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Southern Ocean Acidification and the Antarctic Treaty System

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Abstract

This chapter explores how states party to Antarctic Treaty System instruments have addressed ocean acidification in the Southern Ocean. While there are no obligations explicitly applicable to ocean acidification, states should address the threat as part of their obligations to comprehensively protect Antarctica and its dependent and associated ecosystems, and to apply an ecosystem approach to managing Southern Ocean fisheries. The Chapter provides a critical overview of ATS initiatives to date to develop a strategic policy approach to climate change, noting the significant resistance from states to developing substantive obligations within the ATS in respect of activities taking place outside of the Antarctic Treaty area. It concludes by arguing that Article 2 of the 1991 Environmental Protocol can be interpreted to impose a due diligence obligations on parties to take action to address the causes of ocean acidification in respect of activities outside of the Antarctic Treaty area.

Keywords

Antarctic Treaty System, CCAMLR, ecosystem, due diligence, ocean acidification

1. Introduction

Ocean acidification constitutes one of the greatest threats to the Southern Ocean together with the impacts of climate change, in particular, an increase in ocean temperatures.[1] While there is no regional seas regime per se that covers the Southern Ocean, the region is subject to broadly equivalent obligations relating to fisheries management and pollution under the Antarctic Treaty System (ATS). The ATS is characterised as prioritising the strict environmental protection of Antarctica and its surrounding ocean and, through fisheries management in particular, has adopted a robust ecosystem-based approach to conservation of Southern Ocean marine resources. Moreover, as the location that has generated much of our knowledge about climate change as well as its particular vulnerability to the impacts of climate change, Antarctica and the Southern Ocean has become synonymous *with* climate change. One author has memorably described Antarctica as '*Terra clima*, a place irresistibly about climate change.'[2] It is therefore a paradox that state parties to the various instruments that constitute the ATS have been reluctant to engage with climate change on a policy and management level within the ATS. Measures taken to date, which directly seek to address issues of climate change mitigation and adaptation are unambitious and fail to reflect the urgency of the threat to Antarctica and the Southern Ocean. Moreover, ocean acidification, relative to climate change, is barely addressed within the ATS, mirroring its lesser, 'Cinderella' role at the global level.

[1] For an overview of the impacts of climate change and ocean acidification on the Antarctic and its surrounding seas see M. Meredith, M. Sommerkorn, S. Cassotta et al., 'Polar Regions' in In *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (eds. H. O. Pörtner, D. C. Roberts, V. Masson-Delmotte et al.) (2019) and SCAR, *Antarctic Climate Change and the Environment Report* (2009), p. 286 available at https://www.scar.org/policy/acce-updates/ [hereinafter, ACCE Report]. The latter is regularly updated and updates can be found on the SCAR webpage at: https://www.scar.org/science/acce/home/.

[2] Jessica O'Reilly, 'Antarctic climate futures: how *Terra incognita* becomes *Terra clima*' (2013) 3 *The Polar Journal* 384, 385.

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This Chapter explores the potential applicability of key Antarctic instruments to Southern Ocean acidification, namely, the 1991 Environmental Protocol to the 1959 Antarctic Treaty[3] and the 1980 Convention for the Conservation of Antarctic Marine Living Resources (CAMLR Convention).[4] It argues that while ocean acidification is naturally not subject to specific obligations under either instrument, both are broad enough to require states to address it as part of their obligations to comprehensively protect Antarctica and its dependent and associated ecosystems,[5] and to apply an ecosystem approach to managing Southern Ocean fisheries.[6] The Chapter provides a critical overview of ATS initiatives to date to develop a strategic policy approach to climate change, noting the significant resistance from states to developing substantive obligations within the ATS in respect of activities taking place *outside* of the Antarctic Treaty area. Building on earlier research where this author has argued that a due diligence obligation to address ocean acidification can be found under the law of the sea,[7] this Chapter concludes by arguing that a similar obligation can be read into Article 2 of the 1991 Environmental Protocol. States party to the 1959 Antarctic Treaty[8] and its associated instruments hold themselves out as guardians of Antarctica for the benefit of humankind as a whole.[9] These same states constitute the greatest emitters of greenhouses gases by volume and per capita, and it is acknowledged that the cause of ocean acidification is an excess of carbon dioxide (CO_2) in the atmosphere drawn down into the oceans.[10] How can ATS parties be regarded as fulfilling their obligation to protect the fragile Antarctic and Southern Ocean environment where their activities outside of the Antarctic constitute the greatest threat to region? Applying a teleological or objects and purposes approach to treaty interpretation, Article 2 of the 1991 Environmental Protocol cannot be limited to the regulation of activities *within* the Antarctic Treaty area, if it genuinely seeks to comprehensively protect the Antarctic and Southern Ocean ecosystem.

2. Ocean Acidification and the Southern Ocean

Until the onset of the Industrial Revolution in the eighteenth century, ocean pH was remarkably stable, at approximately 8.2 for over 800,000 years.[11] Over the last 200 years, ocean pH has decreased by 0.1 pH units,[12] the equivalent of an increase in ocean acidity of about 30 percent.[13] Ocean acidification is caused by an excess of carbon dioxide (CO_2) in the atmosphere, subsequently absorbed by the oceans.[14] The oceans are the most important sink for CO_2, storing approximately half of all anthropogenic fossil fuel emissions since the beginning of the Industrial

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[3] Protocol on Environmental Protection to the 1959 Antarctic Treaty, adopted 4 October 1991, entered into force 14 January 1998, 2941 UNTS 3 [Environmental Protocol].
[4] Convention on the Conservation of Antarctic Marine Living Resources, adopted 20 May 1980, entered into force 7 April 1982, 1329 UNTS 48 [CAMLR Convention].
[5] 1991 Environmental Protocol, Art 2.
[6] 1980 CAMLR Convention, Art II.
[7] Karen N. Scott, 'Ocean Acidification: A Due Diligence Obligation under the LOSC?' (2020) 35 *International Journal of Marine and Coastal Law* 382.
[8] Antarctic Treaty, adopted 1 December 1959, entered into force 23 June 1961, 402 UNTS 71.
[9] 1959 Antarctic Treaty, preamble; 1991 Environmental Protocol, preamble.
[10] Scott C Doney, Victoria J Fabry, Richard A Feely et al., 'Ocean Acidification: The Other CO_2 Problem' (2009) 1 *Annual Review of Marine Science* 169, 170.
[11] C Turley and J Gattuso, 'Future biological and ecosystem impacts of ocean acidification and their socioeconomic-policy implications' (2012) 4 *Current Opinion in Environmental Sustainability* 278, 278.
[12] V Rérolle, C Floquet, M Mowlem, 'Seawater-pH measurements for ocean-acidification observations' (2012) 40 *Trends in Analytical Chemistry* 146, 146.
[13] S Dupont and H Pörner, 'A snapshot of ocean acidification research' (2013) 160 *Mar. Biol.* 1765, 1765.
[14] Scott C Doney, Victoria J Fabry, Richard A Feely et al., note 10.

