1. Oceans and coasts in the era of Anthropogenic climate change

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I INTRODUCTION

The world's oceans cover nearly three-quarters of the surface of the planet¹ and, along with coastal ecosystems, are critical to global climate and weather systems, human food security, cultural practices, social wellbeing, economic prosperity and ecological integrity. The oceans also take up large amounts of carbon dioxide and heat from the atmosphere and are a key source of food and livelihoods.² As the interface between land and sea, the world's coastal areas are home to a significant part of the global population and stores of high biodiversity; they provide essential ecosystem services, such as carbon sequestration, and are areas of high-density human settlement and economic activity.

Despite their critical importance, the health of the world's oceans and coasts is declining due to a range of stressors, including: overfishing; poor fishing practices (for example, shark finning); oil and gas development; plastic pollution; vessel- and land-based marine pollution; and coastal urban development. The cumulative effects of these biophysical stressors include regime shifts that compromise ecosystem services essential for human flourishing. This is evident in the collapse of important fisheries, such as the cod fishery in North Eastern America.³

Whilst understanding the precise cause and effect of the complex interactions is a major challenge, there is growing consensus that, with climate change, we risk events of this type at more frequent and larger scales.⁴ Climate change-related impacts are exacerbating these stressors and creating new risks. Human-induced climate change is a global, long-term and slow-moving biophysical change at a global level, with a range of both short- and long-term effects. These effects include direct alterations of the biophysical properties of oceans, such as uptake of heat and carbon dioxide in the oceans, and sea-level rise. The indirect consequences of

¹ United Nations, *Sustainable Development Goals: Oceans*, available at <https://www.un.org/sustainabledevelopment/oceans/> accessed 29 May 2020.

² United Nations, *Sustainable Development Goal 14*, available at <https://www.un.org/en/conf/ocean/background.shtml> accessed 29 May 2020.

³ KC Meng, KL Oremus and SD Gaines, 'New England Cod Collapse and the Climate' (2016) 11(7) *PLoS ONE* e0158487, <https://doi.org/10.1371/journal.pone.0158487>.

⁴ H-O Pörtner et al. (eds), *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (IPCC 2019).

such changes include: species redistribution driven by changing climatic suitability; increased severity of extreme weather events on coastal ecosystems and communities; and the loss of coastal blue carbon sinks. In the absence of mitigation measures, it is estimated that climate change will increase the financial cost of damage to the ocean by \$US322 billion per year by 2050.⁵ Some of the indirect biophysical effects will also prompt changes in human behaviour, such as greater competition for marine resources and conflict over changing geopolitical boundaries.

The intersection of oceans, coasts and climate change is acknowledged to be of global importance.⁶ The next ten years have been heralded in scientific assessments as a 'critical decade' for action on climate change and reversing declining trends in the health of the world's oceans.⁷ Achieving real progress towards this goal demands a combination of scientific, technological, social, economic and management interventions, which will require a strong legal and governance platform. Published in time for the commencement of the UN Decade of Ocean Science for Sustainable Development (2021–30), this collection offers new perspectives on how human systems of law and governance might build on knowledge generated from climate and ocean science in order 'to reverse the cycle of decline in ocean health and gather ocean stakeholders worldwide behind a common framework'.⁸

Traditionally governed as discrete regimes, the connectedness and mutual dependencies between oceans and climate change science are forcing scholars and policy-makers to recognize the linkages between oceans and climate change law. The past and current failure of climate change law to limit global warming to safe levels will likely spell significant change for many aspects of the world's oceans upon which humans have grown to rely. Similarly, weak and/or ineffective management regimes for marine and coastal resources, which fail to respond to the cumulative effects of the stressors mentioned above, render these areas more vulnerable to climate change impacts. Beyond oceans and climate law, the human cost of climate change impacts is also prompting human rights, security and disaster law scholars to argue for the relevance of these fields in debates over climate change and oceans governance.⁹

⁵ See, for example, the United Nations Sustainable Development Goals 13 and 14, available at <https://www.un.org/sustainabledevelopment/sustainable-development-goals/> accessed 7 October 2020.

⁶ UNESCO, *United Nations Decade of Ocean Science for Sustainable Development (2021–2030)*, <https://en.unesco.org/ocean-decade> accessed 29 May 2020.

⁷ 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* (IPCC 2018) (IPCC 1.5°C Report); V Ryabinin, J Barbière, P Haugan et al. (2019), 'The UN Decade of Ocean Science for Sustainable Development' (2019) 6(470) *Frontiers in Marine Science*, <https://doi.org/10.3389/fmars.2019.00470>.

⁸ UNESCO (n 6).

⁹ J McDonald and A Telesetsky, 'Disaster by Degrees: The Implications of the IPCC 1.5°C Report for Disaster Law' (2019) 1(1) *Yearbook of International Disaster Law* 179, <https://doi.org/10.1163/26662531-01001010>; See further: Anastasia Telesetsky, 'Climate

There is already diffuse literature on both oceans law and climate law.¹⁰ However, there remains a paucity of systematic analyses of the intersections between these two bodies of law and the legal issues arising from intersections between ocean issues and climate science. In some volumes – such as *The World Ocean in Globalisation* (2011)¹¹ and the *Oxford Handbook of the Law of the Sea* (2015)¹² – analysis of climate change and oceans issues features as a small part of a broader study of oceans governance. In others, which specifically address climate change interactions with oceans governance, the focus is on a narrower set of governance arrangements. For example, Craig’s *Comparative Ocean Governance* (2012)¹³ specifically focuses on the ways in which place-based marine governance might be adapted to climate change. Similarly, Purcell’s *Geographical Change and the Law of the Sea* (2020)¹⁴ examines how climate change and other biophysical processes impact on maritime delimitation issues. Gerrard and Wannier’s volume *Threatened Island Nations: Legal Implications of Rising Seas and a Changing Climate* (2013) focuses on the legal implications of sea-level rise for island nations. It presents a wider range of voices, particularly those with developing state concerns, but is more narrowly focused on the loss of territory and displacement of peoples.¹⁵

Only two volumes have sought to provide a broader mapping of the governance and legal dimensions of the interactions between climate change, oceans and coastal issues. Warner and Schofield’s volume on *Climate Change and the Oceans* (2013)¹⁶ covers the physical impacts, governance and regulatory frameworks and jurisdictional limits, with a focus on regional Asia-Pacific security, shipping and mitigation measures. Abate’s edited collection *Climate Change Impacts on Ocean and Coastal*

Change, Disaster Law, and Extreme Ocean and Coastal Events’ (ch 9, this volume); Amy Maguire, ‘Climate Change-Related Displacement of Coastal and Island Peoples: Human Rights Implications’ (ch 8, this volume); and Sam Bateman and Anthony Bergin, ‘Naval, National Security and Defence Issues from Climate Change’ (ch 22, this volume).

¹⁰ See, for example, A Boyle, ‘Climate Change, Ocean Governance and UNCLOS’ in J Barrett and R Barnes (eds), *Law of the Sea: UNCLOS as a Living Treaty* (BICCL 2016) 211; J Eagle and U Rashid Sumaila, ‘Climate, Oceans and the Law of Special and General Adaptation’ in CP Carlarne, KR Grey and R Tarasofsky (eds), *Oxford Handbook of International Climate Change Law* (OUP 2016); R Rayfuse, ‘Climate Change and the Law of the Sea’ in R Rayfuse and S Scott (eds), *International Law in the Era of Climate Change* (Edward Elgar 2012) 147; C Redgwell, ‘UNCLOS and Climate Change’ (2012) 106 *ASIL Proceedings* 406; J McAdam, *Climate Change, Forced Migration, and International Law* (OUP 2012).

¹¹ D Vidas and JP Schei (eds), *The World Ocean in Globalisation* (Martinus Nijhoff 2011).

¹² DR Rothwell, AO Elferink, KN Scott and T Stephens (eds), *Oxford Handbook of the Law of the Sea* (OUP 2015).

¹³ RK Craig, *Comparative Ocean Governance: Place-Based Protections in an Era of Climate Change* (Edward Elgar 2012).

¹⁴ KP Purcell, *Geographical Change and the Law of the Sea* (OUP 2020).

