

# Geo-engineering, the Law of the Sea, and Climate Change

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*Plans to address climate change increasingly include proposals for geo-engineering projects, whose effects are likely to be global, at best only partly predictable, not necessarily wholly benign, and extend beyond their objective. Geo-engineering proposals should receive detailed, precautionary scrutiny by the international community, which requires sophisticated international legal instruments and implementation systems. Most advanced are proposals for climate-related geo-engineering projects that involve or affect the ocean, requiring assessment of their compatibility with international law of the sea. This paper summarizes these proposals, reviews the applicable legally binding global instruments and their mechanisms to assess and regulate geo-engineering, and examines their implications for geo-engineering in responding to climate change. It concludes that geo-engineering projects must satisfy a suite of mandatory international legal requirements that are dedicated to protect and preserve the marine environment, or they cannot legally proceed.*

## I. Introduction

Geo-engineering is the direct, large-scale, purposeful intervention in or manipulation of the natural environments of this planet, e.g., land, lakes, rivers, atmosphere, seas, oceans, and/or its physical, chemical, or biological processes. Plans to address climate change increasingly include proposals for geo-engineering projects, which mostly focus on reducing the level<sup>1</sup> or mitigating the consequences of ris-

ing atmospheric carbon dioxide (CO<sub>2</sub>). Their effects on natural environments and their processes are likely to be global, at best only partly predictable, and extend beyond their objective.<sup>2</sup> Furthermore, even their predictable effects, including those of the objective itself, cannot be guaranteed to be benign.<sup>3</sup> Because the whole world has such a high stake in their outcome, geo-engineering proposals should receive detailed, precautionary scrutiny by the entire international community and proceed – if at

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1 Proposals to reduce or eliminate anthropogenic CO<sub>2</sub> and other greenhouse gas emissions at their source are not usually considered to be geo-engineering. See, e.g., Michael C. MacCracken, *Beyond Mitigation: Potential Options for Counter-Balancing the Climatic and Environmental Consequences of the Rising Concentrations of Greenhouse Gases*, Policy Research Working Paper 4938 (Washington, D.C.: The World Bank, 2009), at 5.

2 See, e.g., MacCracken, *Beyond Mitigation*, supra, note 1, at 5–11; John Shepherd et al., *Geo-engineering the Climate: Science, Governance and Uncertainty* (London: The Royal Society, 2009); Dorothee Herr and Grantly R. Galland, *The Ocean and Climate Change: Tools and Guidelines for Action* (Gland: IUCN, 2009) at

43, 62; Christian Nellemann et al., *Blue Carbon: The Role of Healthy Oceans in Binding Carbon* (Arendahl: GRID/UNEP, 2009); Jason Blackstock, et al., "Climate Engineering Responses to Climate Emergencies", 29 July, 2009, <available on the Internet at: <<http://arxiv.org/pdf/0907.5140>> (last accessed 20 November 2009); Intergovernmental Panel on Climate Change (IPCC), 2007, "Climate Change 2007: Mitigation", in Bert Metz, Ogunlade Davidson, Peter Bosch, Rutu Dave, Leo Meyer (eds), *Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2007) at 15, 78–79; Paul Freund et al., "IPCC, Special Report on Carbon Dioxide Capture and Storage", in Eduardo Calvo, Eberhard Jochem (eds), *IPCC Special Reports* (Cambridge: Cambridge University Press, 2005); IMO T5/5.01, *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 and its 1996 Protocol: Statement of Concern Regarding Iron Fertilization of the Oceans to Sequester CO<sub>2</sub>*, IMO Doc. LC-LP.1/Circ.14, 13 July 2007, which noted, *inter alia*, "the potential for large-scale ocean iron fertilisation to have negative impacts on the marine environment and human health";

all – only under strict conditions. Implementing this approach to geo-engineering requires sophisticated international legal instruments and implementation systems.