Revolution.[15] A decrease in ocean pH causes a decrease in the saturation of calcium carbonate ($CaCO_3$) in seawater, and $CaCO_3$ is the principal compound in the shells and skeletons of many marine species.[16] Species most at risk from ocean acidification are calcifying organisms such as pteropods,[17] shelled molluscs[18] and coral reef ecosystems.[19] It is predicted that without a significant decrease in the emission of CO_2 (and other greenhouse gases) ocean pH could decrease to between 7.9 and 7.7 by 2100.[20]

The Southern Ocean 'with its energetic interactions between the atmosphere, ocean and sea ice, plays a critical role in ventilating the global oceans and regulating the climate system through the uptake and storage of heat, freshwater and atmospheric CO_2'.[21] Despite covering less than 25 percent of ocean area, it absorbs more than 40 percent of annual mean CO_2 emissions[22] and, between 1970 and 2017, accounted for 35 – 43 percent of the global heat gain in the upper 2000 m region of the ocean.[23] However, warming of the Southern Ocean, together with an increase in the influx of fresh water from melting ice and glaciers, will, in fact, reduce its ability to absorb CO_2.[24] It is estimated that Antarctica and the Southern Ocean has warmed twice as much as the global average since 1850[25] and the amount of ice lost annually from the Antarctic ice sheet increased at least six-fold between 1979 and 2017.[26]

The upper Southern Ocean is currently 'supersaturated with respect to aragonite (used by important grazers like pteropods), and calcite (used by coccolithophores).'[27] But, as the Southern Oceans becomes more acidic and the 'saturation state changes from super- to under-saturated… with respect to either aragonite or calcite it will no longer be possible for marine organisms to use these compounds to build calcium carbonate shells.'[28] The Intergovernmental Panel on Climate Change (IPCC) has predicted that it is 'very likely that both the Southern Ocean and the Arctic ocean will experience year-round conditions of surface water undersaturation for mineral forms of calcium carbonate by 2100.'[29] However, the fact that CO_2 is more easily absorbed at low water

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[15] *The First Global Integrated Marine Assessment (World Ocean Assessment I) by the Group of Experts of the Regular Process under the auspices of the United Nations General Assembly and its Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects* (2016) available at: http://www.un.org/Depts/los/global_reporting/WOA_RegProcess.htm ch 5, 17.

[16] B. Hönisch, A. Ridgwell, D. Schmidt et al., 'The Geological Record of Ocean Acidification' (2012) 335 *Science* 1058 – 1063, 1059.

[17] James C Orr, Victoria J Fabry, O Aumont et al., 'Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms' (2005) 437 *Nature* 681; Nina Bednaršek, Chris Harvey, Isaac Kaplan et al., 'Pteropods on the edge: Cumulative effects of ocean acidification, warming, and deoxygenation' (2016) 145 *Progress in Oceanography* 1.

[18] Julia Ekstrom, Lisa Suatoni, Sarah Cooley et al., 'Vulnerability and adaptation of US shellfisheries to ocean acidification' (March 2015) 5 *Nature Climate Change* 207.

[19] O Hoegh-Guldberg, P J Mumby, A J Hooten et al., 'Coral Reefs Under Rapid Climate Change and Ocean Acidification' (2007) 318 *Science* 1737. For example, calcification of the Great Barrier Reef has decreased by around 21 percent between 1988 and 2003. See Scott C Doney, Victoria J Fabry, Richard A Feely et al., note 10, 175.

[20] C Turley and J Gattuso, note 11, 278.

[21] SCAR, ACCE Report, note 1.

[22] Ibid, 293.

[23] M. Meredith, M. Sommerkorn, S. Cassotta et al., note 1, 205. It is estimated that this increased to between 45 – 62 percent for the years 2005 to 2017.

[24] ACCE Report, note 1, 351

[25] Martin Siegert, Angus Atkinson, Alison Banwell et al., 'The Antarctic Peninsula Under a 1.5^{0}C Global Warming Scenario' 7 (June 2019) *Frontiers in Environmental Science* Article 102, 4. See also John Turner, Nicholas E. Barrand, Thomas J. Bracegirdle et al., 'Antarctic climate change and the environment: an update' (2014) 50 *Polar Record* 237.

[26] ATCM IP 136, *Antarctic Climate Change and the Environment – 2019 Update* (submitted by SCAR to XLII ATCM, Prague, 2019), 3.

[27] ACCE Report, note 1, 353

[28] Ibid.

