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Geoengineering: The Relevance of the UN Convention on the Law of the Sea and the BBNJ Agreement

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Abstract

Despite earlier calls for a pause, investment in geoengineering technologies and field experiments proposing to counter climate change is booming. At present there is no effective global governance regime to ensure that such technologies are safe, effective or equitable. This article explores the relevant obligations for geoengineering activities with potential impacts on the marine environment and explores what ‘due diligence’ for environmental impact assessments and strategic environmental impact assessments entails, considering, amongst other sources, the recent International Tribunal for the Law of the Sea *Climate Change Advisory Opinion*. It concludes that international rules and national regulations should build upon these obligations before any deployment is approved.

Keywords

LOSC – BBNJ Agreement – geoengineering – carbon dioxide removal – solar radiation management

Introduction¹

Forty years ago, when the *International Journal of Marine and Coastal Law (IJMCL)* was launched, technologies to alter the global climate through geoengineering, for example by reflecting sunlight (solar radiation modification or SRM) or removing or transferring carbon dioxide from the atmosphere for long-term sequestration in the environment (carbon dioxide removal or CDR),² were still the stuff of science fiction.³

In 2007, commercial efforts to issue voluntary carbon credits to fund early ocean fertilisation experiments brought marine geoengineering to international attention.⁴ Discussions were rapidly launched in the *Journal* and beyond to find ways to regulate this new activity, including via the London Convention and London Protocol (LC/LP). These discussions led to calls from the LC/LP to prohibit ocean fertilisation activities except 'legitimate scientific research'⁵ and from the Convention on Biological Diversity (CBD) for a precautionary moratorium until there is 'an adequate scientific basis' and 'a global, transparent and effective control and regulatory mechanism'.⁶ Forty years on, despite earlier calls for a pause, investments in SRM and CDR are booming, with 787 greenhouse gas removal and 16 SRM projects, including 74 field experiments, ongoing and planned around the world.⁷

Before geoengineering transitions to larger-scale projects and potential deployment, there is an urgent need for international safeguards to

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- 1 Acknowledgements: Many thanks to Synchronicity Earth and IUCN for their support. Views are the authors' own.
 - 2 Geoengineering has been defined as 'the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change'. *Geoengineering the Climate: Science, Governance and Uncertainty* (Royal Society, 2009) 1.
 - 3 C Pak, 'Terraforming and geoengineering in science fiction' (Strange Horizons, 2016) available at <http://strangehorizons.com/wordpress/non-fiction/articles/terraforming-and-geoengineering-in-science-fiction/>; accessed 31 May 2025.
 - 4 R Rayfuse, M Lawrence and K Gjerde, 'Ocean fertilisation and climate change: The need to regulate emerging high seas uses' (2008) 23(2) *IJMCL* 297–326.
 - 5 Statement of Concern Regarding Iron Fertilization of the Oceans to Sequester CO₂, IMO Doc LC-LP.1/Circ.14 (13 July 2007); On the Regulation of Ocean Fertilization, IMO Resolution LC-LP.1, adopted 31 October 2008, preamble, recital 6.
 - 6 CBD Conference of Parties (COP) Decision IX/16, Biodiversity and Climate Change (2008) section C: Ocean Fertilization; CBD COP Decision x/33, Biodiversity and Climate Change (2010) para 8(w) (extended to all geoengineering activities); CBD COP Decision 16/22, Biodiversity and Climate Change (2024) para 6 (reaffirming decisions).
 - 7 ETC Group and the Heinrich Boell Foundation, 'Geoengineering map' available at <https://map.geoengineeringmonitor.org/>; accessed 31 May 2025.

ensure that geoengineering can be effectively and equitably regulated to verify its environmental safety, effectiveness, legitimacy, transparency and accountability.⁸ Given the high risks and uncertainties of impact, no geoengineering technologies should be deployed before a robust governance framework is established.

This article seeks to spark a broader discussion of geoengineering through the lens of the international obligations under the 1982 United Nations Convention on the Law of the Sea (LOSC) and its 2023 Agreement for the Conservation and Sustainable Use of Marine Biodiversity in Areas beyond National Jurisdiction (BBNJ Agreement). First, the relevant obligations in the LOSC as illuminated by the recent ITLOS *Climate Change Advisory Opinion* are distilled. Next, the focus is on the BBNJ Agreement with its more specific obligations, principles and approaches relating to environmental impact assessments (EIAs). International rules and national regulations covering geoengineering will be essential to effectively protect the marine environment. These should build upon and not undermine the obligations, principles and standards of the LOSC and the BBNJ Agreement, amongst other sources of international law, including the precautionary principle and the duty to prevent transboundary harm.⁹

What Are the Relevant Obligations under the LOSC?

