ISSN 2464-9724

Maritime Safety and Security Law Journal

2025

Issue 16

Maritime Safety and Security Law Journal

Law of the Sea and Climate Action: Rethinking Marine Geoengineering Governance

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Abstract

On 21st May 2024, the International Tribunal for the Law of the Sea (ITLOS) issued its first advisory opinion on climate change, clarifying States' obligations under the United Nations Convention on the Law of the Sea (UNCLOS) but offering limited guidance on marine geoengineering – an increasingly relevant set of ocean-based interventions for carbon dioxide removal (CDR).

As concerns grow that emission reductions alone may be insufficient to meet the Paris Agreement goals, ocean-based CDR techniques such as ocean fertilization and alkalinization are attracting growing interest, yet they remain largely unregulated under binding international law.

Until now research on ocean-related CDR proposals concentrated its attention on the possible application of UNCLOS, the 1972 London Convention on the prevention of marine pollution by dumping of wastes, the 1996 Protocol to the Convention and its amendments.

This article examines these instruments arguing that their sectoral scope and risk-averse orientation provide only a limited foundation for governing marine geoengineering. It then considers the Agreement on Marine Biodiversity of Areas Beyond National Jurisdiction (BBNJ), not merely as a gap-filling tool but as a framework offering complementary procedural and institutional mechanisms that could support the effective governance of further research and implementation of CDR projects in areas beyond national jurisdiction.

The article argues that international law should evolve to ensure that marine geoengineering is regulated in a way that supports both ocean protection and climate mitigation, while fostering transparency, scientific integrity, knowledge pluralism, and advancing systemic integration between the law of the sea and the climate regime.

Keywords: marine geoengineering; carbon dioxide removal; marine pollution; climate change mitigation; BBNJ Agreement.

First published online: 6 February 2026

1. Introduction

On 21st May 2024, the International Tribunal for the Law of the Sea (ITLOS) issued an advisory

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opinion on climate change,[1] clarifying states' obligations under the United Nations Convention on the Law of the Sea (UNCLOS) regarding climate change mitigation.[2] Despite broad participation in the proceedings, marine geoengineering was only cursorily addressed.[3] The opinion briefly referenced Article 195 UNCLOS –cautioning that marine geoengineering 'would be contrary […] if it has the consequence of transforming one type of pollution into another' – but did not delve deeper into its applicability, thereby underscoring the legal ambiguity surrounding these novel activities.[4]

The Intergovernmental Panel on Climate Change (IPCC) has made clear that limiting the global average temperature increase to 'well below' 2°C above pre-industrial levels, as envisaged in the 2015 Paris Agreement,[5] requires rapid and deep reductions in greenhouse gas emissions across all sectors. In addition, the IPCC underlines that most mitigation pathways consistent with this goal rely on some degree of carbon dioxide removal (CDR), primarily to counterbalance hard-to-abate residual emissions.[6] The importance of CDR has also been acknowledged in international climate negotiations, most recently in the outcome of the first Global Stocktake adopted at COP28, which refers to 'abatement and removal technologies such as carbon capture and utilization and storage, particularly in hard-to-abate sectors'.[7] Land-based CDR methods have been the primary focus.[8] While these methods are technically viable, they pose significant challenges, particularly due to their high land and resource demands, which can create conflicts with other land uses and limit large-scale implementation.[9]

These constraints have driven increasing interest in exploring ocean-based approaches for

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1 *Request for Advisory Opinion submitted by the Commission of Small Island States on Climate Change and International Law* (Advisory Opinion, 21 May 2024) C31 [231], ITLOS Reports 2024 (ITLOS Advisory Opinion).

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

3 Romany M Webb, 'The ITLOS Advisory Opinion and Marine Geoengineering: More Questions, Few Answers' (*Verfassungsblog*, 25 May 2024) <https://verfassungsblog.de/the-itlos-advisory-opinion-and-marine-geoengineering/> accessed 5 March 2025.

4 ITLOS Advisory Opinion (n 1) para 231: '[…] The Tribunal is aware that marine geoengineering has been the subject of discussions and regulations in various fora, including the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters 1972 and its 1996 Protocol, and the CBD'.

5 Paris Agreement (adopted 12 December 2015, entered into force 4 November 2016) 3156 UNTS 79 art 2(1)(a).

6 Jim Skea and others (eds), 'Summary for Policymakers' in IPCC, *Climate Change 2022: Mitigation of Climate Change* (CUP 2022), 16-18.

7 UNFCCC 'Outcome of the First Global Stocktake' (13 December 2023) Decision -/CMA.5 FCCC/PA/CMA/2023/L.17, para 28(e).

8 National Academies of Sciences, Engineering, and Medicine (NASEM), *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda* (The National Academies Press 2019).

9 Kate Dooley and others, 'Over-reliance on Land for Carbon Dioxide Removal in Net-zero Climate Pledges' [2024] Nature Communications 1; Xin Zhao and others, 'Trade-offs in Land-based Carbon Removal Measures under 1.5 °C and 2 °C Futures' [2024] Nature Communications 1.

carbon dioxide removal, such as ocean alkalinity enhancement and seaweed cultivation. While these techniques build on the ocean's natural capacity to absorb CO_2, they also introduce novel ecological risks and regulatory challenges due to limited scientific understanding and the absence of governance frameworks.[10] In recent years, the role of the ocean in climate policy has gained prominence in international climate discussions,[11] including in the context of the Conferences of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC).[12] These discussions have rightly emphasized the protection and restoration of marine ecosystems as natural carbon sinks, particularly in the context of nature-based solutions for climate adaptation. However, this political focus on conservation also provides the essential backdrop for the urgent, and separate, debate on technological interventions like marine CDR (mCDR) for the purpose of mitigation.[13]

This paper argues that while existing ocean law instruments such as UNCLOS and the London Convention and Protocol provide important principles,[14] their sectoral focus on preventing pollution renders them limited in their capacity to govern marine carbon dioxide removal in a way that accounts for both ecological risks and potential climate benefits. [15] By contrast, the BBNJ Agreement, although not expressly designed to regulate geoengineering, introduces procedural innovations that could bridge this gap by embedding more detailed and participatory approaches to transparency, environmental impact assessment, and cross-regime coordination into decision-making, thereby moving toward a strengthened systemic integration of ocean and climate governance.[16]

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10 Martin Johnson and others, 'Can Coastal and Marine Carbon Dioxide Removal Help to Close the Emissions Gap? Scientific, Legal, Economic, and Governance Considerations' [2024] Elementa: Science of the Anthropocene 1; Andreas Oschlies and others, 'Perspectives and challenges of marine carbon dioxide removal' [2025] Frontiers in Climate 1.

11 UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) 'Informal Summary Report by the Co-facilitators of the Ocean and Climate Change Dialogue 2023-2024' (2 October 2024) OceanDialogue2024, 5-6.

12 United Nations Framework Convention on Climate Change (adopted 9 May 1992, entered into force 21 March 1994) 1771 UNTS 107 (UNFCCC); UNFCCC 'Glasgow Climate Pact' (13 November 2021) Decision 1/CMA.3 FCCC/PA/CMA/2021/10/Add.1, para 38; 'Sharm el-Sheikh Implementation Plan' (20 November 2022) Decision -/CP.27, para 18.

13 Andreas Oschlies and others, 'Climate Targets, Carbon Dioxide Removal, and the Potential Role of Ocean Alkalinity Enhancement' [2023] State of the Planet 1.