[29] M. Meredith, M. Sommerkorn, S. Cassotta et al., note 1, 207

temperatures[30] may mean that seasonal aragonite undersaturation in surface waters may occur as early as 2030.[31]

Recent studies focusing on coastal waters off Antarctica indicate that ocean acidification may have a detrimental effect on primary production and on microbial communities.[32] In particular, 'Southern Ocean diatoms are more sensitive to ocean acidification and changes in irradiance than the prymnesiophyte *phaeocystis antarctica*, which may have implications for biogeochemical cycling because diatoms and rymnesiophytes are generally considered key drivers of these cycles.'[33] Pteropods have been found to be vulnerable to ocean acidification and 'new evidence indicates that eggs released at high CO_2 concentrations lack resilience to ocean acidification in the Scotia Sea region.'[34] However, experiments suggest that sea ice algae may be tolerant to ocean acidification.[35] In a recent paper published in *Nature Climate Change*, the authors concluded that 'Southern Ocean acidification-sensitive organisms will experience a sudden decrease in volume of their suitable habitat, including shelled pteropods, foraminifers, cold-water corals, sea urchins, molluscs and coralline algae.'[36] The rapid acidification of the Southern Ocean[37] will create significant challenges for species that have low energetic and cost adaptations in order to allow them to survive at low temperatures but which reduces their capacity to adapt to fast-changing environmental conditions.[38] Moreover, ocean acidification is one of a number of threats to Southern Ocean ecosystems, including ocean warming, which has particular implications for krill, the basis of the Antarctic pelagic food chain,[39] and (over) fishing.[40]

3. Ocean Acidification and the Antarctic Treaty System

The Antarctic Treaty System (ATS) comprises the 1959 Antarctic Treaty, the 1991 Environmental Protocol to the Antarctic Treaty, the 1980 Convention for the Conservation of Antarctic Marine Living Resources (CAMLR Convention) as well as measures in force under those instruments.[41] The Antarctic Treaty and Environmental Protocol apply to the area south of 60° South Latitude, which includes parts of the Southern Ocean.[42] Although Article VI of the Antarctic Treaty preserves the high seas rights of all parties to the Treaty, the parties have

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[30] G. G. Tarling, V. Peck, P. Ward et al, 'Effects of acute ocean acidification on spatially-diverse polar pelagic foodwebs: Insights from on-deck microcosms' (2016) 127 *Deep-Sea Research II* 75, 76.
[31] Claudine Hauri, Tobias Friedrich and Azel Timmermann, 'Abrupt onset and prolongation of aragonite undersaturation events in the Southern Ocean' (February 2016) 6 *Nature Climate Change* 172, 172.
[32] M. Meredith, M. Sommerkorn, S. Cassotta et al., note 1, 230.
[33] Ibid.
[34] Ibid, 231.
[35] Ibid, 230.
[36] Gabriela Negrete-García, Nicole S. Lovenduski, Claudine Hauri et al., 'Sudden emergence of a shallow aragonite saturation horizon in the Southern Ocean' (April 2019) 9 *Nature Climate Change* 313, 316 (references omitted).
[37] It is predicted that aragonite undersaturation events will start around 2030 and 'spread rapidly, affecting [around] 30 % of Southern Ocean surface waters by 2060 and [more than] 70 % by 2100'. See Claudine Hauri, Tobias Friedrich and Azel Timmermann, note 31, 172.
[38] P. Thor, A. Bailey, C. Halsband et al, 'Seawater pH Predicted for the Year 2100 Affects the Metabolic Response to Feeding in Copepodites of the Arctic Copepod *calanus glacialis*' (December 19, 2016) *POLS ONE* DOI:10.1371/journal.pone.0168735; P. Matson, T. Martz and G. Hofmann, 'High-frequency observations of pH under the Antarctic sea ice in the southern Ross Sea' (2011) 23 *Antarctic Science* 607, 612.
[39] It is predicted that krill distribution will move south, and ocean warming may even affect krill growth rates. See ATCM IP 136, *Antarctic Climate Change and the Environment – 2019 Update* (submitted by SCAR to XLII ATCM, Prague, 2019), 7. See also M. Meredith, M. Sommerkorn, S. Cassotta et al., note 1, 205.
[40] See generally, David G. Ainley and Daniel Pauly, 'Fishing down the food web of the Antarctic continental shelf and slope' (2014) 50 *Polar Record* 92.
[41] 1991 Environmental Protocol, Art 1(e).
[42] 1959 Antarctic Treaty, Art VI; 1991 Environmental Protocol, Art 1(b).

nevertheless chosen to regulate a number of activities on the high seas, including fishing and tourism, as well as activities that impact the seas, such as pollution. The scope of the CAMLR Convention is coterminous with the Southern Ocean ecosystem, delimited by the the Antarctic convergence, a natural boundary that divides the colder waters in the south from the warmer waters of the north and which lies between 60° and 45° South Latitude.[43]

While the ATS is today driven by strong environmental principles and seeks to protect the fragile Antarctic and Southern Ocean environment, none of its instruments creates explicit obligations to mitigate and prevent ocean acidification or climate change, and the parties have traditionally regarded these threats as being more appropriately addressed within the 1992 United Nations Framework Convention on Climate Change (UNFCCC)[44] regime rather than within the ATS itself. However, both the 1991 Environmental Protocol and the 1980 CAMLR Convention arguably provide a (limited) mandate to address ocean acidification in relation to activities taking place within the Antarctic Treaty area and/ or as part of decision-making associated with conservation and area-based protection and fisheries management.[45] Furthermore, over the last decade, climate change and, to a lesser extent, ocean acidification have been incorporated into the broader environmental agenda of the ATS. Nevertheless, the conclusion of the IPCC in their 2019 special report on *Oceans and the Cryosphere*[46] was that while the 'capacity of governance systems in polar regions to respond to climate change has strengthened recently… the development of these systems is not sufficiently rapid or robust to address the challenges and risks to societies posed by projected changes.'[47] This author agrees with this conclusion and notes, moreover, that the global 'Cinderella' status of ocean acidification vis a vis climate change is reflected within the ATS in terms of the profile and priority accorded to it.

(a) The 1991 Environmental Protocol and Ocean Acidification

Under the 1991 Environmental Protocol, parties have committed to the 'comprehensive protection of the Antarctic environment and dependent and associated ecosystems'[48] and, in respect of activities taking place within the Antarctic Treaty area (ATA), the protection of the Antarctic environment and its dependent and associated ecosystems must be a fundamental consideration in the planning and conduct of all activities.[49] In particular, activities in the Antarctic Treaty area must be planned and conducted so as to avoid 'adverse effects on climate or weather patterns', 'significant adverse effects on air or water quality', 'significant changes in the atmosphere,

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[43] 1980 CAMLR Convention, Art 1(1). It should be noted that the CAMLR Convention boundaries are set by means of coordinates under Article of the Convention (Article 1(4)) and as the Southern Ocean ecosystem responds to changing conditions, such as warming waters, the scope of the Convention and the Southern Ocean ecosystem will diverge.