The term ‘geoengineering’ covers a vast array of technologies at various stages of development such as ocean fertilisation, alkalinity enhancement, marine cloud brightening, and stratospheric aerosol injection. What these technologies have in common is their aim to have large-scale impacts on the climate system. However, most fail to consider their potential impacts on the marine environment.¹⁰ Yet many of these technologies have the potential to dysregulate ecological processes, decrease photosynthesis, disrupt ocean circulation,

8 GESAMP, *The State of the Science for Marine Carbon Dioxide Removal: A Scientific Summary for Policy-Makers* (UNESCO, 2025); L Bronkalla and D Ruddigkeit, *Solar Radiation Modification (SRM)* (German Environment Agency, 2025); S Prufer, ‘Mitigating Environmental Harm: Enhancing International Governance of Marine Carbon Dioxide Removal’ (J.D. Supervised Analytic Writing, Yale Law School, 2025).

9 D Freestone, ‘Principles applicable to modern oceans governance’ (2008) 23(3) *IJMCL* 385–391.

10 ND Gallo *et al.*, ‘Illuminating deep-sea considerations and experimental approaches form CDR proposals’ (2025) 20 *Environmental Research Letters* 061003.

and alter ocean biochemistry from the sea surface to the sea floor.¹¹ Some even have the potential to *increase* greenhouse gas emissions and lead to unintended warming effects.¹²

As the constitution for the ocean, the LOSC is widely recognised as reflecting international law governing the rights and obligations of States for activities in or affecting the marine environment. While the LOSC is grounded on the principle of ‘freedom of the high seas’, even this freedom is not absolute. Instead, high seas freedoms are to be exercised subject to the conditions laid down in the LOSC and other rules of international law.¹³ These conditions include Article 192, which recognises the responsibility of States to protect and preserve the marine environment. Article 194(5) specifically extends that responsibility to a duty to protect rare and fragile ecosystems and the habitats of threatened, endangered or depleted species. Articles 194–196 contain stringent obligations to prevent, reduce and control various forms of marine pollution.¹⁴ For activities such as geoengineering where there are no international rules in place, Article 197 impels States to ‘cooperate on a global basis, and as appropriate, on a regional basis’, in developing ‘international rules, standards and recommended practices and procedures for the protection and preservation of the marine environment’.

The LOSC, unlike other international instruments, covers the full range of activities taking place on land, sea, the atmosphere or even outer space if such activity may have a significant impact on the marine environment. Other international rules for geoengineering do not have such a far reach. Neither the United Nations Framework Convention on Climate Change (UNFCCC) nor the Paris Agreement includes provisions directly governing geoengineering. Parties to the LC/LP have adopted standards for ocean fertilisation research that could be extended to other forms of marine geoengineering.¹⁵ However, an amendment related to marine geoengineering has not yet entered into force.¹⁶ Moreover, the LC/LP only cover dumping or the placement of matter (likely to cause pollution) into the sea from ships, aircraft, platforms or other

11 *Ibid.*; GESAMP (n 8); Bronkalla (n 8); Prufer (n 8).

12 Gallo (n 10).

13 LOSC, Article 87; Freestone (n 9).

14 LOSC, Article 1(4) (defining pollution).

15 Assessment Framework for Scientific Research involving Ocean Fertilization, IMO Resolution LC-LP.2, adopted 14 October 2010.

16 On the Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and Other Marine Geoengineering Activities, IMO Resolution LP.4(8), adopted 18 October 2013.

manmade structures.¹⁷ Thus discharges from land and SRM-focused initiatives are unlikely to be covered.¹⁸ The BBNJ Agreement has detailed provisions with respect to EIAs for planned activities in areas beyond national jurisdiction (ABNJ), but activities within national jurisdiction that affect ABNJ only need to follow those detailed provisions where no national EIA systems exist. The CBD has a global reach, but many view the CBD decision calling for a moratorium on geoengineering as non-binding.¹⁹ Indeed, VanderZwaag and Mahamah conclude:

The clearest reality is that MGE [marine geoengineering] will stay as a devilish governance challenge and a hotly contested topic. Treacherous waves of ethical, social, and cultural values have to be navigated, and the political tides remain unsettled.²⁰

Thus, LOSC remains very relevant in the context of geoengineering.