14 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (adopted 29 December 1972, entered into force 30 August 1975) 1046 UNTS 120 (London Convention); 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (adopted 7 November 1996, entered into force 24 March 2006) [2006] ATS 11 (London Protocol); See also Convention on Biological Diversity (adopted 5 June 1992, entered into force 29 December 1993) 1760 UNTS 79 (CBD); CBD 'COP Decision IX/16: Biodiversity and climate change' (9 October 2008) UNEP/CBD/COP/DEC/IX/16; CBD 'COP Decision X/33: Biodiversity and climate change' (29 October 2010) UNEP/CBD/COP/DEC/X/33.

15 Rebecca Loomis and others, 'A Code of Conduct Is Imperative for Ocean Carbon Dioxide Removal Research' [2022] Frontiers in Marine Science 1; Lina Röschel and Barbara Neumann, 'Ocean-based Negative Emissions Technologies: A Governance Framework Review' [2023] Frontiers in Marine Science 1.

16 Agreement 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 (adopted 19 June 2023, not yet in force) CN 203 2023 TREATIES-XXI 10 (BBNJ Agreement).

2. The Applicability of UNCLOS to Marine Geoengineering Activities

Geoengineering refers to the deliberate, large-scale manipulation of Earth's natural systems – including oceans – to alter physical, chemical, or biological processes in order to counteract climate change.[17] The 2013 amendment to the London Protocol defines marine geoengineering as 'any activity undertaken deliberately for the primary purpose of manipulating natural processes to counteract climate change, and that has the potential to result in deleterious effects, especially where those effects may be widespread, long-lasting or severe'.[18] While increasingly considered as a mitigation tool, these techniques carry ecological risks marked by significant scientific uncertainty, raising concerns about potential unintended and transboundary effects.[19] Such uncertainties demand a careful examination of existing legal frameworks, beginning with the role of UNCLOS.

Although UNCLOS does not explicitly regulate ocean-based carbon dioxide removal (CDR) activities, it may still have significant implications for both research and deployment of ocean CDR. UNCLOS provisions on marine environmental protection could shape how states regulate and oversee these activities.[20] In particular, Article 1 defines marine pollution broadly, focusing not on the nature of the introduced substances but on their potential harmful effects on the marine environment. This definition is intentionally open-ended, meaning that any substance, including CO_2, can be considered a pollutant under Article 1, provided it meets the necessary criteria.[21]

Part XII of UNCLOS is devoted to the protection of the marine environment, with Article 192 establishing a binding and unqualified obligation for all states to protect and preserve it. This duty applies universally, including to non-parties as a matter of customary international law,[22] and extends both within and beyond national jurisdiction.[23] States must take all necessary measures – individually or collectively – to prevent, reduce, and control marine pollution from any source, using the best practicable means available and considering their capacities.[24]

These obligations cover activities under a state's jurisdiction or control, including land-

17 Olivia Lazard and others, *Geoengineering: Assessing Risks in the Era of Planetary Security* (Carnegie Europe, 16 July 2025).

18 London Protocol 'Resolution LP.4(8) on the Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and Other Marine Geoengineering Activities' (adopted 18 October 2013, not in force) (2013 Amendment).

19 John Shepherd and others (eds), *Geo-engineering the Climate: Science, Governance and Uncertainty* (The Royal Society 2009); NASEM, A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration (National Academies Press 2022).

20 Röschel, Neumann, 'Ocean-based Negative Emissions Technologies' (n 15) 10.

21 ITLOS Advisory Opinion (n 1) para 161.

22 Alan Boyle, 'Further Development of the Law of the Sea Convention: Mechanisms for Change' (2005) 54 International and Comparative Law Quarterly 563; Patricia Birnie, Alan Boyle and Catherine Redgwell, *International Law and the Environment* (4th edn, Oxford University Press 2021).

23 UNCLOS, art 2(3), 56(2) and 87(1).

24 ibid art 194 (1)-(3).

based, atmospheric actions and scientific research that may affect the marine environment.[25] UNCLOS also prohibits the transfer of pollution from one area to another or the transformation of one form of pollution into another.[26] States must adopt regulations addressing pollution from land-based sources, seabed activities, and dumping, and are required to protect rare ecosystems and endangered species habitats.[27] Furthermore, Articles 204-206 impose obligations to assess, monitor, and report the environmental impacts of authorized activities – provisions particularly relevant in evaluating the compatibility of marine geoengineering proposals under the law of the sea.

However, the implications of these obligations for ocean-based CDR activities remain uncertain. Under UNCLOS, techniques such as ocean fertilization or alkalinity enhancement present an inherent ambiguity: they involve introducing substances into the sea, potentially qualifying as marine pollution under Article 1(1)(4), yet they are also conceived as measures to mitigate atmospheric pollution.[28] While it is possible to argue that the risks of such interventions should be balanced against potential climate benefits,[29] UNCLOS itself provides no mechanism for weighing competing environmental harms.[30] Rather, its framework emphasizes prevention and precaution: Article 194 requires States to prevent, reduce and control pollution 'from any source', and Article 195 specifically prohibits transferring or transforming pollution. This suggests that the Convention provides very limited scope on its own for reconciling new ecological risks with anticipated climate benefits.

Nonetheless, UNCLOS is not a static treaty, but it is intentionally designed to evolve and to adapt to changing circumstances.[31] As a framework convention, UNCLOS employs a 'rule of reference' mechanism, allowing it to integrate rules and standards from other international instruments to further define and implement States' rights and obligations.[32] This structure ensures ongoing adaptability in response to new scientific and technical developments.

Part XII's obligations on marine environmental protection are meant to complement, not

25 ibid art 207-216 and 240(d).

26 ibid art 195.

27 ibid art 194(5).

28 Jesse Reynolds, 'Climate Engineering and International Law', *Elgar Encyclopedia of Environmental Law* (2016) Vol 1, 183.

29 Jesse Reynolds, 'International Law', in Michael B Gerrard and Tracy Hester (eds), *Climate Engineering and the Law: Regulation and Liability for Solar Radiation Management and Carbon Dioxide Removal* (Cambridge University Press 2018) 77-78; Ruben Prütz, 'A Taxonomy to Map Evidence on the Co-benefits, Challenges, and Limits of Carbon Dioxide Removal' [2024] Communications Earth & Environment 1.

30 Wil Burns, 'Governance of Ocean-Based Carbon Dioxide Removal Research Under the United Nations Convention on the Law of the Sea' (2023) 75 Maine Law Review 37, 64.

31 Boyle, 'Further Development of the Law of the Sea Convention' (n 22) 568; Reece Lewis, 'The "Constitution for the Oceans"? The Law of the Sea Convention as a Living Treaty' (2025) 74 International & Comparative Law Quarterly 1.