[44] United Nations Convention on Climate Change, adopted 9 May 1992, entered into force 21 March 1994, 1771 UNTS 165 [UNFCCC].

[45] On climate change and ocean acidification within Polar regimes see Duncan French and Karen N. Scott, 'International Legal Implications of Climate Change for the Polar Regions: Too Much, Too Little, Too Late? (2009) 10 *Melbourne Journal of International Law* 631; Rosemary Rayfuse, 'Climate Change and Antarctic Fisheries: Ecosystem Management in CCAMLR' (2018) 45 *Ecology Law Quarterly* 53; Rosemary Rayfuse, 'Climate change at the Poles' in Karen N. Scott and David L VanderZwaag (eds), *Research Handbook on Polar Law* (Edward Elgar, 2020, *forthcoming)* 412; Tim Stephens, 'Ocean acidification at the Poles: regional responses to marine environmental change in the Anthropocene' in Karen N. Scott and David L VanderZwaag (eds), *Research Handbook on Polar Law* (Edward Elgar, 2020, *forthcoming)* 433.

[46] *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (eds. H. O. Pörtner, D. C. Roberts, V. Masson-Delmotte et al.) (2019).

[47] M. Meredith, M. Sommerkorn, S. Cassotta et al., note 1, 208.

[48] 1991 Environmental Protocol, Art 2.

[49] Ibid, Art 3(1).

terrestrial (including aquatic), glacial or marine environments' or 'detrimental changes in the distribution, abundance or productivity or species or populations of species of fauna and flora'.[50] The Protocol also requires regular and effective monitoring to allow the assessment of the impacts of on-going activities.[51] While the scope of Article 3(2) is broad enough to encompass CO_2 emissions from Antarctic bases and other facilities, including ships, within the Antarctic Treaty area – CO_2 being the primary cause of ocean acidification – the contribution of CO_2 emissions from activities within the Antarctic is negligible in the context of global emissions. It would be difficult to argue that CO_2 emissions from Antarctic facilities cause 'significant adverse effects' on water quality, for example.

However, the geographical limitation in Article 3(2) of the Protocol is not present in Article 2, where the obligation to protect the Antarctic environment and dependent and associated ecosystems is expressed in much more general terms. In principle, it could be argued that in order to 'protect the Antarctic environment and dependent and associated ecosystems' a party to the Protocol must take appropriate measures in relation to activities taking place *outside* the Antarctic where those activities negatively affect the Antarctic (and dependent and associated ecosystems). Ocean acidification is a serious threat to the Antarctic environment but is primarily caused by activities taking place outside of the Antarctic. However, while parties have increasingly acknowledged the impact of climate change and, to a much lesser extent, ocean acidification as threats to the Antarctic and its dependent and associated ecosystems, and, have taken steps to reduce emissions from activities taking place in Antarctica (discussed below), they have not generally accepted that the scope of Article 2 of the Protocol extends to activities beyond the Antarctic Treaty area.[52]

The Protocol is supported by six annexes setting out strict conditions relating to environmental impact assessment (Annex I), the protection of flora and fauna (Annex II), waste (Annex III), marine pollution (Annex IV), protected areas (Annex V) and liability (Annex VI, not in force). None of the annexes directly addresses ocean acidification and it is notable that Annex IV on pollution from ships has not been revised to reflect the recently adopted standards relating to air pollution from vessels under the 1973 International Convention for the Prevention of Pollution from Ships (as modified by the 1978 Protocol).[53] Nevertheless, Annexes I, II and V arguably require parties to consider CO_2 emissions as part of their assessment of Antarctic facilities through the process of environmental impact assessment and to consider the (cumulative) risks of ocean acidification and climate change in decisions associated with species and area-based protection. There is little evidence to date however, that ocean acidification (as distinct from climate change) is expressly considered as part of these decision-making processes.

(b) Ocean Acidification with the Antarctic Treaty Consultative Meeting

Notwithstanding the crucial importance of Antarctica to global understanding of climate change and ocean acidification, which was acknowledged by the parties to the Antarctic Treaty as

[50] Ibid, Art 3(2)(b)(i), (ii)(iii) and (iv).
[51] Ibid, Art 3(2)(d).
[52] At the 2014 ATCM, Argentina, for example, 'stressed the importance of limiting the discussions regarding climate change to its consequences in Antarctica.' Several states 'further emphasised that any recommendations should not establish obligations that do not respect the principles of the international regime on climate change, in particular the principle of common but differentiated responsibilities.' See the *Final Report of Seventeenth Meeting of the Committee on Environmental Protection* (Brasilia, Brazil, 28 April – 7 May 2014 [46].
[53] 1973 International Convention for the Prevention of Pollution from Ships as Modified by the Protocol of 1978 Relating thereto, adopted 17 February 1978, entered into force 1983, 1340 UNTS 61. Annex VI.

early as 1989,[54] there has been a reluctance to engage with climate change on a policy level within the Antarctic Treaty Consultative Meeting (ATCM). It was in 2009, twenty years after the ATCM adopted ATCM Recommendation XV-5 (1989), that this began to change, following the adoption of the Washington Declaration on the 50th anniversary of the adoption of the Antarctic Treaty, which confirmed the intention of parties to work together to address climate change in the Antarctic.[55] At that ATCM, the Scientific Council for Antarctic Research (SCAR) presented its report on *Antarctic Climate Change and the Environment* (ACCE Report),[56] and the ATCM endorsed the report's proposal that an Antarctic Meeting of Experts (ATME) on climate change be convened in 2010.[57] The 2010 ATME on *Implications of Climate Change for Antarctic Management and Governance*[58] made 30 recommendations relating to: research; the dissemination and publication of that research to governments, the UNFCCC and the public; reducing emissions from Antarctic operations, including through the process of EIA; and the flexible application of protected area tools to account of climate change effects.[59] It also recommended that the Committee for Environmental Protection (established under the 1991 Environmental Protocol) develop a climate response work programme.[60] Although the ATCM adopted decisions formally welcoming the ACCE report[61] and requesting that it be disseminated to the Executive Secretaries of the UNFCCC and the IPCC and the Secretary Generals of the World Meteorological Office (WMO) and the International Maritime Organisation (IMO) in 2010,[62] it was not until 2015 that a Climate Change Response Work Programme (CCRWP) was formally established by the CEP.[63]