¹⁵ MB Gerrard and GE Wannier (eds), *Threatened Island Nations: Legal Implications of Rising Seas and a Changing Climate* (CUP 2013).

¹⁶ R Warner and C Schofield (eds), *Climate Change and the Oceans: Gauging the Legal and Policy Currents in the Asia Pacific and Beyond* (Edward Elgar 2012).

Law (2015)¹⁷ examines the legal dimensions of climate change on both oceans and coastal law, but from a pre-Paris Agreement perspective and with a strong focus on United States domestic law.

This volume extends the contribution of these other works directed towards the intersections of law, governance, climate change, oceans and coastal management in two key ways. First, it provides a broad, updated analysis of the national and international legal responses to the issues raised by climate change for oceans and coasts, addressing the implications of the 2015 Paris Agreement. Second, it provides new regional approaches to manage the impacts of climate change on species redistribution. This volume also presents a wider geographic scope of analysis and a plurality of voices, including contributors from Europe, Australasia, the Pacific, North America and Asia.

The contributions to this volume are organized into four parts. Part I of this volume is introductory and maps the current state of knowledge of climate change impacts on oceans and coasts along with projections of future impacts. In the following chapter, Hobday and Matear provide an essential scientific voice on climate change, oceans and coasts. Their overview of the physical, chemical and biological impacts of climate change on oceans explains the changes that have already been observed and recorded, as well as projections for future impacts.¹⁸ These interactions – as explained by Hobday and Matear – have been the subject of extensive research, as synthesized recently in the Intergovernmental Panel on Climate Change’s assessment reports,¹⁹ and Special Reports on 1.5°C Degrees,²⁰ Extreme Events²¹ and Oceans and Cryosphere.²² The world’s oceans have absorbed over 90 per cent of the excess heat caused by greenhouse gas emissions since the 1970s. While this has helped slow or stabilize atmospheric change, it is producing profound impacts in the marine environment. Ocean temperatures are increasing: the ocean was warmer in 2019 than it had even been.²³ Ocean warming is driving a range of direct physical impacts, including increases in the intensity of extreme events, such as hurricanes, typhoons and cyclones, storm surges, marine heatwaves, anoxic events and upwelling of acidified

¹⁷ R Abate (ed), *Climate Change Impacts on Ocean and Coastal Law: United States and International Perspectives* (OUP 2015).

¹⁸ Alistair J Hobday and Richard J Matear, ‘The Impact of Climate Change on Oceans: Physical, Chemical and Biological Responses’ (ch 2, this volume).

¹⁹ C Field et al., ‘Technical Summary’ in C Field et al., *Climate Change 2014: Impacts, Adaptation, and Vulnerability – Part A: Global and Sectoral Aspects – Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC 2014), Table TS.3 59–60.

²⁰ Masson-Delmotte et al. (n 7).

²¹ IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change* (CUP 2012) 269.

²² Pörtner et al. (n 4).

²³ L Cheng, J Abraham, J Zhu et al., ‘Record-Setting Ocean Warmth Continued in 2019’ (2020) 37 *Advances in Atmospheric Sciences* 137, <https://doi.org/10.1007/s00376-020-9283-7>.

water.²⁴ Marine heatwaves affect ocean biological productivity and can result in catastrophic losses of some sensitive ecosystems, such as kelp forests and coral reefs.²⁵ Warming of the oceans is also driving slow-onset events like rising sea levels²⁶ and the melting of polar ice.²⁷ Rising sea levels – alone and in combination with more severe storms – jeopardize the habitability of heavily urbanized coastal communities, the integrity of coastal infrastructure, the viability of coastal industries and the health of coastal ecosystems.²⁸ The melting of polar ice is opening up new potential for shipping (in the Arctic), as well as the exploitation of oil and gas deposits and living marine resources, such as finfish and krill (in the Antarctic).

Warmer oceans are also shifting the distribution and abundance of marine species,²⁹ contributing to the spread of marine invasive species.³⁰ The range of some warm-water species is extending polewards, while cold-adapted species are contracting to deeper and more poleward range limits. These species redistributions will further test the adaptability and equity of current legal and governance arrangements. Important habitat-forming species, such as coral reefs, mangroves, seagrass meadows and kelp forests, are in global decline.³¹ Aside from the impacts of ocean

²⁴ See, for example, Field et al. (n 19); IPCC (n 21); O Bellprat et al., 'Towards Reliable Extreme Weather and Climate Event Attribution' (2019) 10 *Nature Communications* 1732, <https://doi.org/10.1038/s41467-019-09729-2>; W Cai et al., 'Increased Frequency of Extreme La Niña Events under Greenhouse Warming' (2015) 5 *Nature Climate Change* 132, <https://doi.org/10.1038/nclimate2492>.

²⁵ L Rogers-Bennett and CA Catton, 'Marine Heatwave and Multiple Stressors Tip Bull Kelp Forest to Sea Urchin Barrens' (2019) 9 *Scientific Reports* 15050, <https://doi.org/10.1038/s41598-019-51114-y>; T Hughes, J Kerry, M Álvarez-Noriega et al., 'Global Warming and Recurrent Mass Bleaching of Corals' (2017) 543 *Nature* 373; ECJ Oliver, MT Burrows, MG Donat et al., 'Projected Marine Heatwaves in the 21st Century and the Potential for Ecological Impact' (2019) 6 *Frontiers in Marine Science* 734, <https://doi.org/10.3389/fmars.2019.00734>; E Oliver et al., 'Longer and More Frequent Marine Heatwaves over the Past Century' (2018) 9 *Nature Communication* 1324, <https://doi.org/10.1038/s41467-018-03732-9>; DA Smale et al., 'Marine Heatwaves Threaten Global Biodiversity and the Provision of Ecosystem Services' (2019) 9 *Nature Climate Change* 306, <https://doi.org/10.1038/s41558-019-0412-1>.

²⁶ CM Domingues et al., 'Improved Estimates of Upper-Ocean Warming and Multi-Decadal Sea-Level Rise' (2008) 453 *Nature* 1090, <https://doi.org/10.1038/nature07080>.

²⁷ Arctic Climate Impact Assessment, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment* (CUP 2004) 184; J Lee, B Raymond, T Bracegirdle et al., 'Climate Change Drives Expansion of Antarctic Ice-Free Habitat' (2017) 547 *Nature* 49.

²⁸ B Azevedo de Almeida and A Mostafavi, 'Resilience of Infrastructure Systems to Sea-Level Rise in Coastal Areas: Impacts, Adaptation Measures, and Implementation Challenges' (2016) 8 *Sustainability* 1115.

²⁹ G Pecl et al., 'Biodiversity Redistribution under Climate Change: Impacts on Ecosystems and Human Well-Being' (2017) 355 *Science* eaai9214, <https://doi.org/10.1126/science.aai9214>.

³⁰ E Oliver et al., 'The Unprecedented 2015/16 Tasman Sea Marine Heatwave' (2017) 8 *Nature Communications* 16101, <https://doi.org/10.1038/ncomms16101>; Smale et al. (n 25).

³¹ On kelp, see, for example, N Arafeh-Dalmau et al., 'Extreme Marine Heatwaves Alter Kelp Forest Community Near Its Equatorward Distribution Limit' (2019) 6 *Frontiers in Marine Science* 499, <https://doi.org/10.3389/fmars.2019.00499>; on coral reefs, see T Hughes

warming, absorption of carbon dioxide is changing ocean chemistry, including increasing salinity, and lower pH and oxygen levels. The effects of acidifying ocean waters will be felt through the entire marine food chain, with potential effects upon various marine species, particularly those with calcium-based exoskeletons. Hobday and Matear make it clear that adverse impacts on human activities are inevitable and most of these changes are irreversible, at least within the next several hundred years. They therefore emphasize the importance of adapting the management of marine resources to these effects.

Part II of this volume examines the ways in which current ocean and coastal governance and legal arrangements can better account for new climate realities and the role of other bodies of international law. Starting with the foundational international law regime for the oceans, this part takes a holistic view of climate change implications for governance regimes, assessing the adaptive capacity of marine regimes and institutions under the law of the sea framework.