32 Myron H Nordquist, Shabtai Rosenne and Alexander Yankov (eds), *United Nations Convention on the Law of the Sea 1982: A Commentary* (Vol 4, Martinus Nijhoff 1991); Alexander Proelss (ed), *United Nations Convention on the Law of the Sea: A Commentary* (Nomos Verlagsgesellschaft 2017) 1396-1398; Lan Ngoc Nguyen, 'Expanding the Environmental Regulatory Scope of UNCLOS Through the Rule of Reference: Potentials and Limits' (2021) 52 Ocean Development & International Law 419.

override, those found in other international agreements,[33] reinforcing the general principles and objectives established by UNCLOS. States are required to implement relevant international standards – even if not party to the underlying instruments – when these are referenced in UNCLOS,[34] with obligations framed using terms like 'no less effective than' or 'at least the same effect as'.[35] This built-in flexibility is evident in UNCLOS's frequent reference to 'generally accepted international rules and standards', allowing the Convention to evolve within the broader international legal system, including the global climate change regime.[36] A further interpretive guide is provided by the principle of systemic integration, as elaborated in the International Law Commission's Fragmentation Report and reinforced by the ICJ's 2025 Advisory Opinion.[37] The Court underscored that treaties must be interpreted in light of 'the broader normative environment of international law', requiring coherence between environmental and climate regimes.[38] Applied to UNCLOS, this suggests that obligations under Part XII should not be read in isolation but in conjunction with states' commitments under the UNFCCC and Paris Agreement. For marine geoengineering, this systemic perspective implies that the evaluation of ocean CDR cannot be confined to pollution-prevention obligations alone but must also reflect the parallel duty to mitigate climate change. Such integration strengthens the case for regulatory frameworks that balance ecological risks with potential climate benefits.[39]

2.1. The 2024 ITLOS Advisory Opinion and Its Implications for Marine Geoengineering

In this context, the 2024 ITLOS advisory opinion offers a useful point of reference. Many of the written submissions presented to the Tribunal argued that carbon dioxide falls within the definition

33 UNCLOS, art 237.

34 Kari Hakapaa, *Marine Pollution in International Law, Material Obligations and Jurisdiction with Special Reference to the Third United Nations Conference on the Law of the Sea* (Academia Scientiarum Fennica 1981) 119; Bernard H Oxman, 'Complementary Agreements and Compulsory Jurisdiction' (2001) 95 American Journal of International Law 277; Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, *The Law of the Sea: Obligations of States Parties under the United Nations Convention on the Law of the Sea and Complementary Instruments* (United Nations 2004) 1-2.

35 UNCLOS, art 208(3), 209(2), 210(6) and 211(2).

36 ITLOS Advisory Opinion (n 1) para 130.

37 International Law Commission, 'Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law' (13 April 2006) Document A/CN.4/L.682 and Add.1; ICJ, *Obligations of States in respect of Climate Change* (Advisory Opinion) 2025 <www.icj-cij.org/sites/default/files/case-related/187/187-20250723-adv-01-00-en.pdf> accessed 19 August 2025 (ICJ Advisory Opinion).

38 ICJ Advisory Opinion (n 37) paras 162-171. See also Inter-American Court of Human Rights, Advisory Opinion AO-32/25 of May 29, 2025 Requested by the Republic of Chile and the Republic of Colombia: Climate Emergency and Human Rights <www.corteidh.or.cr/docs/opiniones/seriea_32_en.pdf> accessed 2 September 2025 [120]-[149].

39 Monica Feria-Tinta, 'The Master Key to International Law: Systemic Integration in Climate Change Cases' (2024) 13 Cambridge International Law Journal 20.

of marine pollution under UNCLOS and that states have a duty to prevent pollution caused by CO_2 emissions.[40] Additionally, most submissions highlighted the importance of interpreting UNCLOS in a manner that systematically incorporates obligations established under the UNFCCC and the Paris Agreement.[41]

The advisory opinion established that GHG emissions constitute pollution of the marine environment under Article 1(1)(4) of UNCLOS.[42] To reach this conclusion, ITLOS analyzed the three key elements of 'marine pollution' outlined in Article 1: (1) the presence of a substance or energy, (2) its introduction into the marine environment by human activities, and (3) the likelihood of causing harmful effects.[43] While ITLOS emphasized that these criteria are cumulative – meaning all must be met – it also highlighted the broad scope of UNCLOS' pollution definition, which applies to any activity satisfying these conditions.[44]

Since ITLOS determined that GHG emissions constitute marine pollution, this triggers Article 194 of UNCLOS, which obligates states to 'take all necessary measures to prevent, reduce, and control pollution of the marine environment from any source'. Although Article 194 grants states discretion in selecting appropriate measures, ITLOS clarified that these decisions must be objective, based on the best available climate science and relevant international rules and standards.[45] After reviewing these, ITLOS concluded that Article 194 imposes a legal duty on states to reduce GHG emissions.[46] It framed this duty as one of 'due diligence', requiring states to establish and enforce national systems to control emissions.[47]

As discussed above (paragraph 1), while ITLOS' focus on GHG emission reductions aligns with the most urgent climate mitigation priority, scientific evidence indicates that reducing emissions alone will not suffice and GHG removal will also be necessary. Despite this, the advisory opinion does not discuss the potential role of GHG removal technologies in addressing marine pollution caused by anthropogenic emissions. The reasoning in the advisory opinion suggests that ITLOS does not view marine geoengineering and GHG removal as pollution mitigation measures, but rather as potentially polluting activities themselves.[48] In its only reference to marine geoengineering, ITLOS

40 Benoit Mayer, 'Request for an Advisory Opinion submitted by the Commission of Small Island States on Climate Change and International Law' (2025) 119 American Journal of International Law 153.

41 ibid.

42 ITLOS Advisory Opinion (n 1) para 179.

43 ibid para 161.

44 ibid.

45 ibid para 206-207.

46 ibid para 223.

47 ibid para 235.

48 Nathaniel Yong-Ern Khng, Advisory Opinion on the Request for an Advisory Opinion Submitted by the Comm'n of Small Island States on Climate Change and Int'l Law (I.T.L.O.S.)' (2024) 63 International Legal Materials 998.

cited Article 195 of UNCLOS, which prohibits shifting environmental damage from one area to another or transforming one form of pollution into another.[49] ITLOS cautioned that marine geoengineering would violate Article 195 if it resulted in such a transformation. However, the advisory opinion does not specify when marine geoengineering activities might constitute marine pollution. This definitional gap highlights a key challenge in the current legal landscape. While preliminary steps to create assessment criteria have been taken under the London Convention and Protocol (LC/LP) and by scientific bodies like the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP),[50] these efforts have resulted in a cautious and fragmented regulatory approach focused primarily on the narrow issue of 'dumping' (see below paragraph 4).[51]

Against this backdrop, ITLOS' interpretation of GHG emissions as a form of marine pollution could provide a useful framework for assessing whether activities such as ocean fertilization fall under UNCLOS Article 1(1)(4). For instance, ocean fertilization involves: (1) introducing a substance (e.g., iron) (2) into the marine environment via human activities (e.g., vessel discharge) (3) with potential harmful effects (e.g., algal blooms, nutrient depletion). The same reasoning could apply to other marine geoengineering methods, such as ocean alkalinity enhancement, reinforcing the idea that states engaging in or allowing these activities could violate UNCLOS pollution regulations.[52]

Despite acknowledging the severe impact of climate change on the ocean, including ocean acidification and warming, ITLOS also recognized that even if all anthropogenic GHG emissions ceased, the harmful effects on the marine environment would persist due to the existing accumulation of GHGs in the atmosphere.[53] Certain marine geoengineering techniques, particularly those involving GHG removal, are presented as potential tools to mitigate these effects. Yet their reliability and ecological safety remain contested,[54] which is why international bodies, including ITLOS, have tended to frame them primarily in terms of potential risks of marine pollution rather than as established mitigation measures. This is significant because Article 192 of UNCLOS imposes an obligation on states to protect and preserve the marine environment. ITLOS described this duty as 'broad in scope',

49 ITLOS Advisory Opinion (n 1) para 231.

50 GESAMP, *High Level Review of a Wide Range of Proposed Marine Geoengineering Techniques* (IMO 2019); IMO 'Report of the Forty-Sixth Consultative Meeting and the Nineteenth Meeting of Contracting Parties' (22 November 2024) LC 46/17.