In 2011, climate change became a standing item on the ATCM agenda[64] and, since 2011 (excepting 2018), states and relevant organisations (such as SCAR, the Council for Managers of Antarctic National Programmes (COMNAP) and the International Association of Antarctic Tour Operators (IAATO)) have regularly reported on relevant scientific findings (including ACCE Report updates), steps taken to reduce the carbon footprint of Antarctic activities, and progress in meeting the recommendations of the ATME on climate change at the annual ATCM. Climate change has also been included in the ATCM Multi-year strategic workplan since 2014. The first information paper on ocean acidification was presented at the 2011 ATCM by the Antarctic and Southern Ocean Coalition (ASOC)[65] and SCAR established an Action Group on Ocean Acidification, which planned to report on ecosystem and species responses to ocean acidification

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[54] The parties did nevertheless formally recognise the importance of scientific research and monitoring environmental change in Antarctica as early as 1989 (see ATCM Recommendation XV-5 (1989) *Human impact on the Antarctic Environment: Environmental Monitoring in Antarctica.* Notably, Recommendation XVII-4 (1992) *Global Change Research and International Cooperation in Antarctica*, which endorsed the establishment by SCAR of a new group of global change and the Antarctic and its research in the area of climate change did not enter into force and was eventually withdrawn in 2017. See however, Resolution 6 (2015) *The role of Antarctica in global climate processes* which encourages parties to 'support their national Antarctic programmes to lead collaborative and ambitious international scientific programmes to underpin and improve understanding of the impact of climatic changes on the Antarctic environment and its dependent and associated ecosystems.' [2].

[55] *Antarctic Treaty Consultative Meeting XXXII Washington Ministerial Declaration on the Fiftieth Anniversary of the Antarctic Treaty* 2009 [10] available at: https://documents.ats.aq/ATCM32/op/atcm32_op022_e.pdf.

[56] SCAR, ACCE Report, note 1. See *Final Report of the Thirty-second Antarctic Treaty Consultative Meeting* (Baltimore, United States, 6 – 17 April 2009), [52, 241 – 244].

[57] Ibid, [52].

[58] The Report can be found at: https://www.ats.aq/devAS/Meetings/Past/75.

[59] Ibid.

[60] Ibid.

[61] ATCM Resolution 4 (2010) *SCAR Antarctic Climate Change and the Environment Report.*

[62] ATCM Decision 5 (2010) *Letters to UNFCCC, IPCC, WMO and IMO on the SCAR ACCE Report.*

[63] ATCM Resolution 4 (2015) *Committee for Environmental Protection Climate Change Response Work Programme.*

[64] Climate change was included as a regular item on the CEP agenda in 2008 although was not included in 2018.

[65] IP 88 (2011) *Ocean Acidification and the Southern Ocean* (ASOC).

in 2013.[66] The ATCM has continued its relatively strong tradition of cooperating with the CAMLR Convention Commission (CCAMLR) and, in 2016, a joint workshop between the CEP and the CCAMLR Scientific Committee (CCAMLR-SC) was held on climate change and monitoring. Nevertheless, beyond the dissemination of the ACCE Report (and relevant updates), the ATCM has been reluctant to engage in international policy making on climate change beyond the ATS. For example, Australian proposals presented to the 2012 ATCM designed to proactively engage with UNFCCC processes, including registering the Antarctic Treaty Secretariat as an observer organisation to the UNFCCC negotiating sessions, were not adopted.[67]

A more strategic approach to climate change within the ATCM was initiated in 2013 when the CEP established an intersessional contact group (ICG) on climate change with the mandate to: review progress on the ATME on Climate Change recommendations; identify additional actions in light of more recent research; and consider how the recommendations might be addressed by developing a prioritised climate change response work programme.[68] In 2015, the Committee for Environmental Protection Climate Change Response Plan (CCRWP) was finally established, to be implemented as a matter of priority.[69] The work of the CCRWP focuses on adaptation to rather than mitigation of climate change, and covers topics such as the management of non-native species, protected areas and ecosystem-monitoring (including closer cooperation with SC-CCAMLR). The CCRWP also has a mandate to review existing management tools to assess their continuing suitability in a climate change context (e.g., EIA guidelines [particularly with regard to planned long-term activities], Specially Protected Species guidelines and the guide to the preparation of management plans for protected areas).[70] In 2016, it was decided that the CCRWP would meet informally intersessionally to manage work on an on-going basis.[71] A Subsidiary Group (to the CEP) on Climate Response (SGCCR) was established in 2017[72] in order to facilitate the coordination and communication of the CCRWP between Members, Observers and Experts as well as to request updates on planned activities and to draft progress reports on the implementation of the CCRWP for the ATCM.[73]

The profile of climate change and its implications for the management of the Antarctic Treaty area has grown substantially over the last decade, with increasing amounts of time devoted to the issue at the ATCM (with the exception of 2018). While much discussion is devoted to scientific issues, including regular updates on the ACCE Report,[74] climate change policy has slowly developed through the work of the CEP ICG on Climate Change and, latterly, the SGCCR. The focus of these initiatives have however, been largely on adaptation and managing other threats (such as non-native species) in a climate-changed Antarctica. With respect to mitigation, states have engaged in work to reduce their carbon footprint in Antarctica and, in 2019, COMNAP

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[66] *Final Report of the Fourteenth Meeting of the Committee on Environmental Protection* (Buenos Aires, Argentina, 20 June – 1 July 2011), [38]. See also IP 52 (2012) *Ocean Acidification: SCAR Future Plans* (SCAR) and IP 52 (2013) *Ocean Acidification: SCAR Future Plans* (SCAR).

[67] *Final Report of the Thirty-fifth Antarctic Treaty Consultative Meeting* (Hobart, Australia, 11 – 20 June 2012), [273 – 278].

[68] *Final Report of the Sixteenth Meeting of the Committee on Environmental Protection* (Brussels, Belgium, 20 May – 29 May 2013), [66 – 67].