The ITLOS *Climate Change Advisory Opinion* gave substance, weight and teeth to these LOSC provisions in the context of greenhouse gas emissions. Contrary to what some have asserted,²¹ we find that a close analysis of the Advisory Opinion reveals it is also directly relevant to geoengineering that may cause pollution or significant or harmful changes to the marine environment.

The key finding of the Advisory Opinion is that LOSC Parties have an obligation to take action to prevent, reduce and control pollution from any source, including greenhouse gas emissions. Most directly on the issue of geoengineering, it provides:

Article 195 of the Convention requires States, in taking measures to prevent, reduce and control pollution of the marine environment, not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another. Marine geoengineering

¹⁷ Rayfuse *et al.* (n 4).

¹⁸ DL VanderZwaag and AH Mahamah, 'International governance of marine geoengineering: Sketchy seascape, foggy future – An essay in honor of Ted L. McDorman' (2024) 55(4) *Ocean Development & International Law* 624–636.

¹⁹ CBD Decision x/33 (n 6) para 8; VanderZwaag and Mahamah (n 18).

²⁰ VanderZwaag and Mahamah (n 18), at p. 636.

²¹ R Webb, 'The ITLOS advisory opinion and marine geoengineering: More questions, few answers' (*Climate Law Blog*, 24 May 2024) available at <https://blogs.law.columbia.edu/climatechange/2024/05/24/the-itlos-advisory-opinion-and-marine-geoengineering-more-questions-few-answers/>; accessed 16 June 2025.

would be contrary to article 195 if *it has the consequence of transforming one type of pollution into another*. It may further be subject to article 196 of the Convention which requires States, *inter alia*, to take all measures necessary to prevent, reduce and control marine pollution resulting *from the use of technologies under their jurisdiction or control*.²² (emphasis added)

In recognising the potential of marine geoengineering to cause marine pollution, the Tribunal enables its reasoning regarding obligations to control greenhouse gas emissions to be applied to geoengineering interventions that seek to reduce the impacts of climate change but could have significant impacts on the marine environment.²³

The Tribunal also recognised that LOSC Articles 204–206 contain important obligations on Parties to monitor the risks or effects of pollution, to publish reports, and to conduct EIAs to address greenhouse gas pollution.²⁴ EIAs were further acknowledged as an essential feature of due diligence for activities that could ‘cause substantial pollution to the marine environment or significant and harmful changes..., including cumulative effects’.²⁵

In addition to developing international rules, due diligence also requires States to adopt and implement effective measures at a national level.²⁶ The national system needs to address actions by citizens and corporations and include avenues for legal relief and compensation.²⁷

Even geoengineering technologies that may not cause marine pollution through the input of substances or energy would be covered by the LOSC, if these have the potential to harm the marine environment. This is due to its wider obligation to protect and preserve the marine environment under Article 192. This entails a two-fold duty to prevent, or at least mitigate, environmental harm, and to preserve ecosystem health and the natural balance of the marine environment.²⁸ What might constitute due diligence to protect the marine environment is next addressed by exploring what has been recently embraced by the BBNJ Agreement.

22 ITLOS *Climate Change Advisory Opinion*, para 231.

23 GESAMP (n 8); Bronkalla (n 8); Prufer (n 8).

24 ITLOS *Climate Change Advisory Opinion*, para 367.

25 *Ibid.*

26 *Ibid.*, para 235.

27 *Ibid.*, para 284.

28 *Ibid.*, para 385.

The Role of the BBNJ Agreement Regarding Geoengineering Activities

As with the LOSC, the BBNJ Agreement stands poised to supplement the climate regime,²⁹ particularly regarding EIAs for geoengineering, pending the development of a more comprehensive global regime.³⁰ Crucially, beyond the environmental dimension of the LOSC, the BBNJ Agreement also opens the door to explore critical human rights dimensions.³¹

The specificity of the EIA requirements, as detailed below, can inform implementation of the stringent due diligence standards in the *Climate Change Advisory Opinion*. As such, the BBNJ Agreement can inform national approaches and help lay the groundwork for international accountability.

EIAs for Geoengineering Activities in ABNJ

The BBNJ Agreement establishes various requirements for Parties to conduct and report EIAs that would be applicable to geoengineering activities in ABNJ.³² Article 34(2) provides an important environmental safeguard for decision-making:

A decision to authorize the planned activity under the jurisdiction or control of a Party shall only be made when, taking into account *mitigation or management measures*, the Party has determined that it has made all reasonable efforts to ensure that the activity can be conducted in a manner consistent with the prevention of significant adverse impacts on the marine environment. (emphasis added)

Furthermore, the BBNJ Agreement requirement for an initial screening of planned activities helps ensure science informs decision-making regarding untested activities, such as geoengineering, in poorly studied marine environments. An initial screening is required for planned activities ‘that may have more than a minor or transitory effect on the marine environment, or the effects of the activity are unknown or poorly understood’ (emphasis added).³³

29 UNFCCC; Paris Agreement.

30 ITLOS *Climate Change Advisory Opinion*, paras 363–366 (noting that the LOSC does not specify the content of EIAs, and that the BBNJ Agreement ‘contains detailed provisions on EIA related to their thresholds and factors’).

31 E Morgera *et al.*, ‘Ocean-based climate action and human rights implications under the international climate change regime’ (2023) 38(3) *IJMCL* 411–446.

32 BBNJ Agreement, Article 27.

33 *Ibid.*, Article 30(1).

If the screening reveals potential for the planned activity to cause ‘substantial pollution or significant and harmful changes to the marine environment’, including via cumulative effects,³⁴ a full EIA is triggered. Should a Party decide that a full EIA is unwarranted, Article 30 provides safeguards to ensure that other Parties and the Scientific and Technical Body can have their views considered. Considering the potential impacts of geoengineering, it is likely these thresholds would be triggered.

The BBNJ Agreement also includes multiple requirements to address the human rights dimensions that could be applicable to geoengineering. For example, an EIA is to consider environmental and ‘associated impacts, such as economic, social, cultural and human health impacts, including potential cumulative impacts and impacts in areas within national jurisdiction, as well as alternatives to the planned activity’.³⁵ The EIA process also enhances transparency and provides opportunity for comment through requirements for public notification, consultation, publication and ongoing reporting through a Clearinghouse Mechanism.³⁶ By broadly defining stakeholders, the BBNJ Agreement ensures that a wide swath of the public will be included in the process.³⁷

Strategic environmental assessments (SEAs), which are used to gather fundamental scientific understanding of a proposed plan beyond site-specific projects, can operate at an earlier and wider scale than EIAs.³⁸ Such a SEA could consolidate the best available science and identify key gaps and research priorities to assess proposed geoengineering technologies or programmes to enable an informed consultation and decision-making process.³⁹

The BBNJ Agreement crystallises a number of existing principles and approaches such as precaution, best available science and use of traditional knowledge, all of which would be applicable to geoengineering activities. It also introduces ‘an approach that builds ecosystem resilience, including to adverse effects of climate change and ocean acidification, and also maintains and restores ecosystem integrity, including the carbon cycling services

34 *Ibid.*, Article 30(2)(e) (noting a specific requirement to assess potential cumulative impacts and the potential impacts in ABNJ).

35 *Ibid.*, Article 31(b).

36 *Ibid.*, Articles 32–35.

37 *Ibid.*, Articles 32(1)–(4).

38 *Ibid.*, Article 39.

39 *Ibid.*, Article 39(2); K Hassanali and R Mahon ‘Encouraging proactive governance of marine biological diversity of areas beyond national jurisdiction through strategic environmental assessment (SEA)’ (2022) 136 *Marine Policy* 104932.

that underpin the role of the ocean in climate'.⁴⁰ This 'ecosystem resilience approach' establishes a crucial science-based indicator for determining unacceptable harm from geoengineering activities.⁴¹ Activities that would not enhance or restore ecosystem resilience or integrity, or would interfere with carbon cycling services, should not be deemed acceptable.

And, finally, in recognition of modern values for stewardship, the preamble of the BBNJ Agreement sets a new thoughtful standard for guiding actions affecting ABNJ across generations:

Desiring to act as stewards of the ocean in areas beyond national jurisdiction on behalf of present and future generations by protecting, caring for and ensuring responsible use of the marine environment, maintaining the integrity of ocean ecosystems and conserving the inherent value of biological diversity of areas beyond national jurisdiction.⁴²

EIAs Within National Jurisdiction and Other Bodies

The BBNJ Agreement also applies in varying degrees to geoengineering activities within national jurisdiction that may cause substantial pollution of or significant and harmful changes to the marine environment in ABNJ.⁴³ Parties are to apply the specific BBNJ Agreement EIA requirements or ensure that an EIA is conducted under the Party's national process and relevant information is provided to the Clearinghouse Mechanism.⁴⁴ Parties are also to monitor the activity, to submit EIAs and monitoring reports to the Clearinghouse Mechanism, and to give the Scientific and Technical Body an opportunity to provide comments.⁴⁵

With respect to geoengineering activities regulated under the auspices of other relevant legal instruments and frameworks and relevant global, regional, subregional and sectoral bodies (bodies), Parties are likewise to promote the use of EIAs in accordance with the BBNJ Agreement.⁴⁶ Through its provisions for cooperation with other bodies,⁴⁷ the BBNJ Agreement can lift the EIA systems employed by such bodies, and in return, such bodies can inform and improve the BBNJ EIA standards.

⁴⁰ BBNJ Agreement, Article 7.

⁴¹ *Ibid.*

⁴² *Ibid.*, preamble, recital 11. See further Barnes in this volume.

⁴³ *Ibid.*, Article 28(2).

⁴⁴ *Ibid.*, Articles 28(2)(a)–(c).

⁴⁵ *Ibid.*, Article 28.

⁴⁶ *Ibid.*, Article 29(1).

⁴⁷ BBNJ Agreement, Articles 29(2)–(6).

Thus, the BBNJ Agreement's EIA requirements should inform not only national EIA processes for geoengineering activities in ABNJ, but also assessment requirements of the LC/LP and other rules related to geoengineering. Furthermore, the BBNJ Scientific and Technical Body is tasked with developing standards and guidelines for EIAs, which may be highly influential in providing best practices for EIAs for geoengineering activities that may affect ABNJ. They can further help to define the contents of what due diligence entails within national EIA systems.

Conclusion

Amongst some circles, geoengineering is seen as a panacea to the climate crisis. However, some geoengineering techniques could cause significant negative impacts to the marine environment. Against this backdrop of high risk and uncertainty, the LOSC creates various obligations on Parties related to geoengineering that can and should be used to fill the gaps left by the currently fragmented governance regime.

As clarified by the ITLOS *Climate Change Advisory Opinion*, the LOSC contains obligations to not transform pollution, to protect and preserve the marine environment, and to exercise stringent due diligence. These obligations are not only relevant to greenhouse gases, but also to geoengineering techniques because of their potential impact on ocean ecosystems. What stringent due diligence entails is further clarified by the BBNJ Agreement, as well as obligations in customary international law, including the precautionary principle and the duty to prevent transboundary harm.

States could be held responsible for failing to abide by these obligations by States seeking recourse through the dispute mechanism provisions of the LOSC and the BBNJ Agreement.⁴⁸ However, it would be impossible to compensate for irreparable harm to the marine environment. Hence, the United Nations should fast track its consideration of next steps for geoengineering: this could include an assessment of the adequacy of the scientific basis to enable informed, equitable and accountable decision-making, the availability of alternatives, and the elements of a robust global governance system. As a first step, the United Nations could convene a joint working group with climate change, law of the sea, environmental, and BBNJ experts as well as scientists, civil society and traditional knowledge holders. This joint working group

48 LOSC, Article 287; BBNJ Agreement, Article 60.

should consider options for bolstering the current regime for geoengineering, taking into consideration the obligations under the LOSC and the BBNJ Agreement, and mechanisms to ensure that geoengineering is not deployed unless and until a robust global governance framework is established.

2024 was the first year to reach over 1.5°C above the pre-industrial level.⁴⁹ Swift action to reduce emissions alongside an effective geoengineering governance and accountability regime is imperative to avoid potentially catastrophic impacts.

49 J Rowlett and M Poynting, 'Planet-warming carbon dioxide levels rose more than ever in 2024' (BBC, 16 January 2025) available at <https://www.bbc.com/news/articles/c30dn5dn53jo>; accessed on 25 June 2025.