51 Karen N Scott, 'Chapter 3 Mind the Gap: Marine Geoengineering and the Law of the Sea' in Robert C. Beckman and others (eds), *High Seas Governance* (Brill 2019); Kerryn Brent, 'Marine geoengineering governance and the importance of compatibility with the law of the sea' in Jan McDonald, Jeffrey McGee, Richard Barnes (eds), *Research Handbook on Climate Change, Oceans and Coasts* (Edward Elgar Publishing Limited 2020); Kangjie Sun and others, 'New Frontiers in the Law of the Sea and Policy Integration' (2025) 17 Water 1.

52 Robert C. Steenkamp, 'Legal Considerations Relevant to Research on Ocean Alkalinity Enhancement' [2023] State of the Planet 1.

53 ITLOS Advisory Opinion (n 1) para 199.

54 Sarah R Cooley and others, 'Sociotechnical Considerations About Ocean Carbon Dioxide Removal' (2023) 15 Annual Review of Marine Science 41.

encompassing all forms of harm to the marine environment, including those caused by climate change.[55] States are therefore obligated to protect marine ecosystems from climate-induced harm, and where damage has already occurred, they may also have a duty to take restorative measures. ITLOS acknowledged this by stating that 'preservation' may include restoring marine habitats and ecosystems.[56] The use of 'may' is best understood as introducing flexibility: the duty of restoration arises where necessary, depending on the status of the marine environment and the extent of climate-related degradation.[57]

In its advisory opinion, ITLOS highlighted that participants identified three main categories of actions to protect and preserve the marine environment in the context of climate change: (1) climate change mitigation measures, (2) adaptation and resilience strategies, and (3) initiatives concerning marine ecosystems, including those with carbon sequestration functions.[58] ITLOS confirmed that states have a legal obligation to reduce GHG emissions and are required to implement resilience and adaptation measures as prescribed under climate treaties.[59] However, it did not explicitly address states' obligations concerning the protection of marine ecosystems that act as carbon sinks.

Although ITLOS acknowledged that marine restoration efforts could enhance carbon sequestration, it did not clarify which specific measures states should or could implement. Many marine geoengineering approaches have the potential to increase carbon sequestration, mitigate ocean acidification, and counteract other climate-related impacts on the marine environment. However, given ITLOS' caution regarding pollution transformation under Article 195, the legal status of these activities under UNCLOS remains uncertain.

3. The Role of the London Convention and Protocol in Regulating Ocean Dumping

With regard to the regulation of pollution from dumping, UNCLOS directly references the London Convention of 1972 and its 1996 Protocol as the competent global framework. First, when defining 'dumping', UNCLOS largely adopted the definition used in the London Convention.[60] Addi-

55 ITLOS Advisory Opinion (n 1) para 385, 388.

56 ibid para 386.

57 ibid para 390; Yoshifumi Tanaka, *The International Law of the Sea* (4th edn, CUP 2023) 404-432; Bastiaan E Klerk, 'The ITLOS Advisory Opinion on Climate Change: Revisiting the Relationship between the United Nations Convention on the Law of the Sea and the Paris Agreement' (2025) 34 Review of European, Comparative & International Environmental Law 181.

58 Wenxian Qiu, Bingqing Wu and Tsung Han Tai, 'Judicialization and Legal Implications of International Maritime Governance in the Context of Climate Change: Insights from ITLOS Advisory Opinion No. 31' (2025) Frontiers in Marine Science 1.

59 ITLOS Advisory Opinion (n 1) para 390.

60 UNCLOS, art 1(1)(5); London Convention, art III (1)(a)-(b).

tionally, UNCLOS requires states to establish national laws on dumping that are at least as effective as the global rules and standards set by these instruments,[61] emphasizing the need for their periodic reassessment.[62] This dynamic has been carried forward by the Contracting Parties to the London Convention and Protocol. In practice, the Convention and the Protocol operate as a single institutional framework, with their Contracting Parties meeting jointly, adopting resolutions, and utilizing detailed waste assessment guidance to inform implementation.[63]

In terms of enforcement, states should exercise jurisdiction in accordance with UNCLOS provisions and relevant international norms formed through competent international organizations or diplomatic conferences.[64] If a state fails to meet its implementation and enforcement duties with respect to dumping, other UNCLOS parties may seek to hold it accountable under the Convention, including through the compulsory dispute settlement procedures provided for in Part XV.[65] The interconnection established through this rule of reference is significant because it ensures that global standards developed under the London Convention and Protocol acquire binding force within the broader UNCLOS framework, thereby reinforcing consistency and avoiding regulatory fragmentation.[66]

A central question for the governance of ocean CDR, therefore, is whether and to what extent these activities fall within the scope of the London Convention and Protocol. Both instruments define 'dumping' broadly as the deliberate disposal of wastes or other matter at sea from vessels, aircraft, platforms, or other man-made structures.[67] However, the definition explicitly excludes the 'placement of matter for a purpose other than mere disposal', provided that such placement is consistent with the treaties' objectives.[68]

Ocean CDR techniques present a challenge to this framework. Although they involve introducing substances into the marine environment, their purpose is not waste disposal, but the intentional

61 UNCLOS, art 210(1) and (6); Tanaka, *The International Law of the Sea* (n 57) 351-439; Proelss, *United Nations Convention on the Law of the Sea* (n 32) 1407-1419.

62 UNCLOS, art 210(4).

63 IMO, 'Waste Assessment Guidelines under the London Convention and Protocol' (IMO 2021); 45th Consultative Meeting of Contracting Parties to the London Convention and the 18th Meeting of Contracting Parties to the London Protocol (2-6 October 2023) 'Statement on Marine Geoengineering' LC 45/LP 18, annex 4; Andrew Birchenough, Fredrik Haag and Zhen Sun, 'The Development and Administration of the London Convention and Protocol: "Two Instruments, One Family" and Their Link to the United Nations Convention on the Law of the Sea' (2024) 39 The International Journal of Marine and Coastal Law 429, 433-434.

64 UNCLOS art 216(1).

65 Robin Churchill, Vaughan Lowe and Amy Sander, *The Law of the Sea* (4th edn, Manchester University Press 2022) 679.

66 London Convention, art XIII; UNCLOS, art 237; International Maritime Organization (IMO) 'Implications of the United Nations Convention on the Law of the Sea for the International Maritime Organization' LEG/MISC.8 (30 January 2014) 75-76; Wanping Zeng, Guihua Wang, 'A Study on the Governance Pathways of the Law of the Sea in Response to Climate Change' [2024] Frontiers in Marine Science 1.

67 London Convention, art III(1)(a); London Protocol, art 1(4)1.

68 London Convention, art III(1)(b)(ii); London Protocol, art 1(2)(2)

stimulation of carbon-sequestering mechanisms[69] either biological (e.g., phytoplankton growth via ocean fertilization or biomass generation through seaweed cultivation) or chemical (e.g., altering seawater alkalinity).[70] While the London Convention and Protocol do not define the term 'disposal', it has generally been understood in practice as the deliberate discarding of materials no longer considered useful.[71] However, the legal interpretation is not straightforward. In some official treaty languages, broader terms are used – for example, the French version refers to '*immersion*', which encompasses any introduction of material into the sea, not just waste disposal. In addition, the phrase 'wastes and other matter' is open-ended, creating uncertainty over whether materials introduced for carbon removal purposes fall within the scope of the Convention and Protocol.[72] As a result, whether an ocean CDR activity qualifies as 'dumping' or exempted 'placement', will depend on its consistency with the objectives of these instruments.