The voice of science resonates strongly in Freestone and McCreath's chapter, which takes as its starting point the scientific case that we are leaving the stable era of the Holocene and entering the unpredictable era of the Anthropocene.³² Accordingly, our legal and political institutions need to respond to both the profound and rapid nature of change in the physical condition of the oceans. Freestone and McCreath note that climate regimes, such as the United Nations Framework Convention on Climate Change (UNFCCC), have evolved slowly and that they lack a mandate to address oceans-specific challenges and adapting to climate change. However, climate regimes can be used to signal and drive the importance of adaptation in oceans regimes.³³ This requires a flexible, dynamic, multipronged approach, combining global and regional agreements with institutional support from multilateral financial institutions. This is necessary because there are gaps in the law of the sea. For example, the United Nations Convention on the Law of the Sea 1982 (UNCLOS) predates climate change understandings, and so lacks specific climate change objectives. Freestone and McCreath show how due diligence obligations to protect and preserve the marine environment and commitments to develop global and regional rules and standards to address, *inter alia*, atmospheric pollution, serve to reinforce commitments to reductions in greenhouse gas emissions (GHG). If we understand how regimes intersect, then we can better coordinate and optimize governance responses. This is important since the causes and impacts of climate change are not distributed evenly across the globe. This multipronged approach is necessary because we cannot simply reinvent oceans' governance institutions. A range of tools and techniques exists that can be mobilized to respond to climate change, either to mitigate climate change (for example, reduction of GHG from shipping or through ocean carbon

et al., 'Global Warming and Recurrent Mass Bleaching of Corals' (2017) 543 *Nature* 373, <https://doi.org/10.1038/nature21707>; on mangroves, see Pörtner et al. (n 4), 18.

³² David Freestone and Millicent McCreath, 'Climate Change, the Anthropocene and Ocean Law: Mapping the Issues' (ch 3, this volume).

³³ See Article 7 of the Paris Agreement.

sequestration) or adapt to its effects (for example, fixing baselines and stabilizing the extent of maritime zones in light of coastal erosion or loss). In an era of profound and rapid change, institutional responses in the law of the sea will involve mobilizing key synergies and complementarities between oceans and climate regimes.

The following chapter, by Hayashi, adopts a similar perspective in his assessment of the response of the law of the sea to the specific challenge of sea-level rise.³⁴ Hayashi notes that impacts are felt differently by states and that localized responses will be required. Some pioneering research on the impacts of climate change emerged in the early 1990s, but only recently has concerted effort been focused on understanding how the law of the sea can accommodate or respond to changes in coastal geography and the loss of territory through sea-level rise. One interesting point to draw from Hayashi's analysis is that, whilst states will drive the creation and implementation of any legal change on sea-level rise, much of the thinking in this area has been driven by the work of the International Law Association, which comprises a range of academic and legal practitioners, rather than state diplomats. Thus, responses to climate change are not always located within formal state institutions.

When considering how individual states can respond to the threat of sea-level rise, Hayashi notes that there are both practical legal and moral arguments in favour of stabilizing current baselines in measuring maritime zones. Unstable baselines generate wider uncertainty in the exercise of maritime jurisdiction. Stabilizing baselines could 'compensate' for the loss of land territory and would not unfairly deprive other states of their rights. Hayashi argues that, although individual states could adapt domestic laws, or enter into agreements with other states to secure their baselines, some wider recognition of this approach (for example, through new agreements, or an amendment of UNCLOS) would serve to legitimize practice. Also, where territorial changes from sea-level rise are more profound, such as to threaten the functional basis of the state, then cross-cutting, multi-institutional responses will be required.

Klein then examines the current capacity of the UNCLOS Dispute Settlement processes to address climate change issues.³⁵ It is not a new idea to use dispute settlement to address failures to mitigate climate change, the implications of sea-level rise for maritime boundaries, and the possible harm to the marine environment caused through mitigation efforts. The UNCLOS framework for compulsory arbitration or adjudication of disputes provides a valuable procedural avenue for handling climate change-related disputes, although no such claims have been pursued to date. Klein points to the recent lowering of procedural and substantive barriers to using UNCLOS dispute settlement to resolve climate change-related claims. But, while UNCLOS dispute settlement holds more promise than may previously have been the case, significant challenges remain. Klein ultimately asks whether UNCLOS dispute settlement is the right mechanism for promoting integration over fragmentation in

³⁴ Moritaka Hayashi, 'Sea-Level Rise and the Law of the Sea' (ch 4, this volume).

³⁵ Natalie Klein, 'Adapting UNCLOS Dispute Settlement to Address Climate Change' (ch 5, this volume).

regulatory approaches to climate change, or whether it is simply trying to ‘fit a square peg into a round hole’.

Takei next looks at the suitability of the international oceans regime to respond to the impacts of climate change on high seas fisheries.³⁶ He notes that existing international instruments relating to high seas fisheries contain scant mention of climate change impacts,³⁷ but the implementation of fisheries and climate change regimes has the potential to be mutually reinforcing. Protecting and preserving the marine environment will enhance the absorptive capacity of oceans as carbon sinks and thus advance the priorities of the Paris Agreement. Similarly, reaching the mitigation and adaptation objectives set out in the UNFCCC and the Paris Agreement is essential, not only for the protection of food security and livelihoods, but also for the effectiveness of conservation and management measures for living marine resources.³⁸ Takei maps the range of ways in which the international fisheries regime, comprising various regional organizations and agreements, might be adapted to account better for climate impacts. He notes that, despite these mutual benefits, existing international and regional instruments relating to high seas fisheries contain scant mention of climate change. Gaps in scientific knowledge and data remain a major challenge. The negotiations for a Biodiversity Beyond National Jurisdiction (BBNJ) Agreement under UNCLOS presents an important opportunity to address the issue of climate change in relation to marine biodiversity of areas beyond national jurisdiction in a cross-sectoral manner. Progress in adopting conservation and management measures to address climate change by Regional Fisheries Management Organizations established under the international framework is still limited. These bodies will need to respond to issues such as new fishing opportunities created by melting sea ice in areas where no agreement is in place or there are gaps in species coverage, and changing species distribution of target fish populations into or beyond the jurisdiction of specific management regimes. It remains to be seen how these and other processes will affect the existing international legal regime for high seas fisheries.

The fifth contribution to this part is Kopela’s analysis of the International Maritime Organization’s (IMO’s) new shipping measures to reduce GHG and their intersection with other areas of international law and policy, following the adoption of the Paris Agreement.³⁹ Kopela considers both binding commitments to enhance energy efficiency on ships and reduce GHG under MARPOL, as well as framework policy measures under the IMO Initial Strategy. The strategy was adopted in part to position the

³⁶ Yoshinobu Takei, ‘Climate Change and High Seas Fisheries’ (ch 6, this volume).

³⁷ A notable exception is the recently adopted Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean. See Section 5.3.1. Until recently, references to climate change and its impacts have been limited also in non-legally binding instruments. For example, the 1995 Code of Conduct for Responsible Fisheries only refers to climate change/climatic factors in the context of research. Articles 7.4 and 12.5.

³⁸ Pörtner et al. (n 4).

³⁹ Sophia Kopela, ‘Climate Change and the International Maritime Organization’ (ch 7, this volume).

IMO as the key regulator of GHG emission reduction in shipping. Kopela highlights that a key challenge at the intersection of shipping and climate regimes has been for the IMO to ensure standards common to all ships, in order to maintain a level playing field in shipping, yet also to implement the principle of common-but-differentiated responsibility under the UNFCCC regime. To an extent, this tension has been addressed through the inclusion of capacity building measures in IMO Resolutions, which now form an important element of the IMO's future work via the IMO Initial Strategy. However, there remains a lack of consensus on all elements of the strategy, such as how it relates to the IMO principles of non-discrimination and no more favourable treatment. The IMO Initial Strategy is important because it aligns the work of the IMO with the UN climate regime, incorporating ambitious targets for the phasing out of the GHG in shipping in the short term (that is, by 2023) and medium term (that is, by 2030). However, the IMO Initial Strategy is non-binding, so much will depend on how the IMO balances its climate ambitions with its role in securing maritime transport as a driver of global trade and development.

The last three contributions in this part argue for expanding the fields of law and governance through which we consider interactions between climate change, oceans and coasts. Maguire's chapter examines this imperative through the lens of forced human displacement from small island states and low-lying coastal areas caused by extreme events and slow-onset changes from sea-level rises.⁴⁰ Given the number of human rights at risk when vulnerable coastal and island populations face climate change induced displacements, she advocates for better integration of human rights principles into the bodies of law governing climate change mitigation and adaptation. This is an important perspective because the law of the sea has traditionally operated in isolation from wider human rights concerns. A more integrated approach will contribute to more coordinated and complementary solutions.

Telesetsky makes similar claims in respect of the capacity of existing disaster law to alleviate future human suffering and ecological damage in coastal zones.⁴¹ With two-thirds of coastal disasters associated with extreme weather events, coastal communities are highly exposed. Extreme events cannot be prevented, but law and policy may help reduce the exposure of many coastal communities and marine activities to future extremes. Disaster response professionals have recognized the need to adapt existing laws and governance practices to prepare for the anticipated impacts of climate change, but integrating disaster risk reduction with climate adaptation programmes has been limited. Telesetsky also advocates for international disaster law to inform the interpretation and application of UNCLOS and regional seas agreements for the management of coastal climate extremes. She evaluates regional disaster risk responses to protect against maritime disasters and argues for greater investment in disaster risk reduction for vulnerable coastal areas.

⁴⁰ Amy Maguire, 'Climate Change-Related Displacement of Coastal and Island Peoples: Human Rights Implications' (ch 8, this volume).

⁴¹ Anastasia Telesetsky, 'Climate Change, Disaster Law, and Extreme Ocean and Coastal Events' (ch 9, this volume).

The final chapter in Part II, by Papanicolopulu and Rocha, shifts the governance focus squarely onto the role of non-state actors in climate change and ocean affairs.⁴² They examine a range of international fora within which non-state actors can participate in the development and review of international law, as well as compliance with it. They find the scope for such participation to be context specific, as the inclusive approach to participation in, say, the UNFCCC conference of the parties process and the work of the IMO, shows. Different international institutions may be open to different categories of actor, whether civil society or industry representatives. However, treaty-making powers are held tightly in the hands of states, with non-state actors participating, at best, as observers or through lobbying activities. Non-state actors generally have no voting rights in international fora governing climate and oceans issues and therefore do not formally participate in the formation of treaties. The authors suggest that litigation presents a new opportunity for non-state actors to engage with climate issues, in particular by ensuring protection of the human rights of the individuals and groups affected by climate change. The findings of Papanicolopulu and Rocha are important in moving the lens of governance beyond state actors; they are also sobering in terms of pointing out the limits to their roles in key international fora on oceans and climate governance.

Together, the chapters in Part II underscore the need for international law and institutions to be capable of the adaptation and responsiveness that climate change impacts demand. They also show that, in many cases, this agility is a challenge to achieve in international institutions and processes. Just as the impacts of climate change are felt differently around the world, so must responses be tailored to regional or local needs and capacities. These findings point to an important role for lower-scale regional and multilateral arrangements, a theme which is taken up in Part III of this volume.

The chapters in Part III offer perspectives on how climate change issues are being addressed within select regional and multinational marine management frameworks. In this vein, Zou and Zhang examine the implications of climate change for governance of the East and South China Seas.⁴³ They argue that the unique geographic features and critical economic and geopolitical importance of these seas make an ideal case study of how the impacts of climate change might play out at a regional scale. The states adjacent to these seas have already taken steps to cooperate at bilateral, intra-regional and inter-regional levels, but, the authors conclude, this cooperation needs to be strengthened to achieve a balance between environmental concerns and economic development that is not tilted too much towards fast economic growth. Creative governance solutions will also be needed to solve maritime disputes that are likely to result from rising sea levels and to protect the marine environment and resources within disputed areas.

⁴² Irini Papanicolopulu and Armando Rocha, 'Oceans, Climate Change and Non-State Actors' (ch 10, this volume).

⁴³ Keyuan Zou and Lei Zhang, 'Handling Climate Change for the East and South China Seas' (ch 11, this volume).

Jabour and Haward look at the impacts of climate change on the Southern Ocean and Antarctica. The Southern Polar region is particularly exposed to climate change impacts, including loss of ice sheets in West Antarctica, which threaten significant global sea-level rise.⁴⁴ The importance of Antarctica and the Southern Ocean for the global climate system also makes the impact of climate change on the region a vital issue. Jabour and Haward examine the Antarctic Treaty System (ATS), which has historically been a successful governance system for the region. They find that, in conjunction with the Scientific Committee on Antarctic Research, the ATS plays an important role in facilitating the generation and dissemination of cutting-edge scientific knowledge on climate change. However, while the ATS has shown some success in reducing GHG in Antarctic scientific research activities (which are minor in global terms), it has had only very limited influence on the broader ambition and success of global emissions reduction.

Johansen and Henriksen focus on the Arctic. They argue that it is now crucial to ensure that the negative impacts of climate change are made as small as possible in the Arctic, and that new uses of the region (their main focus is shipping through ice-free sea areas) do not lead to additional stressors on the Arctic environment.⁴⁵ A legal framework that enables this must be flexible and responsive. They note that the Arctic Council has and will continue to play an important role in improving the knowledge basis for governance and for helping set the policy agenda. Marine protected areas can be important tools in developing protective measures, but these are not frequently used in the Arctic, since they may impinge on high seas freedoms. States, and particularly the IMO, have been key actors in developing responses, through the Polar Code on shipping. The Code is shown to be adaptive, but the process by which decisions on navigation have been reached suggests that decisions are unduly politicized, rather than being based on clear scientific evidence. This may be detrimental to the environment in the longer term.

The response of regional fisheries bodies to climate change is examined in the next two chapters. Techera provides an overview of the importance of fisheries to the diverse Indian Ocean region and the complex legal and institutional arrangements in place for this issue.⁴⁶ These include the five regional fishery bodies in the Indian Ocean, none of which covers the whole region. She observes that, as the mandate of regional fisheries bodies is the utilization of marine living resources, they have largely marginalized the impacts of climate change when adopting their conservation and management standards or recommendations. However, as Techera points out, there is greater scope for sharing fisheries catch data to better understand whether climate change is affecting fish stocks. This will require greater cooperation than

⁴⁴ Julia Jabour and Marcus Haward, 'The Southern Ocean and Changing Environmental Conditions: Antarctic Treaty System' (ch 12, this volume).

⁴⁵ Elise Johansen and Tore Henriksen, 'Climate Change and the Arctic: Adapting to Threats and Opportunities in Arctic Marine Waters' (ch 13, this volume).

⁴⁶ Erika Techera, 'International Law and Institutional Responses to Climate Change and Fisheries Management in the Indian Ocean' (ch 14, this volume).

presently exists between regional fisheries bodies in the area. Techera points to the importance of intra-regional organizations, such as the Indian Ocean Commission and Indian Ocean Rim Association for Regional Cooperation. By building partnerships with out-of-region institutions to secure funding and enhance capacity building of fisheries, these regional fisheries bodies can create additional pathways for climate change responses to filter down into lower-scale institutions within the Indian Ocean region.

The issue of how climate change is affecting the distribution and abundance of commercially valuable biodiversity is taken up by McDonald and Torrens in their examination of adaptation by Pacific regional fisheries management arrangements.⁴⁷ The bleak future for many peoples and nations dependent on range-shifting species demands strong diplomacy in support of collaborative governance models. The Pacific experience of cooperatively managing climate-sensitive shared fish stocks over the past 20 years provides a useful model for more effective, equitable and adaptive regional fisheries governance. They use the example of the Parties to the Nauru Agreement (PNA), whose vessel day system (VDS), adopted in order to deliver a more equitable distribution of income from tuna, can be adjusted to account for climate-driven range shifts and scaled up to regional governance bodies. Refinement of the PNA's vessel day scheme can form part of a region-wide response to tuna range-shifting, offering economic security to Pacific Island Countries and Territories, as climate change affects fisheries in their waters. Beyond 2100, however, significant range shifts may necessitate more radical measures, including tighter controls on total allowable catches and greater engagement with tuna management in the Eastern Pacific.

The remaining chapters in Part III examine the potential for specific mechanisms for ocean planning, management and governance to integrate climate change issues. Scott reflects on the capacity of integrated oceans management (IOM) – typically implemented at regional and national scales – to provide an appropriate management tool to respond to the impacts of climate change on ocean and coastal environments.⁴⁸ She highlights the features of IOM that make it well suited to ensuring that the linkages between climate change mitigation, impacts and adaptation are factored into marine planning and management. But, in surveying the current state of practice, Scott concludes that the promise of IOM has yet to be realized. Effective action on climate change and the oceans through IOM depends on meaningful incorporation of climate change considerations into IOM processes and tools and a genuine commitment to, and implementation of, IOM as an approach to oceans governance.

⁴⁷ Jan McDonald and Shannon Maree Torrens, 'Governing Pacific Fisheries under Climate Change' (ch 15, this volume).

⁴⁸ Karen N Scott, 'Integrated Oceans Management and Climate Change' (ch 16, this volume).

The contribution by Slater and MacDonald offers a detailed study to complement Scott's multilateral inquiry into the role of integrated management approaches.⁴⁹ Using Scotland's marine spatial planning (MSP) framework as a case study, they consider the potential for national MSP approaches to balance existing and new coastal and marine activities, and address both mitigation and adaptation priorities and the sustainability of the marine environment under climate change. Just as Scott concludes that weak implementation constitutes the biggest obstacle to realizing the potential for IOM, so Slater and MacDonald note the slow progress on completing regional marine plans. Aside from legislative and policy complexity, the authors note the difficulty of ensuring that land-based planning processes 'talk' to marine planning initiatives, and the critical importance of strong relationships between the agencies and actors responsible for climate change mitigation and adaptation, as well as those governing coastal and marine activities, resources and protections.

The chapters in Part IV examine the ways in which law and governance can adapt to some specific climate impacts. With a focus on adaptation, the jurisdictional lens and scale of each chapter is necessarily varied according to the scope and nature of the climate impact and the capacity of law to govern interventions. Makomere and McDonald's examination of responses to the climate change-related problem of ocean acidification starts with the premise that acidification trends are largely irreversible over the next several centuries.⁵⁰ It therefore explores what options are available to reduce the ecological and socio-economic impacts of ocean acidification. These options include reducing non-climate-change sources of pollution that contribute to acidification, enhancing the ecological resilience of sensitive ecosystems by removing other non-climate stressors, and human interventions to alter ocean chemistry. A single, unified framework for ocean acidification is unlikely to meet the needs of place-based industries and contexts. Each element of this mosaic of strategies involves a different set of environmental laws, ranging from local, municipal-level stormwater and pollution control laws through to local, national and international biodiversity conservation laws and international law on ocean dumping. The challenge will be to ensure that the combined effect of these arrangements at various scales enhances the resilience of ecosystems that are sensitive to ocean acidification and enables dependent industries to minimise adverse impacts.

The impacts on coastal communities of sea-level rise and more intense coastal storms, and the potential for coastal planning to adapt to these impacts, has been extensively studied elsewhere.⁵¹ There are common themes in the literature about the limitations of 'protect and defend' engineered solutions over the longer term,

⁴⁹ Anne-Michelle Slater and Alison MacDonald, 'Marine Spatial Planning and Climate Change: An Example from Scotland' (ch 17, this volume).

⁵⁰ Reuben Makomere and Jan McDonald, 'Responding to Ocean Acidification beyond Climate Governance' (ch 18, this volume).

⁵¹ See, for example, B Harman et al., 'Global Lessons for Adapting Coastal Communities to Protect against Storm Surge Inundation' (2015) 31 *Journal of Coastal Research* 790, 798; T Bonyhady, A Macintosh and J McDonald (eds), *Adaptation to Climate Change: Law*

and about the need for laws and policies to support strategies of retreat and accommodation.⁵² There is growing interest in the potential for coastal ecosystems, such as mangroves, saltmarsh and seagrass, to provide protection from coastal hazards and to form the basis for ecosystem-based adaptation (EBA).⁵³ This potential is currently hampered by a lack of recognition of coastal ecosystem services in coastal planning policies around the world, which results in other forms of adaptation receiving higher prioritization. In her contribution, Bell-James examines case studies of EBA from the United States and Australia and makes recommendations for incorporating EBA into coastal climate change adaptation laws and policies.⁵⁴

Bai and Cheng examine the implications of climate change for China's domestic biosecurity laws.⁵⁵ They outline the extensive layers of domestic law and policy in China relating to management of the problem of marine invasive species, illustrating the functional separation within Chinese domestic governance institutions between marine invasive species and climate change. This means that the role of climate change as a driver of increased marine invasive species is yet to be addressed. Bai and Cheng's study provides an important illustration of the importance of avoiding functional separation between laws on climate change and wider environmental laws. It is an illustration of the need for better integration of climate change-related issues in a domestic governance context, by building institutional linkages across the legal regimes tasked with responding to climate change and other environmental problems that may be exacerbated by it.

The next two chapters explore the issue of security and climate change. Warner and Kaye examine the impact of climate change upon maritime security in the oceans of the Asia-Pacific.⁵⁶ Climate change might be viewed as a 'threat multiplier' of global and regional insecurity drivers, including overfishing, poverty, social fragility and transnational crime. These include the human security issue of people displacement from climate change impacts and the exacerbation of existing maritime disputes from physical alterations to coastlines and inundation of small islands. This multiplier

and Policy (Federation Press 2010); A Hurlimann et al., 'Urban Planning and Sustainable Adaptation to Sea-Level Rise' (2014) 126 *Landscape and Urban Planning* 84.

⁵² JN Kittinger and AL Ayers, 'Shoreline Armoring, Risk Management and Coastal Resilience under Rising Seas' (2010) 38(6) *Coastal Management* 634; S Temmerman et al., 'Ecosystem-Based Coastal Defence in the Face of Global Change' (2013) 504 *Nature* 79.

⁵³ Temmerman et al. (n 52); RL Morris et al., 'From Grey to Green: Efficacy of Eco-Engineering Solutions for Nature-Based Coastal Defence' (2018) 24 *Global Change Biology* 1827; KL Leo et al., 'Coastal Habitat Squeeze: A Review of Adaptation Solutions for Saltmarsh, Mangrove and Beach Habitats' (2019) 175 *Ocean and Coastal Management* 180, 181–3.

⁵⁴ Justine Bell-James, 'Ecosystem-Based Adaptation in Coastal Areas: Lessons from Selected Case Studies' (ch 19, this volume).

⁵⁵ Jiayu Bai and Jing Cheng, 'The Governance of Marine Invasive Alien Species and Climate Change in China' (ch 20, this volume).

⁵⁶ Robin Warner and Stuart Kaye, 'Shifting Currents: Climate Change and Maritime Security in the Asia Pacific' (ch 21, this volume).

effect reinforces Maguire's call for a more integrated approach.⁵⁷ Warner and Kaye suggest that multilateral collaboration is needed at many levels to effectively manage these threats to maritime security in the region.⁵⁸ The chapter discusses a variety of global and regional initiatives in the Asia-Pacific with the potential to mitigate the maritime security implications of climate change, including: transboundary marine environmental protection initiatives; fisheries conservation and sustainable use agreements; cooperative arrangements to combat transnational crime; and creative solutions to maritime disputes. The authors find that multilateral initiatives in place within the region are currently capable of tackling many of these issues but, with the forecast adverse impacts of climate change, collaborative initiatives to mitigate negative effects on food and human security, as well as the marine environment, will need to be reinforced and augmented at all levels.

Bateman and Bergin analyse the implications of climate change for national security and defence,⁵⁹ particularly the engagement of Australian governments. Aside from efforts to reduce GHG from defence operations, there has been a growing recognition in defence policy circles of the likelihood of increasing calls upon the military to provide increased humanitarian assistance and disaster relief, both domestically and in the region. For example, the Royal Australian Navy provided civilian evacuation and disaster relief on the New South Wales South Coast during extreme bushfires in early 2020. This will stretch the capacities of the defence forces unless properly resourced, and may detract from their primary war-fighting capabilities.

Bateman and Bergin also point to the potential for climate change to act as a 'threat multiplier', exacerbating other threats to national security by increasing the risks caused by pre-existing social, economic and/or political tensions in the region. They point out that factors such as overpopulation, poor governance, weak government institutions and poverty will be reinforced by more severe weather events and sea-level rise from climate change. Finally, they explain the significant likely impacts of climate change on defence infrastructure, activities and personnel through sea-level rise, extreme heat, storm surges and drought, and the effects this may have on operational readiness. They recommend that national security and defence policy continue to engage strongly with the issue of climate change and that regional cooperation on humanitarian assistance and disaster relief be strengthened to build the capacity of defence forces in the region.

Smith's chapter considers the impacts of climate change on marine biodiversity, and whether a global network of marine protected areas (MPAs) would be a valuable adaptation strategy to promote conservation.⁶⁰ She explains the recent history of the idea of protecting marine areas from fishing and other human activities, and shows

⁵⁷ Maguire (n 40) 168.

⁵⁸ Warner and Kaye (n 56) 393.

⁵⁹ Sam Bateman and Anthony Bergin, 'Naval, National Security and Defence Issues from Climate Change' (ch 22, this volume).

⁶⁰ Danielle Smith, 'A Global Network of MPAs: An Important Tool in Addressing Climate Change' (ch 23, this volume).

the important role that related multilateral initiatives can play in protecting marine biodiversity and marine resources from the negative impacts of climate change. Networks of MPAs are key to promoting ecological spatial connectivity, by protecting feeding, breeding and migration areas for transient species and buffering against the impacts of climate change. Smith highlights the importance of the high seas as an integral part of efforts to establish a global network of MPAs that can be used as a tool to reduce the impacts of climate change. She finds that the current negotiations towards an agreement on the Conservation and Sustainable Use of Marine Biological Diversity in Areas Beyond National Jurisdiction may provide an opportunity to better incorporate the high seas into a global network of MPAs.

While ocean ecosystems and coastal communities and industries are bearing the brunt of many climate change impacts, they can also contribute to solutions.⁶¹ The possibilities for marine renewable energy and the legal issues these give rise to have been canvassed elsewhere.⁶² The final part of the collection therefore contains two chapters that identify novel fields for law and governance relating to the role of the oceans in climate mitigation. In addition to reducing new GHG emissions, there is growing recognition that reducing current concentrations of atmospheric carbon dioxide by sequestering atmospheric carbon is essential to keeping global warming below 1.5°C above pre-industrial levels.⁶³

The chapters in Part V explore how we can innovate in our governance mechanisms to deliver marine-based climate mitigation. Brent's chapter argues that oceans play a critical role in addressing such 'negative emissions' strategies.⁶⁴ Ocean-based adaptation strategies can also minimize the severity and timing of climate change impacts.⁶⁵ More controversially, forms of localized marine solar radiation management, such as marine cloud brightening, might also offer short-term shielding from solar radiation, offering a modicum of protection for sensitive locations like coral reefs.⁶⁶ Brent outlines various key proposals for solar radiation management and carbon dioxide removal involving the oceans. Despite some work within the

⁶¹ O Hoegh-Guldberg et al., 'The Ocean as a Solution for Climate Change' (2010) 19 *Public Understanding of Science* 717; J Howard et al., 'Clarifying the Role of Coastal and Marine Systems in Climate Mitigation' (2017) 15 *Frontiers in Ecology and Environment* 42.

⁶² See D Leary and M Esteban, 'Climate Change and Renewable Energy from the Ocean and Tides: Calming the Sea of Regulatory Uncertainty' (2009) 24(4) *International Journal of Marine and Coastal Law* 617; M Gavounelli, 'Energy Installations and the Law of the Sea' in J Barrett and R Barnes (eds), *Law of the Sea: UNCLOS as a Living Treaty* (BIICL 2016); N Giannopoulos, 'Global Environmental Regulation of Offshore Energy Production: Searching for Legal Standards in Ocean Governance' (2019) 28(3) *RECIEL* 289.

⁶³ See J Rojerlj et al., 'Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development' in IPCC, *Special Report: Global Warming of 1.5°C* (IPCC 2019).

⁶⁴ Kerryn Brent, 'Marine Geoengineering Governance and the Importance of Compatibility with the Law of the Sea' (ch 24, this volume).

⁶⁵ SR Cooley et al., 'Overlooked Ocean Strategies to Address Climate Change' (2019) 59 *Global Environmental Change* 101968.

⁶⁶ J McDonald et al., 'Governing Geoengineering Research for the Great Barrier Reef' (2019) 19(7) *Climate Policy* 801, <https://doi.org/10.1080/14693062.2019.1592742>.

ocean dumping regime of the London Convention/London Protocol (LC/LP) to govern marine geoengineering, Brent argues that more governance is required to close spatial and jurisdictional gaps in coverage and allow for clearer ‘risk v risk trade-offs’ between climate change and the narrower goals of regimes such as the LC/LP. She argues that any further development of marine geoengineering governance must be compatible with obligations under UNCLOS to protect and preserve the marine environment and rights and obligations in high seas areas. Brent offers a way forward for better vertical institutional linkage of broad constitutional frameworks for ocean governance and narrower functional regimes.

Gogarty et al.’s chapter offers a new and provocative perspective on the potential for climate change impacts to create new opportunities for carbon sequestration.⁶⁷ They examine the need for governance of new benthic areas of blue carbon arising from melting Antarctic sea ice. As the ice around Antarctica’s coastlines retreats and collapses due to climate change, a vast ‘blue carbon’ (carbon captured and stored by marine ecosystems) sink in the form of living biomass is emerging. If properly promoted and protected, this Antarctic blue carbon sink promises to act as the world’s largest natural negative feedback on climate change, storing large amounts of carbon in the benthos of the ocean floor. This chapter explores how vertical institutional linkage between the ATS and the United Nations climate regime could be developed to account for the carbon sequestration potential of these benthic carbon reserves and provide a financial incentive for their protection. This might provide protection of a large carbon sink that can help offset emissions from other sources.

II IMPLICATIONS AND THEMES FOR MARINE AND COASTAL LAW AND GOVERNANCE UNDER CLIMATE CHANGE

When viewed as a whole, the contributions in this volume reveal some important overarching themes for the future of oceans, coastal and marine governance under climate change. These themes relate to the adequacy of current governance arrangements, the unique features of climate change impacts, and the types of response they require. While the contributions do not necessarily offer clear solutions to these thematic challenges, it is helpful to identify where obstacles are likely to arise. This, then, provides pathways for future research and practical responses.

⁶⁷ Brendan Gogarty et al., ‘Protecting Antarctica’s Coastal Blue Carbon: A Case for International Cooperation’ (ch 25, this volume).

The Problem of Functional and Jurisdictional Fragmentation of Oceans Governance

Several contributors to this collection highlight the fragmentation of ocean governance across jurisdictions and sectors. Fragmentation is not particular to the law of the sea,⁶⁸ but it appears to present a significant barrier to integrated governance. Jurisdictional fragmentation is manifest in spatial zoning approaches to specific rules, dispute settlement and institutional practices. Despite the integrative drive of UNCLOS, the United Nations Fish Stocks Agreement 1995 (UNFSA), the UN Sustainable Development Goals 13 and 14, and the broader situation of both climate and oceans law within the field of international law, there has nonetheless often been a sectoral approach to governance. Various sub-regimes have emerged, concerned with straddling and highly migratory fish stocks, marine pollution, shipping and biodiversity. The interplay between these sub-regimes is often contested. While there may be no formal articulation of hierarchy between them, the framework backed by the most powerful industries often prevails. Fragmentation will likely make efforts to develop solutions to complex and interlinked problems less efficient and less effective. In some frameworks, it will be virtually impossible to address the impacts of climate change on marine and coastal socioecological systems. While there is evidence of improved integration across oceans, climate and wider environmental concerns, and an evolving convergence with disaster law,⁶⁹ other spheres of law, such as human rights, remain on the periphery.

The corollary to the problem of legal and policy fragmentation is the observation that, while climate change impacts are significant in their own right, they are manifesting in a context of declining marine and coastal health due to other causes. In some cases, climate impacts are exacerbating other stressors, such as pollution, over-harvesting and coastal development. While sectoral fragmentation can be a problem from a governance perspective, it is imperative that we improve responses to these non-climate stressors at the same time as we seek to combat climate impacts. Some fora, such as regional fisheries management bodies, can account for certain of these cumulative or multifactorial issues when managing activities within their remit. However, an integrated, comprehensive response will require more systemic coordination and cooperation across institutions and regimes.

⁶⁸ See, for example, ILC Study Group on the Fragmentation of International Law, *Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law*, Report of the Study Group of the International Law Commission (2006), UN Doc A/CN.4/L.682 and Add.1 and Corr.1; M Young (ed), *Regime Interaction in International Law: Facing Fragmentation* (CUP 2012).

⁶⁹ J Peel and D Fisher, 'International Law at the Intersection of Environmental Protection and Disaster Risk Reduction' in J Peel and D Fisher (eds), *The Role of International Environmental Law in Disaster Risk Reduction* (Brill 2016) 1; J Peel, 'International Environmental Law and Climate Disasters' in R Lyster and R Verchick (eds), *Research Handbook on Climate Disaster Law* (Edward Elgar 2018) 77, 78.

IOM and MSP tools offer the best hope for overcoming fragmentation and responding to climate change mitigation and adaptation imperatives. As Scott shows, the key features of IOM – the use of ecosystem-based management, precaution, environmental impact assessment, and integration of institutions and planning processes – should overcome problems of dis-integration. Yet, her survey of current efforts at IOM, along with Slater and MacDonald's assessment of local implementation of MSP, shows just how difficult it can be to overcome jurisdictional hierarchies and sectoral power imbalances.

These issues are by no means unique to marine governance, but they are particularly acute in managing the global ocean commons due to coalitions built around historic freedoms of high seas areas (that is, fishing) and the vast geographic challenges these areas provide in policing the implementation of rules. The chapters in this volume suggest that there is no single 'silver bullet' solution to this problem. The best approach appears to be to integrate from above, where possible, through initiatives such as the BBNJ process under UNCLOS, but at the same time to work from below through local- and regional-scale integration that can augment, and assist in the implementation of these wider initiatives.

Although climate change is not the main focus of the BBNJ Agreement negotiations, its provisions on MSP, as well as the institutional structures it develops to accommodate different existing regimes, may enable cross-cutting approaches that respond to the consequences of climate change.⁷⁰ At the very least, it will enhance dialogue and common understanding of the risks, which, in turn, may result in the more ready formulation of policy and legal responses to climate change. As Kopela shows, encouragingly this cross-fertilization of ideas is already shaping IMO policy-making. The BBNJ negotiations show a strong desire among participating states to ensure that the new agreement 'should not undermine existing relevant legal instruments and frameworks and relevant global, regional and sectoral bodies'.⁷¹ Ensuring the opportunity and coordination of policy and regulatory efforts between existing institutions will therefore be critical moving forward.⁷²

The Scale and Timing of Climate Change Impacts

The issues of fragmentation and complexity are exacerbated by the multiple spatial, temporal and jurisdictional scales at which climate impacts manifest, and the ways in which those impacts will be experienced. Similarly, responses to climate impacts

⁷⁰ Freestone and McCreath (n 32) 79.

⁷¹ UNGA Res 72/249 on an International legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, UN Doc A/Res/72/249 19 January 2018, para 7.

⁷² See further R Barnes, 'Fisheries and ABNJ: Advancing and Enhancing Cooperation' in T Heidar (ed), *New Knowledge and Changing Circumstances in the Law of the Sea* (Brill 2020) ch 7.

also require actions at different scales. Mitigation efforts will contribute to managing global temperatures regardless of where they take place. Many mitigation measures will have a local origin since they are targeted at reducing the flow of heat-trapping gases into the atmosphere from activities mostly based within states. At the same time, since these efforts ultimately contribute to the common problem, governance might appropriately be targeted at the international scale. This is especially the case when implementation of blue carbon initiatives may affect the high seas, for example, by augmenting the rate at which carbon dioxide is absorbed through ocean fertilization. International governance of mitigation is also essential since the ability of states to contribute to mitigation measures varies considerably in practice. Thus, coordination is required to account for variations in capacity and equitable burden-sharing, as well as to evaluate the cumulative effect of such contributions.

Impacts, however, will not be distributed evenly across the world's oceans and coasts, with some areas recording faster rates of warming, sea-level rise and acidification. Meaningful adaptation actions will therefore need to occur at the local-to-regional scale. The role of laws and institutions for each of these adaptation interventions will vary. For example, ocean acidification is a very long-term global problem. Dealing with the cause of ocean acidification (that is, elevated carbon dioxide levels in the atmosphere) demands a coordinated global effort to achieve the overarching goal of global emissions reduction and large-scale carbon dioxide removal and sequestration.⁷³ In the meantime, Makomere and McDonald highlight the lower-scale adaptation options and responses that might be pursued to mitigate the worst effects of acidification where they are felt.⁷⁴ They point to local and national responses to ocean acidification which can target locations and industries that are especially sensitive to the problem, such as coral reefs and shellfish aquaculture. These location-specific responses include reducing localized sources of marine pollution and non-ocean acidification stressors (like fishing), and localized alterations to ocean chemistry through natural and artificial alkalization processes. Such interventions will likely be governed by national and subnational laws and governance, albeit with some international marine pollution and biodiversity treaties providing a background legal framework. This highlights the need for an ensemble of nested, multi-scalar legal and governance arrangements that match the type, scale and timing of impacts and responses.

Bell-James observes that varying coastal geographies will present different opportunities for adaptation measures due to the availability of natural protection against flooding or erosion, through, for example, mangroves or saltmarshes.⁷⁵ This can be accommodated in local planning schemes, but the risk is that local policies are not always in accordance with best practice (for example, favouring engineered solutions). Or, they lack coordination and so displace harm, rather than adapt to it.

⁷³ See Freestone and McCreath (n 32) 52.

⁷⁴ Makomere and McDonald (n 50) 333–7.

⁷⁵ Bell-James (n 54) 349.

This is echoed by Zou and Zhang, who note that East Asian states have developed national-level institutions, but gaps remain: ‘poor intersectoral coordination in disaster response; weak local-scale climate change information and education; low capacity in ocean observation and forecasting for early responses and assessment of impact of marine disasters; and lack of adequate funding’.⁷⁶ The challenge is to develop appropriate location-specific solutions. Bell-James argues that an ecosystem-based approach can be used to properly factor local natural conditions into adaptation measures and draw attention to the wider value of ecosystem services. This is time critical, since engineered solutions may render some ecosystem-based responses unfeasible. Further, governance challenges, such as effective engagement with multiple stakeholders, proper cost-benefit analyses and uncertain science, mean that there is considerable scope for policy learning in this area. There needs to be adaptiveness in climate change adaptation measures.

Mechanisms for Dealing with Trade-Offs

Climate change will create winners and losers, so governance responses must address distributive issues. Impacts on marine and coastal resources will be distributed unequally in a range of ways: spatially, across the globe (or even across regions); sectorally, across the range of marine and coastal resource industries; socio-economically, across marine-dependent communities; and temporally, over generations. Governance of marine and coastal resources and places will therefore involve prioritization of some interests over others. Developing innovative solutions may create win-win outcomes and thus reduce the need for trade-offs in some circumstances. Greater use of EBA, as Bell-James proposes, is a good example of an approach that can generate synergies and multiple benefits. Even this, however, involves a decision to use land for adaptation-oriented ecological restoration, which means limiting its availability for other human uses.

Prioritization of values and uses occurs implicitly already. As climate change impacts interact with other stressors on oceans and coasts, these trade-offs must be made more transparent and explicit. Decision tools and criteria can assist, but it is important that governance arrangements ensure that the process of prioritizing values occurs at a societal, not a technocratic, level. This is especially true when trading future interests against present values.

It is important to consider not just which trade-offs are to be made, but also where we make trade-off decisions. This is because different fora may be predisposed to certain outcomes, or are simply ill-equipped to deal with the full range of factors that need to be considered. Again, this suggests a combination of global and local responses. For example, the risk of submerging states generates acute problems of human displacement, environmental harm as oceans encroach on urban and industrial facilities, and structural challenges of handling the ‘death’ – or at least

⁷⁶ Zou and Zhang (n 43) 219.

de-territorialization – of states. These are not concerns specific to many, indeed, *any* fora.⁷⁷ Since oceans governance instruments (for example, UNCLOS or the LP) are generally created for a specific purpose unrelated to climate change, they contain no express forums for trade-offs between competing risks. There are few models to learn from. The shipping industry is dominated by developed states, advocated for by maritime powers, but often regulated through registries in developing economy states. If shipping is to help mitigate or adapt to climate change, the regulatory and economic burdens of this action may fall unevenly on states. This is a concern identified by Kopela, who notes that the emphasis on harmonized shipping standards may make it difficult to develop nuanced standards that respond to climate policy imperatives to take a common-but-differentiated response between developed and developing states. Since it is states that will determine how such trade-offs take place, there is a risk that powerful states may simply displace regulatory responsibilities, or the economic costs of adaptation, onto states least able to sustain them.

Now is the time for the many and various institutions that administer oceans governance instruments to consider how their regime can accommodate such trade-offs in the future. The uneven distribution of winners and losers suggests a greater need for place-based management and precautionary approaches that address inequity. Thus, McDonald and Torrens argue that a ‘vessel day system’ can ensure equitable distribution of the costs and benefits of spatial redistribution of tuna in the short term, but may need to be expanded over time to cover both Eastern and Western sides of the Pacific. The VDS used by the PNA represents an innovative way to integrate a wider range of factors into a single-issue regional framework focused on the allocation of tuna fishery entitlements in the Western Pacific. The VDS is accounting for the impacts of warming oceans on the range and abundance of target tuna species, and making trade-offs among existing beneficiaries of tuna stocks. Although the VDS does not address how to manage a long-term overall decline in stock across parties or away from PNA parties altogether, it provides a useful starting point for developing new trans-Pacific approaches.

In many cases, trade-offs occur between different uses of and interests in the marine environment, where choices must be made between costs to some interests and benefits to others. As the impacts of climate change worsen, trade-offs will increasingly be between different sets of risks, so governance is needed to choose between ‘the lesser of two evils’. To take one example, the risks to the marine environment posed by attempts to increase carbon sequestration (for example, through iron ocean fertilization) must be offset against the risks to the marine environment if climate change is not abated. Perhaps more controversial will be the choice between the risks of interventions aimed at short-term protection of marine systems through solar radiation management and the potential for catastrophic overshoot of the 1.5°C limit. These choices are more complex because the risks of geoengineering interventions may be felt well beyond the area such interventions seek to protect.

⁷⁷ Hayashi (n 34) 92.

This means that the publics which should have a voice in making these trade-offs are often located across regions and countries. While such trade-offs become more complex, and any corresponding accountability gets harder to ensure, the option of transnational systems of environmental impact assessment and engagement are not clearly contemplated in international law.⁷⁸ The debates concerning how strategic environmental impact assessment could be implemented in areas beyond national jurisdiction are indicative of the challenges in this respect.⁷⁹

Handling of Complexity of Climate Change, Social Drivers and Impacts

Given the observations above, it is almost trite to highlight the complexity of decision-making about oceans, coasts and climate change. Complexity and uncertainty pervade climate and ocean science.⁸⁰ These causal systems and interrelationships may or may not be captured and reflected in governance arrangements. Thus, Gogarty et al. note that the ‘history of Antarctic MPA negotiation suggests that its very nature as a complex marine ecosystem will act as a disincentive to its protection’.⁸¹ The ways that climate impacts manifest (differently in different parts of the world, with different socioeconomic consequences for marine-dependent human communities) is also profoundly complex. There is also an array of social drivers relating to climate mitigation, including: lock-in of the fossil fuel economy; economic growth; political power of fossil fuel interests; dominance of neoliberal political ideology in the West; rapid industrialization in China; increasing per capita consumption levels; and increasing population. While governance arrangements cannot eliminate complexity, there are ways they might better manage it, through enhanced transparency, coordination, consultation and explicit consideration of distributive impacts.

Incorporating Different Voices in Decision-Making

Opening decision-making processes and criteria to a wider range of perspectives and voices can contribute to better and more legitimate decisions. At its most basic, this means ensuring that the science of climate change impacts is brought into decision-making processes in current institutions responsible for marine and oceans governance. But science alone cannot resolve the distributional and equity implications of climate impacts. Only by including a wider range of voices – countries, cultures, disciplines, genders and generations – can this be achieved. Yet, this presents

⁷⁸ N Craik, *The International Law of Environmental Impact Assessment: Process, Substance and Integration* (CUP 2008).

⁷⁹ See M Doelle and G Sander, ‘Next Generation Environmental Assessment in the Emerging High Seas Regime? An Evaluation of the States of the Negotiations’ (2020) 35 *International Journal of Marine and Coastal Law* 498–532.

⁸⁰ See the comments by Hobday and Matear (n 18) 42, 47.

⁸¹ Gogarty et al. (n 67) 482.

considerable challenges for international legal institutions, which typically recognize only states as the formal subjects of international law. Even when scope is provided for other voices – non-state actors – to participate in decision-making, their voice may be impeded by weak or poorly implemented rules on the identity or standing of a group to participate.⁸² And participation may be vulnerable to dominance by powerful interest groups. This may require more creative approaches, such as the use of supra-national petitions that help articulate the complex geographies of peoples and entities affected by climate harms.⁸³ Or, as Maguire suggests, the use of human rights-based approaches.⁸⁴

Ensuring that these voices are heard will demand capacity building of local experts, through education, training and professional partnerships, to ensure they are equipped to engage in international and domestic fora. It also means building up strong relationships between different actors and complementing current reliance on Western modes of science with traditional knowledge systems. This might be difficult to achieve for large commercial resource sectors, such as industrial-scale fisheries with little or no history of artisanal exploitation. However, new mechanisms are needed to ensure that the voices (and choices) of affected coastal communities are heard. Domestic MSP regimes may provide exemplars, but even here there is still scope to enhance participation and develop better working relationships between different stakeholder groups.⁸⁵

III THE FUTURE OF CLIMATE AND OCEANS AND COASTAL GOVERNANCE

The COVID-19 pandemic of 2020 has caused dramatic social and economic shifts across the globe, many with direct implications for the governance of climate change, oceans and coasts.⁸⁶ Long after the pandemic crisis abates, however, climate change will continue to pose an existential threat to life on Earth. Despite the importance of the international community achieving the goal of limiting warming to 1.5°C, the prospects of success are rapidly declining. The enormity of the systemic social and economic shifts needed to achieve emissions reductions/sequestration and the short timeframe in which they are needed are unprecedented.⁸⁷ As the contributions that follow demonstrate, they require greatly strengthened multilevel governance that encompasses multiple actors – both state and non-state. The international commitment, cooperation and governance framework needed to achieve such monumental

⁸² Papanicolopulu and Rocha (n 42).

⁸³ Ibid 198–9.

⁸⁴ Maguire (n 40).

⁸⁵ Slater and MacDonald (n 49) 326–7.

⁸⁶ Jan McDonald, Jeffrey McGee and Richard Barnes, ‘Postscript: Governance for Climate Change, Oceans and Coasts in a Post-COVID-19 World’ (ch 26, this volume).

⁸⁷ Masson-Delmotte et al. (n 7), 95, 172.

transformations are lacking.⁸⁸ This is clearly evident in the current architecture of international oceans governance – a framework that barely addresses climate realities, let alone prioritizes it as the most significant threat of our age.

As our understanding of the challenges evolves, so, too, must our governance institutions. This means retaining a focus on knowledge-based approaches and ensuring there are feedback mechanisms that enable us to assess progress and adapt accordingly.⁸⁹

⁸⁸ Ibid 352–7.

⁸⁹ See Johansen and Henriksen (n 45) 257.