[69] ATCM Resolution 5 (2015) *Committee for Environmental Protection Climate Change Response Work Programme.*

[70] *Final Report of the Nineteenth Meeting of the Committee on Environmental Protection* (Santiago, Chile, 23 May – 1 June 2016), Appendix 2.

[71] Ibid, [77 – 79].

[72] Decision 1 (2017) *Subsidiary Group of the Committee for Environmental Protection on Climate Change Response (SGCCR).*

[73] *Final Report of the Nineteenth Meeting of the Committee on Environmental Protection* (Santiago, Chile, 23 May – 1 June 2016), Appendix 2.

[74] The most recent update was submitted by SCAR to the 2019 ACTM. See IP 136 (2019) *Antarctic Climate Change and the Environment – 2019 Update* (SCAR). At the 2019 meeting the UK also introduced WP1 rev (2019) *The Antarctic Peninsula under a 1.5°C global warming scenario* (UK).

reported that 73 percent of the 30 COMNAP member National Antarctic Programmes were modernising or planning to modernise their Antarctic research stations and, in 22 percent of cases, the primary reason for modernisation was climate change.[75] The recommendations of the 2010 ATME on Climate Change are regularly reviewed, with the ATCM concluding in 2019, that all but one of the recommendations had been addressed.[76] Climate change is included in the ATCM Multi-year Strategic Work Plan, and the version adopted in 2019, prioritises seeking updates from parties on how the effects of climate change have been considered in relation to new infrastructure in the EIA process as well as for future Antarctic, logistics and environmental values.[77]

However, ocean acidification – as distinct from climate change – has barely featured in ATCM discussions outside of scientific updates. This is perhaps unsurprising given that the ATCM has a strong terrestrial focus and has largely left marine issues such as marine protected areas and shipping to other bodies, namely, CCAMLR[78] and the IMO. More significantly, while the focus on activities taking place in Antarctica has symbolic importance, the failure to expressly link the general obligation on all parties to comprehensively protect the Antarctic and its dependent and associated ecosystems with the need to take steps to reduce emissions within the metropolitan borders of states parties, while politically understandable, is regrettable, and demonstrates a relative impotence on the part of the ATS with regards to actually addressing ocean acidification in the Southern Ocean.

(c) Ocean Acidification and the 1980 CAMLR Convention

The CAMLR Convention broadly seeks to conserve Antarctic marine living resources[79] and is based on explicit precautionary and ecosystem-focused approaches to fisheries management.[80] Unsurprisingly, like the Environmental Protocol, it lacks express obligations relating to ocean acidification and climate change, but both threats arguably must be explicitly considered as part of CCAMLR decision-making when setting catch limits for species or as part of protected area management in order to implement an ecosystem-based approach to the conservation of Southern Ocean marine resources.

The development policy awareness relating to climate change and ocean acidification within CCAMLR follows a similar trajectory as that which developed within the ATCM. In 2009, the Commission adopted Resolution 30/XXVIII on *Climate Change* and recognised that global climate change 'is one of the greatest challenges facing the Southern Ocean' and that 'the Southern Ocean will experience increased acidification with possible impacts on its marine ecosystems'.[81] The Resolution urged the Commission to consider the impacts of 'climate change in the Southern Ocean to better inform CCAMLR management decisions' as well as to actively contribute to relevant research and to widely disseminate that research.[82] Finally, the Chairman of the Commission was requested to write to the President of the UNFCCC Conference of Parties (COP) to 'express that the CAMLR Commission considers that an effective goal response by the

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[75] *Final Report of the Forty-second Antarctic Treaty Consultative Meeting* (Prague, Czech Republic, 1 – 11 July 2019), [345]. See also IP 47 (2019) *Modernisation of Antarctic Stations: Survey Results* (COMNAP).
[76] See WP 21 rev.1 (2019) *Overview of outstanding ATME recommendations* (Norway/ UK).
[77] ATCM Decision 5 (2019) *Multi-year Strategic Work Plan*.
[78] No marine area can be designated an ASPA or an ASMA without the prior approval of CCAMLR (1991 Environmental Protocol, Annex V, Art 6(2)).
[79] 1980 CAMLR Convention, Art II(1). 'Conservation' for the purposes of the Convention includes rational use (Article II(2)).
[80] Ibid, Art II(3).
[81] CCAMLR Resolution XXVIII *Climate Change* (2009), preamble.
[82] Ibid, [1, 2 and 3].

UNFCCC is urgently needed to address the challenge of climate change in order to protect and preserve the Southern Ocean ecosystems and their biodiversity.'[83] While acknowledging CCAMLR's role in policy-making concerning adaptation to and enhancing ecosystem resilience in the face of climate change and ocean acidification, this Resolution also emphatically characterises the solution to these threats as lying outside the ATS, notwithstanding that the largest emitters of CO_2 are also CCAMLR parties.

Between 2010 and 2015, climate change was discussed at every CCAMLR meeting with particular focus on scientific issues, the impact of climate change on krill and the extent to which climate change could be integrated into area-based protection to enhance ecosystem resilience and/ or to establish reference areas to monitor the impact of a changing climate. In 2015, an Intersessional Correspondence Group (ICG) was established in order to develop approaches to integrate the consideration of climate change impacts into the work of the Commission, with the particular task of making recommendations as to how the Commission could use information relating to climate change in its decision-making under Article II of the Convention, and how the Commission could consider climate change impacts across its agenda.[84] The ICG on Climate Change has reported regularly to CCAMLR meetings, highlighting in particular, relevant collaborative scientific research being carried out by Commission members.

The area where CCAMLR has had most success – although 'success' is a relative term here – in integrating climate change into policymaking is in relation to area-based protection. The general framework for the establishment of CCAMLR marine protected areas (MPAs)[85] recognises the role of MPAs in contributing to the maintenance of ecosystem function and the ability to adapt in the face of climate change. MPA objectives under the Framework include the establishment of scientific reference areas and 'the protection of areas to maintain resilience or the ability to adapt to the effects of climate change.'[86] The Ross Sea MPA, established in 2016,[87] notes the rich opportunities to study climate change effects in the region and recognises that the 'establishment of CCAMLR MPAs can provide important opportunities to understand the ecosystem impacts of climate change separate from those of fishing'.[88] The objectives of the Ross Sea MPA include providing a reference area for monitoring natural variability and long-term change.[89] Whether climate change objectives can be achieved through the designation of a network of CCAMLR MPAs is debatable however, given that negotiations on other MPAs in the region have largely stalled.[90] More positively, the adoption of CM 24-04 in 2017[91] by the Commission, is a rare example of a pre-emptive and precautionary measure specifically designed to address climate change risks. This measure allows Special Areas for Scientific Study (SASS) to be designated in newly exposed marine areas following the retreat or collapse of an ice shelf, glacier or ice tongue in the Antarctic peninsula region, and for fishing to be restricted in those areas. SASS may be established for an initial two-year period (Stage 1 SASS) or for a ten year period on agreement by the Commission

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[83] Ibid, [4].
[84] *Report of the Thirty-fourth Meeting of the Commission* (CCAMLR XXXIV, Hobart, Australia, 19 – 30 October 2015), [7.12].
[85] CM 91-04 (2011) *General Framework for the establishment of CCAMLR Marine Protected Areas.*
[86] Ibid, Art 2(vi).
[87] CM 91-05 (2016) *Ross Sea region marine protected area.*
[88] Ibid.
[89] Ibid.
[90] See Karen N. Scott, 'MPAs in the Southern Ocean under CCAMLR: Implementing SDG 14.5' in Keyuan Zou (ed), *Rule of Law and the Law of the Sea* (Brill, *forthcoming* 2021).
[91] CM-04 (2017) *Establishing time-limited Special Areas for Scientific Study in newly exposed marine areas following ice-shelf retreat or collapse in Statistical Subareas 48.1, 45.5 and 88.3.*

following detailed review by the Scientific Committee (Stage 2 SASS).[92] In 2017, the Larsen C Special Area for Scientific Study was established as a Stage 2 SASS[93] and, in 2019, the marine area adjacent to the Pine Island Glacier was designated a Stage 1 SASS.[94]

More generally, however, CCAMLR has struggled in its efforts to develop a strategic and comprehensive approach to the impact of climate change and ocean acidification on Southern Ocean fisheries management. In 2017, a proposal to adopt a Climate Change Response Work Program (CCRWP),[95] which was supported by most members of the Commission,[96] failed, owing to the objections of Russia and China, including, 'the overlap with the work of other organisations.'[97] A revised CCRWP was presented at the 2018 CCAMLR Meeting and was designed to provide 'a mechanism for identifying and revising goals and specific actions by the Commission and the Scientific Committee to support efforts within the Antarctic Treaty system to prepare for, and build resilience to, the environmental impacts of a changing climate and the associated implications for the governance and management of the Southern Ocean and the conservation of Antarctic marine living resources.'[98] Although again, the CCRWP was supported by most CCAMLR members,[99] consensus could not be achieved owing to the objection of two (unnamed) states (presumably, China and Russia) relating to concerns over duplication of work in other forums.[100] Moreover, the two states also suggested the CCRWP should be established in the Scientific Committee rather than the Commission,[101] with the presumed effect that this would confine the role of the CCRWP to scientific rather than policy or management matters. There was, however, resistance to this suggestion. As Australia asserted, 'there is little point in scientific research if we do not make management decisions based on its evidence.'[102] No revised proposal for the CCRWP was presented at the 2019 CCAMLR meeting and, while several members advocated that Resolution 30/XXVIIII be updated in light of the advancement of scientific understanding of the implications of climate change and ocean acidification for the Southern Ocean over the last decade, no agreement was reached on this at the meeting.[103]

More generally, there is resistance to any climate change policy or management-based initiative by a small number of states, and the consensus approach to decision-making under the CAMLR Convention[104] means that very limited progress has been made in this area. For example, in 2015, the UK and Norway proposed a non-binding resolution 'that Members include statements on the implications of climate change in all scientific documents that contributed to the work of

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[92] Ibid, [3 – 7].
[93] Ibid, Annex B.
[94] *Report of the Thirty-eighth Meeting of the Commission* (CCAMLR XXXVIII, Hobart, Australia, 21 October to 1 November 2019), [6.6 – 6.14].
[95] *Report of the thirty-Sixth Meeting of the Commission* (CCAMLR XXXVI, Hobart, Australia, 16 – 27 October 2017) [7.2 – 7.6].
[96] Ibid [7.6]. Several members of the Commission, including the UK, Australia, Norway, Belgium and Argentina spoke in strong support of the proposal, expressing significant disappointment of the failure to adopt the CCRWP. See ibid [7.10 – 7.20].
[97] Ibid, [7.7 – 7.8].
[98] *Report of the Thirty-Seventh Meeting of the Commission* (CCAMLR XXXVII, Hobart, Australia, 22 October – 2 November 2018), [8.7].
[99] Ibid, [8.9].
[100] Ibid, [8.11].
[101] Ibid.
[102] Ibid, [8.15].
[103] *Report of the Thirty-eighth Meeting of the Commission* (CCAMLR XXXVIII, Hobart, Australia, 21 October – 1 November 2019 [8.13 – 8.14].
[104] 1980 CAMLR Convention, Art XII(1).