This assessment plays out differently across techniques. Ocean fertilization, for instance, involves the introduction of iron or other nutrients into surface waters for the purpose of stimulating phytoplankton growth.[73] Given that it requires the intentional discharge of substances from a vessel, it aligns closely with the definition of 'dumping', as illustrated by Resolution LC-LP.1 (2008),[74] which restricts non-research ocean fertilization. By contrast, ocean alkalinity enhancement generally entails the dispersal of alkaline minerals or electrochemically produced compounds.[75] These are not 'wastes' in the conventional sense but are introduced deliberately to alter seawater chemistry, raising uncertainty as to whether they fall within 'other matter' under the LC/LP. Seaweed cultivation raises yet another distinct challenge: while the initial placement of cultivation structures may not qualify as dumping, the eventual sinking of harvested biomass to sequester carbon could be interpreted as

69 IMO, 'Report of the 46th Meeting of the Scientific Group under the London Convention and the Seventeenth Meeting of the Scientific Group under the London Protocol' (31 March 2023) LC/SG 46/16; GESAMP, *High Level Review* (n 50) 15-28.

70 For an overview of the current scientific understanding and uncertainties surrounding key ocean CDR approaches, see: Matthew D Eisaman and others, 'Assessing the Technical Aspects of Ocean-Alkalinity-Enhancement Approaches' (2023) 2 State of the Planet 1; Ken O Buesseler and others, 'Next Steps for Assessing Ocean Iron Fertilization for Marine Carbon Dioxide Removal' [2024] Frontiers in Climate 1; Muhammad Ahmed Waqas and others, 'Environmental Performance of Seaweed Cultivation and Use in Different Industries: A Systematic Review' (2024) 48 Sustainable Production and Consumption 123.

71 IMO, 'Waste Assessment Guidelines' (n 63); Birchenough, Haag and Sun, 'The Development and Administration of the London Convention and Protocol' (n 63) 429.

72 IMO, 'Marine Geoengineering Including Ocean Fertilization: Progress Report from the Legal Intersessional Correspondence Group on Marine Geoengineering' (30 June 2023) LC 45/5/1.

73 David Emerson, 'A Cost Model for Ocean Iron Fertilization as a Means of Carbon Dioxide Removal That Compares Ship- and Aerial-Based Delivery, and Estimates Verification Costs' (2024) 12 Earth's Future 1.

74 IMO Resolution LC-LP.1(2008) on the Regulation of Ocean Fertilization (adopted 31 October 2008) LC 30/16 Annex 6 (2008 Resolution).

75 Yiming Guo and others, 'Site Selection for Ocean Alkalinity Enhancement Informed by Passive Tracer Simulations' (2025) 6 Communications Earth & Environment 1.

disposal.[76] These differences indicate that the regulatory assessment of ocean CDR techniques must be tailored to the specific characteristics of each method.[77]

The Parties to the London Convention and Protocol have sought to clarify the scope of their regimes through a series of resolutions. As mentioned above, Resolution LC-LP.1 affirms that ocean fertilization activities are inconsistent with the objectives of the two instruments unless conducted as legitimate scientific research.[78] This approach created a critical distinction: non-research ocean fertilization is considered 'dumping'. For Parties to the stricter London Protocol – which bans all dumping not explicitly permitted in its Annex 1 –[79] this effectively prohibits the activity. For Parties to the older London Convention, a permit could theoretically still be issued, as the substances used are not on its 'blacklist' of prohibited materials.[80] However, the joint resolutions have severely constrained this possibility in practice, thereby confining permissible activities to narrowly defined scientific research. In 2010, the Parties reinforced this stance with Resolution LC-LP.2, which introduced a precautionary assessment framework requiring environmental review before authorizing even research-related projects,[81] a practice reaffirmed in the 2023 Parties' Statement on Marine Geoengineering.[82]

Although these resolutions are not formally binding, they constitute subsequent practice that informs the interpretation of the Convention and Protocol.[83] They carry normative weight beyond the LC/LP system, as their approach is directly relevant to UNCLOS' duty of due diligence to prevent, reduce, and control marine pollution,[84] but it is intended primarily in a precautionary man-

76 Adam D Hughes, 'Seaweed Aquaculture for Carbon Farming: An Assessment Under the EU's QU.A.L.ITY (Quantification, Additionality, Long-Term Storage, Sustainability) Framework' (2025) 32 Corporate Social Responsibility and Environmental Management 3078.

77 NASEM, *A Research Strategy for Ocean-based Carbon Dioxide Removal and Sequestration* (n 19) 39; David L VanderZwaag and Abdul Hafez Mahamah, 'International Governance of Marine Geoengineering: Sketchy Seascape, Foggy Future – An Essay in Honor of Ted L. McDorman' (2024) 55 Ocean Development & International Law 624.

78 2008 Resolution, para 8.

79 London Protocol, Annex I: (1) dredged material, (2) sewage sludge, (3) fish waste, or material resulting from industrial fish processing operations, (4) vessels, platforms and other man-made structures, (5) inert, inorganic geological material, (6) organic material of natural origin, (7) bulky items primarily comprising iron, steel, concrete and similarly unharmful materials, and (8) carbon dioxide streams from carbon dioxide capture processes for sequestration.

80 London Convention, Annex I: (1) organohalogen compounds, (2) mercury and mercury compounds, (3) cadmium and cadmium compounds, (4) persistent plastics and other persistent synthetic materials, (5) crude oil and its wastes, refined petroleum products, petroleum, distillate residues, and mixtures containing those substances, (6) radiative wastes and other radioactive matter, (7) materials produced for biological and chemical warfare, and (8) industrial waste.

81 IMO Resolution LC-LP.2(2010) on the Assessment Framework for Scientific Research Involving Ocean Fertilization (adopted 14 October 2010) LC 32/15 Annex 5 (2010 Resolution).

82 IMO 'Statement on Marine Geoengineering' (n 63).

83 Alexander Proelss, 'Law of the Sea and Geoengineering' in Nele Matz-Lück, Øystein Jensen and Elise Johansen (eds), *The Law of the Sea: Normative Context and Interactions with other Legal Regimes* (Routledge 2024).

84 UNCLOS arts 192, 194; ITLOS Advisory Opinion (n 1) para 234; Chris Vivian and Linda Del Savio, 'The London Convention and Protocol: Adapting to Address the Ocean-Climate Crisis' (2024) 39 The International Journal of Marine and Coastal Law 519.

ner.[85] This underscores the potential limitations of relying solely on UNCLOS and LC/LP for ocean CDR governance. This is exemplified by the 2013 marine geoengineering amendment to the London Protocol, whose strict monitoring and assessment framework was designed to manage precaution rather than to enable a multidimensional evaluation of ecological, climatic, and societal factors.[86]

3.1 The 2013 Amendment: Limits and Prospects for Regulating Marine Geoengineering

In 2013, the Parties to the London Protocol adopted an amendment aimed at regulating marine geoengineering activities.[87] Although it is not yet in force, the amendment has become a key point of reference in subsequent practice, with recent statements of the Contracting Parties explicitly recalling its provisions.[88] Once effective, it will prohibit the placement of matter into the sea for marine geoengineering activities listed in Annex 4 of the London Protocol, unless the listing itself allows for a permit.[89] Moreover, the amendment defines marine geoengineering broadly, encompassing a wide range of ocean CDR techniques.[90] To date, only ocean fertilization has been listed, and consistent with the 2008 resolution, it may be permitted only if conducted as legitimate scientific research.[91]

In response to the growing interest in alternative techniques, the Parties to the London Convention and Protocol, in 2022, identified four additional marine geoengineering approaches – seaweed cultivation, ocean alkalinity enhancement, and two solar radiation management techniques – for priority evaluation.[92] In the same year, they established a working group – the Legal Intersessional Correspondence Group on Marine Geoengineering – to assess, among other issues, whether these four techniques should be added to the 2013 amendment's regulatory framework.[93]

Despite being the most advanced international framework on this topic, the London Protocol's approach has significant limitations. A key shortcoming is that it fails to integrate the increasing necessity of developing geoengineering technologies as part of broader climate change mitigation

85 Youna LBL Lyons, David Santillo, and Federica Catonini, 'Legitimate Scientific Research: Objective Scientific Assessment of Marine Geoengineering Activities under the London Convention and London Protocol' (2024) 39 The International Journal of Marine and Coastal Law 528.

86 José M Pacheco Castillo, Dorothee Seybold, and David Santillo, 'The London Regime's Adaptability and Impact' (2024) 39 The International Journal of Marine and Coastal Law 440.

87 2013 Amendment (n 18).

88 44th Consultative Meeting of Contracting Parties to the London Convention and the 17th Meeting of Contracting Parties to the London Protocol (15 November 2022) LC 44/17; IMO 'Statement on Marine Geoengineering' (n 62).

89 2013 Amendment (n 18) art 6 bis (1).

90 ibid art 1 para 5 bis.

91 ibid Annex 4 para 1(3).

92 LC 44/17 (n 89) Annex 2.

93 IMO, 'Marine Geoengineering Techniques for Climate Change Mitigation - LP/LC Evaluates Potential for Marine Environment Effects' <www.imo.org/en/MediaCentre/PressBriefings/pages/Marine-geoengineering.aspx> accessed 14 March 2025.

strategies. The amendment was negotiated before the 2015 Paris Agreement and therefore reflects a scientific and political context where CDR was not yet framed by the IPCC as a central element of mitigation pathways.[94] Subsequent scientific assessments have highlighted that negative emissions are now regarded as relevant components of climate strategies,[95] a perspective absent when the amendment was drafted.

Furthermore, the amendment's framework assesses activities solely based on their potential to harm the marine environment, without a mechanism to weigh those risks against the profound and worsening risks of climate inaction. Whether a given activity constitutes marine pollution requires an evaluation of its net ecological effect, considering both potential harms and benefits.[96] The objectives of the UNFCCC and the LC/LP are therefore intertwined: stabilizing atmospheric GHG concentrations presupposes that the ocean's carbon absorption capacity remains stable or improves, and both questions must be considered together.[97] While Annex 5 of the amendment requires permitting procedures to minimize environmental impacts, it does not establish a governance mechanism for this balancing act, leaving significant uncertainty.[98]

This suggests that a more differentiated governance approach is needed. Techniques such as ocean fertilization, ocean alkalinity enhancement, and biomass-based methods involve very different types of intervention in the marine environment, and thus raise distinct applicability questions under existing instruments.[99] Building on this recognition, the emerging BBNJ Agreement could provide a pathway to embed ocean CDR governance within a more coherent international framework, ensuring that ocean protection and climate mitigation are pursued in tandem.

4. Bridging Climate and Ocean Governance: Opportunities within the BBNJ Agreement

The Agreement under the United Nations Convention on the Law of the Sea on the Conservation

94 IPCC, *Climate Change 2014: Mitigation of Climate Change. Working Group III Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (CUP 2014); IPCC, *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* (CUP 2018).

95 Mustafa Babiker and others, 'Cross-sectoral Perspectives' in IPCC, *Climate Change 2022: Mitigation of Climate Change* (CUP 2022), 1245-1354; GESAMP, *High Level Review* (n 50).

96 GESAMP, *High Level Review* (n 50) 15-28; IMO, 'Report of the 46th Meeting of the Scientific Group' (n 70).

97 Laura G Elsler and others, 'Protecting Ocean Carbon Through Biodiversity and Climate Governance' (2022) 9 Frontiers in Marine Science 1.

98 Babiker (n 96).

99 Johnson (n 10); Proelss, 'Law of the Sea and Geoengineering' (n 84).

and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (BBNJ Agreement) was formally adopted in June 2023 as the third implementing agreement of UNCLOS. As such, it is intended to complement and operate within the UNCLOS framework, alongside existing global, sectoral and regional instruments, including those relevant to climate and marine environmental governance.[100] The Agreement applies to the High Seas and 'the Area' defined as 'the seabed and subsoil beyond the limits of national jurisdiction'.[101]

Although climate change is only mentioned in passing in the treaty text, the Agreement nonetheless establishes mechanisms that can indirectly address climate related threats to marine biodiversity, such as ocean warming and acidification.[102] In particular, it promotes an ecosystem-based approach designed to enhance resilience to climate change, support the restoration of marine ecosystem integrity, and safeguard ecological processes such as carbon cycling services that are essential to the ocean's role in regulating the global climate.[103] The Agreement also strengthens coherence in decision-making by introducing concrete tools – including Area-Based Management Tools (ABMTs), Environmental Impact Assessments (EIAs), and provisions on institutional cooperation –[104] which can be mobilized to address cumulative pressures on biodiversity, including those associated with climate change and marine geoengineering.[105]

Although some scholars have expressed concern that the BBNJ Agreement could exacerbate institutional fragmentation if treated solely as a gap-filling instrument,[106] it may also serve as a bridging framework between the law of the sea and the international climate regime. In particular, by operationalizing cross-cutting procedures such as EIAs and ABMTs in Areas beyond National Jurisdiction (ABNJ), the Agreement could enhance coherence in decision-making processes affecting biodiversity and climate-relevant marine ecosystems.[107]

The BBNJ Agreement does not explicitly regulate marine CDR (mCDR), yet one of the key drivers behind its adoption was the broader need to assess and manage emerging human activities in areas beyond national jurisdiction. To date, as most mCDR research has been carried out in coastal

100 BBNJ Agreement, art 5.

101 UNCLOS, art 1(1)(1); BBNJ Agreement, art 1(2).

102 BBNJ Agreement, Preamble.

103 ibid art 7(h).

104 ibid arts 17-27 (ABMTs), arts 27-39 (EIAs); arts 47-51 (institutional arrangements).

105 Rakhyun E. Kim, 'The likely impact of the BBNJ Agreement on the architecture of ocean governance' (2024) 165 Marine Policy 1.

106 ibid; Johan Nikolaj Lausen, Johanna Sophie Buerkert, 'Fragmentation Revisited: A Critical Analysis of the Effects of Introducing the BBNJ Agreement into the Ocean Governance Landscape' (2025) 94 Nordic Journal of International Law 184.

107 Elizabeth M De Santo and others, 'Protecting Biodiversity in Areas Beyond National Jurisdiction: An Earth System Governance Perspective' [2019] Earth System Governance 1; Karen N Scott, 'The BBNJ Agreement: Strengthening the Oceans-Climate Nexus?' in James Kraska, Ronan Long and Myron H Nordquist, *Peaceful Maritime Engagement in East Asia and the Pacific Region* (Brill 2022).

and nearshore environments under national jurisdiction, the LC/LP framework has rightly been the primary focus of regulatory attention.[108] However, the BBNJ Agreement is poised to become a critical complementary instrument for two key reasons. First, it provides a framework for governing future large-scale research or deployment that may occur within ABNJ. Second, and perhaps more importantly, it offers mechanisms to assess and manage the transboundary effects of national activities that extend into the high seas. In this sense, it fills a crucial governance gap by providing a framework to oversee mCDR activities that either take place in ABNJ or have significant impacts there.

The BBNJ Agreement may contribute to the governance of ocean CDR activities through its provisions on area-based management tools (ABMTs). The treaty defines an ABMT as a regulatory tool, such as a marine protected area, that applies to a geographically defined region where specific activities are managed to achieve conservation and sustainable use goals.[109] In principle, ABMTs could be used to guide the siting and conduct of mCDR projects – for example, by restricting activities in ecologically sensitive areas or requiring a staged research approach with continuous monitoring.[110] However, this competence is subject to a critical legal limit: Article 5(2) of the Agreement contains a 'not-undermine' obligation. This means that any ABMT established under the BBNJ must respect the mandates and frameworks of other relevant legal instruments and bodies, notably the LC/LP and the UNFCCC.[111] Building on this limitation, Article 8 requires Parties both to strengthen cooperation with other relevant frameworks and to promote the objectives of the BBNJ when engaging in their decision-making.

Read together, Articles 5(2) and 8 establish a balance: the BBNJ Agreement cannot override the mandates of the LC/LP or the UNFCCC, but it can complement them by supplying procedures and institutional mechanisms that those regimes lack.[112] This bridging role is further reinforced by the Conference of the Parties (COP), which is empowered not only to consider proposals for ABMTs but also to oversee EIAs and manage the Clearing-House Mechanism (see paragraph 5.1 below). Decision-making rules under Articles 48 and 49 emphasize broad participation and reliance on the best available science, enabling the COP to develop common standards for the assessment of novel

108 GESAMP, *High Level Review* (n 50) 42-78; Charlotte Clarke and others, 'Cumulative Effect Assessment in the Marine Environment: A Focus on the London Protocol/ London Convention' (2022) 136 Environmental Science & Policy 428.

109 BBNJ Agreement, art 1(1).

110 Bastiaan E. Klerk and others, 'Beyond Equilibrium Thinking: Dynamic Area-Based Management Tools in a Changing Ocean' (2024) 11 Frontiers in Marine Science 1.

111 Daniel Bodansky, 'Four Treaties in One: The Biodiversity Beyond National Jurisdiction Agreement' (2024) 118 American Journal of International Law 299; Robert C. Steenkamp, *International Law and Marine Geoengineering* (Nomos 2025).

112 Shani Friedman, 'The interaction of the BBNJ agreement and the legal regime of the Area, and its influence on the implementation of the BBNJ agreement' (2024) 167 Marine Policy 1.

activities, including ocean CDR, in ABNJ.[113]

The Agreement establishes a comprehensive process for designating and implementing ABMTs, which, if effectively enforced, could contribute to a balanced framework for ocean CDR governance. Under this system, Parties to the BBNJ Agreement can submit to the secretariat proposals for new ABMTs,[114] which are then subject to approval or rejection by the COP through the procedure described above.[115] These proposals must be grounded in the best available science and developed in consultation with relevant stakeholders, including civil society, the scientific community, the private sector and local communities.[116] Subsequently, if a proposal is approved, Parties must establish mechanisms for ongoing consultation and coordination with other international legal frameworks.[117]

The BBNJ Agreement's consultation requirements with the scientific community and other stakeholders ensure that diverse perspectives are considered. This approach promotes a more comprehensive assessment of ocean CDR, explicitly accounting for both risks and potential benefits. By contrast, as highlighted above, the London Convention and Protocol have so far approached marine geoengineering primarily through a precautionary lens, with discussions emphasizing ecological risks. While their assessment frameworks acknowledge that potential climate benefits may be relevant,[118] the regime's focus remains largely on preventing environmental harm, rather than weighing risks and benefits in a broader climate governance context.[119]

Beyond ABMTs, the BBNJ Agreement could also support climate governance through its provisions on environmental impact assessments (EIAs).[120] While the obligation to conduct EIAs is well established in international law, their precise scope and application remain uncertain. Part IV of the BBNJ Agreement helps address this gap by setting out specific processes and thresholds for EIAs in ABNJ. Article 27 explicitly emphasizes the need to consider cumulative impacts in this process.

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113 Christine Gaebel and others, 'Institutionalising Science and Knowledge Under the Agreement for the Conservation and Sustainable Use of Marine Biodiversity of Areas Beyond National Jurisdiction (BBNJ): Stakeholder Perspectives on a Fit-for-Purpose Scientific and Technical Body' (2024) 161 Marine Policy 1.

114 BBNJ Agreement, art 19(1)

115 ibid art 22(1)(a).

116 ibid art 19 (2)-(3).

117 ibid art 22(3).

118 Harald Ginzky and Andreas Oschlies, 'Effective control mechanisms of research on climate engineering techniques for the public good: The London Protocol regulatory approach as a role model' (2024) 6 Frontiers in Climate 1; Youna LBL Lyons and others, 'Legitimate Scientific Research: Objective Scientific Assessment of Marine Geoengineering Activities under the London Convention and London Protocol' (2024) 39 The International Journal of Marine and Coastal Law 528.

119 2013 Amendment (n 18) Annex 4; IMO, 'Statement on Marine Geoengineering' (n 62). See also Compendium of Canada's Engagement in International Environmental Agreements And Instruments (Minister of Environment and Climate Change, 2020) <www.canada.ca/en/environment-climate-change/corporate/international-affairs/partnerships-organizations/london-protocol-prevention-marine-pollution.html> which notes that the Protocol's objective is to 'protect and preserve the marine environment… implementing a precautionary approach' and that amendments target the prevention of marine pollution from geoengineering.

120 BBNJ Agreement, arts 27-39; Scott, 'The BBNJ Agreement' (n 109) 415-416.

Under Article 1(6), cumulative impacts are defined to include climate change, ocean acidification, and related effects. Article 30(1)(ii) further requires that such cumulative impacts be taken into account 'as far as possible' when conducting an EIA. Although the obligation to assess cumulative impacts is already reflected in UNCLOS and further developed through LC/LP practice,[121] the BBNJ Agreement represents an important step forward by expressly integrating climate change and ocean acidification into the EIA process for activities in ABNJ.[122]

On this basis, when a country determines that an activity under its jurisdiction or control may have more than a minor or transitory impact on the marine environment, or when the potential effects are unknown or poorly understood, there is the requirement to conduct a preliminary screening.[123] Given the scientific uncertainty surrounding mCDR, most projects will trigger this requirement. If the screening reveals potential for harmful impacts, a full EIA is required. The Agreement further entrusts the COP with an oversight role: EIA reports must be submitted for circulation, transparency, and review, thereby strengthening accountability and enabling consistency across Parties.[124] This process ensures that the COP can function as a central forum for scrutinizing information and facilitating coordination with other international frameworks, supporting consistent standards and informed decision-making on ocean CDR activities.[125]

4.1. The Clear-House Mechanism: Enabling Inclusive Governance of Marine CDR

Some scholars argue that due to various forms of scientific uncertainty – including incomplete data and limited understanding of the potential impacts of ocean CDR on marine biodiversity – it is unlikely that the decision-making bodies established under the BBNJ Agreement will have the necessary mandate or expertise to effectively address the challenges posed by climate change and ocean acidification.[126] We argue that the BBNJ Agreement's new institutional instrument – the Clearing-House Mechanism (CHM) – could play a key role in enhancing transparency, coordination, and information-sharing related to ocean CDR activities. Established under Article 51 of the BBNJ Agreement, the CHM will function as an open-access platform to be developed by the Conference of the Parties.

Indeed, one of the main challenges in assessing and governing marine carbon dioxide removal

121 UNCLOS, arts 204-206; IMO Resolution LC-LP.2 (n 82).

122 BBNJ Agreement, art 1(6).

123 ibid art 30(1) and 31(1)(a).

124 ibid art 47(6).

125 Ibid arts 29(2) and 38(1).

126 De Santo and others (n 109) 2-3; Scott, 'The BBNJ Agreement' (n 109) 414-415.

is promoting knowledge pluralism.[127] This concept entails the engagement with diverse knowledge systems, disciplines, and stakeholder perspectives to support informed and inclusive decision-making processes and it is increasingly recognized as essential for the effective assessment and governance of mCDR approaches.[128] The purpose of the CHM is to facilitate the sharing, provision, and dissemination of information related to activities carried out under the Agreement, including those involving environmental impact assessments. Alongside its role in supporting environmental impact assessments and information exchange, the CHM should also be considered for its potential to facilitate knowledge pluralism. In particular, by enabling broader participation and integrating different perspectives, the CHM could contribute to more comprehensive evaluations of ocean CDR research and implementation proposals in, or with impacts on, areas beyond national jurisdiction.

In addition, complementing this mechanism is the Scientific and Technical Body (STB), established under Article 49 of the BBNJ Agreement, which could support the CHM and EIA processes by providing expert advice and guidance. In electing the STB's members, the Conference of the Parties (COP) is required to consider the importance of multidisciplinary expertise – including scientific and technical knowledge, as well as traditional knowledge held by Indigenous Peoples and local communities – along with equitable geographical representation.[129] This inclusive language opens the door for the participation of diverse knowledge holders within the STB, allowing the body to reflect a broader understanding of marine environments that extends beyond conventional scientific expertise.

Consequently, the CHM and STB could play a significant role in supporting the EIA process. Once an mCDR activity is approved, the proponent state assumes ongoing obligations to monitor and report on its impacts.[130] States are required to prepare regular reports and make them publicly accessible through the Clearing-House Mechanism.[131] The Scientific and Technical Body will review the reports and use the information to identify best practices and contribute to the development of future monitoring guidelines. In this way, the scope of monitoring extends beyond environmental effects to include economic, social, and health impacts. Therefore, these provisions create different channels through which a range of knowledge holders can contribute feedback on the monitoring and reporting of mCDR activities.

However, despite the treaty's promising language, the way in which the CHM will be operational-

127 Miranda Boettcher, Kerryn Brent, 'The Potential of the BBNJ Clearing House Mechanism to Enhance Knowledge Pluralism in Marine Carbon Dioxide Removal Assessment' [2024] Frontiers in Climate 1.

128 GESAMP, *High Level Review* (n 50); Miranda Boettcher and others, 'A Code of Conduct for Marine Carbon Dioxide Removal Research' (November 2023) Aspen Institute: Energy & Environment <https://oceanrep.geomar.de/id/eprint/59778/1/110223_Code-of-Conduct_FINAL2.pdf> accessed 25 March 2025.

129 BBNJ Agreement, art 49(2).

130 ibid art 35.

131 ibid art 36.

ized in practice to promote knowledge pluralism remains uncertain. This challenge extends beyond the governance of mCDR and reflects broader concerns in high seas governance. As currently described, the CHM is intended to serve as a structured, open-access platform for sharing information related to activities under the BBNJ Agreement. Nonetheless, the mere availability of information does not guarantee its accessibility. A central concern is how information submitted by proponent states, the STB, and other stakeholders will be presented. If materials are overly technical and lack clear, user-friendly summaries, the CHM's potential to support plural knowledge synthesis will be significantly constrained. To address this, the Conference of the Parties should consider how the STB or other relevant bodies might enhance accessibility – such as by requiring plain-language summaries or explanatory materials to facilitate engagement from a broader range of knowledge holders.

In addition, merely making information available does not ensure meaningful participation. The treaty provides limited guidance to proponent states on how notification and consultation should be conducted. Nevertheless, Article 38 – by mandating the STB to develop guidelines and standards for notification and consultation processes – creates an opportunity for the STB to define best practices for stakeholder engagement, particularly for activities in areas beyond national jurisdiction, including mCDR initiatives. The inclusion of diverse forms of knowledge – scientific, local, traditional, and Indigenous – will be essential to ensuring that assessments are inclusive and representative.[132]

Consequently, to realize the CHM's full potential in supporting inclusive governance of mCDR, we argue that several factors must be addressed during the treaty's implementation phase. These include ensuring that the STB reflects a diversity of expertise, that the CHM facilitates broad and meaningful access to information, and that robust standards for consultation are adopted. If effectively implemented, the BBNJ's Clearing-House Mechanism could play a central role in shaping the future governance of the mCDR on the high seas. Addressing these challenges proactively would not only advance knowledge pluralism in marine assessment processes but also contribute to the development of a stronger, more inclusive legal framework for the governance of marine geoengineering in response to climate change.

Nonetheless, the BBNJ Agreement's effectiveness will ultimately depend on the commitment of states to implementing its provisions. The treaty was opened for signature on 20th September 2023 and, to date, has been signed by 112 countries. However, only 21 countries have completed the ratification process. For the treaty to enter into force, it must be ratified by at least 60 countries, a process that could take considerable time.

132 Yoshifumi Tanaka, 'Reflections on the Environmental Impact Assessment in the BBNJ Agreement: Its Implications for the Conservation of Biological Diversity in the Marine Arctic beyond National Jurisdiction' (2024) 55 Ocean Development and International Law 85.

5. Final remarks

As the international community seeks to address the dual crises of climate change and marine biodiversity loss, the emergence of marine carbon dioxide removal in the global climate agenda underscores the need for legal frameworks that can integrate ocean protection obligations with emerging climate responses. Existing instruments such as UNCLOS and the LC/LP establish important principles for marine environmental protection but were not designed to address novel technological developments at the intersection of climate mitigation and ocean governance. For instance, the LC/LP's framework for assessing the 'dumping' of wastes is not well-equipped to evaluate the systemic, transboundary effects of activities like ocean alkalinity enhancement, which alter ocean chemistry rather than simply adding a pollutant. Their sectoral scope and limited institutional mechanisms leave uncertainties about how to assess, authorize, and monitor these activities in a coordinated manner.

In this respect, the BBNJ Agreement offers procedural innovations that provide complementary mechanisms to existing regimes. Its provisions on environmental impact assessments, area-based management tools, and transparency obligations provide new avenues for integrating climate-related risks into ocean governance. At the same time, its potential is subject to important limitations: the Agreement does not explicitly regulate marine geoengineering; its 'not undermine' clause requires careful coordination with existing regimes such as the London Convention and Protocol, and its effectiveness will depend heavily on the pace of ratification, the design of its institutions, and the political will of Parties. Nonetheless, the Agreement's emphasis on cumulative impacts, consultation with diverse knowledge systems, and inclusive decision-making broadens the range of perspectives that can be brought into regulatory processes, advancing the systemic integration of ocean protection and climate governance and offering opportunities for more context-sensitive governance of ocean-based CDR.

Rather than displacing precaution, these procedural tools could reinforce it within a more coherent governance framework by operationalizing a more balanced and procedural application of the principle. This ensures that, whereas the London Convention and Protocol have tended to approach marine geoengineering within a predominantly risk-averse framework centred on pollution prevention, both ecological risks and potential climate benefits are assessed transparently and collectively. If implemented effectively, the Agreement may serve as a bridge between the law of the sea and the climate regime by embedding cross-cutting mechanisms such as EIAs and ABMTs in areas beyond national jurisdiction, complementing rather than replacing the role of the LC/LP. In this way, the BBNJ Agreement could provide an adaptive legal framework – one capable of responding to evolving scientific knowledge, technological developments, and the need for inter-regime cooperation – while helping to prevent fragmentation in the governance of marine geoengineering.