Most advanced at present are proposals for climate-related geo-engineering projects that involve the ocean or affect the marine environment,<sup>4</sup> which requires assessment of a proposal's compatibility with international law of the sea. This paper briefly describes a representative selection from the current proposals, reviews the applicable legally binding global instruments, particularly the 1982 United Nations Convention on the Law of the Sea (LOSC),<sup>5</sup> the 1972 London (Dumping) Convention (LC) and its 1996 Protocol (LP),<sup>6</sup> and their mechanisms to assess and regulate geo-engineering, and finally examines the implications of international law of the sea for geo-engineering in developing responses to climate change. This paper does not address the political, ethical and social aspects of geo-engineering, and the complex environmental implications are discussed only insofar as necessary to support the argument that they trigger applicability of the law of the sea to geo-engineering.

## II. Climate-related Geo-engineering Projects Involving or Affecting the Ocean

### 1. Overview

These projects fall into one of two categories, namely to:

- i) lower atmospheric CO<sub>2</sub> by accelerating its removal from and delaying its return to the atmosphere,
- ii) lessen incoming solar light and heat by deflecting it directly or by increasing the planet's albedo (reflectivity), thereby offsetting warming caused by rising CO<sub>2</sub> (and other greenhouse gas (GHG) emissions).

The first method manipulates marine biological and geochemical processes through ocean fertilization and capturing CO<sub>2</sub> (and other forms of carbon) for sequestration in the deep sea and below the seabed.<sup>7</sup> The second method reduces sunlight, the primary source of energy for biological processes and a major driver of ocean circulation, by increasing marine cloud reflectivity and cover, injecting sulphate aerosols into the stratosphere, and placing solar radiation deflectors in space.

For purposes of the present legal analysis, these methods are assumed to be technically feasible and capable of achieving their objective. In addition, economic feasibility is defined in this paper as the "financing [that] will be available if the desire is great enough".

### 2. Review of Selected Geo-engineering Projects

Briefly summarized below are the geo-engineering proposals currently receiving the most attention because they are either already the subject of scrutiny under international law of the sea (ocean fertilization and CO<sub>2</sub> sequestration) or likely to become so in the near future (ocean alkalization and shad-

IMO, A Compilation of Recent International Statements, Agreements and Recommendations Regarding Ocean Fertilization, IMO Doc. LC 30/INF.4, 28 August 2008 and LC 30/INF.4/Add.1, 8 September 2008; Aaron Strong et al., "Ocean Fertilization: Time to Move On", *Nature*, 17 September 2009, at 347-348; Bulletin of the Atomic Scientists, "20 Reasons Why Geo-engineering May Be A Bad Idea", May/June 2008, available on the Internet at: <<http://climate.envsci.rutgers.edu/pdf/20Reasons.pdf>> (last accessed on 20 November 2009); Philomene Verlaan, "Experimental Activities that Intentionally Perturb the Marine Environment: Implications for the Marine Environmental Protection and Marine Scientific Research Provisions of the 1982 United Nations Convention on the Law of the Sea", 31 *Marine Policy* (2007), 210-216.

3 Ibid.

4 The term "marine geo-engineering" is deliberately not used in this paper, as it could exclude geo-engineering projects that may not directly manipulate or intervene in marine environments or

processes, but still affect them, or be likely to, and international law of the sea would also apply to these projects.

5 United Nations Convention on the Law of the Sea (LOSC), Montego Bay, 10 December 1982, in force 16 November 1996, 21 *International Legal Materials* (1982), 1245 et sqq.

6 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (LC), London, 29 December 1972, in force 30 August 1975, 11 *ILM* (1972), 1294 et sqq. and the 1996 Protocol (LP), London, 7 November 1996, in force 24 March 2006, 36 *ILM* (1997), 1 et sqq.

7 Insofar as CO<sub>2</sub> emitted from power plants and industries, and other forms of carbon, even if technically captured at the source, i.e. the point of emission, are then stored in the natural environment in locations, volumes and at scales where these substances would not normally exist, these processes, known as carbon capture and storage (CCS), are geo-engineering as defined in this paper. International law of the sea applies to CCS that involves the ocean or the marine environment.

ing). The proposals are also representative of the issues raised under international law of the sea by geo-engineering projects involving or affecting the ocean.<sup>8</sup>

#### a. Ocean Fertilization

Nutrients (e.g., iron, nitrate, phosphate, urea) are added to seawater to stimulate phytoplankton blooms, thereby increasing the seawater's atmospheric CO<sub>2</sub> uptake and the concomitant transport of fixed carbon to depths from which it would be unlikely to reenter the atmosphere as a gas for at least a century. These nutrients can be introduced directly to surface seawater from a ship or by raising nutrient-rich deep water to the surface (artificial upwelling).

#### b. Ocean Alkalinization

Limestone (calcium carbonate), silicates and/or calcium hydroxides are added to and dissolved in seawater to reduce its acidity by enhancing its ability to form (bi)carbonates with CO<sub>2</sub> dissolved in seawater, thereby increasing its capacity for atmospheric CO<sub>2</sub> absorption.

#### c. Carbon Sequestration or Carbon Capture and Storage (CCS)

CO<sub>2</sub> is captured from large point sources of CO<sub>2</sub> emissions, transported by ship or pipeline and injected in sub-seabed geological formations (SSGFs) for long-term storage. Major CO<sub>2</sub> point sources include fossil fuel power plants (especially coal), steel and cement works, and fuel processing plants. CCS removes the CO<sub>2</sub> that would have otherwise entered the atmosphere and contributed to global warming, and entered the ocean and contributed to its acidification.<sup>9</sup> The sub-seabed geological formations include depleted offshore oil and gas fields and sub-seabed saline aquifers. These are located worldwide and can store amounts of CO<sub>2</sub> equivalent to at least decades of global emissions.

#### d. Shading

Ships are equipped with spraying devices that expel a mist of seawater droplets and dissolved salts to 300 metres altitude (~1,000 feet). As the droplets evaporate, the salt crystals reflect sunlight and

serve as condensation nuclei to form new droplets. This reaction increases marine cloud cover which then reflects even more sunlight. Other planetary albedo-modifying or solar energy-deflecting methods, even if not deployed from ships, will also affect the ocean.

### III. Principal International Law of the Sea Instruments Relevant to Geo-engineering

#### 1. The United Nations Convention on the Law of the Sea

##### a. Overview

Considered to be a "Constitution for the ocean",<sup>10</sup> and adopted by over three-quarters of the 192 member-States of the United Nations,<sup>11</sup> the LOSC is the primary, overarching, legally binding, global instrument on the law of the sea. According to the preamble, its Parties intended "to settle all issues relating to law of the sea" and to establish "a legal order for the seas and oceans," bearing in mind "that the problems of ocean space are closely interrelated and need to be considered as a whole". The LOSC is not a "framework treaty"; it does not depend for its implementation on the development of annexes and protocols, and "its provisions form an integral whole."<sup>12</sup> It governs all activities, including geo-engineering projects, which involve or affect the marine environment.

8 Detailed descriptions and analyses of these and other geo-engineering proposals can be found in, e.g., MacCracken, *Beyond Mitigation*, supra, note 1, at 7-13; Shepherd et al., *Geo-engineering the Climate*, supra, note 2; Herr and Galland, *Ocean and Climate Change*, supra, note 2; Nellemann et al., *Blue Carbon*, supra, note 2; Blackstock et al., "Climate Engineering Responses", supra, note 2; IPCC, "Climate Change 2007: Mitigation", supra, note 2; IPCC, "Special Report on Carbon Dioxide Capture and Storage", supra, note 2.

9 Other forms of ocean-related CCS, described in, e.g., the publications listed supra, note 8, are less imminent and not addressed here, but they are also vulnerable to challenge under the law of the sea, for reasons similar to those discussed infra.

10 Tommy Koh, "A Constitution for the Oceans", in *United Nations, The Law of the Sea* (New York: United Nations, 1983), xxxiii-xxxvii.

11 The LOSC had 159 parties on 12 November 2009.

12 Alan Boyle, "Further Development of the 1982 Convention on the Law of the Sea: Mechanisms for Change", in David Freestone, Richard Barnes and David Ong (eds), *The Law of the Sea: Progress and Prospects* (Oxford: Oxford University Press, 2006), 40-62.

## b. Marine Environmental Provisions

Concern for the marine environment permeates the LOSC. The Preamble lists the LOSC's objectives to include the marine environment's study, preservation and protection, as well as the conservation of marine living resources. The LOSC's very first Article comprehensively defines pollution of the marine environment.<sup>13</sup> It is not the nature of the substances introduced that is decisive, but their potential deleterious effect(s) on the marine environment, the list of which is not exclusive. Any substance, including CO<sub>2</sub>, regardless of its innocuousness under natural circumstances, can become a pollutant within the meaning of Article 1 if the requirements are met, and thus caught by the LOSC.

Part XII is wholly devoted to the marine environment, and environmental provisions are found in other parts of the LOSC. Article 192 requires States to protect and preserve the marine environment. The LOSC contains no exception to this unqualified obligation. Even the sovereign rights and high-seas freedoms of States must be exercised in accordance with their duty to observe this obligation.<sup>14</sup>

The general consensus is that Article 192 is now customary international law,<sup>15</sup> and the view is increasing that much of the rest of Part XII is as well.<sup>16</sup> The significance of this customary international law status is that non-parties to the LOSC are

thereby bound to comply with the relevant provisions.<sup>17</sup> International law obliges LOSC signatories that have not yet ratified to "refrain from acts which would defeat [its] object and purpose."<sup>18</sup> Consequently all States must protect and preserve the marine environment.

This obligation applies within<sup>19</sup> and beyond<sup>20</sup> national jurisdiction to all marine activities, including scientific research,<sup>21</sup> under a State's jurisdiction or control, and to activities on land or in the atmosphere if they are likely to affect the marine environment. States must ensure that their nationals, companies, ships flying their flag, and any other entities operating under their legal jurisdiction or control act in accordance with their environmental obligations under the LOSC. Accordingly, a State cannot abdicate its own responsibility for its environmental obligations because, for example, the potentially or actually deleterious activities are conducted by its legal or individual nationals on a foreign-flagged vessel.

States must "take, individually or jointly as appropriate, all measures necessary to prevent, reduce and control pollution of the marine environment *from any source*,<sup>22</sup> using for this purpose the best practicable means at their disposal and in accordance with their capabilities ..." Only the *nature* of the measures is qualified; the obligation to *take* measures is unqualified. Doing nothing about marine pollution is not an option under the LOSC.

13 Pollution of the marine environment is defined as: "the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities." LOSC, 21 ILM (1982), supra, note 5, Art. 1(1)(4).

14 Ibid. Arts. 193 and 87, respectively.

15 David Freestone, "The Conservation of Marine Ecosystems Under International Law", in Michael Bowman and Catherine Redgwell (eds), *International Law and the Conservation of Biological Diversity* (Leiden: Kluwer Law International, 1996), 91, at 108; Patricia Birnie, Alan Boyle and Catherine Redgwell *International Law and the Environment*, 3rd ed. (Oxford: Oxford University Press, 2009); Jon Van Dyke, "Giving Teeth to the Environmental Obligations in the LOS Convention", in Alex Oude Elferink and David Rothwell (eds), *Oceans Management in the 21st Century: Institutional Frameworks and Responses* (Leiden: Brill, 2004), 167-186; David Freestone and Rosemary Rayfuse, "Ocean Iron Fertilization and International Law", 364 *Marine Ecology Progress Series* (2008) 227, at 229.

16 Birnie et al., *International Law and the Environment*, supra, note 15; Boyle, "Mechanisms for Change", supra, note 12; Interna-

tional Law Association (ILA), "Formation of General Customary International Law: Final Report", in Alfred Soons and Christopher Ward (eds), *Report of the 69th ILA Conference* (London: ILA, 2000), 712-790.

17 Vienna Convention on the Law of Treaties, Vienna, 23 May 1969, in force on 27 January 1980, 8 *International Legal Materials* (1969) 679, at 694, "Nothing in articles 34 to 37 precludes a rule set forth in a treaty from becoming binding upon a third State as a customary rule of international law, recognized as such." See also, e.g., Freestone, "Conservation of marine ecosystems", supra, note 15; Birnie et al., *International Law and the Environment*, supra, note 15; Van Dyke, "Giving Teeth to the Environmental Obligations", supra, note 15; ILA, "Formation of General Customary International Law", supra, note 16.

18 Vienna Convention on the Law of Treaties, 8 *International Legal Materials* (1969), Art. 18.

19 For example, the territorial sea and Exclusive Economic Zone (EEZ); LOSC, 21 ILM (1982), supra, note 5, Arts. 2(3) and 56(2), respectively.

20 For example, the high seas (LOSC, 21 ILM (1982), supra, note 5, Art. 87(1)).

21 Ibid. Art. 240(d).

22 Ibid. Art. 194(1), emphasis supplied.

The measures must deal with *all* sources of pollution of the marine environment.<sup>23</sup> Activities must not cause damage by pollution to other States and their environment; pollution arising from such activities must not spread outside those areas.<sup>24</sup> States must take the measures “necessary to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species and other forms of marine life.”<sup>25</sup> The LOSC does not limit these measures to combating pollution.

States are obliged “not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another,” “in taking measures to prevent, reduce and control pollution of the marine environment.”<sup>26</sup> States must prevent, reduce and control pollution of the marine environment resulting from the “use of technologies under their jurisdiction or control or the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto.”<sup>27</sup> These provisions are crucial to assessing the compatibility with the law of the sea of geo-engineering proposals to mitigate climate change by transferring CO<sub>2</sub> from the atmosphere to the ocean.

Requirements that States “ensure,” “deal,” and “protect and preserve” set out in Article 194(2), (3) and (5) are unqualified. The mandatory “shall” is seldom qualified in the LOSC, and almost never in the environmental provisions. The LOSC is remarkable for the mandatory, unqualified and usually specific nature of the obligations placed upon States in general and its environmental provisions in particular. This characteristic further confirms its “non-framework” nature.

States must adopt the necessary laws and regulations,<sup>28</sup> enforce them,<sup>29</sup> and assess “planned activities under their jurisdiction or control” for their propensity to pollute the marine environment. Articles 204, 205 and 206 set out assessment requirements, including the obligation to “keep under surveillance” the effects of any activities States permit, and to report the results of the assessments.

### c. State Responsibility and Liability

States are “responsible for the fulfilment of their international obligations concerning the protection and preservation of the marine environment. They

shall be liable in accordance with international law.”<sup>30</sup> Furthermore, States must ensure that “recourse is available in accordance with their legal systems for prompt and adequate compensation or other relief in respect of damage caused by pollution of the marine environment by natural or juridical persons under their jurisdiction.”<sup>31</sup> Finally, the LOSC does not affect recourse to “civil proceedings in respect of any claim for loss or damage resulting from pollution of the marine environment.”<sup>32</sup>

### d. State Duty to Cooperate

Article 197 requires “states [to] cooperate on a global basis, and, as appropriate, on a regional basis, directly or through competent international organizations, in formulating and elaborating international rules, standards and recommended practices and procedures consistent with this Convention, for the protection and preservation of the marine environment, taking into account characteristic regional features.” This supports the general obligation in Article 194 on states to “endeavour to harmonize their policies” to prevent, reduce and control pollution of the marine environment.

The International Court of Justice (ICJ) ruled that obligations to cooperate set out in legally binding instruments require “meaningful negotiations” by States and are “a special application of a principle which underlies all international relations, and which is moreover recognized in Article 33 of the Charter of the United Nations as one of the methods for the peaceful settlement of international disputes.”<sup>33</sup> The International Tribunal for the Law of

23 LOSC, 21 ILM (1982), *supra*, note 5, Art. 194(3); emphasis supplied. The release of toxic, harmful or noxious substances, from land-based sources (including rivers), from or through the atmosphere, or by dumping must be minimized. Art. 194(3)(a)). Arts. 207, 212, and 210, respectively, address these three sources of pollution in detail. Dumping, defined in Art.1(5), is discussed *infra* (section III(2)).

24 LOSC, 21 ILM (1982), *supra*, note 5, Art. 194(2).

25 *Ibid.* Art. 194(5).

26 *Ibid.* Art. 195.

27 *Ibid.* Art. 196.

28 LOSC, 21 ILM (1982), *supra*, note 5, Arts. 207, 208, 210, 212.

29 *Ibid.* Arts. 213, 214, 216-222.

30 *Ibid.* Art. 235(1).

31 *Ibid.* Art. 235(2).

32 *Ibid.* Art. 229.

33 North Sea Continental Shelf Cases (Federal Republic of Germany/Denmark; Federal Republic of Germany/Netherlands), Judgment, 20 February 1969, ICJ Reports (1969), pp. 3 *et seq.*, at 47.

the Sea (ITLOS) ruled that “the duty to cooperate is a fundamental principle in the prevention of pollution of the marine environment under Part XII of [LOSC] ... and general international law.”<sup>34</sup>

Hence, a non-cooperative State is not fulfilling its Part XII duties. However, States cannot argue that cooperation is a prerequisite to fulfilling their marine environmental duties under the LOSC. The LOSC does not subjugate the duty to protect and preserve the marine environment to the duty to cooperate.

#### e. “Due Regard” Provisions

The mandatory nature of the environmental obligations set out in the LOSC is reinforced by its mandatory “due regard” provisions. In their Exclusive Economic Zone (EEZ), coastal States must have due regard to the rights and duties of other States in exercising their own rights and performing their own duties under the LOSC.<sup>35</sup> The LOSC sets concomitant obligations on the other States in terms of their rights and duties *vis-à-vis* those of coastal States.<sup>36</sup> “Due regard” obligations also exist on the high seas.<sup>37</sup>

The “due regard” obligation was interpreted by the ICJ to require cooperation between States for conservation of living resources even on the high seas, when “the needs of conservation for the benefit of all” are involved, replacing the former “*laissez-faire* treatment of the living resources of the sea in the high seas.”<sup>38</sup>

These interpretations underline another central, unifying concept of the LOSC embodied in Article 300: enjoying rights and benefits involves the concomitant undertaking of duties and obligations; duties must be fulfilled in good faith and rights exercised non-abusively. It would be incompatible with the letter and spirit of the LOSC for geo-engi-

neering projects to be undertaken without the full and formal prior approval of the international community, and only pursuant to the detailed observance of the marine environmental requirements imposed.

#### f. Relationship of the LOSC with Other Legally Binding Global Instruments

The LOSC is not intended to be static or to operate in isolation: it envisages its own evolution and development in a dynamic international context, as long as its fundamental objectives and purposes are not thereby undermined. This is evident from its stated relationship to general international law, which governs “matters not regulated by [the LOSC]”<sup>39</sup> and is also invoked elsewhere in the LOSC, and to other global and regional treaties, to which the LOSC also refers (see further *infra*), and through the incorporation by reference of other generally accepted international agreements, rules and standards.<sup>40</sup>

The LOSC “shall not alter the rights and obligations of states parties which arise from other agreements compatible with this Convention and which do not affect the enjoyment by other states parties of their rights or the performance of their obligations under this Convention;” this provision “does not affect international agreements expressly permitted or preserved by other articles of this Convention.”<sup>41</sup>

The obligations set out in Part XII “are without prejudice to the specific obligations assumed by states under special conventions and agreements concluded previously which relate to protection and preservation of the marine environment and to agreements which may be included in furtherance of the general principles set forth in [the LOSC].”<sup>42</sup> It continues: “specific obligations assumed by states

ures the necessity of which is shown to exist in those waters.”

*Ibid.* In this author’s opinion, the “due regard” obligation, the ICJ’s interpretation, the requirements of Part XII and those concerning living resources in other Parts arguably support and under appropriate circumstances may mandate the establishment of marine protected areas in the high seas. This also has ramifications for geo-engineering projects proposed to be conducted there.

39 LOSC, 21 ILM (1982), *supra*, note 5, Preamble.

40 These are referred to in LOSC, 21 ILM (1982), *supra*, note 5, Arts. 207–214 and 217–220.

41 LOSC, 21 ILM (1982), *supra*, note 5, Art. 311.

42 LOSC, 21 ILM (1982), *supra*, note 5, Art. 237.

34 The MOX Plant Case (Ireland/United Kingdom), Order, 3 December 2001, ITLOS Order, para. 82.

35 LOSC, 21 ILM (1982), *supra*, note 5, Art. 56(2).

36 The former must “comply with the laws and regulations adopted by the coastal state in accordance with [the LOSC] ... and other rules of international law ...” LOSC, 21 ILM (1982), *supra*, note 5, