's fossil fuel expansion and maintained a strong position of the need for dramatic decarbonization of the world's economy. For instance, the 2017 United Nations Framework Convention on Climate Change Conference of the Parties (COP23) in Bonn, Germany was presided over by Fiji's Prime Minister Bainimarama, the first time a small island developing state had assumed the presidency of the negotiations. At this and subsequent climate negotiations, Pacific small island developing states have called for members of the Organisation for Economic Co-operation and Development to phase out coal by 2030, followed by other countries by 2040. Moreover, recent trade and security discussions between Australia and Pacific Island nations have provided a venue for continued criticism of Australia's fossil fuel agenda. As Fiji Prime Minister Bainimarama stated to Australia's Prime Minister Morrison, in reference to earlier jokes made by Australian politicians about sea level rise:¹²

Here in Fiji, climate change is no laughing matter. From where we are sitting, we cannot imagine how the interests of any single industry can be placed above the welfare of Pacific peoples — vulnerable people in the world over.

6.5 Implications for politics and security

Despite Australia's short-term focus on a "business as usual" model of fossil fuel expansion, worsening scientific projections of climate change impacts pose serious challenges not only for vulnerable Pacific Island nations, but also for developed economies such as Australia. These extend

11 Paris Agreement, above n 1, article 5(1)(a).

12 Stephen Dziedzic and Erin Handley "Climate Change Is 'No Laughing Matter', Fiji's PM Frank Bainimarama Tells Australia During Scott Morrison's Pacific Trip" (18 January 2019) ABC News <abc.net.au>.

across financial and economic uncertainties, to physical and geopolitical risks that require strategic consideration and planning over coming decades.

The economic and financial risks of Australia's commitment to fossil fuel expansion occur at several levels. First, the Australian government's commitment to the development of export coal and gas relies upon the continuation of strong and growing global demand for these products. In terms of thermal coal, Australia is now the world's second biggest exporter behind Indonesia. However, there are signs that global demand for imported thermal coal is waning and some financial analysts have argued that the commodity is actually in structural decline (Buckley, 2015). This is evident in the shift in China towards significant investment in renewable energy (Mathews, 2017), concerns over urban pollution in major Chinese cities fuelled by coal combustion, and plentiful domestic coal reserves. Other major export markets for Australian coal, including Japan and India, are also seen to be weakening. Indeed, the opening of major new export-oriented mines in Queensland's Galilee Basin threatens to flood world markets with a further supply of thermal coal, thereby depressing prices for existing Australian coal exports (Buckley, Nicholas and Shah, 2018). While Australian politicians have sought to leverage their support for new coal mines as vote winners in economically depressed regional centres, this "jobs and growth" message is unlikely to come to fruition given broader global shifts in energy markets away from coal and towards renewable energy.

The financial risks of a "fossil fuels forever" agenda also extend into the economic impacts of worsening climate change upon established industries in Australia and the Asia-Pacific region. Australia is particularly exposed to climate change impacts evident in recent extreme weather events, such as drought, heatwaves, wildfires, cyclones and coral bleaching (Head, Adams, McGregor and Toole, 2014; Steffen, Stock, Alexander and Rice, 2017). For instance, the 2018 World Employment and Social Outlook estimates that climate change directly threatens 1.2 billion jobs worldwide, particularly in primary industries, such as agriculture, forestry and fishing exposed to extreme weather events, droughts and warming oceans.¹³ Moreover, these climate induced impacts extend across global supply chains, as graphically illustrated in Thailand's 2011 floods which caused an estimated USD 45 billion in direct losses and global impacts across the automobile, computer and consumer goods industries (Aon Benfeld, 2012). As extreme weather events heighten in intensity, so the costs to government and industry from disaster relief and climate adaptation are also increasing. Indeed, recent analysis suggests a business as usual scenario of three to four degrees Celsius warming by 2100 would reduce global per capita output by between 25-30 per cent (Burke, Davis and Diffenbaugh, 2018). Thus, the economic costs of Australia's current energy policy are likely to be significant.

Beyond economic impacts, a "business as usual" scenario based upon continued use of fossil fuels also raises a range of humanitarian and geopolitical concerns. Worsening climate change will further fuel mass migration around the world as people flee communities endangered by flooded coastlines, droughts, famines, storms and floods (Berchin, Valduga, Garcia and de Andrade Guerra, 2017). According to the United Nations High Commissioner for Refugees, extreme weather has already

13 See generally International Labour Organization *World Employment Social Outlook 2018: Greening with Jobs* (International Labour Organization, Geneva, 2018).

displaced 22.5 million people since 2008, and by 2050, climate change is estimated to force around 700 million to migrate to new locations around the world (Markham, 2018). This mass movement of "climate refugees" is likely to be pronounced in the Asia-Pacific region, where vulnerable communities are particularly concentrated around equatorial regions. Australia's controversial, hard-line approach to refugees, particularly its so-called "Pacific solution" of outsourced refugee camps in Nauru and Papua New Guinea,¹⁴ suggests future mass movements of people will further challenge government policy. To date, Australia has turned a deaf ear to calls for tangible responses to the migration of Pacific Island populations endangered by rising sea levels resulting from climate change and appears wedded to a continuation of its uncompromising border security policy (McMichael, Farbotko and McNamara, 2019).

The impacts of climate change-induced extreme weather also raise geopolitical risks as nation states seek to protect their interests and expand their influence in an increasingly unstable world. For instance, military analysts have for some time argued that climate change acts as a "threat multiplier" in that extreme weather events can precipitate crop failures, threaten food supplies and access to water, heighten domestic political tensions, and potentially fuel regional conflicts and wars (Dyer, 2010; CNA Military Advisory Board, 2014). These security concerns are already evident in the Asia-Pacific region under China's expansionary "Belt and Road" initiative, which seeks to project China's economic influence within developing nations through low-cost loans for infrastructure development (Wang, 2016). The security implications of China's expansion into the Pacific have not been lost on the Australian government, which after years of reducing foreign aid, has recently shifted to a more active security approach, including commitments to fund new naval bases and military training for Pacific Island nations (O'Keefe, 2019). While the Australian government has become more focused on military and security issues, Pacific Island nations have used this increasing attention to promote their own concerns over climate change and sustainable development. It remains to be seen to what extent Pacific Island nations can leverage Australia's security focus into more tangible climate change commitments.

6.6 Conclusion

Climate change represents an existential crisis for humanity. Two centuries of fossil fuel-based economic expansion have resulted in the disruption of Earth's carbon cycle resulting in a warming of the planet and extreme weather events that now threaten the basis of human society. To date, countries have neglected the global nature of the problem and responded to the climate crisis through a short-term focus on their individual national interests. The costs of climate change will thus be disproportionately borne by those who have least contributed to the problem, specifically developing nations and future generations.

This fundamental climate injustice is particularly stark in the case of Australia's relationship with its Pacific Island neighbours. As one of the world's leading carbon exporters and one of the largest per capita carbon emitters, Australia's status as a prosperous, developed economy has greatly

14 Eberhard Weber "The Pacific Solution – a Catastrophe for the Pacific!?" (2015) 3(4) *Environment and Ecology Research* 96 at 100-102. See also Chapter 9 in this book.

benefitted from its fossil fuel profligacy. By contrast, its nearby Pacific Island neighbours have not only lacked access to this economic development, but are at the frontline of the climate change impacts that fossil fuel use has created. This chapter has sought to draw out the political and security implications of our climate-changed future. While Australia continues to maintain a "business as usual" approach to climate and energy policy, the financial, humanitarian and geopolitical implications of the growing climate crisis appear likely to undermine this political narrative. One sign of this shift is the growing anger amongst Pacific Island nations to Australia's continued promotion of fossil fuel expansion and their willingness to use regional security concerns as a political lever for more productive commitments to regional aid and climate adaptation.

Pressure is growing, both diplomatically and within civil society, for governments to take the threat of climate change more seriously. It is these political pressures which will determine the degree to which humanity can avoid the worst implications of a rapidly unravelling climate crisis.

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7

THE 2020 CLIMATE CHANGE REGIME – FIT FOR PURPOSE
FOR THE PACIFIC?

*Adrian Macey**

7.1 Introduction

Small island states left the 2015 Paris Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC),¹ known as COP21, feeling that they had at last been listened to. This was a contrast to many preceding COPs where these states, negotiating under the umbrella of the Association of Small Island States (AOSIS), were left frustrated. A common pattern was for their concerns to be squeezed out towards the end of these annual climate summits as the big countries crafted the final deals. The issues dividing the major players were often not relevant to the small island states.

The moral force of the small island states' appeals to the global community was inescapable. They were among the most vulnerable to climate change and at the same time the least responsible for it. The message has been eloquently conveyed by a number of small island state leaders, at times quite dramatically, such as when the 2009 Copenhagen COP collapsed into chaos (Vidal, Stratton and Goldenberg, 2009). For them, the survival of their countries was at stake. This gave them a strong interest in universal participation in an agreement, an ambitious temperature goal and a recognition of the importance of adaptation, technology and finance. Until Paris, these interests were far from having been met.²

What made the difference? Much credit must go to France's hard work in the 12 months leading up to COP 21. France's energetic diplomacy built trust in their forthcoming presidency among the parties. It also brought increased engagement with local government and business, which paid off in increased pressure on governments to conclude a deal. The Pacific was not left out. Shortly before the COP, France convened a "France-Oceania Summit" where Pacific leaders were able to set out their

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1 United Nations Framework Convention on Climate Change 1771 UNTS 107 (opened for signature 4 June 1992, entered into force 21 March 1994) [UNFCCC].

2 The role of the Association of Small Island States (AOSIS) in the negotiations is discussed in Timothee Ourbak and Alexandre K Magnan "The Paris Agreement and climate change negotiations: Small Islands, big players" (2018) 18(8) *Regional Environmental Change* 2201; and Ian Fry "The Paris Agreement: an insider's perspective - the role of Small Island Developing States" (2016) 46(2) *Environmental Policy and Law* 105.

main concerns and their expectations for the conference.³ This gave them the opportunity to lend weight to the Suva Declaration on Climate Change, agreed three months before.⁴ The Declaration called for a temperature goal of below 1.5 degrees Celsius above pre-industrial levels and for action commensurate with it. The urgent need for fast-track finance and assistance with energy transitions such as in the maritime transport sector in the Pacific was also highlighted.

7.2 Pacific gains from the Paris Agreement

The Paris Agreement goes a long way towards meeting many of the Pacific concerns.⁵ It is universal, both in terms of the membership and commitments. The Pacific countries had long supported an agreement that would include all major emitters, developed and developing, recognising that this was the only way to achieve the necessary reductions in emissions. The temperature goal of "well below 2 [degrees Celsius] ... and pursuing efforts to limit the temperature increase to 1.5 [degrees Celsius]" does not go quite as far as the Suva Declaration, but nonetheless was a real breakthrough in the negotiations.⁶ It had previously been the subject of some strong opposition, especially by fossil fuel dependent countries.

The Paris Agreement breaks new ground in giving adaptation and finance equal status to mitigation in the objectives of a climate treaty. Article 2(1)(a) states the temperature goal; article 2(1)(b) refers to adaptation, resilience and low-carbon development; and article 2(1)(c) calls for finance flows consistent with these needs. Additionally, there is a global goal on adaptation in article 7.

Thus, the new legal framing is better aligned with the Pacific requirements for both adaptation and mitigation. In the Paris Agreement and the accompanying decisions, there is new language on loss and damage, technology and capacity building, the latter being given higher status with a new committee. Importantly for the Pacific, it was made explicit that the Green Climate Fund (GCF), established in 2010 to invest in low-emission and climate-resilient development in developing countries, would serve the Agreement.⁷ The Fund has a coordinating role and maintains links with multilateral agencies outside the UNFCCC, including the Global Environment Facility.

The stronger recognition of non-state actors in the Paris Agreement also has the potential to be of use to the Pacific in the future. Non-state actors (or non-party stakeholders as they are now called) include cities, other sub-national entities such as states and provinces, business and civil society. The UNFCCC was among the first United Nations bodies to recognise these actors and give them observer

3 Pacific Islands Development Forum (PIDF) "PIDF Participates in France-Oceania Summit" (4 December 2015) <www.pidf.int>.

4 Pacific Islands Development Forum "Suva Declaration on Climate Change" (Pacific Islands Development Forum Summit of Leaders (PIDF3), Suva, Fiji, 2-4 September 2015) <www.pidf.int/suva-declaration-on-climate-change/pacificidf.org>.

5 Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016).

6 Id, article 2(1)(a).

7 Green Climate Fund "About GCF" <<https://www.greenclimate.fund/about>>.

status in the negotiations. But they often felt frustrated by being confined to the margins, with little or no explicit recognition of the contribution they could make to either the negotiations or the various UNFCCC programmes. Some parties were reluctant to accord non-state actors any formal recognition. The Paris Agreement strengthens their role, both by a generic reference in the Agreement itself,⁸ and a listing in the accompanying decisions from COP21.⁹

Agreeing to uphold and promote regional and international cooperation in order to mobilize stronger and more ambitious climate action by all Parties and non-Party stakeholders, including civil society, the private sector, financial institutions, cities and other subnational authorities, local communities and indigenous peoples.

Apart from the overdue recognition, there is an operational value to these provisions, since they give a potential mandate for inclusion of non-state actors alongside governments in the activities carried out under all the bodies under the UNFCCC. To take just one example, the GCF gives a prominent role to non-state actors in the financing of mitigation and adaptation projects. Recognition of non-state actors also serves the mitigation goal because the huge investments necessary to bring about the energy transition will be done largely by the private sector. Similarly, for adaptation, cities are at the forefront of adaptation to climate change.

Another landmark for the Pacific from COP21 was the decision to invite the Intergovernmental Panel on Climate Change (IPCC) to do a special report on 1.5 degrees Celsius (IPCC SR15) – both on impacts of this amount of warming compared and possible emissions scenarios that could meet this target.¹⁰ Previously, most scientific literature had focused on the higher two degrees Celsius figure and there was uncertainty over whether 1.5 degrees Celsius was achievable in any circumstances. So, having an objective scientific analysis was a necessary complement to the political "win" of securing the reference in the Paris Agreement. If there were no conceivable pathways to 1.5 degrees Celsius, it would remain a dead letter. The publication of the special report in 2018 had a major impact and has increased support for the 1.5 degrees Celsius goal.

8 Paris Agreement, above n 5, preamble at [15]: "*Recognizing* the importance of the engagements of all levels of government and various actors, in accordance with respective national legislations of Parties, in addressing climate change".

9 Conference of the Parties, UNFCCC *Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015 — Addendum — Part Two: Action Taken by the Conference of the Parties at its twenty-first session* FCCC/CP/2015/10/Add.1 (2016), Decision 1/CP.21 "Adoption of the Paris Agreement", preamble at [16].

10 Intergovernmental Panel on Climate Change (V Masson-Delmotte et al (eds)) *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* (2018) <<https://www.ipcc.ch>> [IPCC SR15].

The Paris Agreement also consolidates various elements of the UNFCCC institutions and mechanisms and points to further consolidation as the Kyoto Protocol¹¹ – whose second commitment period covers the gap between the first commitment period (2008-2012), and 2020 when the Paris Agreement comes into effect – gives way to the more universal single framework. This is helpful and should avoid duplication.

7.3 Building on Paris

After the adoption of the Paris Agreement, negotiations returned to their familiar slow pace, with ever longer texts, increasing bureaucracy and institutional content, but no progress on the emissions reduction "ambition" – the *raison d'être* of the Agreement. But other aspects relevant to the Pacific have taken shape, and new dimensions added.

The concept of "loss and damage" was a latecomer to the negotiations, having been advocated by AOSIS for some time. It has gradually secured a place among the many UNFCCC institutions and mechanisms.¹² Under the Warsaw International Mechanism for Loss and Damage, it began working on a comprehensive five-year work plan.¹³ There is nothing to criticise in the plan itself, which is well designed, but the different components add more dimensions and more complexity. While new topics such as early warning mechanisms and risk transfer (insurance) were included, there has been no recognition of liability or compensation and hence no additional source of finance. It is difficult to see why such issues could not have found a place under existing umbrellas in the UNFCCC, such as adaptation. Needless complexity has also afflicted some longer-established entities such as the Kyoto Protocol's Clean Development Mechanism,¹⁴ where the evolution of its rulebook owed as much to non-expert negotiators as to experts in markets and finance. A similar analysis could be applied to two other subjects important to the Pacific, technology and capacity building.

Yet another subject heading for more complexity and institutionalisation is that of "response measures",¹⁵ a topic originally introduced into the negotiations by Saudi Arabia and other oil-producing states to reflect their concerns about the effects on their economies of the transition away from fossil fuels in the developed world. For a long time, the content of decisions on the topic was vague and non-operational. But it has gradually broadened its coverage, so that it is now relevant

11 Kyoto Protocol to the United Nations Framework Convention on Climate Change 2303 UNTS 162 (opened for signature 16 March 1998, entered into force 16 February 2005) [Kyoto Protocol].

12 On the history of loss and damage prior to the Paris Agreement, see Erin Roberts and Saleemul Huq "Coming full circle: the history of loss and damage under the UNFCCC" (2015) 8(2) *International Journal of Global Warming* 141.

13 Executive Committee of the Warsaw International Mechanism "Five-year rolling workplan of the Executive Committee of the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts" UNFCCC <<https://unfccc.int>>.

14 Kyoto Protocol, above n 11, article 12.

15 Paris Agreement, above n 5, article 4(15): "Parties shall take into consideration in the implementation of this Agreement the concerns of Parties with economies most affected by the impacts of response measures, particularly developing country Parties."

beyond its original sponsors. It has grown into a forum with a permanent governance structure, a committee of experts and a multi-year work programme.

Overall, progress has been mixed. The proliferation and expansion of institutions and mechanisms under the UNFCCC has continued as the examples discussed above show. Apart from this needless complexity, there have been some major blockages in the negotiations. The important issue of carbon markets was left unresolved at COP24. The GCF became dysfunctional towards the end of 2018 because of serious disagreements among board members; its director resigned suddenly.¹⁶ Undertaking governance of a body with such a critical role through a body mixing climate negotiators with finance specialists was never going to be easy.

These limitations and setbacks have not derailed the implementation of the Paris Agreement. By far the single biggest step forward since Paris was the adoption at COP24 of the "Paris rulebook",¹⁷ the term used to describe the set of more detailed decisions needed to make the Paris Agreement operational. Though still incomplete,¹⁸ the information, transparency and review requirements are enough to enable the Paris Agreement to come into operation on time. The fact that the Paris work programme met its deadline was also a political success, which will build confidence in the robustness of the Agreement.

7.4 A Pacific contribution

The Fijian COP23 presidency invigorated and gave a Pacific character to the "facilitative dialogue" that COP21 had decided would take place in 2018. The purpose of the dialogue was to assess collective efforts towards the long-term goal of the Paris Agreement, and help parties to draw up their Nationally Determined Contributions (NDCs). It was launched under a new title of "Talanoa", a term that reflects a Pacific way. Involving story-telling and sharing, it is non-confrontational, inclusive and transparent, thus being an antidote to the often fraught and non-transparent character of the negotiations. It both avoids conflict and builds trust. This cultural contribution to the somewhat impersonal ways of international interaction recalled the South African "ubuntu" that were held a few years earlier and helped bring the Durban COP (COP17) to a successful conclusion. The ubuntu spirit of "I am because we are" also encouraged a sense of unity through sharing.

The talanoa process broadened the range of participants and gave a greater role to non-state actors compared to the ubuntu. Its value was both to inform and to show the benefits of collective action,

16 Jess Shinkleman "Climate Changed. UN's Green Climate Fund at 'Low Point' After Director Resigns" (5 July 2018) Bloomberg <www.bloomberg.com>.

17 Conference of the Parties, UNFCCC *Report of the Conference of the Parties on its twenty-fourth session, held in Katowice from 2 to 15 December 2018 — Addendum — Part Two: Action Taken by the Conference of the Parties at its twenty-fourth session* FCCC/CP/2018/10/Add.1 (2018), Decision 1/CP.24 "Preparations for the implementation of the Paris Agreement and the first session of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement". For a full analysis of the COP24 decisions, see 12(747) *Earth Negotiations Bulletin* <<https://enb.iisd.org/vol12/enb12747e.html>>.

18 The main outstanding point has been carbon markets under article 6 of the Paris Agreement, which was still unresolved a year later, after COP25.

which too often get lost sight of when parties clash over issues in the formal negotiations. The idea was that while convened centrally, it would be a catalyst for local and regional initiatives, all contributing ideas back to the centre.

The simple questions contributors were asked ("Where are we? Where do we need to be? How do we get there?") were refreshing in their clarity and encouraged new thinking. Inputs were sought from, and grouped under, presidencies, parties and non-party stakeholders. The dialogue was given a platform at the UNFCCC where views and experiences could be shared online. It was made good use of by governments, non-governmental organisations and the range of non-state actors and is a useful resource for Pacific countries. Small island states responded well to the dialogue. AOSIS commented: "[f]or too long we have avoided some of the central questions that must be addressed if we hope to avoid the worst impacts of climate change before it is too late".¹⁹ AOSIS also proposed continuing the format until the Paris Agreement becomes operational: "Identify steps to take the Talanoa Dialogue forward through to 2020, including how it might feed into the 2019 Secretary-General's Climate Summit."²⁰

The Talanoa Dialogue had achieved good momentum before COP24 in Katowice. It was used there as a forum for discussion of the IPCC SR15.²¹ The final stage of the dialogue, also at COP24, was the political phase involving ministers. It concluded with a "call to action" by the Polish and Fijian COP presidents, which was criticised as too weak and non-binding by some observers.²² But this was to ignore its value as a consensual call for greater ambition.²³ The final decisions from COP24 invited parties to consider the results of the dialogue. While this brought a formal close to the Talanoa Dialogue itself, the success of the format may well mean it can be re-used. It is a more inclusive and higher-level version of the informal processes that have taken place over the years.

7.5 The role of the IPCC SR15

The IPCC SR15, discussed at the Talanoa Dialogue, but also widely covered in the media around the world, was a boost to Pacific interests in several ways. It demonstrated that impacts from the extra 0.5 degree Celsius of warming compared to two degrees Celsius were significantly more severe; it was more than a marginal difference. Naturally, Pacific Island states would be amongst the most severely affected by the impacts highlighted in the report. Greater sea level rise, more intense tropical storms, saline intrusion into aquifers are all at the forefront of Pacific concerns. Of equal importance

19 AOSIS Representative "AOSIS Statement at Talanoa Closing" (May session's closing dialogue, 9 May 2018).

20 Ibid.

21 IPCC SR15, above n 10.

22 Vijeta Rattani "COP24: Talanoa Dialogue ends with a weak declaration" (13 December 2018) Down to Earth <downtoearth.org.in>.

23 Antonio Guterres "Remarks at the closing of the High-Level Segment of the Talanoa Dialogue, COP24" (12 December 2018) United Nations Secretary-General <www.un.org>.

to the Pacific, the report shows that it is still technically possible to keep within the 1.5 degrees Celsius limit, albeit with some heroic assumptions about the effectiveness of future international cooperation.

Aside from these two broad findings, the status of SR15 means that it has been accepted by the parties to the Paris Agreement – approval of the summary for policy-makers requires the agreement of government representatives. The importance of these factors and their implications for the future explains the arguments at COP24 – which dismayed and puzzled many observers and held up progress of the negotiations – over whether or not the report should be "welcomed". The small island states pushed for "welcoming" rather than "noting", which was the term in the draft negotiating text. Four fossil fuel producing states, Kuwait, Russia, Saudi Arabia and the United States of America, opposed the change. The United States explained that "approving" the report would imply endorsement, a subtle difference given that it was a consensus document from the IPCC. But it was entirely consistent with the United States position at the IPCC meeting itself ("acceptance of this report ... does not imply endorsement by the United States of the specific findings or underlying contents of the report").²⁴

In the end, the small island states and their many supporters were unsuccessful. But they had achieved something possibly more useful than a word change – greater public awareness of the IPCC's findings, and of the fact that they contained some inconvenient truths.

7.6 Pacific prospects for 2020 and beyond

As the new climate regime takes shape, likely future climate impacts on the Pacific continue to be alarming. Recent studies since SR15 have addressed the effects of warming in the physical environment. Impacts on temperature, acidity, sea level rise and storms and waves are already being detected.²⁵ Some of these changes are observed to be affecting biodiversity of mangroves, corals and fish.

The priorities of the Pacific are clearly heavily towards adaptation and resilience, which dominate government expenditures on climate change. This means that mitigation per se becomes secondary. But there is not always a clear distinction. A good example is the solar energy project in Tokelau, involving a complete shift from diesel to solar power supplemented by renewable generation source in the form of biofuel from surplus coconut. This is serving adaptation, resilience and mitigation goals all at once. The project provides resilience and reduces running costs through eliminating the transport by sea of drums of diesel and providing a large reserve potential well beyond Tokelau's current consumption. The successful implementation of this transition has allowed Tokelau to call itself the world's first truly renewable energy nation.²⁶ Such projects, most of which would be on a much larger

24 Coral Davenport "Major Climate Report Describes a Strong Risk of Crisis as Early as 2040" *The New York Times* (online ed, 7 October 2018) <nytimes.com>.

25 Ella L Howes, Silvana Birchenough and Susana Lincoln "Impacts of Climate Change Relevant to the Pacific Islands" [2018] Pacific Marine Climate Change Report Card: Science Review 1. See also Chapters 2 and 4 in this book.

26 See Government of Tokelau "Solar Project: The world's first truly renewable energy nation" <www.tokelau.org.nz>.

scale than in Tokelau, are an excellent example of how Pacific countries can benefit from finance and technical assistance. Sometimes, small-scale projects can be an advantage, as they can serve as pilots for new approaches.

While much argument in the negotiations has been over quantified climate finance goals and commitments within the UNFCCC, this should not be a major concern of the Pacific. Bilateral and other aid programmes universally include a climate change component, as do those of the United Nations and other multilateral agencies. Availability of funds on a scale appropriate to the Pacific does not appear to be a serious problem. Accessing the money and other support is where difficulties exist; requirements for funding proposals can be complex and burdensome. Bilateral aid partners working directly with Pacific Island states can help them navigate funding sources.

Pacific Island states face a crowded landscape of facilities for climate change, in and outside of the UNFCCC. They have grown in an uncoordinated fashion without an overall strategy. Each will have its own criteria and application procedures. Even where the mechanisms most directly serve Pacific priorities, the requirement to be part of their governance and work programmes can be a burden for government officials.

The need to advance so many separate subjects has led to a proliferation of simultaneous meetings at each of the main sessions through the year. This has been frustrating for small countries who cannot send large delegations to the sessions. At any time, meetings will be happening under several bodies – the UNFCCC, the Kyoto Protocol, the Paris Agreement and their subsidiary bodies. The result is duplication and a bewildering complexity to anyone unfamiliar with the UNFCCC world and to some of those within it. Indeed, it has become so complex that a second layer of mechanisms in, or outside, the UNFCCC is growing to help governments and other users learn how to access them and/or find out what activities they are already supporting. Technology and climate finance, both key for the Pacific, are cases in point.²⁷

7.7 Conclusion

The Pacific nations have their concerns fully registered on the new climate map. The inclusion of the 1.5 degrees Celsius target in the new climate treaty that will govern the climate regime over the next decades is a reference point for collective and national action. The case for supporting small island states' adaptation and mitigation needs does not need to be made. But the multiple "windows" for financial and other assistance – each apparently serving a distinct purpose – are counterproductive. The UNFCCC system remains complex and bureaucratic and taxes the resources of small countries wanting to access it. The fact that money and support are there, but not easily accessed, does not appear to be about to change.

27 The UNFCCC's website has a useful overview of climate finance: UNFCCC "Climate finance: the big picture: introduction to climate finance" <unfccc.int>. An independent guide is Robert Tippmann and others *Accessing climate finance: a step-by-step approach for practitioners* (Climasouth E-Handbook N.8, Climasouth, Project, EU, 2016). Another independent study, which includes commentary on Australian and New Zealand aid programmes in the Pacific, is Nic Maclellan and Sarah Meads "After Paris: Climate Finance in the Pacific Islands" (September 2016) Oxfam Australia and Oxfam New Zealand <oxfam.org.au>.

There are ways around these difficulties. Bilateral aid can often be simpler because only one external partner is required. As part of their support, bilateral partners can also help Pacific Island states navigate the UNFCCC system. There is potential for more involvement of the private sector and non-governmental organisations as already provided for in the GCF. All these options can lessen the administrative overheads for small countries.

Finally, ever-increasing complexity is not a fatality. Some of the institutional build-up is a by-product of negotiating the core treaty rather than a considered response to clearly identified needs. Once the Paris Agreement is bedded in and fully functioning, it should be possible to rationalise the too-numerous bodies that are serving it. In the meantime, the best approach for Pacific Island states is to focus on clear identification of their needs and to make the bureaucracy adapt to them, rather than the reverse.

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8

CAN JUDGES MAKE A DIFFERENCE? THE SCOPE FOR JUDICIAL
DECISIONS ON CLIMATE CHANGE IN NEW ZEALAND DOMESTIC LAW*Sir Geoffrey Palmer QC**

8.1 The context

Legal systems in constitutional democracies adhere to the rule of law. This means that the authority of the state and its policies must be expressed by legal rules contained in legislation. The law "must be accessible and so far as possible intelligible, clear and predictable".¹ The law is applied by the judiciary in cases that are brought before the courts. It is applied independently of those who made the law and of those responsible for executing the laws. In New Zealand, Parliament makes the law, the government is responsible for its administration and the courts interpret what it means in contested cases. These arrangements constitute an essential feature of liberal democratic government. They are designed to preserve the freedom of the individual as far as practicable and to keep the power of the state within limited bounds.

In the age of the Anthropocene, where human activity threatens to change irreparably the environment in which we live, there exist serious challenges to the traditional law-making techniques of the liberal democratic state. While not confined to climate change, these challenges apply acutely

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Previous articles on this topic, or related to it, by the author include: "New Ways to Make International Environmental Law" (1992) 86 *American Journal of International Law* 259; "An International Regime for Environmental Protection" (1992) 42 *Washington University Journal of Urban and Contemporary Law* 5; "The Implications of Climate Change for International Law and Institutions" (1992) 2 *Transnational Law & Contemporary Problems* 205; "The Earth Summit: What went Wrong at Rio?" (1992) 70 *Washington University Law Quarterly* 1005; "Climate Change in New Zealand: Is It Doom or Can We Hope?" (2015) 11(4) *Policy Quarterly* 15; "New Zealand's Defective Law on Climate Change" (2015) 13 *New Zealand Journal of Public and International Law* 115; "Global Society and the Challenges of Governance" (paper presented to New Zealand Centre for Global Studies, Waiheke (New Zealand), May 2016); "The Paris Climate Change Agreement and the Law" [2016] *New Zealand Law Journal* 152; and "Intergenerational Governance: problems of legislation" (2017) 13(3) *Policy Quarterly* 68.

1 Tom Bingham *The Rule of Law* (Allen Lane, London, 2010) at 37.

to that phenomenon.² The judgment expressed to the United States Senate in 2013 concerning the security implications of climate change is widely supported by scientific research. Dr James Clapper, in testimony to the Senate, stated that "[e]xtreme weather events (floods, droughts, heatwaves) will increasingly disrupt food and energy markets, exacerbating state weakness, forcing human migrations, and triggering riots, civil disobedience and vandalism."³

Combatting climate change requires actions on two fronts: the reduction of greenhouse gas emissions; and taking steps to adapt to changes that will occur. The development of such policies involves complex interaction between international norms, such as those contained in the Paris Agreement of 2015,⁴ and domestic law. No nation state alone created climate change and none alone can stop it. International cooperation is essential for success. Since the first authoritative report that foretold the threats posed by climate change was published in 1990, there have been many false starts to combat the problem both internationally and domestically (Houghton, Jenkins and Ephraums, 1990; Tegart, Sheldon and Griffiths, 1990). Coherent policy parameters that will succeed in avoiding the threats listed above remain to be put in place. It is quite possible, even likely as matters stand currently, that international efforts to combat climate change will not succeed in preventing many of the deleterious consequences that have been predicted.

The challenge of climate change and the prospect of failing to combat it effectively raise constitutional questions of the first order in importance. There will be few lifeboats available. There has been a strange unthinking and unrealistic character to the debate since the climate change issue first arose as a political issue. While climate sceptics, who doubted the threat, have largely been vanquished, the failure to make adjustments to policy both nationally and internationally in a timely fashion has been surprising, given the evidence. Policy-makers have discounted the future in favour of the present, not wishing to face up to the real and adverse political consequences that effective action will require. The difficulty in such a stance lies in the fact that sudden adjustments to policy will be much harder to manage than those that can be instituted over a longer timeframe. And the time for adjustments is rapidly shrinking.

Policy frameworks are governed by constitutions. New Zealand does not have a constitution in the sense that other countries do. We rely on statutes passed by Parliament and the common law. Parliament can pass whatever statutes it likes whenever it likes. The restraints are few. The seeming

2 The field of international environmental law is replete with examples. See Jonathan C Carlson, Geoffrey Palmer and Burns H Weston *International Environmental Law and World Order: A Problem-Oriented Coursebook* (3rd ed, West Academic Publishing, St Paul (MN), 2012).

3 James R Clapper *Statement for the Record: Worldwide Threat Assessment of the US Intelligence Community* (Senate Select Committee on Intelligence, 12 March 2013) at 9.

4 Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016).

surface simplicity of these arrangements is attractive to governments who wish for maximum flexibility. We are one of three countries in the world without a codified, written constitution.⁵

One largely unexplored aspect of climate change lies in its potential to force the revision of many fundamental and long-accepted methods of conducting government and the organisation of its institutions. The Four Horsemen of the Apocalypse in the Book of Revelation were pestilence, war, famine and death. Climate change has the capacity to produce those conditions to a worrying extent in the future. We underestimate at our peril the challenges that it will bring and that it has brought already (Ghosh, 2017).

Ensuring that the institutions of government both domestically and internationally can adjust to meet those challenges poses a formidable set of issues. These issues, however, cannot be solved by New Zealand and they will depend upon levels of international cooperation as yet not achieved. Endless further iterations of the Paris Agreement will be necessary before substantial progress is made. As I have written elsewhere, I am not sanguine that the mechanisms for making international law and enforcing it effectively are adequate to allow us to be confident that climate change can be properly addressed.⁶

In June 2017 in Paris, the *Global Pact for the Environment* was unveiled and it is a powerful document that would remedy many difficulties with the international law for the environment if it were to become binding.⁷ That does not seem an immediate possibility.⁸ The bulk of this chapter addresses New Zealand's domestic legal situation and the role of the courts within it. The wider framework, however, needs to be optimally designed so that it can endure over time and is not the subject of sudden policy lurches due to changes of government.

8.2 *Thomson v The Minister for Climate Change Issues*

On 2 November 2017, Justice Mallon in the High Court delivered a notable and careful judgment in *Thomson v The Minister for Climate Change Issues*.⁹ This proceeding for judicial review was

5 The United Kingdom and Israel are the others. See also Constitutional Advisory Panel *New Zealand's Constitution: A Report on a Conversation* (November 2013).

6 Geoffrey Palmer "Small Pacific Island States and the Catastrophe of Climate Change" in Petra Butler and Caroline Morris (eds) *Small States in a Legal World* (Springer, Heidelberg, 2017) 3 at 16.

7 Environment Commission of the Club des Juristes *Draft Project: Global Pact for the Environment* (24 June 2017).

8 *Id.*, articles 23-24.

9 *Thomson v The Minister for Climate Change Issues* [2017] NZHC 733, [2018] 2 NZLR 160 [*Thomson*]. There have been a handful of other cases in New Zealand that have touched upon climate change: *West Coast Ent Inc v Buller Coal Ltd* [2013] NZSC 133, [2014] 1 NZLR 32 (the relevance of climate change to granting a resource consent under the Resource Management Act 1991); *Meridian Energy Ltd v Central Otago District Council* [2011] 1 NZLR 482 (HC) (it is not necessary to discuss climate change every time in Resource Management Act cases); *Imported Motor Vehicle Industry Assoc Inc v Minister of Transport* HC Wellington CIV-2011-485-1972, 1 December 2011 (a challenge to emissions standards for imported used light petrol powered vehicles); and *New Zealand Climate Science Education Trust v National Institute of Water and*

brought by a law student who was concerned at the Key-English government's response to climate change and the adverse consequences the policies may visit upon future generations. Justice Mallon reviewed extensive expert scientific affidavit evidence and the relevant elements of the international framework by which New Zealand is bound. She also reviewed New Zealand's domestic legislation and analysed the law in light of New Zealand's international obligations.

The case was filed in court in November 2015. Normally, judicial review cases are dealt with promptly, but for good reasons this one took longer. The preparation of expert scientific evidence on both sides was one cause. Further, discovery of documents was a more complex process than usual given the complexity of the target issues. The case was argued on 26, 27 and 28 June 2017. The judgment was delivered on 2 November 2017, after a new government had been installed that had announced different climate change policies from those of the government whose actions were the subject of the action for judicial review.

While this development made the task of the judge easier, it also reduced the significance of the decision itself to some extent. Had there not been a change of government following the 2017 general election, the decision would have had greater impact. The coalition of Labour and New Zealand First, with the support of the Green Party, announced after the election a new target of zero carbon by 2050, twice as ambitious as the previous target of the outgoing government.¹⁰

The first cause of action concerned whether the minister was required to review the 2050 target for the reduction of greenhouse gases gazetted on 31 March 2011 under section 224 of the Climate Change Response Act 2002. That target required a 50 per cent reduction in emissions, using 1990 as a baseline. The plaintiff argued that this needed to be revised in light of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), published in stages between September 2013 and November 2014. This was the most up-to-date assessment of the science and indicated a rather more serious situation than the previous report in 2007.

On this cause of action, the issue before the judge was one of statutory interpretation. This required close construction of both sections 224 and 225 of the Climate Change Response Act. The judge was clear that the obligation to review did not arise under section 225(3), but did it arise under

Atmospheric Research Ltd [2012] NZHC 2297, [2013] 1 NZLR 75 (challenging NIWA science advice to the government that New Zealand had experienced a warming trend).

10 The following footnote provided by the judge in *Thomson*, above n 9, at [72], footnote 77, is instructive as it relied on political developments reported in the media: "The Zero Carbon Act was a Green Party election priority: Green Party 'Climate Protection Plan: For a better future' (13 September 2017) <www.greens.org.nz>. The Rt Hon Jacinda Ardern has said following the election that climate change will be a priority for her government, including a Zero Carbon Act: Henry Cooke 'Live: Labour-led government to make climate change a priority' (20 October 2017) Stuff <stuff.co.nz>; 'NZ First, Green Party, Labour coalition deals revealed' (24 October 2017) Stuff <stuff.co.nz>; and Karl Mathiesen 'Jacinda Ardern commits New Zealand to zero carbon by 2050' (20 October 2010) Climate Home News <www.climatechangenews.com>."

section 224? The minister had a statutory discretion to review the target, but was the minister obliged to do so? The judge thought she was.

The two sections of the Act provided for two distinct processes for setting targets. The two provisions produce instruments of different legal qualities. The first, under section 224, is a notice in the *Gazette* indicating that New Zealand sets a target; the second produces a regulation, a form of subordinate legislation that has legal effect:

224 Gazetting of targets

- (1) The Minister must set a target.
- (2) The Minister responsible for the administration of the Act may set a target, or amend or revoke an existing target, at any time.
- (2A) Before the Minister sets, amends, or revokes a target, the Minister must consult, or be satisfied that the chief executive has consulted, persons (or their representatives) that appear to the Minister or the chief executive likely to have an interest in the target.
- (3) As soon as practicable after setting, amending, or revoking a target under this section, the Minister must—
 - (a) publicly notify the target or revocation of the target in the *Gazette*; and
 - (b) make the target or revocation of the target publicly accessible via the Internet site of the department of the chief executive.
- (4) To avoid doubt, a *Gazette* notice under this section is neither a legislative instrument nor a disallowable instrument for the purposes of the Legislation Act 2012 and does not have to be presented to the House of Representatives under section 41 of that Act.
- (5) To avoid doubt, any number of targets may be set using the process under this section.

225 Regulations relating to targets

- (1) The Governor-General may, by Order in Council made on the recommendation of the Minister, make regulations setting a target.
- (2) Before recommending the making of an Order in Council under subsection (1), the Minister must consult, or be satisfied that the chief executive has consulted, persons (or their representatives) that appear to the Minister or the chief executive likely to have an interest in the order.
- (3) The Minister—
 - (a) must review the target following publication of any Intergovernmental Panel on Climate Change Assessment Report or report of a successor agency; and
 - (b) may at any time recommend to the Governor-General the setting of a target, or amendment or revocation of a target, having regard to the following matters:

- (i) any Intergovernmental Panel on Climate Change Assessment Report or report of a successor agency:
 - (ii) any other matters the Minister considers relevant.
- (4) To avoid doubt, any number of targets may be set using the process under this section.

Section 224 involves more elaborate processes within the government and requires public consultation on the face of the statute. It is not evident why two such provisions are either necessary or desirable.

People may wonder why these provisions do not altogether seem consistent with one another. The answer lies in the extent of amendments made to the Climate Change Response Act since its enactment in 2002. The most important of these were the result of changes of government policy, including changes of government. Section 224 was inserted by the Climate Change Response (Emissions Trading) Amendment Act 2008. Section 225 resulted from the Climate Change Response (Moderated Emissions Trading) Amendment Act 2009. There were also amendments to the provisions in 2011 and in 2013.

The learned judge states at [94] of her judgment that in her view, what is express under section 225(3) is implicit in section 224(2). Since the IPCC reports provide the most up-to-date scientific consensus on climate change, she considered that "the publishing of a new IPCC report requires the minister to consider whether a target set under section 224 should be reviewed".¹¹ The minister was obliged to consider whether the new report:¹²

... materially alters the information against which an existing target was set. If it does, a review of the target must be undertaken. That review may or may not lead to a decision to amend an existing target or to set additional targets, depending on the outcome of the review process undertaken.

The next point was whether the target was consistent with the new report; it was common ground that it was consistent with the previous report. There was expert evidence for the defendant that "it is also consistent with the AR5 and at the more ambitious end of the range".¹³ The judge pointed out that this "counts against any remedy requiring the Minister to consider whether the 2050 target ought to be reviewed in light of the AR5".¹⁴ She indicated that had it not been for the change of government it may have been appropriate to seek further submissions from the parties in order "to reach a

¹¹ *Thomson*, above n 9, at [94].

¹² *Ibid.* Although the issue does not appear to be raised in *Thomson*, the government may be able to rely on the royal prerogative in respect to some climate change issues, especially when they touch upon compliance with international obligations.

¹³ *Id.*, at [97].

¹⁴ *Ibid.*

concluded view on whether it would have been appropriate to direct the Minister to review the target in light of the AR5".¹⁵

In other words, there was now no need for the judge to decide the matter and she did not do so. The issue was rendered moot by the change of policy announced by the new government.

The second cause of action put forward by the plaintiff revolved around the 2030 target communicated under the Paris Agreement. This target required a 30 per cent reduction in greenhouse gas emissions by 2030, using 2005 as baseline. This was New Zealand's Nationally Determined Contribution (NDC) as required by the Paris Agreement.¹⁶ It had also been advanced to the United Nations Framework Convention on Climate Change negotiations in July 2015 as New Zealand's Intended Nationally Determined Contribution (INDC) target.

The case for the plaintiff was that the defendant had failed to take into account the costs of dealing with the adverse effects of climate change in a "business as usual" situation.¹⁷ Second, that Tokelau as a dependant territory was particularly vulnerable.¹⁸ And third, that according to the scientific consensus, both the extent and speed of the INDCs fell short of what is required to stabilise greenhouse gas concentrations.¹⁹

The reasoning of the judge on this cause of action engaged with the key policy difficulty for courts in the climate change arena. She addressed the question of whether the issues were justiciable, in the sense of whether it was an appropriate case for a court to decide. The defendant argued that it was not. The judge then examined decisions from other jurisdictions where climate change policy had been adjudicated upon. The judge discussed cases from the United States of America, Canada, the United Kingdom and the Netherlands.²⁰ These cases showed that there was a propensity to consider the climate change issue justiciable; there was standing to bring suit in some cases and in the United Kingdom, case relief had been granted to ensure steps were taken to implement the legal obligations of a directive concerning emission limits of nitrogen dioxide in particular zones.

15 Ibid.

16 Paris Agreement, above n 4, article 4(2).

17 *Thomson*, above n 9, at [99].

18 Ibid.

19 Ibid.

20 *Massachusetts v Environmental Protection Agency* 549 US 497 (2007); *Juliana v United States of America* DC Eugene, Oregon 6:15-cv-1517-TC, 8 April 2016, upheld on review in *Juliana v United States of America* 217 F Supp 3d 1224 (D Or 2016); *Friends of the Earth v Canada (Governor in Council)* 2008 FC 1183, [2009] 3 FC 201; *R (on the application of ClientEarth) v Secretary of State for the Environment, Food and Rural Affairs* [2015] UKSC 28, [2015] PTSR 909; and *Urgenda Foundation v The State of the Netherlands (Ministry of Infrastructure and the Environment)* DC Hague C/09/456689/HA ZA 13-1396, 24 June 2015.

The judge found that "these cases illustrate that it may be appropriate for domestic courts to play a role in Government decision making about climate change policy".²¹ She noted the claims had all succeeded to some extent, with the exception of the Canadian case, and observed that:²²

The courts have not considered the entire subject matter is a "no go" area, whether because the state had entered into international obligations, or because the problem is a global one and one country's efforts alone cannot prevent harm to that country's people and their environment, or because the Government's response involves the weighing of social, economic and political factors, or because of the complexity of the science.

The judge resisted the submission that there could be no review on the issues in the case.²³

The importance of the matter for all and each of us warrants some scrutiny of the public power in addition to accountability through Parliament and the General Elections. If a ground of review requires the Court to weigh public policies that are more appropriately weighed by those elected by the community it may be necessary for the Court to defer to the elected officials on constitutional grounds, and because the Court may not be well placed to undertake that weighing.

But in the judge's view, this was not a case where the court should on these facts intervene. She did not find herself able to hold that the INDC or the NDC were outside the proper bounds of the minister's power because of the manner in which the economic modelling was undertaken.

Nor was she persuaded on the facts that the argument about Tokelau had merit. It was clear, she held, that New Zealand had Tokelau in mind when deciding whether to ratify the Paris Agreement and it intended to assist Tokelau. The impact on Tokelauans was a mandatory relevant consideration for the government to consider, but she was not persuaded this meant that New Zealand's NDC target "needed to be consistent with a 1.5°C target" as the plaintiff had argued.²⁴

Neither did the third argument succeed; the nature of the NDC involved the balancing of a number of competing factors. The fact that a differently constituted government may have balanced the competing factors differently did not mean the NDC was outside the minister's power.

The third cause of action was that the NDC decision of the minister was unreasonable and irrational. The judge was not persuaded that the minister had the wrong global temperature aim in mind when setting the NDC. The 1.5 degrees Celsius limit was to be subjected to further international dialogue. Nor was she persuaded that:²⁵

21 *Thomson*, above n 9, at [133].

22 *Ibid*.

23 *Id*, at [134].

24 *Id*, at [157].

25 *Id*, at [168].

... the NDC decision was unreasonable in a judicial review sense because the costs of deeper targets are comparatively small and there are other costs associated with delay. How the costs considerations are appropriately balanced is properly for the Executive to decide, especially as the international legal framework does not stipulate how a country is to determine this.

The argument that the 2030 target was not consistent with the 2050 goal fared better but did not prevail. Here, there was evidence from duelling expert climate change science professors. While the judge accepted that New Zealand's 2030 target was somewhat less ambitious than its 2050 target that did not mean it was inconsistent with the global temperature agreement under the Paris Agreement, nor that it was inconsistent with New Zealand's international obligations or was outside the minister's power to make.²⁶

The learned judge characterised her own result at the conclusion of her judgment. The minister was required to turn her mind to whether there had been any material change between the AR4 and AR5 that was relevant to the 2050 target, but this did not occur. But the cause of action was overtaken by events in that the new government was intending to set a new target. Earlier in her judgment, the judge pointed out the same result could have been reached even if the decision had been reconsidered, such as the discretionary space available to the decision-maker.

The application for judicial review was dismissed and the judge expressed her preliminary view that the costs should lie where they fall. It is not uncommon in judicial review proceedings for the courts to assert their power to intervene, thus keeping the capacity of the court alive for the future, but to find on the facts that intervention is not appropriate on the facts of the case before the court. This can be regarded as good judicial statecraft. It emphasises to decision-makers that they need to go about making such decisions carefully and properly in order to avoid litigation.

8.3 What can judicial review contribute to climate change policy?

The foregoing account gives a flavour of the approach that the New Zealand courts are likely to bring to climate change issues in judicial review proceedings.²⁷ While the decision was one at first instance and lacks the benefit of refinements that may result from an appellate decision, it was careful, orthodox and prudent. It was the most significant New Zealand judicial decision on the topic of climate change since it involved a direct challenge to government policy. The decision is a fair and accurate indication of what to expect from the courts. While the judicial review of administrative

²⁶ *Id.*, at [176].

²⁷ Many statutes provide for appeal against various types of government decisions. The grounds for appeal can be wide or narrow depending upon the statute. For example, under section 145 of the Climate Change Response Act, there is a right of appeal for an affected person to the District Court from the review of a decision by the Environmental Protection Agency made under parts 4-5 of the Act. Under section 145, the court "may confirm, reverse, or modify the decision appealed against". Appeals involve adjudication on the merits of a decision (unless they are restricted to points of law), whereas judicial review is concerned with the legality of a decision: Philip A Joseph *Constitutional & Administrative Law in New Zealand* (4th ed, Thomson Reuters, Wellington, 2014) at 863.

action has expanded greatly over the past 50 years, there are confined limits within which the judges must operate.

Obviously, it is important that governments are required to observe the legal boundaries laid down in statute and that they follow proper process. Legal authority for actions taken by government must be established; actions have to be authorised by law. But, as *Thomson* illustrates, too much cannot be expected from judicial review in an area like climate change that exhibits a difficult mix of national and international obligations, hard science, high politics and many uncertainties.²⁸

The most significant feature to emerge from the judgment is the margin of discretion available to ministers in an area like climate change. Where discretion has been entrusted to ministers, the courts are going to be wary before they intervene and hold that the discretion has been wrongly exercised and is, therefore, unlawful. This particular judge and New Zealand judges in general will be reluctant to substitute their own policy views for those of ministers and they will be scrupulous to avoid doing that.

There is a tendency in the environmental arena, both in New Zealand and overseas, to bring legal actions where groups are convinced government policy is inadequate in the hope that the decisions will be overturned by the court. I know that litigation on climate change issues was seriously contemplated in several quarters against the previous New Zealand government, but the timing of international negotiations was often an obstacle. Such litigation is often aimed at a political goal that has not been capable of achievement by political representations. I am not suggesting that there is anything improper in such proceedings. There are instances where governments will have approached issues in the wrong way, not in accordance with the requirements of the statute or have been influenced by improper considerations. In such cases, decisions can be reconsidered and different outcomes may result.

There does exist something of an international movement to encourage climate change litigation. It is aided by the fact that environmental laws generally are not well enforced and litigation opportunities for private enforcement do exist. Environmental illegality can affect many people. For example, a public inquiry was held after the widespread outbreak of gastroenteritis in Havelock North in August 2016, with more than 5,000 people falling ill following the confirmation of the presence of E coli in the water supply. The inquiry found grave weaknesses in the law, policy and administration that required urgent and early action.²⁹ It is likely that as time progresses the courts will be more deeply involved in environmental issues than they are now. A recent book concerning a novel public interest law firm aimed at environmental issues deserves attention (Thornton and Goodman, 2017). It argues that the firm ClientEarth exists to give the environment a legal voice. It uses litigation to open the courts to the environmental concerns of citizens. The firm has won some significant victories in

28 The science is particularly difficult to litigate. See Laura Hardcastle "Can't See the Science for the Solicitors: Judicial Review of Scientific Research in Light of *NIWA's Case*" (2014) 12 *New Zealand Journal of Public and International Law* 291.

29 Government Inquiry into Havelock North Drinking Water *Report of the Havelock North Drinking Water Inquiry: Stage 2* (Department of Internal Affairs, Auckland, December 2017) at 232-235.

Europe, the United States of America and elsewhere. It successfully attacked government policies in the courts. Many of the legal weapons available in other countries are not available here because of New Zealand's existing constitutional arrangements.

As the law stands, at least in the New Zealand context, it will not often occur that major climate change decisions of government will be quashed. The expense of bringing judicial review litigation in the High Court is substantial. The burden of costs awarded where the party is unsuccessful makes this form of litigation more uncertain than most, especially because the remedies are discretionary. There are, of course, benefits that derive from what the Crown Law Office booklet for public servants aptly named *The Judge Over Your Shoulder*.³⁰ The threat of litigation encourages decisions on important issues to be made after careful consideration on the basis of extensive advice. The documents will be trawled through by litigants to see what holes there are in what has been decided. The Official Information Act 1982 is a significant tool for that purpose.

The New Zealand public service has many highly competent officials and ministers in this country do not tend to make reckless decisions. It is also true that the judges are not trained in policy analysis and the judicial process is not well suited for the making of policy decisions.³¹ What is appropriate for judicial decision and what is not are real issues in the climate change arena, as Justice Mallon's judgment has well illustrated.

Slowly and gradually over time the factors to which the judges will respond have widened. Yet, they are more likely to be persuaded to intervene on matters of injustice done to individuals by poor process where, for example, the principles of natural justice have not been applied. Or if mistakes in statutory interpretation have been made in the decision, the chances of intervention increase. The variability and unpredictability of judicial review, however, makes advising on the prospects of success difficult. On matters of high government policy, into which category much of climate change policy falls, the prospects for success are always going to be harder. Influencing government policy is not usually best achieved by making an application for judicial review. It is very much a last resort and requires deep pockets.

Where the courts are strong is applying the law and determining what is legal and what is not. At the margins, however, this line can be unpredictable. The most likely judicial review application to succeed will be where decision-makers have not properly applied the statute. Statutory interpretation is a vast field of law and the cardinal rule of statutory interpretation in New Zealand is to be found in section 5 of the Interpretation Act 1999:

30 Crown Law Office *The Judge Over Your Shoulder: Judicial Review of Administrative Decisions* (1989). One can find no reference to this or any successor on the present Crown Law Office website <www.crownlaw.govt.nz>.

31 Some difficult issues are involved in the relationship of lawyers, legislation and policy. See Geoffrey Palmer "The Law Reform Enterprise: Evaluating the Past and Chartering the Future" (2015) 131 *Law Quarterly Review* 402 at 413.

5 Ascertaining meaning of legislation

- (1) The meaning of an enactment must be ascertained from its text and in the light of its purpose.
- (2) The matters that may be considered in ascertaining the meaning of an enactment include the indications provided in the enactment.
- (3) Examples of those indications are preambles, the analysis, a table of contents, headings to Parts and sections, marginal notes, diagrams, graphics, examples and explanatory material, and the organisation and format of the enactment.

"Context" is also important and will be added by a measure presently progressing through Parliament.³² Two points need to be emphasised. Words matter a great deal. Close and careful analysis of the words in any statutory provision needs to be carried out. Second, the architecture of modern complex statutes such as the Climate Change Response Act or the Resource Management Act 1991 requires examination of the entire statute to ensure that all elements of the statute are brought to bear upon the issue concerned. The purpose of the legislation, interpreted in its full social, cultural, economic and political context, matters as much as the words. The strongest ground will always be that the statute does not permit the construction it has been given. That is to say, the decision is outside the power that Parliament has conferred or *ultra vires*.³³

The grounds of judicial review are many and they may suggest at first blush that judges have a whole range of powers to intervene on government decision making. They do in theory, but not so much in practice. Beyond issues of bare legality, the decision-maker must take into account all relevant considerations and must not take into account irrelevant considerations. The decision must not be the subject of bias. The decision must not have been predetermined. It must be exercised in most cases in accordance with the principles of natural justice, themselves rather elaborate. Naked abuse or wrongful use of power will be caught by applications for judicial review, but in reality in New Zealand matters are more nuanced and seldom can an administrative law smoking gun be discovered in a decision.

The threshold to be met for judicial review to succeed is high. Judicial review is not simple and the basis of the doctrine beyond the principle of *ultra vires* is often unclear. While it was put on a statutory basis by the Judicature Amendment Act 1972 (now incorporated with some revisions in the Judicial Review Proceedings Act 2016), in essence judicial review is a common law doctrine that depends for its development upon decisions of the judges and the doctrine of precedent.

Expansion is slow because the judges are concerned not to overstep what is considered in New Zealand as the appropriate judicial role. What is sometimes labelled judicial activism in this field has not been evident in New Zealand and is not likely to be. Ministers have unlimited access to the

32 Clause 10 of the Legislation Bill 2017 (275-1) adds the words "and its context" at the end of section 5(1) reproduced in the text.

33 The leading textbook on statutory interpretation is Ross Carter *Burrows and Carter Statute Law in New Zealand* (5th ed, LexisNexis, Wellington, 2015).

legislative machinery to change the law should they feel threatened by judicial review of their actions. It is a sensitive line the judges tread. And not all judges feel familiar enough with the institutions and processes of government to have the confidence to intervene.

The following list of grounds for judicial review has been gathered together from various legal texts and they should not be regarded as authoritative, but merely illustrative:³⁴

- Illegality, exceeding the powers given or making errors of law;
- Improper purpose;
- Taking into account irrelevant considerations;
- Failing to take into account relevant considerations;
- Making serious errors of fact;
- Applying a predetermined policy;
- Acting under dictation from elsewhere;
- Failing to consult where consultation is required;
- Acting unfairly, particularly in relation to the manner in which the decision was reached;
- Breaching the rules of natural justice;
- Acting under an invalid delegation of power;
- Making a decision that no reasonable decision-maker could have arrived at;
- Where the decision-maker has bias, such as a financial interest in the decision; and
- Procedural and sometimes substantive legitimate expectations.

These grounds for judicial review have many reported judicial decisions exploring their parameters. The grounds do overlap to some degree. Administrative law in New Zealand has developed since the 1972 Act, but it lacks both coherence and simplicity. It is difficult to predict whether judges will intervene in particular cases and there is a worrying variability about whether they will or will not. This has led to serious efforts to analyse the theoretical underpinnings of judicial review (Knight, 2018). That is not to say that judicial review lacks utility. Keeping decision-makers within the bounds of their legal powers is important. Having statutes authoritatively interpreted by independent judges is a protection. But judges in New Zealand should not be regarded as alternative policy-makers who can readily be persuaded to review decisions on their merits and substitute their own decisions for those to whom the decision has been entrusted by law. If there were constitutional provisions about the environment in an entrenched Bill of Rights, the situation would be different as the next section of this chapter suggests.

Climate change policy has to be regarded as a matter of high policy. The principal elements of the policy will be difficult to subject to judicial review, especially by direct challenges to government policy. Unfair application of the rules in particular cases will attract judicial attention, however. While judicial review will not be impotent for breaches of statutes or clearly illegal decisions, the scope for improving the quality of climate change stewardship via the courts is limited. That is the main

34 The most recent legal text on the subject of judicial review covers 1,300 pages: Matthew Smith *New Zealand Judicial Review Handbook* (2nd ed, Thomson Reuters, Wellington, 2016).

message I wish to convey about New Zealand law as matters now stand. Here and there the courts may give the policy a nudge, but do not expect quantum leaps forward in climate change policy to emanate from the New Zealand courts. Having said that, there is greater scope for judicial decisions on climate change adaptation (as opposed to emissions) since that issue is primarily dealt with under the Resource Management Act.

8.4 Would it make a difference if we had a written constitution with an environmental right?

New Zealand does not have a written, codified constitution. It is one of only three countries without one. Parliament can make any law it likes. There are few limits except triennial elections and public opinion. The New Zealand Bill of Rights Act 1990 is not superior law. It can be overridden by a statute. It has been overridden in this way on 37 occasions since it has been in existence.³⁵

In our 2016 book *A Constitution for Aotearoa New Zealand*, Andrew Butler and I proposed that the existing Bill of Rights be made part of a superior law constitution so it is binding upon Parliament and so other statutes must be in conformity with it.³⁶ We also proposed some additional rights, including an environmental right. We believe that the environment needs protection up there along with the human rights that are already protected by the current New Zealand Bill of Rights Act. So, our proposed draft Constitution in 2016 included such a guarantee.

There has been over the last 20 years a rapidly growing international movement to connect the strong developments in human rights law with the magnitude of the global environmental crisis. More than 80 nations have enacted constitutional reforms to provide recognition for environmental rights (Boyd, 2012). We believe the time has come to follow that trend in New Zealand. The model we chose in our first draft of Constitution Aotearoa was based on the widely admired South African Constitution. There were fewer reported judicial decisions on the environmental provision than we expected. We concluded that the right had not produced an avalanche of litigation.

Our aim was to ensure that people can enjoy an environment that is not harmful to their health or well-being and to protect the environment for the benefit of present and future generations by ensuring that economic development is sustainable. Among other things, constitutional protection means in this context that environmental standards could not be reduced by a small majority in the House of Representatives.

We were persuaded by explicit consultations we conducted with environmental organisations and the submissions we received, that our draft of the environmental right in the 2016 book needed to be

35 Geoffrey Palmer "What the New Zealand Bill of Rights Act Aimed to Do, Why it did not Succeed and How it can be Repaired" (2016) 14 *New Zealand Journal of Public and International Law* 169 at 201-208.

36 Geoffrey Palmer and Andrew Butler *A Constitution for Aotearoa New Zealand* (Victoria University Press, Wellington, 2016). The proposal for the addition of an environmental right to an entrenched Bill of Rights was developed further in Geoffrey Palmer and Andrew Butler *Towards Democratic Renewal: Ideas for Constitutional Change in New Zealand* (Victoria University Press, Wellington, 2018) [*Towards Democratic Renewal*] at 163-166.

revised and strengthened. We received almost no submissions explicitly opposing the right, and we received 440 submissions from the public. In our 2018 version, we have placed more emphasis on conservation and biodiversity values. There is also more emphasis on ecological issues and Māori values. The earlier draft was too anthropocentric and it needed to lean in the direction of giving the environment itself legal rights, as was done in the recent legislation concerning the Whanganui River.³⁷ There needs to be less space for economic development to trump environmental values. Here is the provision we have drafted for the 2018 book:³⁸

Environmental right

- (1) Everyone has the right—
 - (a) to an environment that is not harmful to their health or well-being; and
 - (b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that—
 - (i) prevent pollution and ecological degradation;
 - (ii) promote conservation and biodiversity;
 - (iii) secure ecologically sustainable development and the use of natural resources in a manner that is managed to maintain the equilibrium of the environment;
 - (iv) include kaitiakitanga, which is the exercise of guardianship by the tangata whenua of an area in accordance with tikanga Māori in relation to natural and physical resources.
- (2) The Commissioner for the Environment may, if the Commissioner considers it appropriate to do so,—
 - (a) conduct litigation to safeguard the rights contained in this Article;
 - (b) intervene in litigation in which issues relating to those rights are raised.

We believe a provision of the type we propose would be of value in preserving and enhancing the quality of New Zealand's environment. Of course, what is proposed is a significant change from the existing law and empowers the judiciary with new tools. One of our submitters argued that such a right would result in the following benefits:

- the enactment of stronger environmental laws;
- the provision of a safety net for gaps in the statutory environmental laws;
- raising the profile of environmental protection as compared to competing interests;
- creating opportunities for better access to justice and accountability for environmental decisions;
- and
- contributing to better environmental performance.

37 See Te Awa Tupua (Whanganui River Claims Settlement) Act 2017.

38 Palmer and Butler *Towards Democratic Renewal*, above n 36, at ch 19, Constitution Aotearoa, article 26.

How much difference such a right would make would depend upon the context in which the issue arose. One test is to ask whether the result of the case in front of Justice Mallon would be any different if such a provision were part of the law. Certainly, such a provision would strengthen the case for the plaintiffs. But could it be confidently predicted that the measures adopted by the previous government were not "reasonable legislative ... measures" given the complex overlay of international obligations in the climate change space? Such a right would be likely to have considerable weight in improving water quality in domestic law, but on climate change perhaps not so much. On the other hand, inactivity in light of clear evidence on environmental threats could attract a constitutional remedy from the courts.

There are important human rights issues bound up in environmental protection. The future of New Zealand will be inextricably bound up with the global environmental problems that threaten to overwhelm the planet. The challenges these problems pose to the development of public policy in New Zealand are formidable.

Climate change is one of the issues, but it is not the only one: water quality, the health of the oceans and acidification, the disposal of waste, loss of top soil, air quality and chemical pollution are others. In such circumstances, it may be prudent to set out some constitutional markers to ensure that New Zealand's standards of environmental protection are enhanced and not reduced, as is the current trend.

Restraints will be placed on the capacity of policy-makers to breach the constitutional guarantees. The public will know what the bottom lines are. Ministers and members of Parliament will be bound by the Constitution and so will the judges. In other words, for such constitutional rights to be meaningful, they must be enforceable.

In May 1994, an international group of experts on human rights and environmental protection convened at the United Nations in Geneva and drafted the first declaration of principles on human rights and the environment.³⁹

Part I of that document contains a succinct statement of the principles:⁴⁰

1. Human rights, an ecologically sound environment, sustainable development and peace are interdependent and indivisible.
2. All persons have the right to a secure, healthy and ecologically sound environment. This right and other human rights, including civil, cultural economic, political and social rights, are universal, interdependent and indivisible.
3. All persons shall be free from any form of discrimination in regard to actions and decisions that affect the environment.

39 Fatma Zohra Ksentini *Report of the Special Rapporteur on Human Rights and the Environment* UN Doc E/CN.4/Sub.2/1994/9 (6 July 1994).

40 *Id.*, at 74-75.

4. All persons have the right to an environment adequate to meet equitably the needs of present generations and that does not impair the rights of future generations to meet equitably their needs.

The rapidity with which constitutional protection for preservation of the environment and its life-sustaining qualities has spread around the world is noteworthy. It began with the Stockholm Declaration in 1972 following the global eco-summit held that year.⁴¹

Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being, and he bears a solemn responsibility to protect and improve the environment for present and future generations.

Should New Zealand provide constitutional protection for the environment, the courts would have increased powers. They could in appropriate cases adjudicate on whether the tests provided in the Constitution have been met. It is a stronger form of judicial review than exists under the powers of judicial review that presently reside in the New Zealand courts. But it is not an appeal on the merits of a decision. It is an adjudication on whether stated constitutional standards have been met in the circumstances. And under the proposals made, Parliament would have the last word.⁴²

The conclusion for this portion of the chapter is that standards for environmental protection in New Zealand would increase and the capacity for judicial measurement of the environmental obligations would be enhanced by the proposal. It would give the environment a significant legal voice. Nevertheless, it is important to emphasise that the political policy-makers would still be in control of the fundamental policy parameters, not the courts.

8.5 The Waitangi Tribunal

The importance of the Waitangi Tribunal in the context of this chapter is that it provides a forum for the presentation of an alternative narrative on climate change issues to that contained in the official policy. The same is true of reports from the Parliamentary Commissioner for the Environment made under the Environment Act 1986.⁴³

While the recommendations of the Tribunal are not binding upon the government, history shows that its capacity to develop environmental arguments based on the Treaty of Waitangi have had

41 Stockholm Declaration on the Human Environment in *Report of the United Nations Conference on the Human Environment* UN Doc A/CONF48/14/Rev1 (1972), principle 1.

42 See Palmer and Butler *Towards Democratic Renewal*, above n 36, at ch 19, Constitution Aotearoa, articles 109-111.

43 There were outstanding reports of high quality on climate change made by the Parliamentary Commissioner for the Environment, Dr Jan Wright, that had little impact on government policy. I instance the following: *A Zero Carbon Act for New Zealand: Revisiting 'Stepping stones to Paris and beyond'* (7 March 2018); *Stepping stones to Paris and beyond: Climate change, progress and predictability* (27 July 2017); *Climate Change and agriculture: Understanding the biological greenhouse gases* (19 October 2016); and *Changing climate and rising seas: Understanding the science* (November 2014).

persuasive power in a number of situations. The reports are readily available.⁴⁴ An early example was the claim that Te Atiawa brought to the Tribunal in 1981 against a Think Big project. The Māori claim was that untreated sewage and industrial waste from a synthetic fuels plant discharged through the Motonui outfall would pollute traditional fishing reefs. The Tribunal reported clearly in favour of the Māori claims in 1983. The then government proposed to ignore the claim, but was forced to back down after heavy public concern was expressed. The outfall was abandoned. This decision was followed by other reports with an environmental aspect: the Kaituna River and the Manukau Harbour claims.⁴⁵

This is not the place to discuss the detailed arguments on climate change that can be made on the basis of the Treaty to the Tribunal; suffice it to say that claims based on climate change policy deficiencies are already before the Tribunal (Sharp, Smith and Te Whenua, 2018). The Treaty of Waitangi Act 1975 gives the Tribunal jurisdiction to entertain claims from Māori. Section 6 currently provides in part:

6 Jurisdiction of Tribunal to consider claims

- (1) Where any Maori claims that he or she, or any group of Maoris of which he or she is a member, is or is likely to be prejudicially affected—
- (a) by any ordinance of the General Legislative Council of New Zealand, or any ordinance of the Provincial Legislative Council of New Munster, or any provincial ordinance, or any Act (whether or not still in force), passed at any time on or after 6 February 1840; or
 - (b) by any regulations, order, proclamation, notice, or other statutory instrument made, issued, or given at any time on or after 6 February 1840 under any ordinance or Act referred to in paragraph (a); or
 - (c) by any policy or practice (whether or not still in force) adopted by or on behalf of the Crown, or by any policy or practice proposed to be adopted by or on behalf of the Crown; or
 - (d) by any act done or omitted at any time on or after 6 February 1840, or proposed to be done or omitted, by or on behalf of the Crown,—

and that the ordinance or Act, or the regulations, order, proclamation, notice, or other statutory instrument, or the policy or practice, or the act or omission, was or is inconsistent with the principles of the Treaty, he or she may submit that claim to the Tribunal under this section.

The history of the Waitangi Tribunal shows that well-researched analytical reports from the Māori perspective can influence the wider public discourse and policy positions over time. On the Waitangi Tribunal website, there are almost 130 reports and a significant number of them have involved

44 See Waitangi Tribunal <www.waitangitribunal.govt.nz>.

45 For a discussion of the development of the Waitangi Tribunal's jurisdiction, see Geoffrey Palmer *New Zealand's Constitution in Crisis: Reforming our Political System* (John McIndoe, Dunedin, 1992) at 78-82.

analysis of Māori approaches to environmental issues. Whether the Tribunal can make a significant contribution in the climate change space remains to be seen. But it is a voice that should be heard.

8.6 Conclusion

This chapter has advanced a limited number of propositions thought to be necessary if a viable New Zealand legal framework is to be developed to combat climate change.

Climate change is a multifaceted problem that presents unique policy challenges. Solving it depends upon making progress through an inordinately complex set of legal relationships between the development of international norms and domestic legal rules around the world.

The New Zealand domestic legal system and its constitutional arrangements are such that it cannot be reasonably expected as matters stand that the courts can make a significant contribution to nudging policy-makers in the direction of adequately addressing the issues when decisions of government fall short.⁴⁶

The provision of an environmental right in a written, codified constitution would give the courts more capacity than they have now to adjudicate on climate change issues. Despite such a change, the courts would not become principal players in the climate change policy arena. An environmental constitutional right would, however, change the current balance of forces within the New Zealand legal system and move it towards ensuring that constitutional guarantees for the environment were satisfied in practice. Their role would still revolve around legality and they could be helpful and constructive, but not central.

The Parliamentary Commissioner for the Environment and the Waitangi Tribunal also have the potential to provide alternatives to the official narrative and these could both be helpful in stimulating public opinion to demand more from elected representatives.

The development of a robust legal framework within which New Zealand can address climate change issues that does not result in big public policy fluctuations flowing from general elections should be forged.

An enduring policy framework, with appropriate institutions, is urgently required. Even then, there is no guarantee of success, given that all nations need to row in the same boat. But without such a framework, there is little prospect of success.

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9

ADDRESSING THE CHALLENGES TO STATEHOOD ARISING FROM
CLIMATE CHANGE: FUTURE BASES FOR ACTION TO PROTECT
LOW-LYING ATOLL NATIONS

*Alberto Costi**

9.1 Introduction

The fate of states that, in the coming decades, will become partially or totally uninhabitable as a result of climate change constitutes one of the most important questions confronting international law today. At the very least, the erosion of fertile lands, the salinization of water sources and the impact of extreme weather events on infrastructure will make living conditions difficult. More drastically, in some cases, populations could be forced to relocate within borders or, in extreme situations, migrate towards other states. The question becomes whether a state would simply cease to exist or would it be able to survive without its territory being habitable and with its population located elsewhere, or ex situ? This question has real implications for low-lying atoll nations; it is not posed for mere theoretical or philosophical debate.

Climate change touches upon various areas of international law. From migration and the inadequate framework of refugee law to disaster management and insurance law, from the preservation of the right of a people to determine its legal and political system (right to self-determination) to the need to ensure compliance with environmental treaties, the international legal order needs to evolve if it is to tackle efficiently the greatest challenge of the 21st century. In other works, I have addressed some of the issues arising in the context of the Pacific region.¹ In this chapter, the idea is to focus more precisely on the most extreme of scenarios that could one day affect the very essence of low-lying atoll nations in the Pacific: the subject of statehood, and how it can be

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1 See for example Alberto Costi and Yves-Louis Sage (eds) *Droit de l'Environnement dans le Pacifique: Problématiques et Perspectives Croisées/Environmental Law in the Pacific: International and Comparative Perspectives* (New Zealand Association for Comparative Law/Association de Législation Comparée des Pays du Pacifique, Wellington, 2005); Alberto Costi "De la Définition et du Statut des 'Réfugiés Climatiques': Une Première Réflexion" (2010) 16 Yearbook of the New Zealand Association for Comparative Law 489; and Alberto Costi and Nathan Ross "The Ongoing Legal Status of Low-Lying States in the Climate-Changed Future" in Caroline Morris and Petra Butler (eds) *Small States in a Legal World* (Springer, Heidelberg, 2017) 101.

maintained, either in situ (on-site) or ex situ, when some of the traditional indicia, or criteria, of statehood are at risk: territory; permanent population; and government's control of its territory.

The risk of so-called "disappearance" of a state,² or to be accurate, the disappearance of habitable territory, is a fairly recent phenomenon, one that is real (Klein, 2017), yet contentious as some studies show evidence that islands are geologically dynamic and in some cases growing in size.³ Whether that is correct or not, as low-lying countries, many Pacific Island nations will continue, until we reverse trends, to be extremely vulnerable to sea level rise and the increased frequency of extreme weather events such as storm surges and flooding, as well as soil erosion and water salinization. As a result, by the end of the 21st century, many Pacific Island nations are likely to be irreversibly affected, with some of them becoming wholly or partially uninhabitable.⁴ Despite this looming crisis and efforts by inter-governmental and non-governmental organisations to tackle issues arising from anthropogenic climate change, international law lacks a proper framework to address the legal status of low-lying states under threat and to protect sufficiently those who are displaced by climate change.

This gap in international law should be of particular concern to the Pacific region. Low-lying Pacific Island nations are likely to produce high levels of out-migration while countries in the region with larger and higher-lying land mass could face increasing migration pressure from the most affected of their neighbouring states. This creates a considerable incentive for countries like New Zealand to begin examining possible responses both at the international and national levels (a subject for another paper). Despite best efforts towards resilience building undertaken through international fora and domestic initiatives, in the absence of clear norms on the subject, the topic forces us to test the limits of international law and find solutions that can preserve and, in fact, reinforce the position of Pacific Islands as full members of the international community.

The scope of this chapter is thus two-fold. First, it examines the current state of the law. It explores whether, in the absence of a permanent population and a defined territory as commonly understood, and possibly, therefore, without fulfilling two of the criteria considered necessary to *establish*

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- 2 The use of the term "disappearance" implies a certain legal outcome, one which might not materialise, not least since recent studies show that the likelihood of low-lying atoll nations disappearing completely is not likely to occur. Although sometimes employed in political discourse by low-lying states' leaders who say that their whole territory, or their sovereignty, is at risk, this language also implies a legal outcome, but, as we shall see, there are no rules or precedents that might suggest this result is even possible, let alone likely. Where possible, the use of the word "disappearing state" in this chapter will be avoided and replaced by "low-lying state" as it is based on an objective fact of the topography that links these states to a common issue without implying any weakness, or any loss of sovereignty or legal personality: Costi and Ross, above n 1, at 103.
- 3 Megan E Tuck, Paul S Kench, Murray R Ford and Gerd Masselink "Physical modelling of the response of reef islands to sea-level rise" (2019) 47(9) *Geology* 803 at 805-806.
- 4 Intergovernmental Panel on Climate Change "Choices made now are critical for the future of our ocean and cryosphere" (press release 2019/31/PR, 25 September 2019) <<https://www.ipcc.ch/site>>. See also Leonard A Nurse et al "Small islands" in VR Barros et al (eds) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, Cambridge and New York, 2014) 1613 at 1618 and 1640. See Chapter 4 in this book.

statehood,⁵ states can *continue* as legal persons in international law. This involves examining case studies of *ex situ* continuity of the state either in its entirety or in some reduced form, particularly important for the peoples of the Pacific, for which governments play a central role in protecting culture, custom, language and other critical characteristics of their communities. It also requires us to develop an understanding of what *ex situ* continuity entails in terms of rights and duties in international law for the low-lying atoll nations at risk.

Secondly, the chapter proposes some forward-looking thinking by considering alternative, and sometimes contentious, bases for action to protect those states. This will be done by borrowing legal and philosophical concepts discussed by international law experts. There may be obligations on the international community in general: for instance, the principle of respect for the right of a people to self-determination; the concept of an emerging international or regional "duty of assistance", an idea I have developed elsewhere (Costi and Sage, 2005); or even "a responsibility to protect" nations and their populations at risk. The chapter sketches the nature of such a "duty" and "responsibility": what these terms entail, and whether they translate into legal or political obligations to ensure low-lying nations can put in motion adaptation strategies that protect the state's survival.

The chapter is structured as follows. After this introduction, I expose the scenario under consideration and some of the key issues at stake. I then discuss the maintenance of legal personality in international law by examining the concept of statehood and assessing its applicability to the contemplated scenario, also pointing out its possible limitations and the importance for low-lying atoll nations of ensuring recognition of their borders and maritime zones by other states. I then consider future bases for action to protect low-lying states by reviewing other useful legal principles and concepts, namely continuity of statehood and the right to self-determination; a possible duty of assistance; the idea of the state as fiduciary of humankind; and finally the notion of responsibility to protect. I conclude by noting that there is no legal reason for low-lying states to lose statehood and that there may be sufficient existing and emerging legal principles and concepts on which the international legal community can base its actions for the protection of low-lying states; I also enumerate some resulting questions for future discussion.

9.2 Climate change scenario and issues at stake

The ability of peoples of low-lying atoll nations to remain and thrive in their homelands is undermined by climate change and its effects. According to the Intergovernmental Panel on Climate Change (IPCC), the sea level is rising at an increasing rate due to the thermal expansion of oceans and the thawing of snow and ice, and that rate is four times greater in the Pacific than the global average (Chambwera et al, 2014). If the most visible effect is that of "sinking" or "submerged" islands, climate change causes other problems compounding the situation, like cyclones, erosion of coastlines,

5 Montevideo Convention on the Rights and Duties of States 165 LNTS 19 (opened for signature 26 December 1933, entered into force 26 December 1934) [Montevideo Convention], article 1:

The State as a person of international law should possess the following qualifications: (a) a permanent population; (b) a defined territory; (c) government; and (d) capacity to enter into relations with the other States.

damage to ecosystems and habitats of marine species, spread of infectious diseases, injuries from extreme weather events (Farbotko, 2010). As internal and external displacement ensues, there are also other significant effects of climate change. These include, for example, the fracture of homogenous ethnic groups and destruction of culturally significant sites (for instance, sepulchres) as well as the emergence of security issues due to an increase in population density and loss of livelihood, thus multiplying threats, as indicated by the Security Council of the United Nations (UN).⁶

The problem is multifaceted. First, low-lying atoll nations are unable to protect themselves from a situation created by activities outside their region. The cost of current adaptation strategies, even with external assistance, is simply prohibitive in the long term (Chambwera et al, 2014), even for developed states (Holden, 2019). The risk to their territorial integrity is forcing low-lying states to consider ex situ solutions. For some, this is simply a question of time (Church et al, 2013). Secondly, the current climate change regime does not yet consider the continuity of states, instead addressing climate change challenges without looking beyond in situ solutions. The UN Framework Convention on Climate Change⁷ and the Kyoto Protocol⁸ are mostly aimed at mitigating greenhouse gas emissions. The concept of adaptation is only indirectly inferred from article 1 of the Framework Convention, under which the possible "disappearance" of a state could be considered an adverse effect of climate change. Although the Conference of the Parties (COP) has adopted mechanisms such as the Warsaw International Mechanism on Loss and Damage, established at COP19 in 2013 to address costly damages from climate change, and discussion of disaster management at COP16, this process has been timid.⁹ For instance, an earlier draft of the Paris Agreement contained an idea of a climate change displacement coordination facility, but that was shut down by several states, including Australia (Costi and Ross, 2017). Article 7 of the Paris Agreement¹⁰ is more aspirational than some of the COP decisions regarding adaptation. According to article 7(1), parties recognise that the current need for adaptation is significant and that greater needs are accompanied by greater costs. Moreover,

6 "Climate change recognized as 'threat multiplier', UN Security Council debates its impact on peace" (25 January 2015) UN News <<https://news.un.org>>.

7 United Nations Framework Convention on Climate Change 1771 UNTS 107 (opened for signature 4 June 1992, entered into force 21 March 1994) [UNFCCC].

8 Kyoto Protocol to the United Nations Framework Convention on Climate Change 2303 UNTS 162 (opened for signature 16 March 1998, entered into force 16 February 2005).

9 Conference of the Parties, UNFCCC *Report of the Conference of the Parties on its nineteenth session, held in Warsaw from 11 to 23 November 2013 — Addendum — Part Two: Action taken by the Conference of the Parties at its nineteenth session* FCCC/CP/2013/10/Add.1 (2014), Decision 2/CP.19 "Warsaw international mechanism for loss and damage associated with climate change impacts".

10 Paris Agreement 55 International Legal Materials 743 (adopted 12 December 2015, entered into force 4 November 2016).

parties recognise that the needs of the particularly vulnerable states must be given support, and this requires international cooperation.¹¹

Although the partial or total disappearance of a state would represent an extreme failure of the international legal system, no international agreement to date either mentions or impedes the loss of statehood – that is, the status conferring legal personality in international law with its particular privileges and obligations (Costi and Ross, 2020). Yet, the issue of statehood draws its importance from the fact that the principal function of a state is to ensure its persistence in order to protect its citizens, and hence, any international support and cooperation should aim at the persistence of statehood. In tune with this view is the work of the UN High Commissioner for Refugees (UNHCR) on planned relocation.¹² Its guidance states that relocation of at-risk populations to protect them from disasters and the impacts of environmental change, such as the effects of climate change, carries serious risks for those it is intended to benefit, including the disruption of livelihoods and loss of cultural practices. The UNHCR, therefore, sets out general principles to assist states and other actors faced with the need to undertake a "planned relocation". The UNHCR aspires for these general principles to helpfully serve as a process for states and supporting actors should they wish to formulate laws, policies, plans and programmes to that effect.¹³

Similarly, the Office of the UN High Commissioner for Human Rights (OHCHR) had earlier reiterated the well-known fact that the effects of climate change were already being felt by individuals and communities around the world, and that the most vulnerable were those living on the "front line" of climate change.¹⁴

... in places where even small climatic changes can have catastrophic consequences for lives and livelihoods. Vulnerability due to geography is often compounded by a low capacity to adapt, rendering many of the poorest countries and communities particularly vulnerable to the effects of climate change.

The OHCHR report refers to the possible scenario of forcible displacement across national borders and points to some of the human rights issues such a situation would raise, for example, the rights of affected populations vis-à-vis receiving states and possible entitlement to live in community. The report goes on to state:¹⁵

Human rights law does not provide clear answers as to the status of populations who have been displaced from sinking island States. Arguably, dealing with such possible disasters and protecting the human rights

11 Id, article 7(6). I mention here the idea of cooperation and the concept of support for vulnerable states as they will form the basis of some of the points discussed later in the chapter.

12 *Guidance on Protecting People from Disasters and Environmental Change through Planned Relocation* (UNHCR, Brookings and Georgetown University, October 2015).

13 Id, at 5.

14 *Report of the Office of the United Nations High Commissioner for Human Rights (OHCHR) on the relationship between climate change and human rights A/HRC/10/61* (2009) at [93].

15 Id, at [60].

of the people affected will first and foremost require adequate long-term political solutions, rather than new legal instruments.

These bold statements from the UNHCR and the OHCHR are important. They stress the fact that while terms like displacement and migration may have a particular connotation, "planned relocation" seems to be a novel concept that could be used to include solutions for entire states. The foremost priority for low-lying states is, in any event, the maintenance of their legal personality (Burson, 2018).

9.3 Maintaining legal personality in international law¹⁶

Why is it important to maintain the legal personality of affected states? Since 1648, the concept of state ("Westphalian" state) has been based to a large extent on the principle of territory, which is directly threatened by climate change. States are the only full subjects of international law, that is, only states have full legal capacity and are juridically equal insofar as they enjoy an equal right to establish law and administer justice.¹⁷ They "make" international law; other (non-state) subjects derive their own legal personality from the will of states – the concept of derived legal personality (Costi and Ross, 2020). Moreover, states owe protection to all those on their territory and can also engage in diplomatic protection of their nationals abroad. These attributes are significant, not least for low-lying states with large numbers of relocated citizens.

The most critical priority for low-lying states is thus to maintain their legal personality. This is dependent on maintaining statehood, analysed typically against the orthodox criteria for statehood, and the related concept of state recognition.

9.3.1 Statehood

Turning first to statehood, article 1 of the Montevideo Convention on the Rights and Duties of States relates to the criteria for establishing statehood. Although the continuity of already established states is a separate legal question examined later, discussing these "orthodox" criteria is important for assessing any possible risks for low-lying states.

9.3.1.1 Defined territory

In the extreme event of relocation of the entire population of a state due to the effects of climate change ("climate change scenario"), can the requirement of a territory as per the Montevideo Convention's criteria of statehood be maintained?

There is no minimum size for a state's territory. The world's smallest states are Monaco (2.1 km²), Nauru (21 km²) and Tuvalu (26 km²). The size of the territory of a state does not affect the level of statehood; all three mentioned states receive equal voting rights in the UN General Assembly

¹⁶ This section is based in part on Costi and Ross, above n 1; and Alberto Costi and Nathan Jon Ross "International Legal Personality" in Alberto Costi (ed) *Public International Law: A New Zealand Perspective* (LexisNexis, Wellington, 2020) 75.

¹⁷ Montevideo Convention, above n 5, article 4.

alongside larger states.¹⁸ Even though the UN Convention on the Law of the Sea (UNCLOS) refers to "a naturally formed area of land, surrounded by water, which is above water at high tide",¹⁹ this definition is for the purpose of allocating maritime resources and defining boundaries. It is not for establishing or maintaining statehood.

Also, a reading of the *Island of Palmas* arbitration may help to understand the meaning of territory for islands.²⁰ First, delimited borders are not essential. What matters is that there be a physical and identifiable territory. The territory is not always perfectly defined – maritime and territorial disputes testify to that reality (Costi and Ross, 2020). It is unlikely that the territory of low-lying states will disappear completely. It might, however, become partially or totally uninhabitable. Hence the importance of delimited maritime boundaries deposited with the UN or through bilateral agreement or domestic legislation to provide a record that may be opposed to other states, a point that has escaped the attention of regional leaders:²¹

We confirm that the baselines that determine our territorial boundaries, once established, under the UN Convention on the Law of the Sea, shall remain unchanged despite the effects of sea level rise. Our sovereignty will not be compromised by climate change.

The second point from the *Island of Palmas* arbitration pertains to sovereignty as a key element for determining whether the territory criterion of the Montevideo Convention continues to be satisfied. Sovereignty is not a criterion for establishing statehood, but rather a right that arises as a consequence of the legal personality of the state being established (Costi and Ross, 2020). The *Island of Palmas* arbitration (insofar as the sovereignty element of the territory criterion is concerned) determined that the right of sovereignty over territory could only be upheld if it was effectively exercised (*animus occupandi*). Whether sovereignty, as envisaged by the arbitral tribunal (without having in mind low-lying states when deciding the case) persists with respect to the novel climate change scenario for low-lying states is, of course, untested.

The more specific question here is whether the loss of habitable territory in itself results in the discontinuity of the sovereign state as entity. Rosemary Rayfuse seems to presume that disappearance of territory means extinguishment of statehood.²² Cedric Ryngaert and Sven Sobrie believe that

18 Charter of the United Nations 1 UNTS XVI (opened for signature 26 June 1945, entered into force 24 October 1945) [UN Charter], article 18(1).

19 United Nations Convention on the Law of the Sea 1833 UNTS 397 (opened for signature 10 December 1982, entered into force 16 November 1994), article 121(1).

20 *Island of Palmas (Netherlands v United States of America) (Award)* (1928) II RIAA 829 at 838 and 855.

21 Polynesian Leaders Group "Amatuku Declaration on Climate Change and Oceans" (8th Polynesian Leaders Meeting, Tuvalu, 29 June 2018) at [12] <[https://www.sprep.org/sites/default/files/documents/executive_board/2018/Information%20Paper%202\(b\)%20-%20Amatuku%20Declaration%20on%20Climate%20Chance%20and%20Oceans_FINALsigned.pdf](https://www.sprep.org/sites/default/files/documents/executive_board/2018/Information%20Paper%202(b)%20-%20Amatuku%20Declaration%20on%20Climate%20Chance%20and%20Oceans_FINALsigned.pdf)>.

22 Rosemary Rayfuse "International law and disappearing states: maritime zones and the criteria for statehood" (2011) 41 *Environmental Policy and Law* 281 at 284.

central to the Montevideo Convention is the principle of effectiveness. They wonder how a state can be effective without physical territory resulting from displacement of the population.²³

There is no legal authority for reaching a conclusion with such drastic consequences. After all, a state can claim title over an uninhabited territory or *terra nullius* (Costi and Ross, 2020). As the *Eastern Greenland* case stated, sovereignty requires an intention to act as sovereign and some actual exercise or display of authority.²⁴ This can be performed through other arrangements. For instance, nothing in law prevents the *ex situ* continuity of sovereignty (Burkett, 2011). For example, governments in exile during World War II operated from outside their borders because of special circumstances – the difference here is that the threat might be long-term and lead to permanent loss of habitable territory due to climate change.

Moreover, as James Crawford explains, there is presumption of continuity of states: "There is a substantial body of practice protecting the legal personality of the state against extinction, despite prolonged lack of effectiveness."²⁵

What lies underneath the defence of statehood is the protection of human rights and the collective right of a people to exercise its right to self-determination, best protected by the state. History shows the devastating effects for peoples when deprived of their national identity, culture, customs and language. There is a range of possible futures for a low-lying state *ex situ* that could address border delimitation and sovereignty.

9.3.1.2 Permanent population

Although permanent population is often considered as the least important indicia or criterion of statehood, there is no doubt this will be undermined in the climate change scenario. The matter of climate change effects threatening the population led former Kiribati President Anote Tong to announce plans for "migration with dignity", even going so far as to purchase an island off Fiji belonging to the Church of England (Caramel, 2014); and Tuvalu's current Prime Minister Enele Sopoaga considered approaching Australia and New Zealand to buy a parcel of land back in 2015.²⁶

Regarding population too, size is irrelevant. What really matters is the permanence of a form of community life in the sense of sharing a common identity.²⁷ For Ian Brownlie, population is

23 Cedric Ryngaert and Sven Sobrie "Recognition of States: International Law or Realpolitik?" (2011) 24 *Leiden Journal of International Law* 467 at 472.

24 *Legal Status of Eastern Greenland (Norway v Denmark) (Judgment)* (1933) PCIJ (Series A/B) at 46.

25 James Crawford *The Creation of States in International Law* (2nd ed, Oxford University Press, Oxford, 2006) at 132.

26 "Tuvalu looking at buying NZ and Aust land for displaced" (24 August 2015) Radio New Zealand <<https://www.rnz.co.nz>>.

27 Administrative Court of Cologne (1978) *In re Duchy of Sealand* 80 ILR 683 at 687.

interlinked with territory. It is a stable community in control of a specific area.²⁸ On first impression, permanent population as the second criterion for establishing statehood will not be met in the event all the inhabitants of a state leave or if the territory becomes uninhabitable. It can be argued, however, that if the entire population or a large majority of it relocates to a new land, there nevertheless remains a population with a form of community life, reasonably homogenous, linked by ethnicity, culture, history and language. In fact, the main threat of relocation is the risk of fragmentation across borders. Hence the importance of a "planned relocation" suggested by the UNHCR and the OHCHR for avoiding fragmentation and assimilation on the one hand, while, on the other, keeping alive the right to self-determination, exercised collectively by the people, wherever located.

It is also worth noting that although a territory may become uninhabitable, nothing in international law requires it to be habitable, except for specific purposes such as maritime delimitation (Mossop, 2017). It is theoretically possible, then, for a state to persist in a form of government in exile. Thus, the territory made uninhabitable by the adverse effects of climate change remains the territory of the state *in absentia*. The inclusion of uninhabited land within a state's territorial claims certainly has precedent. New Zealand, for example, has numerous islands that form part of its territory, including some which have never been inhabited, such as the Solander Islands (except when five sealers were stranded there for five years).²⁹

In summary, in the scenario of total loss of habitable territory, the permanent population criterion will not be met in situ. The issue, however, must be measured against the legal requirements for continuity of statehood discussed later. As will be seen, in principle, low-lying states may persist ex situ, where the entirety or most of the population relocates.

9.3.1.3 Government

The third criterion for statehood is a government. Often thought to be the most important requirement, it reflects the need for a state to have, on the one hand, international representation and, on the other, the actual capacity to exercise power over a territory and a population (Costi and Ross, 2020). Does this criterion require simply a government in power, or an effective government? Crawford applies criteria for effective government more strictly to situations of establishing states rather than those of continuity of states.³⁰ Effective government refers to the ability of the government to control the territory and people, and to exercise such authority exclusively.

A concern then, is the ability of governments of low-lying states to continue to fulfil their essential functions, such as guaranteeing basic rights and services to their citizens. One issue, here, is whether increasing funding from other states may lead to a degree of dependency. Another one relates, for instance, to displacement of large numbers of people, leading to internal instability and threatening domestic order and social cohesion. As a result of the impacts of climate change, the legitimacy of

28 Ian Brownlie *Principles of Public International Law* (7th ed, Oxford University Press, Oxford, 2008) at 70-71.

29 Costi and Ross, above n 1, at 115.

30 Crawford, above n 25, at 59.

the government could be questioned, especially should a government be forced to relocate in another territory. One could argue that a government is not effective if unable to carry out its functions within its territory or rule over the displaced population, especially if the latter is fragmented and located in different countries.

However, there are many examples of states that have been, for long periods of time, unable to provide public services required of government over the whole territory (for instance, Somalia in recent times). Yet, states, wrongly adorned in legal terms with the epithet "failed", did maintain their statehood. Bosnia and Herzegovina and Croatia were admitted to the UN in spite of the fact that non-governmental forces controlled large tracts of their respective territories.³¹ Article 4 of the Montevideo Convention provides that the rights of each state "do not depend upon the power which it possesses" to exercise them. Thus, the mere prospect of a limited capacity of a Pacific Island government to exercise its powers should not by itself threaten statehood. Neither should the form of government be an issue. As commented by the International Court of Justice (ICJ) in the *Western Sahara* advisory opinion, the form of government is irrelevant.³² Add to this Crawford's conclusion that international law does not lay down "specific requirements as to the nature and extent of this [governmental] control [of territory], except that it includes some degree of maintenance of law and order and the establishment of basic institutions."³³ He further remarks that there is "a distinction between the creation of a new State on the one hand and the subsistence or extinction of an established State on the other. In the former situation, the criterion for effective government may be applied more strictly".³⁴

It is, therefore, possible to argue that a low-lying state could continue to have a government – even an *ex situ* government – that is exercising any form or degree of control over its territory, including uninhabited islands and territorial sea; that would be sufficient to satisfy the government criterion of the Montevideo Convention. Although there might be problems in practice, the fact is that continuity of state may well persist and follow the government and the people of the low-lying state rather than being extinguished by the loss of existing territory and permanent *in situ* population.

9.3.1.4 Capacity to enter into international relations

This last indicia of statehood relates to the competence of the state to conduct international relations with other states. Whereas satisfaction of the other criteria of the Montevideo Convention is "basically factual, fulfilment of this criterion depends on competence – the state ought to have the ability to conduct international relations – and on other states' willingness to reciprocate."³⁵ But as

31 *Admission of the Republic of Bosnia and Herzegovina to membership in the United Nations* GA Res 46/237, A/Res/46/237 (1992); and *Admission of the Republic of Croatia to membership in the United Nations* GA Res 46/238, A/Res/46/238 (1992).

32 *Western Sahara (Advisory Opinion)* [1975] ICJ Rep 12 at 43-44.

33 Crawford, above n 25, at 59.

34 *Ibid.*

35 Costi and Ross, above n 16, at 89.

Crawford suggests, capacity is not "a criterion, but rather a consequence of statehood, and one which is not constant but depends on the status and situation of particular States."³⁶ Now, low-lying states have already shown capacity to enter into treaties, to lay claims to their maritime zones, and to participate in international negotiations, for instance climate change, individually and through the Alliance of Small Island States (AOSIS).³⁷

Two points should be made at this stage: agreements entered into by low-lying states before a potential relocation are presumed to continue; and capacity to enter into new agreements after relocation, however, will depend on the willingness of other states. Although not a formal requirement, continued state recognition will have practical effects, especially as regards capacity, as noted by Malcolm Shaw:³⁸

... the more overwhelming the scale of recognition is in any given situation, the less may be demanded in terms of the objective demonstration of adherence to the criteria. Conversely, the more sparse international recognition is, the more attention will be focused upon proof of actual adherence to the criteria concerned.

It is, therefore, important for low-lying states, for instance, to make submissions to the UN Commission on the Limits of the Continental Shelf, and to enter into treaties (on fisheries, for instance) that record clearly the precise delimitation of their maritime borders. In doing so, they ensure that other states recognise their current status for the future.

9.3.2 Importance of state recognition and presumption of continuity

Both customary international law and the Montevideo Convention only determine requirements for a new state to be *established* and gain statehood. Neither specifies the requirements for the *continued* existence of states. Moreover, customary international law includes a principle of state continuity, which is based on a strong presumption against the extinguishment of states once they have been firmly established, as is the case for low-lying states. The principle was affirmed in the *Tinoco* arbitration.³⁹

No involuntary extinction of states has occurred in fact since 1945; any extinction of state has been by purposeful dissolution (Burkett, 2011). There is nothing to suggest that the principle of continuity will become moot if a low-lying state no longer satisfies a statehood criterion. Ivan Shearer, for instance, makes the argument that once a state is already established, the requirement of territory is not necessary.⁴⁰ Thomas Grant makes a similar point, in that once an entity "has established itself

36 James Crawford *The Creation of States in International Law* (Clarendon Press, Oxford, 1979) at 47.

37 On the latter point, see Chapter 7 in this book. The argument can also be made that a low-lying state could delegate the conduct of its international relations to another state without this affecting statehood, as exemplified by Liechtenstein requesting Switzerland to represent it via its embassies and consulates (Duursma, 2006).

38 Malcolm N Shaw *International Law* (8th ed, Cambridge University Press, Cambridge, 2017) at 164.

39 *Tinoco Claims Arbitration (United Kingdom v Costa Rica) (Award)* (1923) 1 RIAA 369.

40 Ivan Shearer (ed) *Starke's International Law* (11th ed, Butterworths, London, 1994) at 85.

in international society as a state, it does not lose statehood by losing its territory or effective control over that territory."⁴¹ Even if these writings were in the context of World War II and the more recent conflict in Somalia, they nevertheless indicate the continuity of statehood once established.

Regarding low-lying states, two observations are necessary. First, their fate cannot be analysed in isolation. Many principles of international law apply to the situation of low-lying states: statehood; self-determination; and sovereign equality. Secondly, the concept of recognition takes on a new dimension in the context of climate change. Since the factual scenario is novel, the reaction of the international community will be crucial.

Politics is likely to play an important role and could interfere with legal norms. For low-lying states with valuable maritime resources, as mentioned earlier, laying out coordinates and nautical charts with the UN or in legal instruments is important. Low-lying states may also argue that withdrawing recognition could be seen as interference in their internal affairs. Assuming that low-lying states engage in efforts to maintain statehood *ex situ*, any removal of recognition could be seen as a breach of the principle of non-intervention. More importantly, withdrawal of recognition of a state actively engaged in securing its continued statehood could amount to a denial of a people's right to self-determination.

9.3.3 Concluding remarks

At first sight, low-lying states are not only vulnerable due to the physical impacts of climate change effects, but also because reliant on the goodwill of more powerful states whose interests might not necessarily take theirs into account. The challenges to a state, due to the uninhabitable character of the territory as a result of climate change, raise important legal concerns, but orthodox principles of international law can tackle effectively any legal concerns, even positing novel solutions, such as the prospect of a "deterritorialized nationhood" (Burkett, 2011). Presently, statehood appears to be defined only in relation to the establishment of states, not their disestablishment. State continuity is presumed in international law as a principle. State extinction so far appears to relate only to states dissolving into a number of smaller states, as with the former Yugoslavia, or those being absorbed into larger ones (for instance, England and Scotland into the United Kingdom).

Although the literature has analysed in detail other forms of legal personality, only continued statehood, wherever the government is located, can procure the best possible protection to its nationals. The least preferred option, lack of a legal status, will not be able to afford citizens any protection. The latter will be "at the mercy" of the hosting states where the people will have relocated, in accordance with domestic and international human rights instruments (Ross, 2014). Resolving the issue of the legal status of low-lying states is crucial before any other legal issues (for instance, fate of the population, maritime zones, access to resources, etc) can be addressed.

41 Thomas D Grant "Defining Statehood: The Montevideo Convention and its Discontents" (1999) 37 *Columbia Journal of Transnational Law* 403 at 435.

9.4 Future bases for action to protect low-lying states

So far, this chapter has built on the current state of international law to argue for the most favourable status for low-lying states in the climate change scenario: continued statehood. International law has not developed with the physical destruction of a state's entire land territory in mind. The international legal order is also based on the premise that states act in good faith to fulfil their obligations to protect and restore the environment albeit, "[i]n view of the different contributions to global environmental degradation, States have common but differentiated responsibilities", as "developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command".⁴²

Unfortunately, the legal instruments, with the Paris Agreement in tow, impose few hard legal obligations on state parties. Equally, and without doubting the causal linkage between human activity and climate change, the latter poses significant challenges to international law and international courts: issues associated with climate change cut across national boundaries; the sources of the problem are varied and broad; and it is difficult to link the activity in one country directly to the damage caused to another.⁴³

The absence of clear actionable legal obligations puts pressure on the need to develop initiatives and programmes that may only in the long term curb current patterns. In the meantime, it is necessary to consider novel, or adapt existing, legal norms directly addressing the scenario of states under threat due to climate change.⁴⁴ Hence, exploring future bases for action to protect those states is warranted.

From an international law viewpoint, there may be obligations on the international community in general: for instance, an obligation *erga omnes* (opposable to all without exception) to protect the right to self-determination; an emerging concept of an international or regional "duty of assistance"; or even "a responsibility to protect" states and their populations at risk. This part examines the protection afforded to continued statehood and to the right to self-determination before exploring the nature and scope of the "duty of assistance" and the "responsibility to protect". Could they translate into obligations to provide assistance so that states at risk from climate change can put in motion adaptation strategies that protect them adequately?

42 See for example Rio Declaration on Environment and Development A/CONF.151/26 (Vol I) (1992) at 8 (adopted 14 June 1992) [Rio Declaration], principle 7.

43 See Philippe Sands "Climate Change and the Rule of Law: Adjudicating the Future in International Law" (2016) 28 *Journal of Environmental Law* 19 at 22-23. The same cannot be said about climate litigation at the domestic level, where courts, for instance, have used their powers under judicial review and statutory interpretation to curb governments' powers. See Chapter 8 in this book.

44 Costi and Ross, above n 1, at 115.

9.4.1 Continuity of statehood and relevance of the right to self-determination

Given the centrality of states in the international legal order, it is unsurprising that there is "a principle of the continuity of state."⁴⁵ This principle is discussed relative to the Montevideo Convention's criterion of government; that is, whilst governments change, the state is presumed to continue. For Crawford, for instance:⁴⁶

There is a strong presumption that the State continues to exist, with its rights and obligations, despite revolutionary changes in government, or despite a period in which there is no, or no effective government.

This reflects a practically necessary distinction between governments and states in numerous situations, for example, where there are governments in exile or lengthy civil wars. In relation to low-lying states, the question arises as to whether this presumption of continuity could also apply when indicia of statehood other than, or in addition to, government are severely affected. The challenge to these states is, of course, unprecedented: there are no instances where the status of an existing state has been questioned because of loss of permanent population or habitable territory. If states have become extinct in the past, it has been for reasons entirely different from the situation confronting low-lying states. Again, Crawford explains:⁴⁷

...there is a strong presumption against the extinction of States once firmly established. It is significant that almost all the cases of extinction ... involved either entities that were ephemeral or whose independence was not clearly established or were instances of voluntary extinction, when a people (as in the case of the GDR [German Democratic Republic]) or their representatives (as in the case of Czechoslovakia) decided to put an end to their State and to opt for a different future.

The Montevideo Convention specifies that recognition by other states (a state of affairs currently enjoyed by all low-lying states) "is unconditional and irrevocable".⁴⁸ Overall, it is clear that international law takes an extremely conservative approach to the extinction of states.

There are many reasons why this conservatism and the presumption of continuity ought to apply to low-lying states. First, these states are, in Crawford's words, "firmly established"; there is no doubting the status of their current statehood. Accordingly, the possibility that they also enjoy the presumption of continuity ought to be considered.

Secondly, as discussed earlier, there are no rules for terminating statehood except under circumstances unrelated to the climate scenario examined here: state succession in situations of decolonisation; dismemberment of an existing state; secession; merger and, historically, annexation (Shaw, 2017). By definition, succession requires that sovereignty is inherited by another, and so, in

⁴⁵ *Tinoco Claims Arbitration*, above n 39, at 377.

⁴⁶ Crawford, above n 25, at 34.

⁴⁷ *Id.*, at 715.

⁴⁸ Montevideo Convention, above n 5, article 6.

all such cases, "[t]here is never simply a void", as Jane McAdam explains.⁴⁹ In fact, events leading to state succession are entirely different from the climate change scenario. There is, therefore, as already mentioned, nothing in international law that suggests that the presumption will become moot if a low-lying state no longer satisfies a criterion for creating states.

Thirdly, the right to self-determination belongs to the people, not to the territory. That right is a non-derogable, peremptory norm that exists in perpetuity (Ross, 2019). Continued international legal personality (statehood or otherwise) is the only way to secure the external dimension of self-determination, which is currently enjoyed by the peoples of low-lying states both *de jure* (in law) and *de facto* (in fact). If statehood is terminated by some external body, through whatever juridical means, without voluntary forfeiture by the peoples of low-lying states, "the effects on their human rights, including their right to self-determination and to development, [would] be devastating".⁵⁰

Fourthly, enjoying the collective right to self-determination is a prerequisite for the enjoyment of all individual human rights.⁵¹ Therefore, depriving peoples of their state by any exogenous force – other states' greenhouse gas emissions, climate change, and (hypothetical) subsequent termination of their state – would certainly exacerbate the risks of impoverishment and human rights challenges inherent to the relocation enterprises of low-lying states. Relocation through ordinary immigration schemes would transform peoples "socially and politically from being members of an outright majority in their own States to being members of minorities in the destination State";⁵² and fragmentation into dispersed communities would challenge their collective decision-making powers and "jeopardise their continued enjoyment of self-determination".⁵³

Finally, in the absence of any rules for terminating statehood in the circumstances faced by low-lying states, international actors are in a position to decide on the development of international law: whether to deprive a people of their statehood and external self-determination or, instead, to enable the perpetual statehood otherwise presumed. Embracing the presumption of continuity as a starting point advances a resolution suitable for enabling collective and individual human rights.

9.4.2 Duty of assistance

The existence of a principle of cooperation has been recognised in international legal instruments for some time. It has also been raised in legal and non-legal texts, leading to the timid emergence of

49 Jane McAdam "'Disappearing States', Statelessness and the Boundaries of International Law" in Jane McAdam (ed) *Climate Change and Displacement: Multidisciplinary Perspectives* (Hart, Oxford, 2010) 105 at 109.

50 *Report of the Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment* A/HRC/31/52 (1 February 2016) at [29].

51 *The right of peoples and nations to self-determination* GA Res 637 A (VII) (1952), preamble.

52 Nathan Jon Ross *Low-Lying States, Climate Change-Induced Relocation, and the Collective Right to Self-Determination* (PhD Thesis, Te Herenga Waka—Victoria University of Wellington, New Zealand, 2019) at 38.

53 *Id.*, at 39.

a plea for a duty of assistance when a state at risk makes a request, a notion I have discussed before, while acknowledging the difficulties in establishing a corresponding legal obligation at present (Costi and Sage, 2005).

It is found in the UN Charter,⁵⁴ as one of the UN's purposes. Although article 1(3) is not binding, it highlights the importance for the UN and its members to address and resolve "international problems of an economic, social, cultural, or humanitarian character, and in promoting and encouraging respect for human rights and for fundamental freedoms for all without distinction as to race, sex, language, or religion." In addition, articles 55 and 56 of the UN Charter ensure that members individually and jointly will take action to create conditions of stability and well-being for enabling the economic and social development of their peoples. Read together with the right to self-determination, it is possible to say that cooperation would include efforts to assist peoples of low-lying states to continue to exercise their right to self-determination.

The principle of cooperation is also traditionally prescribed in international environmental law instruments – too many to cite here – often linked with a call to provide assistance to developing states. According to the Rio Declaration, for instance, the notion of sustainable development is presented as requiring solidarity among states and different peoples, and states should "cooperate to strengthen endogenous capacity-building" by improving scientific understanding and "by enhancing the development, adaptation, diffusion and transfer of technologies, including new and innovative technologies".⁵⁵ Principle 7 of the Rio Declaration calls upon states to cooperate in a spirit of global partnership with a view to conserve, protect and restore the health and integrity of earth's ecosystem. This principle, already cemented in the Stockholm Declaration five decades ago,⁵⁶ is also found in AOSIS' programmes that call for cooperation of the international community with small developing states.⁵⁷ Cooperation may take various forms. At a more general level, it entails the need for parties to a treaty to work together to ensure compliance with its terms in good faith (Costi, Davidson and Yarwood, 2020). At a more practical level, cooperation may comprise financial and technical assistance and technology transfers.⁵⁸ The various forms of cooperation are found in many provisions of the UN Framework Convention on Climate Change and the Paris Agreement.⁵⁹

54 UN Charter, above n 18, article 1(3).

55 Rio Declaration, above n 42, principles 5 and 9.

56 Stockholm Declaration on the Human Environment in Report of the United Nations Conference on the Human Environment A/CONF.48/14 at 2 and Corr.1 (1972) (adopted 16 June 1972).

57 See for example Alliance of Small Island States and United Nations Development Programme *Rising Tides, Rising Capacity. Supporting a Sustainable Future for Small Island Developing States* (UNDP, June 2017). For a summary of the low-lying states' participation in international climate change discourse, see Lilian Yamamoto and Miguel Esteban *Atoll Island States and International Law: Climate Change Displacement and Sovereignty* (Springer, Heidelberg, 2014) at 105-119. See also Chapter 7 in this book.

58 See for example Paris Agreement, above n 10, articles 7, 9, 10 and 13.

59 See for example UNFCCC, above n 7, article 9; and Paris Agreement, above n 10, articles 8 and 14.

The cooperation principle is also included in many human rights treaties and statements by human rights bodies. For example, the OHCHR noted: "international cooperation is not only expedient but also a human rights obligation and that its central objective is the realization of human rights".⁶⁰

The realisation of human rights demands not only respect by the international community of the right of a people to self-determination, as already mentioned, but also its prioritisation as it provides the best conditions for a people to ensure its development and for individuals to thrive in the knowledge that their rights are protected. Article 2(1) of the International Covenant on Economic, Social and Cultural Rights (ICESCR)⁶¹ refers to the obligation of each state party:

... to take steps, individually and through international assistance and co-operation, especially economic and technical, to the maximum of its available resources, with a view to achieving progressively the full realization of the rights recognized in the present Covenant by all appropriate means, including particularly the adoption of legislative measures.

This provision has been interpreted by the UN Committee on Economic, Social and Cultural Rights as requiring the international community to assist a state that lacks financial resources or expertise (McAdam, 2012). Although the level of assistance is not set out clearly, this provision should be read in conjunction with article 23, which defines international action for the achievement of the rights in the ICESCR as:

... including such methods as the conclusion of conventions, the adoption of recommendations, the furnishing of technical assistance and the holding of regional meetings and technical meetings for the purpose of consultation and study organized in conjunction with the Governments concerned.

There is a clear expectation that a state should be able to ask for assistance, which should be provided upon request. Many other instruments also speak to the need for international action.

Although the existence of some sort of duty to assist is largely undisputed, its precise meaning remains unclear and so does its legal nature.

The following legal arguments suggest a duty of assistance may slowly come to be recognised as an emerging principle of international law and may help clarify its possible substance.

First, it most likely entails an obligation to take the interests of other states into account; before a state undertakes an activity that may have transboundary effects, it is clearly established that it should consult and exchange information with interested states.⁶² To satisfy such a requirement, there is a need for the rights of all parties to be recognised.⁶³ Concerning the climate change scenario

60 *Report of the Office of the United Nations High Commissioner for Human Rights (OHCHR) on the relationship between climate change and human rights*, above n 14, at [99].

61 International Covenant on Economic, Social and Cultural Rights 993 UNTS 3 (opened for signature 19 December 1966, entered into force 3 January 1976).

62 *Lake Lanoux Arbitration (France v Spain) (Award)* (1957) 24 ILR 101.

63 *Fisheries Jurisdiction (United Kingdom v Iceland) (Merits)* [1974] ICJ Rep 3 at 30-31.

contemplated here, this would not be objected to by developed states, many having shown solidarity with the plight of states at risk.

Secondly, the "duty of assistance" is likely to call for pro-active measures along the traditional lines of financial and technical assistance, and possibly even conclusion of assistance agreements. As long as there is no compelling states to subscribe to specific substantive obligations, it is unlikely to raise major objections. According to McAdam, "it would be difficult to find authority to support the proposition that the duty to cooperate impose a responsibility on States to facilitate adaptation through migration where *in situ* adaptation to climate change cannot remedy the pressures on the local population."⁶⁴ There is thus an expectation that states will work together to protect peoples from the effects of climate change without this commitment being a legally binding obligation upon any particular state to provide any particular form of assistance.

Thirdly, at a more practical level, and by analogy, one can find isolated examples of existing duties of assistance. For instance in regard to individuals, the International Law Commission in its work on disaster law has reflected on the broad entitlement to human rights protection held by those persons affected by disasters.⁶⁵ Its work also serves as a reminder of the duty of states to ensure compliance with all relevant human rights obligations applicable during both the disaster and the pre-disaster phase. Another example may be found in the law of the sea. A duty to assist persons in distress at sea is a long-established rule of customary international law dating back centuries (Papanicolopulu, 2016). This duty extends to both other vessels and coastal states in the vicinity; and all persons, including irregular maritime migrants, remain protected. This rule has been codified in UNCLOS, which prescribes relevant duties for flag and coastal states at article 98:

1. Every State shall require the master of a ship flying its flag, in so far as he can do so without serious danger to the ship, the crew or the passengers: (a) to render assistance to any person found at sea in danger of being lost; (b) to proceed with all possible speed to the rescue of persons in distress, if informed of their need of assistance, in so far as such action may reasonably be expected of him; (c) after a collision, to render assistance to the other ship, its crew and its passengers and, where possible, to inform the other ship of the name of his own ship, its port of registry and the nearest port at which it will call.
2. Every coastal State shall promote the establishment, operation and maintenance of an adequate and effective search and rescue service regarding safety on and over the sea and, where circumstances so require, by way of mutual regional arrangements cooperate with neighbouring States for this purpose.

Beyond the law of the sea, it is interesting to note that the Convention Governing the Specific Aspects of Refugee Problems in Africa, unlike many other instruments, explicitly recognises that

64 Jane McAdam *Climate Change, Forced Migrations, and International Law* (Oxford University Press, Oxford, 2012) at 258.

65 International Law Commission *Report of the Work on its Sixty-Second Session (3 May-9 June and 5 July-6 August 2010)* A/65/10 (2010), draft article 5.

particular countries will have to call for help when they are over-burdened with refugees, and it imposes a duty on the other states to assist.⁶⁶

Where a Member State finds difficulty in continuing to grant asylum to refugees, such Member State may appeal directly to other Member States and through the OAU [Organization of African Unity, replaced by the African Union], and such other Member States shall in the spirit of African solidarity and international cooperation take appropriate measures to lighten the burden of the Member State granting asylum.

These examples show some acceptance on the part of states of certain obligations they owe to other states in circumstances where life may be under threat. One possibility would be to read the duty of assistance in line with the principle exposed in *Island of Palmas*, that:⁶⁷

territorial sovereignty ... involves the exclusive right to display the activities of a State. This right has as corollary a duty: the obligation to protect within the territory the rights of other States, in particular their right to integrity and inviolability in peace and in war, together with the rights which each state may claim for its nationals in foreign territory.

This means, at the very least, that states have an obligation not to interfere in the affairs of other states, a duty to prevent trans-boundary harm,⁶⁸ and possibly a duty of assistance upon request by another state.

Leaving the confines of the law, prominent non-legal thinkers too have espoused the emerging idea of a duty of assistance. For instance, political philosopher John Rawls made the duty of assistance one of the eight principles in his *Law of the Peoples*, stating that peoples have "a duty to assist other peoples living under unfavorable conditions that prevent their having a just or decent political and social regime".⁶⁹ For Rawls, peoples are domestic societies which are burdened in the sense that they face what he calls "unfavorable conditions", namely conditions that make it "difficult if not impossible" for the society in question to establish and stabilize the basic arrangements required for that society to be well-ordered. He notes that a society may face "historical, social, and economic circumstances" which result in a lack of the required "political and cultural traditions, the human capital and know-how" and "often, the material and technological resources" which make it possible to sustain a well-ordered regime.⁷⁰ He considers that although "internationally reasonable peoples" have interests which they pursue in their foreign policy, they are willing to "limit their basic interests as required by the reasonable ... guided by and congruent with a fair equality and a due respect for all peoples".⁷¹ Being "internationally reasonable", therefore, does not simply involve imposing moral

66 Convention Governing the Specific Aspects of Refugee Problems in Africa 1001 UNTS 45 (adopted 10 September 1969, entered into force 20 June 1974), article 2(4).

67 *Island of Palmas*, above n 20, at 839.

68 *Trail Smelter Case (United States of America v Canada) (Award)* (1938 and 1941) 3 RIAA 1905.

69 John Rawls *The Law of Peoples* (Harvard University Press, Cambridge (MA), 1999) at 37.

70 *Id.*, at 90 and 106.

71 *Id.*, at 29 and 44-45.

constraints on an otherwise wholly self-interested foreign policy: it also involves a positive concern to secure justice for other societies, grounded in the natural duty of justice.⁷² One could also view this moral motivation of peoples in terms of a criterion of reciprocity among peoples: for Rawls, "internationally reasonable peoples" are those willing to satisfy what he calls the "criterion of reciprocity" in their mutual relations as peoples. Among "internationally reasonable peoples" and conceiving peoples as free and equal, the principles by which each people proposes to govern the "mutual relations among peoples" are those they believe "it is reasonable for them to propose" and also that "it is reasonable for other peoples to accept".⁷³ His views have been defended as a viable approach to managing climate change (Kenehan, 2015).

In an attempt to find a rationale behind this idea of a duty to assist, one can also look back at the *dédoublément fonctionnel* or role-splitting theory elaborated by Georges Scelle in the first half of the 20th century (Scelle, 1932-1934). For Scelle, the realisation of law in any society must rest on legislative, judicial and enforcement functions although the means of performance of those functions may vary depending on the society. In the absence of a central organ at the international level capable of performing those three functions, it is left to states' organs to perform them in the international legal order. Hence, a dual role is performed by the state and its organs: as national organs, they protect state interests and those of their nationals; as international organs, they adopt international rules and standards (legislative role), may create dispute resolution and compliance mechanisms, and "any time one or more state officials undertake an enforcement action (resort to force short of war, reprisals, armed intervention, war proper) they act as international enforcement agencies."⁷⁴

This dual-splitting role of the state would ideally lead states to adopt a more altruistic approach to problems facing the international community. One would hope that states, including those most responsible for greenhouse gas emissions, would assume the role of advocate of the international community in the protection of the global environment, hopefully with international institutions filling progressively any gap in the international legal order (Scelle, 1948).

Other theories, often used in the field of environmental policy, draw on concepts of guardianship or stewardship. One such view is that of the state serving, under current international law, as a fiduciary of humanity (Criddle and Fox-Decent, 2016). In law, the fiduciary duty imposes a legal obligation on one party to act in the best interests of another. Evan Criddle and Evan Fox-Decent argue that, in general, states' authority to govern and represent their people is dependent on their fulfilment of numerous duties, the most general of which is to establish a regime of secure and equal freedom on behalf of the people subject to their power. They contend that international institutions also serve as fiduciaries of humanity and are similarly subject to fiduciary obligations. The fiduciary theory reconciles state sovereignty and responsibility by explaining how a state's obligations to its people are constitutive of its legal authority under international law. They in fact attempt to chart a

72 Id, at 29.

73 Id, at 35, 57 and 121.

74 Antonio Cassese "Remarks on Scelle's Theory of 'Role Splitting' (*dédoublément fonctionnel*) in International Law" (1990) 1 *European Journal of International Law* 210 at 212-213.

path towards greater convergence between "the moral ideal" of sovereignty as a "sacred trust" and "the legal rules intended to give it effect" in order to lend greater coherence and integrity to the international legal system as a whole.⁷⁵

This fiduciary theory explains the cosmopolitan obligations of states to peoples as correlates of the entitlement of every member of humanity to security and equal freedom. Under this theory, therefore, the provision of assistance to peoples under threat of climate change would be viewed, by other states, as the "juridical price" of statehood. And although the right to assistance is not absolute, in the event the state denies assistance, it should be prepared to submit such decisions to independent and international review. Under this theory's framework, the centrality of international institutions raises the question of their relationship to sovereign states and the people living in them. Criddle and Fox-Decent argue that the fiduciary theory of sovereignty best explains the duty of non-refoulement as a peremptory norm of international law.⁷⁶ A state's obligation to provide refuge to foreign nationals fleeing persecution abroad flows from the intersection of the state's two positions: on the one hand, its position as a joint trustee of the earth's surface on behalf of humanity; and, on the other hand, its position as a local fiduciary that international law entrusts with sovereignty over the people within a certain territory. As a fiduciary of humanity, the state acquires a cosmopolitan duty to grant refuge when an individual fleeing unsurmountable threats to their human rights appears at its border.

Although Criddle and Fox-Decent do not address climate change directly, their views about refugee law could be adapted to the situation of Pacific peoples under threat from sea level rise, the fiduciary theory of sovereignty meaning that a state has a cosmopolitan duty to welcome peoples fleeing climate change.

This leads us back to the 2009 OHCHR report mentioned earlier:⁷⁷

While there is no clear precedence to follow, it is clear that insofar as climate change poses a threat to the right of peoples to self-determination, States have a duty to take positive action, individually and jointly, to address and avert this threat. Equally, States have an obligation to take action to avert climate change impacts which threaten the cultural and social identity of indigenous peoples.

The report raises several questions warranting further investigation. Is this report referring to a positive or a moral duty? Is the duty a procedural or a substantive one? By and against whom is the duty enforceable? What does that duty actually entail?

9.4.3 Responsibility to protect

Another helpful concept might be the "responsibility to protect" (R2P) and its possible applicability to those who are displaced by natural disasters, when their own governments are unable

75 Evan J Criddle and Evan Fox-Decent *Fiduciaries of Humanity: How International Law Constitutes Authority* (Oxford University Press, New York, 2016) at chapter 1.

76 *Id.*, at chapter 7.

77 *Report of the Office of the United Nations High Commissioner for Human Rights (OHCHR) on the relationship between climate change and human rights*, above n 14, at [41].

or unwilling to assist them. R2P has become a familiar concept in the past two decades. It was first drawn out by the International Commission on Intervention and State Sovereignty (ICISS) with two central elements. The first concerned a shift in the understanding of sovereignty from "sovereignty as control" to "sovereignty as responsibility". That is, sovereignty is no longer to be understood as a right to perform whatever internal actions the state desires. The reason for sovereignty, it is submitted, is essentially the protection of the people's most fundamental rights from the most egregious acts of violence; and hence, sovereigns have a responsibility to fulfil this protection.⁷⁸ The second element of R2P is that, while the state has primary responsibility for protecting its citizens, should the state be unwilling or unable to fulfil that mandate, then the responsibility shifts to the international community.⁷⁹

On this basis, the international community is called upon to fill what Ramesh Thakur calls the "responsibility deficit" that arises when the state fails to fulfil its primary obligation.⁸⁰ R2P thus imposes a responsibility on states to not harm and to pro-actively protect their populations; and in the event the state cannot or will not live up to its responsibility, it imposes a responsibility on the wider community of states to engage in appropriately authorised and multilateral actions – including, if need be, using coercive force – to protect those populations (Bellamy and Luck, 2019).

The core concept of R2P was elaborated first by the ICISS and then in a somewhat diluted format accepted by UN member states.⁸¹ Thus understood, R2P is strongly distinguished from a "right of unilateral intervention", but providing legitimacy to multilateral action aimed at protecting the local population, in the process favouring initially less coercive and intrusive measures (Bellamy and Luck, 2019). R2P has since been invoked by the UN Security Council in a few resolutions.⁸² Later work has largely affirmed the significance of this distinction, though some have argued the point of difference can be overplayed. Some authors have criticised several of the major claims to intervene based on R2P that distinguish it from "humanitarian intervention", stressing the fact that the significance of prevention, as distinct from reaction, is substantially overplayed in the literature (Weiss, 2016) and subject to controversies regarding its scope of application (Costi and Donohue, 2020).

What is less known is that the ICISS' original conception called for R2P to apply not only to cases of war crimes, crimes against humanity, genocide and ethnic cleansing, but also extraordinary natural or ecological disasters, hinting at the possibility of an intervention by the international community in the event of an overwhelming natural or environmental disaster, "where the state concerned is either

78 International Commission on Intervention and State Sovereignty (ICISS) *Report of the International Commission on Intervention and State Sovereignty* (International Development Research Centre, Ottawa, 2001) at 13.

79 *Id.*, at 17.

80 Ramesh Thakur "Intervention, Sovereignty and the Responsibility to Protect: Experiences from ICISS" (2002) 33 *Security Dialogue* 323 at 324.

81 *2005 World Summit Outcome* GA Resolution 60/1, A/Res/60/1 (16 September 2005) at [138]-140].

82 Security Council Resolution 1706 S/RES/1706 (31 August 2006); and Security Council Resolution 1973 S/RES/1973 (17 March 2011).

unwilling or unable to cope, or call for assistance, and significant loss of life is occurring or threatened."⁸³ Omission of any reference to extraordinary natural or ecological disaster in the *World Summit Outcome* resolution adopted by the General Assembly,⁸⁴ the non-recourse to R2P after Cyclone Nargis in 2008 inflicted intense damage on Myanmar, and the narrow interpretation and inconsistent application of R2P in recent conflicts, suggest that any attempt to extend the concept to an existing or emerging responsibility towards those at risk of displacement by climate change, let alone its operability in such a scenario, would present some difficulties.

9.5 Conclusion and questions arising

The above analysis leads me to conclude that there is no legal reason for low-lying states to "disappear" and lose statehood. Moreover, there are enough existing legal principles and emerging concepts on which the international legal community could potentially base its actions for the protection of low-lying atoll nations in the future. It seems indeed possible to interpret existing norms in a way that would help protect states and the rights of their peoples. In fact, the issues confronting low-lying states threatened by climate change are not so much legal as they are political.

Some questions ensue. Is the presumed continuity of states in the envisaged scenario likely to be politically acceptable by the international community? Where will the boundaries of acceptability lie? To what extent will states be agreeable to a duty of assistance or a responsibility to protect the affected low-lying atoll nations? Where is resistance most likely to be expected?

The key question is whether there is sufficient political will in the international community to positively interpret the existing, and any emerging, legal principles and concepts to ensure continued statehood, or at least legal personality, and to incorporate them into workable legal norms and action plans. Interested regional powers may be well advised to leverage their position and already start establishing more precisely the contours of the legal norms likely to emerge eventually from applicable legal principles and concepts.

The survival of several small developing island nations in the Pacific region and beyond can only be safeguarded if there is concerted global effort. The future development of public international law may require a renewed creative commitment. Addressing the challenges to statehood arising from climate change provides a case in point.

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83 ICISS, above n 78, at 33.

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10

CLIMATE CHANGE AND THE ISLAND STATES OF THE SOUTH PACIFIC:
AN INSURANCE PERSPECTIVE ON HAZARDS, RISKS AND RESPONSES*Tim Grafton**

Among the many persuasive reasons for addressing climate change are its impacts on the south Pacific. This vast region is home to some of the world's smallest, most vulnerable countries who face the prospect that their very existence will be washed away by sea-level rise.

The hazards these countries face can exert a heavy toll on their economies. Insurance has a critical role to play in meeting the costs to sovereign states as well as to individuals and businesses. Some insurance solutions may be more cost-effective than other means of meeting these losses.

At the northern end of this region lies Kiribati, a very low-lying country comprising 32 atolls straddling either side of the Equator, which is no more than one metre above sea level, with a population of 118,000.

Tokelau (population of 1,500), a non-self-governing territory of New Zealand (see Figure 1), and Tuvalu (population of 11,000) are about two metres above sea level on average.



Figure 1: aerial image of the atoll of Nukunonu, Tokelau. Source: courtesy of Neville Peat.

* Chief Executive, Insurance Council of New Zealand.

Low-lying countries are also prone to erosion of their coastline from the actions of the sea, a process which is more pronounced with storm surges (Haddow, Bullock and Coppola, 2017). Storm surges and high tides make homes vulnerable to more frequent flooding due to climate change (see Figure 2).

Sea level rise makes what fresh water is available increasingly salinated and affects the crops that can be grown. Land erosion also limits the land available to grow crops. Long before the ocean washes over Kiribati, the country may become uninhabitable, creating climate change refugees in need of a new home.

Climate change will make the oceans more acidic. That is bad news for marine ecosystems including coral, a major tourist attraction and vital source of revenue for these fragile economies.

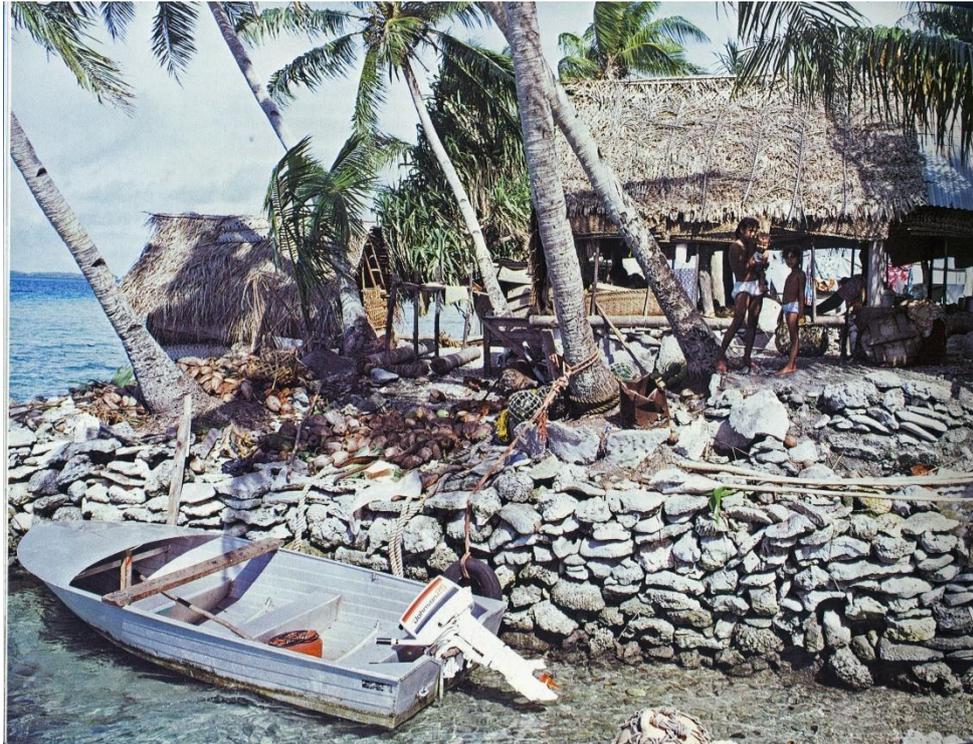


Figure 2: fale in the village of Fakaofa, Tokelau. Source: courtesy of Neville Peat.

If it is a year characterised by La Niña weather patterns, drought becomes a more significant challenge factor, while during El Niño patterns, the threat of destructive cyclones come more into play.¹

Climate change will have a profound impact on the 2.5 million people who inhabit the south Pacific Islands. But the hazards it brings are not the only natural disasters they face.

Lying on the so-called "ring of fire", an area of high seismic activity that extends around the Pacific, the islands face the threat of large earthquakes capable of creating tsunami well over one metre high. In 2009, Samoa experienced a moment magnitude (M) earthquake of 8.1 M adjacent to the Kermadec-Tonga Subduction Zone that created a 4.5-metre tsunami devastating the shoreline and killing over 120 people (Earthquake Hazards Program, 2009).

Tonga was hit by a 7.6 M earthquake earlier the same year. And the Solomon Islands were hit by an 8.1 M earthquake in 2007 which also caused a tsunami with loss of life and property, and again in 2013 by an 8.0 M earthquake.

Several of these countries (Samoa, Solomon Islands and Vanuatu) also have active volcanoes that have all erupted in living memory.

Why is it relevant to talk about these seismic risks in the context of climate change? It is because we are more concerned about the devastating impacts of natural disasters on people, property, businesses and the national economy than what the cause was.

The focus is naturally on how to make these countries more resilient to the total array of risks that they face. With a small, remote, fragile economy heavily dependent on foreign aid and tourism, efforts to manage long-term climate change challenges could be pushed back years by a major earthquake, tsunami or volcanic eruption.

Much can be learned from the insurance sector about managing risk. Insurers take a long-term view of risk. They calculate the probability of an event occurring and the severity of the impact measured by the financial loss.

By looking at the range of natural hazards, climate change and seismic events, that could have a catastrophic impact, it is possible to calculate the annual average loss an economy might sustain. When thinking of catastrophes, it is important to remember that these refer to relatively rare events which bring heavy losses when they occur. So, more severe impacts occur less frequently.

It is possible, therefore, to estimate the losses that will occur for a range of credible scenarios, such as events that are likely to occur once a year and once every 50, 100 or 250 years. For each scenario, the dollar loss and what that represents as a proportion of the size of the island state's economy can be calculated as shown in Figure 3.

1 See Chapter 2 in this book.

This table is taken from data extracted from a 2015 report by the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI).² Six nations are listed and alongside each is a measure of the annual average loss (AAL) they can expect to experience from all-natural hazards in American dollars and what that represents as a percentage of their GDP.

Country	AAL	50 year	100 year	250 year
Fiji	USD 77 m	USD 610 m	USD 834 m	USD 1.2 b
	2.5 % GDP	20.3 % GDP	27.7 % GDP	39.6 % GDP
Samoa	USD 6.9 m	USD 79 m	USD 134 m	USD 268 m
	1.2 % GDP	13.9 % GDP	23.7 % GDP	45.6 % GDP
Cook Islands	USD 4.9 m	USD 57 m	USD 103 m	USD 198 m
	1.4 % GDP	16.8 % GDP	30.3 % GDP	58.4 % GDP
Solomon Islands	USD 5.8 m	USD 45 m	USD 64 m	USD 101 m
	1.3 % GDP	10.2 % GDP	14.7 % GDP	23.4 % GDP
Tonga	USD 9.5 m	USD 78 m	USD 126 m	USD 213 m
	2.2 % GDP	18.1 % GDP	28.9 % GDP	49.3 % GDP
Vanuatu	USD 37 m	USD 241 m	USD 311 m	USD 398 m
	5.0 % GDP	33 % GDP	43 % GDP	55 % GDP

Figure 3: the table above illustrates the challenge to their economies that island states face from all natural hazards. Source: data extracted from a 2015 report by the PCRAFI.

What the table starkly shows is that even on an annual loss basis, these countries can expect a hit to their GDP of anywhere from 1.2 per cent for Samoa, up to five per cent for Vanuatu.

Losses of this order for small developing economies are a significant deadweight on their growth. But these of course are the return periods of today. They do not reflect what the world will be like in

2 Pacific Catastrophe Risk Assessment and Financing Initiative *Pacific Catastrophe Risk Insurance Pilot. From Design to Implementation: Some Lessons Learned* (Japanese International Cooperation Agency (JICA) and the World Bank—Global Facility for Disaster Reduction and Recovery (GFDRR) Disaster Risk Financing and Insurance (DRFI) Program, 2015).

2050 or later in the century when climate change events will be more extreme, including the impact of sea level rise, and more frequent, such as extreme weather events (Seneviratne et al, 2012).

The threshold for a catastrophic event with a very large impact on the economy is low. A 100-year frequency event, for example, would have a massive impact of 43 per cent of the Vanuatu GDP and about a 30 per cent impact on the GDP of the Cook Islands, Fiji and Tonga.

To put this into perspective, an equivalent loss in New Zealand (30 per cent of GDP) would cost over USD 60 billion or about NZD 85 billion. Our largest ever natural disaster loss, the Canterbury earthquakes, cost about half that, and that was more like a 1:2,500 return period.

Losses in the order of 20 per cent plus of GDP can set the development goals of these island states back years. Taking an all-hazards approach to economic risk presents the scale of the risk management challenge. Only by first understanding the scale of the risk to be managed can well-informed decisions be made about how to avoid, control, transfer or accept the risk. If the right balance of these ways of managing risks are made, then they will support Pacific Island nations to survive and thrive.

Risk management starts by assessing what it is that needs to be avoided. Catastrophic economic loss is clearly well up the priority list. That will lead to considerations about whether such events will lead to increasing sovereign debt or protecting funds ear-marked for development projects.

Where risks pose such extreme levels of volatility, there is a critical role for insurance to play to match risk with capital. The rest of this chapter will examine this in more detail. It will also lead to thinking about specific risks like loss of life, damage to property or prolonged business interruption, for instance, if tourists do not come because of the devastation wrought by a cyclone.

Risk analysis requires looking at the likelihood of events occurring as Figure 3 has done for four scenarios. So, the analysis must consider the worst possible outcome both over the short and long term, noting that the lowest probability may well be the most catastrophic.

Scenario planning will inform the widest possible range of what could happen. It should draw on the best available science, but it will also require value judgments to be made. Such judgments should be explicit and open to scrutiny.

Once a full assessment of risk has been undertaken, the next step is deciding what can be done to reduce risks reflecting the resources available. There will be a range of adaptation measures such as requiring changes to construction methods, where buildings are located, relocatable housing, critical infrastructure protection, action to prevent coastal erosion, flood protection, water storage and desalination plants and the increased use of renewable energy that will feature.

Although small economies will be limited in what they can do, the economics of pre-disaster resilience is compelling. Every dollar invested in risk-reduction can save at least 5 dollars in post-disaster recovery costs (Hallegatte, Rentschler and Rozenberg, 2019). This is the business case to place before donor nations, the World Bank and other supporting institutions.

Disaster preparedness plans reduce losses when the worst happens, but risk can never be eliminated. If the risk analysis is done well, then the likely cost of a disaster will be known, which leads to decisions about how to obtain financial protection from these losses.

Critical to successful risk management is the availability of funds to meet recovery costs. So, insurance and reinsurance have a major role to play alongside adaptation initiatives that reduce risk. Risk reduction makes risks more attractive to insurers and more affordable for the insured because insurance simply transfers risk; it does not reduce it. Hence, insurance is only ever part of the solution.

In some circumstances, insurance cannot respond. Insurance protects the insured against the sudden and unexpected. It is not possible to insure what is certain and expected. It is, therefore, critical to understand that insurance will not cover sea level rise. So, the challenges that poses are solely reliant on an adaptation solution.

The availability of finance drives the speed of social and economic recovery after disaster strikes. Post-disaster recovery needs vary across the distinct phases that follow catastrophe.

There are the immediate short-term needs to provide the necessities of life to enable communities to survive, the medium-term loss of income from export crops or the absence of tourists. Long-term challenges arise when funds are required to enable reconstruction of infrastructure, housing and commercial buildings.

The sum of these costs is the total economic loss of a disaster. This can be reduced by insurance and the extent to which they are not is the protection gap, that is, the cost that will need to be borne by individuals, businesses or governments.

Figure 4 depicts, in the first column, the financial risks, in the second, who carries those risks, and the third one shows the kind of arrangements for transferring those risks.

Small island nations carry macro-risk, for example, the impact on the economy due to loss of public assets, emergency response costs and foregone government revenue, for instance, when the tourists do not come. These sovereign risks can be transferred to the reinsurance markets.

In contrast, businesses, homeowners and farmers who carry the risks to their own properties can seek to transfer these risks to traditional insurance pooling arrangements. Individuals on very low incomes who are at risk of losing all their income and property at these times are particularly vulnerable as social security systems are minimal. They may not ordinarily be able to afford traditional insurance products, so micro-insurance products tailored for those on very low incomes may be more appropriate means of transferring the risks they face.

On the right hand-side of Figure 4 are risk transfer solutions which are managed at the macro-level for nation states, through traditional insurance pooling and, at an individual level, micro-insurance specially designed for those on very low incomes. Micro-insurance differs from traditional insurance as it is tailored for specific risks like crop failure and income loss. Premiums are small and proportional to the likelihood and cost of the relevant risk.

How to close the protection gap

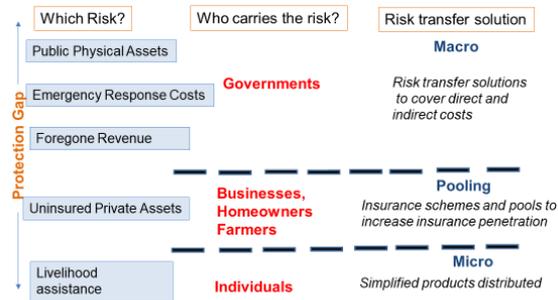


Figure 4: financial risks, risk bearers and possible arrangements for transferring those risks. Source: table inspired from references consulted by the author.

At the government level, trying to finance (that is, meet the costs of) disasters after they have struck is fraught with problems for any country, but magnified many times for small, fragile economies.

A government can raise taxes, but it takes time to collect the revenue and it will likely not be either politically or practically viable if a large swathe of the population has had its income cut because of a disaster.

Foreign aid can come either in the form of a direct financial injection or aid in kind. But how much aid and when that aid arrives is uncertain.

Governments can, of course, borrow. However, many of these countries have challenging debt-servicing costs, so they are not well placed to be negotiating debt terms after a disaster when revenue has been slashed. It is also possible to re-allocate current spending, but that presents risks to development programmes.

The other option for governments is to attempt to pre-fund the cost of disasters. Pre-funding the costs of disasters has the advantage of providing certainty about how much is available to fund recovery and ensures that it is available from the outset. It is an option best used to pre-fund the costs of frequent low costs events. This too, though, diverts funds that could otherwise have been deployed on development projects. So, it comes with opportunity costs.

Credit facilities can be negotiated before an event occurs. This has the advantage of being able to negotiate terms from a stronger position than after a disaster has occurred. This can be used to ensure funds are released immediately after a large event. On the other hand, obtaining this contingency funding will be dependent on current debt-servicing arrangements.

Transferring sovereign risk through an insurance arrangement, by contrast, carries many benefits other options lack. Possibly, the most significant of these in the region is provided by the Pacific Catastrophe Risk Insurance Company (PCRIC).

This was originally piloted by the PCRAFI as the first sovereign catastrophe risk transfer in the Asia Pacific region. PCRIC has now evolved into an arrangement for five island nations – the Cook Islands, the Marshall Islands, Samoa, Tonga and Vanuatu – and is based in the Cook Islands. It is a scheme that is backed by the World Bank, with support from donor countries – Germany, Japan, the United Kingdom and the United States of America – who have provided a capital injection to the fund under the G7's climate risk resilience initiative (PCRIC, 2020). Reinsurance companies also provide cover, enabling up to USD 45 million in funds to be available.

The scheme is like other regional schemes such as the African Risk Capacity and the Caribbean Risk Insurance facility. PCRIC provides what is called "parametric" cover³ for cyclones, earthquakes and tsunamis. Parametric cover releases funds, in this case within 10 days, of a threshold, such as 200 km/h winds or a 7.0 M earthquake occurring, being met.

For example, in February 2018, Tonga received USD 3.5 million in funds from PCRIC shortly after Cyclone Gita hit the island nation. The great advantage of the scheme is that the cash injection is not dependent on assessment of loss, which can delay the release of funds.

The scheme's inaugural Chief Executive David Traill is on record as saying he wanted to see the pool available to grow and for it to include as many Pacific nations as possible (PCRIC, 2018). He was also talking about expanding the range of perils it should cover to include flood and drought, reflecting the diversity of risks in the region.

Such schemes may at first glance seem limited by the trigger definition. For example, if the trigger is a 200 km/h cyclone and a damaging 199 km/h wind speed is recorded, there would be no response. This can easily be addressed by designing layers to the parametric so that, for example, there are automatic smaller pay-outs for 150-199 km/h winds.

Schemes like PCRIC bring several advantages for nation states.

The rapid release of funds enables quick and more substantial deployment of resources which will lead to a more efficient recovery. Access to the funds is guaranteed and saves governments the liquidity problems that they face after a major hit on their GDP.

It enables governments to budget ahead before an event because the premiums are fixed and there are no obligations to pay back lending institutions. This avoids the disadvantage of having a liability on the balance sheet if the country is dependent on debt-financing the recovery.

Perhaps most importantly, it reduces the pressure governments will have to divert funds from other important development projects after a disaster.

3 Parametric insurance is defined by three elements: a parameter (for instance, wind speed, earthquake magnitude); a geographic location where this must occur; and a payment if the first two conditions are met. See generally Morten Broberg "Parametric loss and damage insurance schemes as a means to enhance climate change resilience in developing countries" (2020) 20(6) *Climate Policy* 693.

Such schemes are designed for large losses. Standard insurance is more appropriate for property owners and businesses because it will cover small-scale frequent events as well less frequent, catastrophic events.

The advantage of standard insurance is that it pays out on all losses regardless of the size of the event – there is no trigger. The relative disadvantage is that the assessment of loss takes longer, so full payment is not immediate.

Innovative parametric products though can be developed to cover losses for businesses. One innovation that may have potential in the Pacific is one offered by Swiss Re, which is insuring 160 kms of reef on the Yucatan Peninsula in Mexico. The reef helps protect hotels on the shoreline as it reduces more than 90 per cent of wave energy during storms and it is also a drawcard for tourism (The Nature Conservancy, 2019).

A trust has been established by hotel owners, the government of the state of Quintana Roo and Mexico's National Commission of Natural Protected Areas, which collects and manages funds for reef maintenance and repair.

The trust has purchased parametric insurance for the coral reef. If wind speeds in excess of 100 km/h hit the pre-defined area, such event triggers an insurance payment that will be swiftly available to fund damage assessments, debris removal and initial repairs with funds available for longer-term restoration (The Nature Conservancy, 2019).

Parametric cover releases funds to repair the reef after a hurricane when fast action is required. The hotel owners pay the premiums instead of the government which as to now levied them for beach and reef protection work.

Reinsurance and insurance have a critical role to play once a major event has occurred. To keep this cover affordable and available when faced with an increasing risk profile requires the risk to be reduced. That can only be achieved by adaptation measures. It is estimated that adaptation can reduce post-disaster costs significantly (Mechler et al, 2014).

Adaptation options need to respond to specific local conditions, so they will vary across the Pacific. Discussions should be holistic and take place at the community level. This chapter has focused a lot on physical and financial capital at risk from climate change and other natural hazard events. Human, social and environmental capital lie at the heart of the culture of the islands and it is difficult to price their loss.

Decisions will need to be made about what is worth protecting. As adaptation brings a cost and because its benefit is over a long horizon, there is a tendency to prioritise spending on short-term issues.

This is short-sighted. Extreme events occur right now if the conditions are right. Every dollar invested in pre-event prevention saves five dollars in post-event costs, quite apart from minimizing the wider social and economic disruption: "CBA studies show that for every dollar spent on selected

flood risk reduction measures, an average of five dollars is saved through avoided and reduced losses."⁴

Investment can be incremental to lower up-front costs, so it is more affordable to undertake some work now. The earlier investment occurs, the less costly it will be later.

The impact of sea level rise on the lowest lying islands appears to leave no option other than eventual retreat. The global response to the 2015 Paris agreement⁵ will determine how big the impact is.

Kiribati has already taken steps to purchase land in Fiji to relocate some of its population. That is possibly the most extreme adaptation to where it is no longer viable to live, but surviving and thriving demand all options be considered.

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4 Reinhard Mechler et al *Making Communities More Flood Resilient: The Role of Cost Benefit Analysis and Other Decision-support Tools in Disaster Risk Reduction* (White Paper, Zurich Flood Resilience Alliance, 9 September 2014) at 2.

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11

"THE BIGGEST STORY EVER"

*Jamie Morton**

11.1 Introduction

New Zealand website *The Spinoff* once called climate change journalism's "biggest and most difficult story, ever".¹

It was quite the summation.

I am among a small stable of science and environment journalists in New Zealand who write about climate change almost every day.

Before joining the *New Zealand Herald* in 2011, I had covered news beats that spanned from crime and court to health and local government, each presenting their own difficulties.

Many veteran journalists might figure that approaching a feared criminal on the steps of a court house or stepping into the aftermath of a tragedy would be the toughest assignments a young reporter might face.

But in writing about climate change, I have found a much larger trial.

It is enormous in almost every way that one can imagine – and it is urgent.

As the pressure for nations to act mounts, so too does the journalist's challenge of reaching the average Kiwi.

Because for people to tackle the impacts of climate change in New Zealand and the Pacific, everyone will need to know more, and care more.

For the media, the defining question of our time might well be how we, as truth brokers, help slow the climate change train before it hurtles off the rails.

I have heard colleagues liken this to learning about a transformative event like the Christchurch earthquake – decades in advance – and trying in desperation to raise the warning sign.

* Science Reporter, *New Zealand Herald*. Some of the quotations in the chapter are from interviews conducted by the author.

1 "Covering climate change: journalism's biggest and most difficult story, ever" (16 August 2017) *The Spinoff* <<https://thespinoff.co.nz>> ["Covering climate change"].

Decades from now, when our world will be inevitably warmer and wilder, will we be able to tell ourselves that we did everything we could, when it counted the most?

That is something that seems to have always been front of mind for journalist and *New Zealand Geographic* founder Kennedy Warne:²

I think anyone who cares about life on Earth – or who has grandchildren, and I tick both of those boxes – must have an interest in persuading fellow members of the species to act with the planet's future in mind.

He recounts something *Grist* magazine climate writer David Roberts told an audience during a TEDx talk in 2012.

"Your job," Roberts said, "anyone who hears this, for the rest of your life, your job is to make the impossible possible."³

Indeed, the way we cover it will affect how well societies deal with the problem.

As climate change takes hold, people will demand information about what is happening and what they and their governments can do about it.

Wise and responsive editors are learning that climate change presents an opportunity to grow and better serve our audiences.

Three of the media's traditional roles – informing audiences, acting as watchdogs and campaigning on social issues – are especially relevant here.

For journalists like myself, coverage of climate change means several things.

At a local level, our work can save lives, forge plans, change policy and empower people to make informed choices.

Through informed reporting, we can shine a light on the wealth of activities that people are already undertaking to prepare for climate change.

And at the international level, we can bring stories from this corner of the world to global audiences and help encourage the rich and powerful countries to act.

But it is also worth noting that climate change is not just a story: it is the context in which so many other stories will unfold.

As such, it is not a subject solely for science or environment reporters like me to cover.

That is why I feel it is essential for all journalists to understand at least the basics of climate change, and realise that there is more to it than apocalyptic headlines.

2 Ibid.

3 "Climate change is simple: David Roberts at TEDxTheEvergreenStateCollege" (13 June 2012) <<https://www.youtube.com/watch?v=A7ktYbVwr90>>.

Contrary to popular belief, this is an issue full of stories that can sell newspapers and attract new audiences online, in print and on the airwaves.

Yet, my colleagues have also pointed out the paradox that climate change journalism now faces.

At a time our industry is battling for its existence, and in which journalists are under more pressure than ever, our jobs have never been more relevant, nor important.

11.2 Moving past denial

Although it might seem that the news media have only woken to the crisis now, journalists in New Zealand and the Pacific have been reporting on global warming for decades.

Research suggests coverage, for the most part, has been in line with the scientific consensus.

The first scholar to examine the New Zealand mainstream media's treatment of climate change was likely Alan Bell.

After exploring newspaper coverage over a six-month period in 1988, he found that "reporting of basic scientific facts was overwhelmingly accurate".⁴

Fast-forward to more recent times, and we find that a study of television news over three months in 2012 showed "no attempt made to give climate change naysayers equal time in a misguided attempt to appear balanced".⁵

New Zealand media's responsible editorial line contrasted with the historical coverage of climate change in the United States of America, where a "balanced" reporting approach effectively undermined the strength of scientific consensus (Boykoff and Boykoff, 2004).

All the while, climate change sceptics have been there on the fringes, pressuring newsrooms to peddle their misinformation.

For instance, in 2007, the New Zealand Climate Science Coalition received funding from the United States-based Heartland Institute and, in 2008, lobbied to get stories questioning the reality of climate change in the business pages of national media.

These attempts to create uncertainty in the minds of the general public were promptly exposed in the magazine *New Zealand Listener* (Hansford, 2008).

"Obviously, there was a giant speed bump in media coverage when oil-company funding of climate change scepticism and outright denial kicked in," Warne says.⁶

4 Allan Bell "Media (mis)communication on the science of climate change" (1994) 3 *Public Understanding of Science* 259 at 259.

5 Michael Bourk, Jennifer Rock and Lloyd S Davis "Mediating the Science: Symbolic and Structural Influences on Communicating Climate Change Through New Zealand's Television News" (2017) 11(6) *Environmental Communication* 821 at 834.

6 "Covering climate change", above n 1.

When denialist groups successfully turned climate into controversy, this had two effects.

It took media attention away from the reality of the threat to the vacuous details of the "pro/anti debate".

Worse, it scared large numbers of the public away from engaging with what the previous Parliamentary Commissioner of the Environment rightly described as "the ultimate intergenerational issue."⁷

How have climate sceptics sometimes succeeded in getting coverage?

Perhaps it is because of the truth that climate science actually does not have all of the answers.

After all, scientists did not have temperature gauges in the 15th century, let alone 150,000 years ago.

Instead, to recreate ancient climates that countless studies are based on, scientists use proxy data, such as ice cores from Antarctica, or tree rings in ancient forests.

And these are not always exact, which is one argument the climate sceptics have jumped on to suggest that global warming is just the normal ebb and flow of the earth's temperature.

However, climate scientists have compiled many different proxy data sets from many different regions, and they all point to one direction – up.

It is now incontrovertible that temperatures are rising,⁸ and that we are causing it, so journalists need not be distracted by sceptics who try to sway our coverage from these fundamental facts.

We need to accept that the debate has gone beyond scepticism – and that we should be concentrating our stories on the voices that are more vulnerable to the effects of climate change, such as those many Pacific communities.

Warne feels it has taken years for media to get over the false assumption that balanced reporting required covering the views of sceptics.⁹

He suspects a legacy of this misinformation campaign is that reporters and editors have been apprehensive about alienating a portion of their readership – much as they probably remain apprehensive about reporting on 1080-related issues today.

Prominent Kiwi science writer Veronika Meduna recalled standing up at a Radio New Zealand editorial meeting back in 2001 – around the time of the Intergovernmental Panel on Climate Change

7 Parliamentary Commissioner for the Environment "Time to take a historic step for climate change, says Environment Commissioner" (media release, 27 July 2017) <<https://www.pce.parliament.nz>>.

8 See Chapters 2 and 4 in this book.

9 "Covering climate change", above n 1.

(IPCC)'s Third Assessment Report (IPCC, 2001) – to suggest that coverage should start focusing on whether policy development reflects the scientific evidence.

With hindsight, she admitted, that seemed laughably naive.

It was some years after that when Radio New Zealand's *Insight* dedicated an entire programme solely to talking to climate sceptics.

"I made an official internal complaint, which resulted in a very useful document about coverage of asymmetrical debates," Meduna says.

"It helped to shift things but I still felt that I was seen as a trouble-maker rather than as someone who was trying to lead on an issue.

"It's been changing over the last 15 years or so, but even during the coverage of [the IPCC's Fifth Assessment Report] in 2014 I was still told that there's too much gloom in climate change coverage and that it has to be 'balanced'."

A common problem has been credible news outlets allowing regular columnists to indulge their denial of climate change.

Editors have sometimes attempted to defend or excuse these columns as offering a counter-view or "balance", as Meduna notes, or simply a case of freedom of speech.

One such columnist, former ACT Party leader Rodney Hide, used his *National Business Review* column to attack me and colleagues for reporting on climate change according to the evidence. He wrote:¹⁰

Newspapers are not picking a middle path providing analysis and facts and opposing argument. They are instead shunting readers to their predetermined conclusion and are eager to provide copy that "pressures authorities into being more proactive".

Outside the mainstream media, right-wing blogger Cameron Slater has long presented a strong, anti-IPCC view on climate change on his website *Whale Oil*, which claimed to have two million visits each month in 2014 – the same year it controversially won "best blog" at the 2014 Canon Media Awards.

Another sceptical blog, *climateconversation.org.nz*, did not have such a high readership, but focused entirely on climate change.

Reflecting on her time with the *New Zealand Herald* in the late 2000s, *Stuff* climate change editor Eloise Gibson recalled tit-for-tat pieces published in the newspaper's opinion pages.

10 Rodney Hide "The media take on climate change" *National Business Review* (online ed, February 2018) <www.nbr.co.nz>.

"I think we've moved on to writing about more interesting areas where the science really is uncertain and towards covering some of the other thorny, difficult questions that researchers really are grappling with," Gibson says.

"There's still plenty of room to find tension and uncertainty to write about, but it's not about whether climate change is happening."

On this point, Warne agrees.

"If I were to use RNZ as a case study, I would say that coverage has improved markedly over recent years," he says.

"At least climate change is treated as a fact, not a hypothesis, any more. The jury is finally 'in' on that point."

Meduna's former Radio New Zealand colleague and *Our Changing World* co-host, Alison Ballance, has also observed a sea-change over the past decade:

From giving the tiny number of climate change deniers the right of reply to all comments from climate change experts, we have seen the media slowly embrace the idea that climate change is a real and urgent problem, and that we should be giving climate change scientists and other experts a much clearer voice.

If there has been a discernible turning point, some journalists have pointed to the climate change campaign launched by *Stuff.co.nz* in late 2018, dubbed "Quick! Save The Planet" (Crewdson, 2018).

The campaign, spurred by the United Nations' recent report into the IPCC's 1.5 degrees Celsius aspiration (IPCC, 2018), has come with a series of high-quality feature articles putting climate change in a New Zealand context.

More recently, *Stuff* has hired two full-time journalists dedicated to reporting climate change issues, while running daily atmospheric CO₂ counts, through a partnership with NIWA.

These were admirable steps by the media in taking the issue seriously, while also stamping out the sceptical view – *Stuff* now no longer gives coverage to denialism.

11.3 How do journalists cover climate change?

I have watched my industry shrink dramatically over the past decade, on the back of declining advertising revenue and pressure from new market players like Google and Facebook.

That pressure is not easing.

In 2018, for instance, New Zealand's print market shrank considerably after *Stuff* closed more than 35 per cent of its newspapers and announced further cuts (Edmunds and Pullar-Strecker, 2018).

"Overall, I think there are still too few journalists with an interest or background in science and environment reporting," says Meduna, "and equally too few people who are given the time to delve a little deeper, beyond news-driven day to day coverage".

The daily news cycle might be likened to a crowded, noisy party.

What stories you commit to have to be important enough to cut through that noise.

Before pitching a climate change story to a chief reporter, you have to ask yourself those same questions that any journalist does about any piece – "How will this be relevant or interesting to my readers, why is it important, and, crucially, what's new? What are you telling them that they don't already know?"

The stories that journalists choose, and the effort they put into them, can range from spending weeks on a feature article exploring the nuances of agricultural methane emissions, to 20 minutes re-writing a university's press release on a new scientific paper.

As comes with the broad scope of climate change, you might find yourself explaining new figures around potential mitigation costs that coastal communities or what farmers are doing to prepare for future droughts.

It might be the announcement of a new government policy or what climate change has to do with snow-starved ski field operators being forced to delay the opening of their season.

Climate change is one of the very few topics that can take a reporter from a threatened village on a Pacific atoll, to a flood-prone suburb or a dairy farm in New Zealand, to a core drilling expedition in Antarctica.

My experience has been that any story will resonate with readers if the subject-matter affects them somehow – as climate change of course will – and if it is presented well, or just sharply told.

We have to remind ourselves that we are writing for a general audience, not *Nature Climate Change*, and have to keep things simple, while retaining that fact and accuracy.

The most shared story I have ever written was about new evidence showing the East Antarctic Ice Sheet was much more sensitive to climate change than we first believed (Morton, 2015).

This was all based off one interview with an Australia-based scientist.

Another well-read piece was a listicle of 10 New Zealand species, that we might rely on as sentinels or "climate change canaries" to signal the first effects of climate change.¹¹

That got plenty of play online and the news editors did a great job of laying it out across a centre-spread in the following day's *Herald*.

Journalists working in different mediums find they have different strengths – and different challenges.

TV news relies on pictures and generally on shorter simpler items, and "good talent".

Climate change stories often provide none of these.

11 Jamie Morton "10 climate change canaries" *New Zealand Herald* (online ed, 12 October 2015) <www.nzherald.co.nz>.

"There are no new pictures to go with a story about revised modelling, so we rely on the same old images we've been trotting out for 20 years," broadcaster and Aotearoa Science Foundation founder Damian Christie says.

"It's much easier to focus on specific stories, like flooding in a particular place, or the death of a species, but often these are difficult to link directly to climate change."

And then there are the pressures that come with simply producing a story.

A journalist's daily grind can be gruelling: it means finding a story, carrying out interviews, turning those into a package, and filing the piece all before deadline.

In today's fast-paced, web-driven environment, this often needs to be done inside an hour, or hard against deadline, or with accompanying videos and visual elements.

Meduna adds that resourcing is always a constant challenge, too.

"And I say this from the perspective of somebody who produced a weekly programme, so actually had the luxury of time – just no money."

Even then, she adds, it is sometimes difficult just to get your head around the science, let alone to understand the implications of it.

"Finding fresh talent and angles has been another significant barrier – but it shouldn't be going forward, given that climate change impacts are so pervasive."

Another major issue continues to be the perspective that the media covers climate change from.

Warne says there is a problematic tendency for the issue to be treated as an environmental one.

Rather, climate change is an economic issue, a social issue, a political issue, an agricultural issue – a civilisational issue, if you will.

Climate disruption will be severe and systemic across all humanity.

The critical next step for climate coverage, Warne says, is linked-up reporting that looks at how climate perturbations will affect markets, environments and human well-being at the same time, in ways we have barely begun to consider.

One New Zealand journalist who has notably taken this broad view is *Stuff*' national correspondent Charlie Mitchell.

He feels coverage has improved, at least in terms of volume and seriousness.

"I've only covered it for a couple of years, but I feel like it's changed even in that time," he says.

"There's more urgency coming across, and at least anecdotally, I've noticed more news stories that frame climate change as something that is currently happening, not some vague ominous thing that will suddenly happen at some indistinct point in the future."

But he echoes Warne's point that the topic itself tends to be vague to the media.

He put this down to a lack of reporters specifically covering it as an issue.

"Climate change gets reported as true, and as a problem, but it tends to be presented as one all-encompassing, monolithic thing – climate change – rather than as a specific series of events, each with their own consequences, like sea level rise, ocean acidification, biodiversity loss, and so on," he says.

"I guess I'd say the reporting could do with more of that nuance, including my own.

"It becomes easier to dismiss the problem when it's not presented as distinct, measurable phenomena that happen to have a shared cause."

Gibson similarly sees a noticeable gap in journalists connecting the scientific and environmental aspects of climate change with what governments are doing – or are not – to tackle the problem.

Coverage of debates about carbon laws, energy, transport and agricultural policies still tend to be dominated by discussions about who is doing the cleverest or most on-brand political manoeuvring, with not quite enough discussion of the basic scientific reality.

Her widely-respected work in her previous role as science and environment editor at current affairs website *Newsroom.co.nz* has explored many of the facets that are not easily understood as rising seas threatening peoples' holiday baches (Gibson, 2018).

A shining example was an in-depth article on the current disagreement between members of the scientific community on how methane should be treated under policy.¹²

"The technical parts of the science can be a challenge – but another area where New Zealand is lucky is that our climate scientists engage pretty well with the media and do their best to stop us making a hash of it."

11.4 Explaining the science

As my colleagues point out, covering climate science can indeed be challenging.

But journalists who can report accurately on the science in ways their audiences can relate to and understand will find they have more opportunities to tell stories, and even make a difference.

Rather than just reporting what scientists have found, the key challenges for us is to understand the real-life implications of new research for media audiences – and to help them appreciate how the new information is relevant to them.

Often, the first step is to know when scientists have published new climate-related studies.

¹² Eloise Gibson "What's the beef with methane?" (28 November 2018) *Newsroom.co.nz* <<https://www.newsroom.co.nz>>. She further stated: "It might seem like an argument only climate scientists would care about. But the outcome may help shape the government's planned Zero Carbon Bill and the rolling targets that will be set by a climate commission".

Luckily, there are many ways to stay up-to-date without having to dig through technical and research papers.

Science information sources such as the *New Zealand Science Media Centre*, *Science Alert* and *Science Daily* provide regular updates of the latest scientific research from around the world.

The Conversation website provides short, professionally-edited stories and opinions from experts around the globe and has a daily email newsletter.

Meduna, now serving as *The Conversation's* New Zealand editor, feels it has taken some time for the gap between science and the media to be bridged.

"I was studying genetics during a time when geneticists were discussing the ethics of genetic modification and had panel debates about moratoria, and when I became a journalist nearly a decade later, I was shocked to see how little of that had filtered through to newsrooms, let alone public debate," she says.

"That gap between what scientists are currently talking about and what people outside of science and academia hear about has since narrowed significantly, but it's still there – and I don't think it's helping decision-making."

So should we try to become communicators of the science ourselves?

It is neither critical, nor probably not possible, for journalists to become a climate science expert.

But we should certainly cultivate a good network of experts who can explain things clearly, and who will respond quickly to our requests for interviews or information.

They are critical for providing important context for climate stories, and telling us how studies compare to one another, and whether new results draw previous findings into question.

Of course, reporting the findings of a study is just one component of a journalist's job; providing a balanced assessment is just as important.

Just because a study is peer-reviewed does not mean it is above critical evaluation.

We have to remember to be as nuanced as possible and remember that even when scientists – or their press officers – say their research is "revolutionary", very rarely does a study completely contradict a large body of scientific research.

To most effectively cast a critical eye on academic studies, we have to examine the purpose of the study, the researchers' methodology and the report's funding.

And then there is the common hurdle of risk and uncertainty.

As the Union of Concerned Scientists puts it: "To most of us, uncertainty means not knowing. To scientists, however, uncertainty is how well something is known."¹³

While scientists know that research points towards a greater understanding of a phenomenon or event even if there is uncertainty, that uncertainty can be enough for the public and policy-makers to conclude that something is not real.

In the case of climate change, that is a dangerous difference.

One challenge is that while scientists use numbers that describe how statistically probable something is, non-scientists use words to explain how certain they are.

The IPCC uses a simple chart to convert the numbers into words, so a probability above 99 per cent means "virtually certain", a value above 66 per cent means "likely", and so on.¹⁴

Yet, one person's understanding of "likely" is the same as another person's understanding of "virtually certain".

We can also report on the factors that scientists say account for their uncertainty.

Scientists can have various levels of certainty about a given subject.

They can be sure that seas are rising because they can measure that directly, and they are nearly certain about what is causing sea levels to rise.

But they are much less certain about how much sea levels will rise in different parts of the world, and when.

Such scientific uncertainty makes it important for us to avoid comparing unlike scenarios and aggregating statistics from different studies or regions.

Risk is the other major scientific concept for journalists to understand and explain.

Though deceptively simple, risk is one of the hardest things to communicate accurately, partially because it can be very hard to actually determine what a real risk is, and partially because public perceptions of risk can be very different from those of scientists and other experts.

We should be aware that our readers tend to perceive risks that have been imposed upon them as more dangerous than those they have chosen – or that risks that have natural origins are often seen as less threatening than human-made.

13 Union of Concerned Scientists "Certainty vs. Uncertainty: Understanding Scientific Terms About Climate Change" (19 March 2010) <<https://www.ucsusa.org>>.

14 Intergovernmental Panel on Climate Change (Core Writing Team, RK Pachauri and LA Meyer (eds)) *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, Geneva, 2014) at 2 footnote 1.

If we fail to become familiar with this, we can create disproportionate fears or unrealistic hopes, lose the trust of our audiences, and can discourage scientists from talking to us.

11.5 Hype, doom, hope

In a similar vein, alarmism is a term that climate sceptics often use to discredit climate change journalism – and climate science itself.

But nearly every journalist who regularly writes about climate change has probably been guilty of alarmism at least one time in their career.

One of my own biggest regrets was a headline written by a sub-editor that implied the world could expect Biblical levels of sea level rise this century.

My article that carried this headline actually described various sea level rise scenarios occurring over millennia – and the misrepresentation embarrassed the scientist concerned at a time he happened to be attending an international conference (Morton, 2013).

Warne says the alarmist storytelling mode is tempting for media, because sensation has become the default expectation of both editors and audience.

He feels editors are conditioned by strong, persistent media narratives as much as their readers.

"These messages are self-reinforcing. Once 10 or 20 or 50 stories have been written with variations of the sinking islands narrative, it becomes pretty difficult to believe that's not real," he says.

"How hard is it to avoid? Once you realise that it is ineffective and incorrect, not so hard in your own reporting, but still difficult when negotiating with an editorial ecosystem that is still under the influence of that narrative."

He sees another issue that is just as much of a problem: generalisation.

People rely on heuristics – shortcuts, rules of thumb, generalisations – to negotiate a complex world.

"We seem stuck in a discourse characterised by simplification and generalisation – on all environmental issues, and climate change in particular," he says.

"If journalists believe that the public's attention span is six seconds – or whatever the latest finding is – then of course they're going to be tempted to simplify and generalise.

"But I think the onus is on media to break the generalising, sensationalising cycle. Can you sound an alarm without being alarmist? It's difficult, but I think it can be done."

Another risk of sensationalism is a well-studied backlash effect that entrenches apathy.

Because the potentially devastating consequences of global warming can threaten our fundamental tendency to see the world as safe, stable and fair, people often respond by discounting the evidence, or simply looking at the problem as too big.

Indeed, one 2018 poll found few Kiwis believed that humanity would do what is needed to escape the worst impacts.¹⁵

Research suggests that if the media – and scientists – avoid doomsday narratives and focus on positive messages, people will not only be more receptive of the evidence, but will be more willing to reduce their carbon footprint (Hall, 2017).

This is something I try to keep in mind when writing about potential scenarios New Zealand and the Pacific could be facing in decades to come.

Warne agrees powerful psychological drivers such as loss aversion make it inherently difficult for people to engage.

"And on the flipside, coverage of what can be done to reverse the trajectory of runaway emissions – the aspirational story – needs to be ramped up," he says.

"I think public interest in low-carbon solutions is growing and growing fast.

"Decarbonization – both at industrial and domestic scales – is a fount of potential stories. People want to know: how do we fix this? That's a great question for journalists to be exploring."

11.6 The human story – and the bigger story

For reporters covering it, climate change can seem a completely impersonal story.

I recalled thinking this when receiving daily progress reports from New Zealand's negotiating team at the landmark United Nations Climate Summit at Paris.

Why would the ordinary Kiwi worry about carbon trading mechanisms being provided for in the final agreement?

If you had stopped someone on the streets of Dannevirke or Dargaville, would they know what an Intended Nationally Determined Contribution (INDC) is, or would they even care?

The same thought occurred to me when I spent two nights camping in Antarctica's Taylor Valley, discussing with scientists such concepts as post-glacial rebound and morphological zonation.

What do unseen and slowly-unfolding processes on the coldest, driest, windiest, least inhabited continent on the planet have to do with everyday life back in New Zealand?

It is just those kinds of reasons that lead *New Zealand Geographic* editor Rebekah White to think climate change stories are the hardest she produces.

As she points out, they have everything going against them: they are distant, hypothetical, terrifying, and, as I noted earlier, they make people feel helpless.

15 Jamie Morton "Poll: Few Kiwis think world will overcome climate challenge" *New Zealand Herald* (online ed, 15 July 2018) <www.nzherald.co.nz>.

"Uncertainty is a hard sell. It's very difficult to establish relevance to people's lives, or to present projections in a way that doesn't sound apocalyptic, even if the projections are apocalyptic, because cataclysms are hard to take seriously," White says.

"I do think it's pretty hard for someone to care about melting ice when there's no obvious impact on their daily life, and no meaningful personal action they can take about it.

"What's more, it's hard to construct a compelling narrative around a story that isn't physically taking place, when there's very little fieldwork to report on – just people sitting in front of computers constructing models."

In the end, it all does come back to the human story.

When I am writing any piece concerning climate change, I think of Russell Horrell.

The agricultural consultant nearly drowned when the van he was in was caught in a swollen Kaiwaka River, near Waitangi (New Zealand), in July 2014.

Scientists later calculated that human-driven climate change had approximately doubled the chances of that storm happening.

"We talk about global warming, but we are going to see more and more of these sorts of events," Horrell told me.

His experience proved an ideal opening to a *Weekend Herald* feature¹⁶ that tied together all of the many facets of climate change: the politics, the policy, the science and, most of all, the human cost.

Mitchell is also mindful of the need to marry the human story with the bigger picture.

"For me, the issue is finding a way to report climate change in a way that's engaging, so people will bother to read about it," he says.

"We can write a news story every time some major report warns that climate change will be catastrophic, but I don't think that moves things forward much at this point. It gets a bit abstract.

"I'm fortunate that *Stuff* has gone all in when it comes to seriously covering climate change, so I never have issues on the management front – the difficulty is in coming up with ways to treat the issue with appropriate seriousness without turning people off, which is probably an issue journalists have generally."

Journalism has now found many stories like Russell Horrell's, that put a human face on climate change.

16 Jamie Morton "Last Chance to Save the Planet" *Weekend Herald* (online ed, 28 November 2015).

Mitchell's 2018 lengthy feature article "Beach RD" told the tale of Tracey Reeves, a local of a Thames suburb that is among the most vulnerable spots to sea level rise in New Zealand.¹⁷

In other cases, a simple image can prove powerful enough.

Anyone doubting this can look at a photograph taken by David White for the *New Zealand Listener*, which showed farmer Kent Sambells preparing to shoot dead a pregnant cow amid the drought that parched northern Waikato in the summer of 2013.¹⁸

But, turning back to Warne's point, White argued journalism was not personalising the positive story.

"Many aspects of people's daily lives are going to shift, but I feel we don't have many visions of the future, or solutions proposed, that are realistic," she says.

"Generally the media is quite bad at providing a sense of scale to climate change solutions – that emphasis on changing lightbulbs, for instance, as opposed to consuming fewer animal products.

"Some of the best stories recently have been the ones about insurance withdrawal and foolishly-located housing developments, because of their immediacy."

Rebecca Macfie, one of New Zealand's most respected investigative journalists, says personalising climate change journalism is important.

"Not because it will save the world, but because when people are psychologically engaged enough to, say, cut down on meat consumption, they are more likely to be aware of the political and corporate response and therefore more able to properly judge the adequacy of what government and companies are doing."

But she does not see this as the only angle that journalists should be pursuing.

"Getting serious climate action happening will rely on holding governments and powerful economic players to account – not by reducing the challenge down to some kind of kitchen table response."

And there is more than enough survey data to show that Kiwis want action from their leaders.

Three quarters of respondents to a 2018 poll thought the government had a responsibility to step up – yet less than half figured the country's response had been on the right track and just a third deemed it "good" (IAG, 2018).

17 Charlie Mitchell "Beach Rd: The rising sea and the reshaping of New Zealand" (27 November 2018) Stuff <<https://interactives.stuff.co.nz/2018/11/beach-road/>>.

18 "Drought takes deadly toll on farms" *New Zealand Herald* (online ed, 13 March 2013) <www.nzherald.co.nz>, reproducing a photograph originally appearing in "A scorched earth: Scenes from the drought" *New Zealand Listener* (online ed, 13 March 2013).

If journalists needed a reason for urgency in their reporting, most of those people in the same survey believed New Zealand needed to start right now: 64 per cent believed we need to meet or exceed our international commitments; and 78 per cent were of the view that we should act even if other states do not (IAG, 2018).

Three quarters thought climate change was an important issue to solve and 60 per cent had become more concerned over recent years – something that myself and others in the media have noticed while covering the issue.

11.7 Social media: a blessing or a curse?

It is difficult to tell whether social media platforms like Facebook and Twitter have had a positive or negative effect on climate change issues.

The answer is likely both.

One 2017 study found that, on the plus side, social media has been encouraging greater knowledge, is helping mobilise activists and is giving people a space to discuss the issue with others (Larson, 2017).

On the negative side, however, social media has provided a platform for sceptics who have been craving public reach since being largely shut out of the mainstream media (Nuccitelli, 2018).

Companies like Facebook have done little to curtail these misguided views being spread across their networks, despite the vast amount of users who might be exposed to them and influenced (Wickenden, 2019).

You might perhaps argue that the world's most dangerous climate change sceptic, United States of America's President Donald Trump, might not be sitting in the White House were it not for the unchecked powers of social media.

"Social media continues to offer the potential to progress the issue and at the same time to misrepresent it and thwart progress," technology commentator and science journalist Peter Griffin says.

"Social media activism on climate change can be incredibly powerful and engaging, particularly when it comes to the power users – millennials – who will be left to deal with the implications of climate change in future."

Social media has, after all, been a big part of the development strategy of new digital media organisations, including some that specialise in climate change, like *Carbon Brief*, and which has likely helped mainstream media by pre-digesting specialist reports.

At the same time, it has allowed some climate scientists and climate journalists to build a strong profile – and in turn be used more by mainstream media.

But Griffin is quick to point out its facilitation of inaccurate and misleading information going viral – and it was not just sceptics that posed a risk here.

"When an environmental activist group photoshops an image to show dire consequences of climate change, it threatens to set back discourse on the whole issue."

It is worth noting that the problem with social media is not specific to climate change or environmental issues.

Across the board, society is struggling to get the best out of social media while limiting the negative consequences.

The Facebook scandal over fake news and Twitter's efforts to tackle to clean up its network were all part of this.

But it is also about people taking personal responsibility for the tone of their discourse and their activity on social media – and that is a big issue to tackle.

In the meantime, people and organisations with an interest in climate change have powerful tools to make the most out of an incredibly effective and engaging medium.

11.8 Climate change and the arts

That description can also apply to another medium that has been around much longer: the arts.

It is proving a critical bridge between climate advocates and the public, but, just as with journalism, it has not always been that way.

As climate activist Bill McKibben notably wrote in 2005: "Where are the books? The poems? The plays? The goddamn operas?"¹⁹

In more recent times, Kiwi curators and galleries have been showing exhibitions focused on climate change, with many more planned.

This might be because of the case for urgency: the more pressing the cause and the greater our knowledge, the more confident artists are to reflect it through their work.

And that work is not just confined to paintings: it is sculptures, installations, performance and media.

Art is a cultural interpreter, an expression of our identity, a reflection of our society.

A dance, song, film or painting is experienced viscerally, activating different senses, recruiting different parts of our brain and nervous system to generate a response.

Some artworks intentionally use the approach of embodiment to physically engage the audience – and in that way, they can make a deeper connection and build empathy that stirs people to act.

19 Bill McKibben "What the warming world needs now is art, sweet art" *Grist* (online ed, 22 April 2005) <<https://grist.org/article/mckibben-imagine>>.

"The arts can be an entry point for people to engage on climate change, to become more receptive, be open to information and potentially engage more deeply," says Sarah Meads, the founder of Track Zero, a charity that works across the arts and science to advocate climate action and awareness.

"For people to feel engaged they need to have 'conversations'. The arts can create spaces for this two-way dialogue to happen interactively, compared with a newspaper article."

"The arts also have greater audience reach and can go to where communities live and work."

Gabby O'Connor, an installation artist and doctoral student based at NIWA, said arts appealed to people's feelings – a unique difference that made the medium a Trojan horse for communicating climate science.

"We all emotively react to art. The way I am currently thinking about this is that we need all forms of communication about climate change," O'Connor says.

"The arts are but one form of communication and possibly, it can provide an in-road to a topic that is otherwise complex."

The arts often provide a physical experience, something more visceral to an audience, and this will often be remembered more than a written piece.

The experience of the art might then make the audience member more open to further information about the issues, O'Connor explains.

"One form of communication is not better than another, but due to the complexity of climate change, we need all forms, from aural, visual, written, experiential so that the messages about climate change are communicated across all learning styles."

O'Connor is an interdisciplinary artist – that being one which works alongside scientists, architects and designers.

Having already collaborated with researchers in Antarctica, she is now working on an art-science community project, dubbed "The Unseen", and which helps children explore the way marine ecosystems are managed in the face of climate change.

There are now plenty of other such examples in New Zealand. Auckland artist and academic Janine Randerson has created installations inspired by meteorology, while research scholar and choreographer Carol Brown's project "LungSong" angrily confronts "climate chaos".

At least here in the Pacific region, that cultural uprising that McKibben called for now appears to be in full effect.

Many Māori and Pasifika artists draw on ancestral symbols and knowledge, simply because their spiritual relationship with nature is intrinsic and inseparable from their art.

Some like Taranaki's Wharehoka Smith and Waikato's Zena Elliott choose to work exclusively with Māori symbols and the process of creating the work, while others, like Michel Tuffery and the Mata Aho Collective, use their work to talk about the issue of climate change.

Some other notable examples include: Māori musicians like Tiki Taane, Pereri King and Rob Ruha pushing for action through their work; spaces like Auckland's TEMP, showing interactive art focused on climate change; and environmental themes running strongly through projects by influential Kiwi artists such as Sam Mahon, Sam Trubridge, Nigel Brown, Dan Mace and Jenna Packer.

A performance by top Royal New Zealand Ballet dancer Corey Baker, filmed in Antarctica, offers yet another stunning illustration of art's power in storytelling (Baker, 2018).

O'Connor says that while art is beginning to be recognised for such potential, there are still challenges with finding support for this kind of work.

"Often working with climate change, means that you are conducting interdisciplinary work – and this can make it harder for funders – be it art or science – to support as the outputs are not clear cut," she says.

"The art can be perceived as too sciencey, or the science represented being too arty, or of less value – this stems from historic values ascribed to different subjects."

Meads thought that, for all successes, the arts remain surprisingly understated as a force for positive change.

"Sometimes arts and artists endure the false flattery of being seen as the 'object' – like a painting on a wall or end point, the destination, rather than the road to get there," she says.

"In New Zealand, the arts can also be perceived as a luxury, something to be enjoyed at leisure, for our entertainment and lifestyle, such as going to a concert.

"If you're not from a traditional culture, where art form is used to hand down knowledge and express identity, then that part of society is unaccustomed to seeing the arts as having a role in shaping our future.

"I believe the arts can play a broader role, including in business and technology."

O'Connor, at least, is determined to break that ground.

"I believe that climate change is a social problem and as a citizen of the earth, I feel like it is my social duty to use my skills and connections to connect the public with the issue, either overtly, or more subtly," she says.

"We are freaking out, and this is one way that we can at least do something productive."

11.9 A mission for good

One of the most inspiring speeches I have heard was Rebecca Macfie's address to the 2016 Canon Media Awards at Te Papa in Wellington.

In it, she described climate change as the defining issue of our times – and called on all of those leading journalists and editors in the room to act.

Before she later exited the *New Zealand Listener* to write the late Helen Kelly's biography, it was that strong sense of personal duty that brought hesitation about leaving journalism.

"I'm incredibly conscious of the views and feelings of young people, and the way they must be receiving the information about the climate crisis and what it does to their mental health and their feelings about their future life."

Because of New Zealand's three-year government term, we in the media have a huge role to play in advocating for and holding the government to account on long-term plans around climate change.

We need to pursue more stories exploring the ramifications of policy decisions from a climate change point of view, and point out which actions would provide the best climate change solution, giving people something to advocate for to their MPs.

As journalists, we really need to take a similar role regarding climate change as we have regarding the #metoo – forcing people to confront something they do not really want to acknowledge or deal with.

And, as Macfie notes, we should feel a personal responsibility to the young people who are now doing a huge amount of work in the media industry.

Mitchell, a millennial himself, ironically had little interest in environmental issues when he took on the beat at *The Press* a few years ago.

He has since found it an incredibly rich and important subject to report on.

Climate change became part of that, naturally, being the biggest environment story in the world.

"My interest in climate change is largely the same as everything else I report on: I think journalists have a duty to report truth, or what is as close to the truth as we can possibly get, as a defence against those who would distort the truth for their advantage," he says.

"Which is a classically self-righteous journalist answer, but it's true. Like most people, I would rather the world and the natural systems on it didn't collapse because we couldn't resolve a problem we knew all about and were perfectly able to avoid.

"Why I care about reporting on climate change, though, is the same as why I care about journalism as a profession, which is that I think its function in society is invaluable."

The science of influence tells us that the cumulative reinforcing of messages again and again from varied sources is that leads people to change their behaviour.

Covering climate change can seem like a thankless task at times, but all of those contributions each reinforcing the need for change is what makes the difference in the long run.

The tide is turning – but we have an obligation to continue shining our light.

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12

FAITH AND SPIRITUALITY – THE EARTH IS SHAPING US TO LIVE WITH LESS

*John Howell**

12.1 Introduction

The earth is shaping us to live with less. In the short time we have to prevent catastrophic climate damage, questions of faith and spirituality impinge on how we transition to find the good life while living with fewer resources. We need good science, far-sighted political vision, and wise and fair communities that have faith in the future. I will argue that faith communities have wisdom traditions to draw on with an alternative spirituality to fear and panic.

This chapter, in two parts, begins by clarifying what is meant by faith and spirituality. I will argue that these are not exclusively religious terms, although they are important concepts in religious thought and practice. Because I understand religious narratives under the broad brush of the poetic, and their vitality is located in song, prayer, myths, liturgy, parables and proverbs with the metaphorical and the analogical, then in the second part of the chapter, I will use poems to elucidate some key issues of faith and spirituality to point a way forward from our current materialistic straitjacket.

Stephen Gardiner describes the runaway emissions as an ethical tragedy like a moral storm with three fronts. The first is global, with the rich nations favouring their own interests. The affluent can retreat to their fortresses and leave the rest to their fates. The second is intergenerational, with the current generations taking advantage of future generations. The third is theoretical in that our moral and political institutions are under-developed for the task.¹ An example is disregard for the polluter-pays principle.

I will consider the following:

- The urgency of the coming storm. Is it too late? I will distinguish between end-of-world predictions and the prophets.
- I will contend the earth covenant in the Noah story will rebalance human exploitation.
- Stern claims climate change is a classic example of market failure (Stern, 2007). How can economics serve the common good in this transition?

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1 Stephen M Gardiner *A Perfect Moral Storm: The Ethical Tragedy of Climate Change* (Oxford University Press, Oxford, 2011) at 6.

- The wise person does not build a house on sand. As sea level rises and extreme droughts and floods displace populations, how are we to care for climate change refugees?
- If technological fixes will only take us so far to carbon neutrality, is it time to seek life in traditions different from the script of a consumer society?

I will connect each of these strands with what I consider to be the underlying spiritual values located in the sacred stories of religious literature, with the hope that some of their insights will point to a future for my grandchildren.

12.2 Part one

12.2.1 A definition of faith

Let us take faith as a trust or commitment, which presupposes belief and has a cognitive aspect. It is close to "believing in", as opposed to "believing that", but will presuppose some beliefs of this latter kind. Faith can also involve insight, discernment and understanding.

Having faith is having trust. Faith is not the same as belief. Faith does entail some beliefs. If I have faith in a person, I believe them to be trustworthy. Faith is situated in a relationship. I have faith in the pilot of the aircraft, or the driver of my car. I have faith in the other drivers on the road to obey the law so I will be safe. I trust the music teacher to teach in the belief that he or she will act in good faith so my child will learn the musical skill I pay the teacher to instruct and inspire them in. If the music teacher touches them in sexually inappropriate ways, then my trust is misplaced and I can say that they acted in bad faith. In business, the employment law requires the parties to bargain in good faith. When a business partner acts in bad faith, then business relationships collapse. Anywhere there is a relationship of trust that the people involved have faith.

• *Moral code.* Faith requires a moral code. I have trust in my bank. Trust is implied, for example, in the very title of a promissory note, which is based on the promise that the parties will act in certain ways in the future. When banks act out of greed, as a Royal Commission in Australia has recently found (Royal Commission into Misconduct in the Banking, Superannuation and Financial Services Industry, 2019), failing to meet the basic standards of honesty, then our faith in these institutions is diminished.

• *Faith in private and in public.* Paul Fiddes discusses two of Shakespeare's plays: "Measure for Measure" and "The Merchant of Venice".² Elizabethan jurists made a distinction between private and public spheres of life. Fiddes says Shakespeare stands with Erasmus, who declared that "there can be no good prince who is not also a good man".³ The connection between the administration of justice and the person of justice – including the judge's own morality – is a theme that Shakespeare

2 Paul S Fiddes "Law and divine mercy in Shakespeare's religious imagination: Measure for Measure and The Merchant of Venice" in Francesca Bugliani Knox and David Lonsdale (eds) *Poetry and the Religious Information: The Power of the Word* (Routledge, Abingdon (UK), 2016) 109.

3 Desiderius Erasmus *The Education of a Christian Prince (1516)* (translated by Lester K Born, Columbia University Press, New York, 1936) at 189, quoted in Harvie Ferguson *Religious Transformation in Western Society: The End of Happiness* (Routledge, London, 1992) at 77.

continually works at in dramatic form. In the "Merchant", the fundamental contrast is the generous risks of love and the mathematics of commerce, in theological terms, between law and grace. If we think about applying the characteristic of acting in good faith to our leaders, this challenges the practice of turning a blind eye to bullying or predatory behaviour, or denial of climate science by CEOs on the justification of their financial results for the company. We need our business leaders to act in good faith and with integrity as we transition towards a net zero carbon economy. Their dilemma is that "it is not just legal for them to maximise profits, it is also a requirement that shareholders can enforce".⁴ While the financial returns from oil are higher than renewables, a transition is hindered.⁵ This makes it urgent for nations to legally adopt pollution taxes and to cease to subsidize the extraction of fossil fuels. Oil companies can act in good faith by recognising the validity of the climate science, ceasing their lobbying to continue business as usual, and adopting transition planning.

• *Faith in the wrong things.* Michael Sandel, in his book *What Money Can't Buy: The Moral Limits of Markets*, says:⁶

The logic of buying and selling no longer applies to material goods alone, but increasingly governs the whole of life. The years leading up to the financial crisis of 2008 were a heady time of market faith and deregulation – an era of market triumphalism. The era began in the early 1980's, when Ronald Regan and Margaret Thatcher proclaimed their convictions that markets, not government, held the key to prosperity and freedom. And it continued in the 1990's, with the market-friendly liberalism of Bill Clinton and Tony Blair, who moderated but consolidated the faith that markets are the primary means for achieving the public good. Today, that faith is in doubt.

I will return later to suggest some different metaphors than the "market" or the "invisible hand" that economics might use.

• *Radical trust.* In his book *Out of the Wreckage*, George Monbiot uses the lessons of Bernie Sanders' campaign as a way to bring about transformational change. He cites women's suffrage, civil rights and the end of apartheid as mass mobilisation of citizens.⁷ While acknowledging all political parties rely on volunteers, Sanders' campaign was an attempt to connect with a different constituency than "big money", and avoid employing staff. Two of Sanders' campaigners, Becky Bond and Zack Exley, explain how close he came to gaining the Democratic Party nomination. They developed a model called "radical trust", delegating the biggest possible tasks to volunteers and leaving them to get on with the job. They found that passion is more important than perfection, and they trusted passion. They had faith that the passion of those who wanted an alternative to the control of the rich and powerful would attract a like-minded faith (Bond and Exley, 2016).

4 Editorial "Crude Awakening" *The Economist* (9-15 February 2019) 9 at 9.

5 Id.

6 Michael Sandel *What Money Can't Buy: The Moral Limits of Markets* (Allen Lane, London, 2012) at 6.

7 George Monbiot *Out of the Wreckage: A New Politics in the Age of Crisis* (3rd ed, Verso, London, 2017).

• *Leadership.* Monbiot does not highlight the place of inspired leadership, nor refer to religious history. But the change movements he mentions had religious leadership or support, Martin Luther King being one example. King's first and second names come from Martin Luther, the leader of the Protestant reformation, who nailed his 95 theses to a church door in 1517 (Perrigo, 2017). It is not insignificant that Luther's catch cry was "justification by faith". At the same time, the founder of the Jesuits, St Ignatius of Loyola, developed his spiritual exercises of meditations, prayers and contemplations. Both were responding to the need for institutional changes similar to the challenges we face today. Is the climate change problem too big for democracy? Inspired leadership in the past has come from leaders with religious motivation. We are waiting for today's religious leaders to answer this call.

• *We all have faith of some kind.* Faith, then, is not the exclusive domain of religious belief. All the relationships we enter into, such as in marriage, parenting, education, business, politics have an element of faith and trust. Our faith has a religious dimension when we bring to it a belief structure and practice, such as a monotheistic God, or a special person like Jesus Christ or Muhammad.

12.2.2 The concept of spirit and spiritual function

Spirit is a verb

Spirit is a verb
fire and wind
found in a burning bush.
Take off your shoes.

Spirit is Leunig's duck
flying in the slipstream
brooding in the nest.
Wing it.

Spirit is Talisker Whisky
craft, barrel, mature
it will have body.
Savour it.

Spirit is my father's cornet
played in war and peace
a family treasure.
Blow it.

Spirit is an old running shoe
battered in the hills.
worn in the garden.
Recycle it.

Spirit is a shadow
shade from heat

always with light.
Touch it.

Spirit is water
drink in the desert
green in the garden
twinkle in the eye
balm for the ache.
Take this cup.
Drink it.

Paul Morris, in his essay at the end of a poetry collection on spiritual verse, writes:⁸

Spirituality always makes cultural and communal claims. Spirituality is cultural. To fail to recognize my spiritual dimension is to diminish my divine self-image and to deny myself full personhood. Spirituality is personal and collective identity. Each particular form of life generates and is underpinned by a specific spirituality, a mode of thinking and practice that allows one to participate in the "divine" body. One of the most significant forms of modern spiritual identity is to be found in the heretical form of national identity.

Morris uses the notion of the divine image to define spirituality, and a secular spirituality is regarded as heretical. However, he describes atheistic or secular spirituality, and acknowledges that spirituality has a wider scope of expression than within a religious frame.⁹ The heresy of national identity could refer to the tyranny of Hitler's Germany. (Morris wrote this before "Make America Great Again", or Putin's Russia came along.)

Bearing in mind Holcroft's observation that Christianity never really took root in New Zealand as a cultural identity as, say, in Britain, religious institutions cannot claim that spirituality is narrowly restricted to religious belief or practice.¹⁰ No one church or strand dominates the religious plurality.

Spirituality does require a worldview, a belief system of some kind, and in using spirituality, we refer not only to the individual ("He was down in spirit"), but also to a team (consider how we evoke the team spirit in the haka before the All Blacks play rugby) and a nation ("It was the fighting spirit that got the British through the war"). We can speak of spirit as breath, giving us character and identity.

8 Paul Morris "New Zealand Spirituality: A time for re-enchantment" in Paul Morris, Harry Ricketts and Michael Grimshaw (eds) *Spirit in a Strange Land: A Selection of NZ Spiritual Verse* (Godwit, Auckland, 2002) 182 at 182-183.

9 Paul Morris, Harry Ricketts and Michael Grimshaw "Introduction" in Paul Morris, Harry Ricketts and Michael Grimshaw (eds) *Spirit in a Strange Land: A Selection of NZ Spiritual Verse* (Godwit, Auckland, 2002) 9 at 11.

10 Paul Morris "Spirit Abroad: Reflections on New Zealand Spirituality and Identity" in Paul Morris, Harry Ricketts and Michael Grimshaw (eds) *Spirit Abroad: A Second Selection of NZ Spiritual Verse* (Godwit, Auckland, 2004) 217 at 224.

In biblical times, the spirit was not a personal being. It was a principle of action, not a subject. It never becomes part of the structure of the living being. The Hebrew word translated spirit can also be translated wind or breath. As a principle of activity, the spirit is morally neutral and can be found in both good and bad activity. (Hence the reference to the "unclean spirit".) We can think then of spirit as breath, that activity that gives us life, or that activity that moves us. That movement can be either good or bad.¹¹ If I ask the question: "What is it in this that gives me life, or breath, or character, or a connection to place?", then I am describing my spirituality.

I have chosen the definition of spirituality from a collection of spiritual verse, as opposed to a creed or theological doctrine, because the genre of the biblical story is poetry or prose. Engaging with the language of poetry is more likely to catch the spirit, compared with the organisational control of a creed. Spirit is a verb defined in practice and poetry.

12.3 Part two

12.3.1 Is it too late to stop disastrous climate change?

When the train has left the station

Railway track
you carry the carriages
to Tangiwai bridge.

River track
you carry the lahar
from crater lake.

Loco KA949
you head from Waiouru
at Christmas in '53.

Whangaehu River
six metres high
silt and rocks, ash and sand
you smash pier 4.

Charlie Parker
you brake the train
to slow its jump
into weeping waters.

Is it too late to stop the train? What is going on with the driver? Are the warning signs sufficient? Since the 1953 tragedy, warning measures are now in place to prevent such a disaster occurring at

11 John L McKenzie "Aspects of Old Testament Thought" in Raymond E Brown, Joseph A Fitzmyer and Roland E Murphy (eds) *The Jerome Biblical Commentary* (Chapman Publishing, London, 1968) 736 at 742.

Tangiwai again.¹² But if the train gets too close to the bridge, its momentum will carry it even if the brakes are applied. The timing, the speed and the size of the train are critical factors. For a driver to ignore the warnings now would be a dereliction of duty. Is it too late to stop the climate disaster train? There are examples of religious groups that have predicted when the world will end.

- *Rapture theology.* Rapture Christians take literally the second coming of Christ, and predict the end of the world is coming. Millenarianism takes Revelation chapter 20 literally. Belief in the Rapture, also known as millenarianism or eschatology, has multiple variations, but the core view is that there will be an apocalyptic war, Jesus will return, and true Christians will be "raptured" or ascend to heaven, with the rest of the earth's inhabitants punished (Kaplan, 2017). Rapture believers are split about the order of events, but they are united in the belief that only Christians will be saved (Maza, 2018).

- *Rapture influence in the White House.* Rapture theologians and historical evangelicals hold several other views that hew closely to Trump administration policies. They believe that earth was created for man's use, for example, and that environmentalism is a form of blasphemy (Meyler, 2017). It appears that a significant number of members of Trump's executive are Rapture Christians, including the Vice-President, and a Rapture preacher, Ralph Drollinger, holds regular bible study in the White House. The presence of Rapture Christians in the White House raises questions about the theological and scientific illiteracy of White House appointments, and how the bizarre and the extreme now influence the White House (Timmons, 2018). It reinforces President Trump's denial of climate science.

- *End of world predictions.* Jerry Falwell Snr was a fundamentalist preacher who predicted in 1999 that the Second Coming would probably be within 10 years. His is one of an extensive list of predictions and claims for the second coming of Christ with announced dates for the end of the world (Gribben, 2009). They have all failed.

- *Evidence is important.* We may take two messages from these failures. The first is that reading the Bible with this exegetical framework is a nonsense. It is bad faith. It can be seen as a rationalisation that seeks to undercut or weaken the moral prescriptions, and in so doing undermine the ethical challenge of climate change. In that sense, it is morally corrupt.¹³ The second is that predictions of the future need to be tested with a caution. Evidence is important.

The mainstream Christian traditions do not literally interpret the symbolism in the book of Revelation, nor entertain doomsday fantasies: "You do not know what day your Lord is coming."¹⁴

12 Tangiwai is a small rural community in the Ruapehu District of the Manawatū-Whanganui region of New Zealand's North Island, near where the country's worst rail disaster occurred on 24 December 1953: see Kevin Boon *Tangiwai Rail Disaster* (Price Milburn, Nelson, 1990).

13 Gardiner, above n 1, at 301, 306.

14 Matthew 24:42; 25:13.

• *Prophetic voices.* The narratives of the prophets state a predicted calamity will occur if the Ruler continues to follow a particular path. Jonah, for example, preached to the city of Nineveh to change its ways. It did. (The legend of the whale is not the main point of the story.) Often, the prophets are arguing for doctrinal purity, or against wickedness, or to turn away from false gods. The plot structure is, if you go down this path, then this is the consequence, so repent, change.

One of the key differences today is the base of scientific data. While the science is evidence-based, how the future will unfold is a calculated estimate. Yet, there is an argument that the climate scientists who warn us of these future predicaments stand in the biblical tradition of the prophets (but not the eschatologists), and we should hear the voice of God in what they say.

• *Heed the warnings.* As the train gets closer to the bridge, and if its momentum increases or even holds, then our worries about the end can be taken seriously. This is particularly so if a major polluter and/or its leadership is in denial. As time runs out, the collapse of our civilisation in some form is more likely.

12.3.2 The earth covenant (compare the Earth Charter)

Noah opens the window of the ark

There's a tui in the Ngaio tree.

I think of Noah's raven
flying over the waters until they dried.

The tui is not a gannet nor albatross
skimming the waters a long way from home.

It needs a branch to sing from,
a portal into which to chortle.

• *Noah story.* There are two strands of oral tradition that are woven into the Noah account, and it is not science or history, but a religious story (Brueggemann, 1982). Whereas Genesis 1 has humankind as vegetarian, by the time we get to Noah, humankind is eating every living thing as food. The outline of the story is this: humankind was wicked, the creator grieved that, and wondered if human beings should be blotted out. However, Noah was a righteous man, God instructed Noah to make an ark, with two of every kind of living thing. There was a great flood, the ark survived the flood, and after the event, God entered into a covenant.

The Noah story in Genesis 6 links with the first story of creation (Genesis 1-2:4a). In Genesis 1, humankind is granted dominion following the making "in our image". There is a blessing to be fruitful and multiply, and fill the earth and subdue it (Genesis 1:28). This is a role which is associated primarily with kings, and within Israelite royal tradition, one frequently finds a connection between the ideal king and the fertility of the land.¹⁵ Two texts from elsewhere in the Hebrew Bible make it

15 Mark G Brett "Earthing the human in Genesis 1-3" in Norman C Habel and Shirley Wurth (eds) *The Earth Story in Genesis* (Volume 2, Sheffield Academic Press, Sheffield, 2000) 73 at 77-78.

clear that the dominion of a god-like king would create harmony with the physical earth (Psalm 72:3) and the non-violence of other creatures (Isaiah 11:6-11:8).¹⁶

Augustine, Aquinas and Luther do not support any simplistic notion that "dominion" is to be treated as a synonym of exploitation.¹⁷

That the earth was ruined by the time we get to Noah suggests that this dominion was improperly exercised, and God resolved to destroy it (Genesis 6:11-6:13).

There are three significant differences between Genesis 1 and Genesis 6.

In the first creation story, humankind and the beasts and birds are vegetarian (Genesis 1:29-1:30). In the Noah story, every living thing shall be food (Genesis 9:3). One of the important choices we face today is what kind of food we eat. This is a major topic outside the scope of this chapter, except to say that those who choose to be vegetarian do so with the authority of the first creation myth.

Secondly, it is noteworthy that in Genesis 9:1 and 9:7, permission to subdue the earth is withdrawn.

Thirdly, in Genesis 9:13, it says: "I have set my bow in the clouds, and it shall be a sign of the covenant between me and the earth."

The earth is a living entity in its own right, and as such has an intrinsic value.¹⁸ Intrinsic value is important in ecological ethics, and in how we measure and value non-human life in economics. It gives foundation, for example, to the legal personality of the land in section 3 of the Te Urewera Act 2014:

- (1) Te Urewera is ancient and enduring, a fortress of nature, alive with history; its scenery is abundant with mystery, adventure, and remote beauty.
- (2) Te Urewera is a place of spiritual value, with its own mana and mauri.
- (3) Te Urewera has an identity in and of itself, inspiring people to commit to its care.
- (9) Tūhoe and the Crown share the view that Te Urewera should have legal recognition in its own right...

Other examples are found with the Whanganui River and Taranaki Maunga. There is scope for the law to do more of this.

The covenant, of which the rainbow is a reminder, is between God and Noah and his descendants, with every living creature, and with the earth. The promise is a flood will never destroy the earth. A promise is a two-way relationship: our part of the covenant is to live in such a way that God does not regret his creation; that we fulfil the promise of creation.

16 See Gardiner, above n 1, at 125.

17 Robin Gill *A Textbook of Christian Ethics* (3rd ed, T&T Clark, London, 2006) at 272.

18 Gardiner, above n 1, at 125.

• *No insurance against climate change.* Some Christian groups believe that this is an insurance policy against climate change (Hanley, 2018). Unfortunately for them, large parts of the earth are becoming uninhabitable, not by floods, instead by extreme fire events. The forests dry out and become fuel. The rise in global temperatures will melt glaciers and ice caps, and cause sea level rise. It is sea surges that will make the Pacific Islanders migrate. The sea birds will adapt, the land birds, such as tui, need a tree. If we are like Noah, we will open the window and watch the birds.

12.3.3 Earth as a garden

A matter of degrees

Pure

As long as the air was clean,
 so was the rain;
 as long as the land was unsoiled,
 so was the stream;
 as long as the stream was filtered,
 so was the lake;
 as long as the lake was alive,
 so was the river.

River, when we drink your water,
 it clears our throats.

The gardener sings, works,
 marries land and river
 in fertile soil.

Drought

The morning mist burns off.
 The garden tries to lick its lips.
 Wilting plants lose their spine.
 This was a land of plenty.

River, you are the artery of the land,
 your pulse is slowing.

The gardener works in the cool of night,
 wonders when trout and river will run again.

Flood

From the courtyard wisteria,
 bronze leaves and raindrops
 implode the puddles.
 The gully begins to avalanche.
 Rain roars to the lake outlet.

River, you are a storm water drain,
uncontained.

The gardener stores the last of the vegetables,
preserves the seeds.
waits through the night.

Temperature rise

We shall walk in ashes and dust,
dark grey out of the blue,
unexpected but unsurprising,
like when the thin skin of the earth erupted
a volcanic cloud over the garden,
except it's a gradual tipping point,
a matter of degrees.

• *The second creation account in Genesis.* The second and older creation account in Genesis 2-3 is set in a garden. The Lord God (this divine title is a clue that it is different from the priestly account of Genesis 1) forms man from the dust of the ground and breathes into his nostrils the breath of life. Breath is also translated as spirit – that which makes a living being.

Man is put in the garden to till it. It is not good for man to be alone, so he is given a partner as his helper. Man is also given the power of language to name every living creature. Woman is made out of his rib and they "cling" together to become one. (Different but one is not a relationship of submission by either partner.) Anatomically, this is not scientific, but then this is not a story of science. It is a story of relationship, of our human condition.

Genesis 3 pictures a serpent leading to the brokenness of the relationship between the gardeners. The serpent is a wily old fox. A fruitful garden depends upon land, water and plants. This is the given of the garden for humankind to till. I suggest it is a foundational image of understanding creation. When we lose our relationship with the land, we lose something fundamental to our identity and our existence. Māori talk of the land as their bones.

The biblical image is a flourishing garden as the context for the good life. When God formed humankind from the dust of the ground, and breathed into them the breath of life, he put humankind into a garden. Dust, breath or spirit, garden (Genesis 2:7-2:8). And then:¹⁹

But just as we have the same spirit of faith that is in accordance with scripture Yes, everything is for your sake, so that grace, as it extends to more and more people, may increase thanksgiving, to the glory of God. ... Even though our outer nature is wasting away, our inner nature is being renewed day by day.

Notice here that the spirit of faith is in accord with the biblical narrative. Our spirit connects with, or is checked against, the story. Grace extends through this process, a process that renews our inner

19 2 Corinthians 4:13-4:16.

nature. And note the role of the narrative here. The story is a way of evoking and balancing. As such, it requires judgment and imagination. The result is a renewal of our inner nature.

• *Applying the garden metaphor in economics.* Sandel has written about how the metaphor of the market economy, instead of being a tool for organising productive activity, has become a way of life – making a market society.²⁰ The intention of the New Zealand government to adopt a living standards framework to measure well-being is a change in direction (New Zealand Treasury, 2018).

An alternative metaphor to "market" might be to think of the economy as a "garden". A garden image includes crops for production, but not just the commercial. The gardener knows how to protect and care for water and soil, and factoring in good husbandry with knowledge of the science, especially climate science.

12.3.4 Sea level rise

The sandpiper's lament

Between sea and coastal cliff,
estuary tides rip, shift.

The dredge spits slurry on to dunes,
a circular war, a windblown ruse.

Gulls grace, glide,

eye the drift, cyclone, tide,
eye the lift, oil, soil, spoil.

The setting for this poem is the Mangawhai Heads (township in Northland, New Zealand). There are many places, and more to come, where sea surges are eroding the coastline. It shows clearly the circularity of dredging sand which is then by wind and sea returned to the same place. Coastal communities throughout the world, and islands in the Pacific, are now facing dilemmas not of their making:²¹

Everyone then who hears these words of mine and acts on them will be like a wise man who built his house on rock. The rain fell, the floods came, and the winds blew and beat on that house, but it did not fall, because it had been founded on rock. And everyone who hears these words of mine and does not act on them will be like a foolish man who built his house on sand. The rain fell, and the floods came, and the winds blew and beat against that house, and it fell—and great was its fall!

The parable of the wise and the foolish in Matthew 7 is apt for thinking about the transition we face as we move towards a net zero carbon target. Face the fact we need to build on solid foundations and avoid shifting sand. Will we adopt a just and generous assistance to innocent victims to relocate?

20 Sandel, above n 6, at 10.

21 Matthew 7:24-7:27.

Whatever we do, let's not move sand around.

12.3.5 Refugees

Old bones

High tides seep into the garden. Again.
Too high. Too often.
The fence crumbles.

Bleached coral stalks the reef.

The Tuvalu Rev pours, at his sanctuary,
his stormy outburst to his ancestors.

The cyclone has wound the clock to breaking.
The graves are waterlogged canoes.
On higher ground he reinters.
The benediction blown to the oceans.

- *A view from Tuvalu.* From a Tuvalu perspective, the issue is that the pollution of the air by carbon is caused by the major industrial nations (although we all contribute in our own way). Tuvalu contributes little to nothing in comparison, yet they will lose their island due to rising seas (Roy, 2019). The polluter should pay, in this case, the cost of relocation.

- *An ancient story contrasting law and spirit.* An ancient relocation story is the exile of Israelites to Babylon. The first move to Babylon was through conquest. It is the return from Babylon that is full of interest. Persian armies won a decisive battle against Babylon at Opis on the Tigris river in 539 BCE, and Cyrus removed the oppressive conditions in Babylon. He allowed those in exile to return. Ezra came from Babylon with a copy of the Law and the power to enforce it:²²

For you are sent by the king and his seven counselors to make inquiries about Judah and Jerusalem according to the law of your God, which is in your hand.

The law is a product of both internal Jewish incentive and external Persian directives. That is, the directives of the exiled community and the directives of the Persian King defined the world of Judah. Ezra's law was in many senses exclusive (no foreign wives or children) and elitist (the returning exiles had precedence over the locals). But it was based on shaping a national identity through religious worship and the Torah. It was conservative. By contrast, the post-exilic Second Isaiah (40-55) is rich in poetry and religious imagination. It contains the four servant songs. The remaining chapters of Isaiah extend the covenant to all who obey and are an invitation to abundant life. It is from Isaiah 61 that Jesus reads in the synagogue: "The spirit of the Lord is upon me".²³

22 Ezra 7:14.

23 Luke 4:18.

- *Two paths.* These two paths of closing ranks to preserve identity (law), or having an open inclusive character driven identity (spirit or grace), are being played out in the world's immigration policies for refugees. Some refugees set up a copy of their home of origin in their new place, stuck in their old home religion and culture. Others take an open inclusiveness to their new place. These open and closed patterns are mimicked by the host. There is a lesson we can learn from refugees. They know what it is to suffer loss and they know the experience of sacrifice. They will have deep insights into how to live simply. (Should we have sympathy for those rich refugees buying large and exclusive tracts of land, escaping to our precious landscapes? The Overseas Investment Office might have a clause that asks not just how much money they have, but how they will contribute in climate change mitigation.)

- *Spirituality is demanding.* Belden Lane writes: "Extremity is the necessary, even normative starting point for understanding the strenuous character of the spiritual life."²⁴ He then adds: "My fear is that much of what we call 'spirituality' today is overly sanitised and sterile, far removed from the anguish of pain In fierce landscapes one knows that being good, being sweet, being nice, will not cause life to sing."²⁵ In the transition to carbon neutrality, scaremongering and fear may undermine the imperatives before us. The strenuous character Lane refers to will require courage and serenity.

12.3.6 The consumer society

Enough stuff, stuff enough?

Mum, I want a watch.
 Why do you need another?
 Steve Jones has the latest.
 Have you talked with your father?
 He said talk with you about stuff.
 Don't you have enough stuff?
 I've enough toy stuff,
 I want big boys' stuff.

The landfill tips into the plastic ocean.

The mother looks to the grandmother.
 The father looks at the grandson.
 The grandmother cries time.

- *A New Zealand report on options to achieve carbon neutrality by 2050.* In a report prepared for GLOBE-NZ, Vivid Economics found that if New Zealand substantially afforests and there are beneficial low emission technologies along with land use changes, the country could achieve domestic net zero emissions by 2050. Beyond 2050, New Zealand will not have further land for forestry

24 Belden C Lane *The Solace of Fierce Landscapes: Exploring Desert and Mountain Spirituality* (Oxford University Press, Oxford, 1988) at 20.

25 *Id.*, at 43.

abatement and will rely on new technologies, as yet unknown.²⁶ This "faith" in the future is admirable, but there is a glaring gap. Technological development consistent in a sustainable economy will only take us so far – relying on technological fixes is high risk.

- *Limits on water.* Consider, for example, the component of our renewable electricity generation that relies on water. We harness the melting snows as they flow into our lakes and rivers. Climate change will produce extreme weather events of drought and flood. In times of extreme drought, these water flows will reach a point insufficient to generate electricity. As the ice/glacier volume shrinks, as measurements show it is, then ice melt and water flow will reduce. At what point this run-off will bottom out is uncertain, but it lies ahead.²⁷ With our current technology, electricity generation from water will increasingly be a limited resource.

- *New technology.* Any new technology takes time, and like a new medicine, we may not know its side effects immediately. Our current technologies and their substitutes, of course, have roles to play. But what are these roles and what is the play? Technology has a mix of benefits and harms, it can be used for good or evil – or perhaps shades of grey rather than black and white.

- *The consumer society.* The consumer society is scripted to customers and shareholders. It has many benefits to our civilisation. These virtues become vices if this is the only script we play. The consumer society has no ability to harness whether it is serving our need or our greed. It strokes our appetite to buy. A market demand assumes our ability to pay, and those that cannot afford to buy, such as a house, become homeless. It ignores the gift "economy", those services which feed our deepest needs for love and self-worth found in relationships and community, not a market segment. This is the spirituality of gift.

- *Spirituality of fear and greed and the risk of war.* Mahatma Gandhi said: "The world has enough for everyone's needs, but not everyone's greed".²⁸ Securing our borders and defending our privileged way of life from conquest is a common ploy now in political power plays. Fear and the imaginings of dispossession will employ spirited rhetoric. Peace is fragile. The risk of war as we adjust to sustainable societies and to carbon neutrality is a real threat.

- *Materialism.* Kasser contrasts materialistic goals of money, image and status (encouraged by consumer capitalism) with the intrinsic goals of personal and community well-being. His research shows: "The more that people care about materialistic goals, the lower their personal well-being."²⁹

26 Vivid Economics *Net zero in New Zealand: Scenarios to achieve domestic emissions neutrality in the second half of the century: Report prepared for GLOBE-NZ* (Vivid Economics, March 2017) at 34.

27 Kennedy Warne, Dave Allen and Rob Suisted "The Final Meltdown" *New Zealand Geographic* (Issue 154, November-December 2018) 50-59. See also Motu "Drought under climate change: what do New Zealanders need to know now?" (29 November 2018) <<https://motu.nz>>.

28 Mahatma Gandhi, quoted in Oliver Balch "The relevance of Gandhi in the capitalism debate" *The Guardian* (online ed, 28 January 2013) <www.theguardian.com>.

29 Tim Kasser "The True Cost Interview" (2016) The True Cost <<https://truecostmovie.com/tim-kasser-interview>>.

They tend to lower health and happiness. In particular, they care less about ecological sustainability and their lifestyles tend to have a more damaging effect on the planet.

His studies show more exposure to advertising leads to stronger materialistic values.

Kasser advocates various curbs on advertising, including regarding it as unethical to advertise to children under 12. They have a right to be protected in their formative learning years from advertising until they have a value foundation to assess and balance the advertising to consume.³⁰

• *A spirituality of enough*. A spirituality of enough is learning to live with less "stuff" to free us to value a non-materialistic lifestyle.³¹

Many expressions of spirituality (for example, the Papal Encyclical and the World Council of Churches) teach that the "good life" lies not in the competitive quest for possessions, the accumulation of wealth, or fortresses and stockpiles of armaments to provide for our security. The Accra Confession from the Reformed Churches, for example, rejects "the culture of rampant consumerism and the competitive greed and selfishness of the neoliberal global market system or any other system [including absolute planned economies], which claims there is no alternative."³²

Kasser says:³³

... the very earliest writings in philosophy and religions and such – Socrates and Lao Tzu and the Bible and Mohammed and Buddhism – suggest to people that materialism is pretty problematic, that it will crowd out what it means to have a meaningful life, that it will crowd out spiritual strivings, and that it will crowd out authenticity.

Professor Yuan T Lee, President of the International Council for Science, believes a deep transformation to global sustainability is needed, beginning immediately with dramatic reductions in human footprint, population growth and consumption. His simple formula was "Shrink + Share".³⁴

30 Tim Kasser "Living in a material world" *New Philosopher* (Issue 18, winter 2017-2018) 52.

31 World Council of Churches "Statement on COP 24 and Just Transition to Sustainable Economy" (7 November 2018) <www.oikoumene.org>.

32 World Communion of Reformed Churches "The Accra Confession" (2004) at [21].

33 Kasser, above n 30, at 52.

34 Yuan T Lee (2014) (personal note taken from his talk at Victoria University of Wellington, 5 September 2014).

12.4 Conclusion

The earth is shaping us to live with less.

It is challenging us to:

Listen to its voice,
heard in the science of the climate,
and the warnings of the waters.

Listen to the birds,
for if we burn or flood their nests,
our nests will wane too.

Cultivate our planet as a garden,
where the market is in a corner to enjoy its shade.

Reject "fear and greed". Imagine another script,
for our and future generations,
where treasures of life are found in simplicity and humility.

Say enough is enough,
for we have enough stuff to go around.

Build our house on solid rock, not shifting sand,
and care for our neighbour and the refugee,
for peace is a precious gift.

These are matters of the spirit,
lived in good faith to sustain life for our grandchildren,
and their grandchildren too.

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Climate change is already modifying weather patterns and seasonal climate and raising sea levels across the globe. Left unchecked, climate change presents significant risks for food security, water availability and habitability. It is the number one problem facing humanity. How climate change affects the oceans, and life within the oceans, is central to the future of the planet. Containing the vast majority of the heat in the climate system, and home to a vast array of biodiversity, the global oceans hold the key to the effects of climate change for centuries to come. Nowhere is climate change, and ocean change, a more urgent issue than across the Pacific, home to many low-lying island nations and sensitive to large swings in climate from year to year.

On 21-23 February 2018, Te Herenga Waka—Victoria University of Wellington and SPREP hosted the Second Pacific Climate Change Conference, entitled "Pacific Ocean – Pacific Climate", at the Museum of New Zealand Te Papa Tongarewa in Wellington. The conference brought together a broad range of voices on climate change, from the arts, scientific, business, health and faith communities; Pasifika communities; as well as activists, NGOs and members of the public. They provided a rich exchange of diverse ideas on how to tackle this most pressing problem. The contributions in this volume come from some of the keynote and principal speakers at the conference. They represent a multitude of viewpoints on how to deal with the problem confronting us all. The chapters address topics ranging from the science of climate change to its impacts on the environment, examine law and policy matters, and discuss the issues raised by climate change through economic, media and faith perspectives.

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