CCAMLR where practicable and such information exists.'[105] Even though the proposal was for a non-binding resolution, it did not achieve the consensus necessary for adoption. In 2018, Australia, Norway and the UK proposed a similar mechanism to communicate the nature and implications of known and potential climate change impacts in papers submitted to the Commission and Scientific Committee,[106] and this was also rejected by two states[107] on the basis that 'the potential implication[s] of climate change should be based on sound scientific analysis of time-series data and not a limited number of observations, and therefore statements should only be provided on a voluntary basis, and not as a tool for decision-making by the Commission.'[108] A number of members nevertheless committed to including climate impact statements in papers on a voluntary basis.[109]

The awareness of the implications of climate change and ocean acidification for Southern Ocean marine resources has steadily increased within CCAMLR over the last decade and this was clearly demonstrated at the 2019 meeting where the recent reports of the IPCC on Oceans and the Cryosphere, a UK paper on the implications of a 1.5° global warming scenario for the Antarctic peninsula, an FAO paper on the impact of climate change in the upper 2000 m of the deep ocean, the 2019 ACCE Report update and the work of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services were all discussed.[110] Moreover, there is clear recognition on the part of most Commission Members that the threats of climate change and ocean acidification to the Southern Ocean require a policy and management response and discussion of them cannot be confined to questions of science. Nevertheless, although climate change has been somewhat incorporated into area-based management – which is controversial on its own terms – there is little evidence that it has been integrated into fisheries management more generally, including the setting of catch limits. Attempts to develop a more strategic approach to addressing climate change and ocean acidification within CCAMLR continue to be thwarted by China and Russia. China, in particular, emphasised its position at the 2019 meeting by reaffirming its engagement on the topic of climate change 'by noting its adherence to the Paris Agreement,'[111] articulating the view held by a number of states that CCAMLR specifically and the ATS more generally does not constitute the appropriate forum for climate-focused action.

4. Concluding Remarks

The ATS has been described as an 'inward looking regime' largely unconcerned with external threats[112] and this has largely characterised its approach to Southern Ocean acidification thus far. The paradoxical gap between recognizing the importance of Antarctica in order to understand climate change and its global implications, and the development of actual policy and initiatives to protect the Antarctic and Southern Ocean ecosystem from the impacts of climate change, has narrowed over the last decade, but is far from closed. The most progress has been made in relation to area-based protection, under both the 1991 Environmental Protocol and the

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[105] *Report of the Thirty-Fourth Meeting of the Commission*, (CCAMLR XXXIV, Hobart, Australia, 19 – 30 October 2015), [7.13].
[106] *Report of the Thirty-Seventh Meeting of the Commission* (CCAMLR XXXVII, Hobart, Australia, 22 October – 2 November 2018), [8.1 – 8.6].
[107] Ibid, [8.3].
[108] Ibid.
[109] Ibid., [8.5].
[110] *Report of the Thirty-eighth Meeting of the Commission* (CCAMLR XXXVIII, Hobart, Australia, 21 October – 1 November 2019), [8.1 – 8.20].
[111] Ibid, [8.8].
[112] Tim Stephens, note 45, 451.

1980 CAMLR Convention. States are attempting to mitigate the carbon footprint of their Antarctic programs and this is a commendable but largely symbolic action in the context of the actual causes of ocean acidification: the emission of CO_2 on a scale that has contributed to a geological shift from the Holocene to the Anthropocene. There is little evidence that CCAMLR, is actively considering ocean acidification as one of an accumulation of threats when setting catch limits and adopting other measures as part of their management of Southern Ocean fisheries.

The applicability of the UNFCCC and the law of the sea to ocean acidification is dealt with in other chapters of this book[113] and is not explored here. Nevertheless, elsewhere, this author has argued that there is a due diligence obligation on states to address ocean acidification as 'pollution' under Article 194 of the 1982 United Nations Convention on the Law of the Sea (UNCLOS)[114] and that obligation cannot be met merely by complying with commitments made under the 2015 Paris Agreement[115] where those commitments do not specifically address ocean acidification and its causes.[116] This obligation applies to all states party to ATS instruments by virtue of the law of the sea. Furthermore, given the threat posed by Southern Ocean acidification to the Antarctic environment and its dependent and associated ecosystems, Article 2 of the 1991 Environmental Protocol should be similarly interpreted to impose a due diligence obligation on parties to address ocean acidification, through measures to reduce CO_2 emissions (or measures with equivalent effect) taken within and *beyond* the Antarctic Treaty area. It is acknowledged that some developing country ATS members have valid concerns about substantively addressing climate change within the ATS where core UNFCCC principles, including the principle of common but differentiated responsibilities, do not expressly apply. However, the current approach of ATS state parties leads to an incongruous situation whereby some of the largest emitters of greenhouse gases by volume (United States, China, India) and per capita (Australia, New Zealand) have committed to the 'comprehensive protection of the Antarctic environment and dependent and associated ecosystems', yet are ignoring the greatest threat to the continent and the Southern Ocean. This limited interpretation of Article 2 of the Protocol is arguably incompatible with both a textual and teleological interpretation of Article 2 in light of the objects and purposes of the Protocol more generally.[117] The jurisdictional boundary between the ATS and the UNFCCC created by parties to both instruments demonstrates how the more general fragmentation of international environmental law can risk undermining efforts to address threats such as ocean acidification. Recent developments within the ATS, while demonstrating a much greater scientific and policy awareness among members of the implications of climate change and ocean acidification to the Antarctic and the Southern Ocean, nevertheless illustrate that fragmentation continues to characterise the policy, regulatory and management initiatives designed to address ocean acidification at both the global and the regional level.

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[113] See Chapters XXX. See also Rachael Baird, Meredith Simons and Tim Stephens, 'Ocean Acidification: A Litmus Test for International Law' (2009) 4 *Carbon & Climate L. Review* 459; Ellycia R. Harrond-Kolieb and Dorothée Herr, 'Ocean Acidification and the UNFCCC: Finding Legal Clarity in the Twilight Zone' (2016) 6 *Wash. J. Envtl. L. & Pol'y* 613; Nifufer Oral, 'Ocean Acidification: Falling Between the Legal Cracks of UNCLOS and the UNFCCC' (2018) 45 *Ecology Law Quarterly* 9 ; Karen N. Scott, 'Ocean Acidification and Sustainable Development Goal 14: A Goal but No Target?' in Myron H. Nordquist, John Norton Moore, and Ronan Long (eds), *The Marine Environment and United Nations Sustainable Development Goal 14: Life below Water* (Leiden, Koninklijke Brill, 2018) 323.

[114] United Nations Convention on the Law of the Sea, adopted 10 December 1982, entered into force 16 November 1994, 1833 UNTS 3 [UNCLOS].

[115] Paris Agreement on Climate Change, adopted 12 December 2015, entered into force 4 November 2016, [2016] ATS 24.

[116] See Karen N. Scott, note 7.

[117] Vienna Convention on the Law of Treaties, adopted 23 May 1969, entered into force 27 January 1980 155 UNTS 331, Art 31(1).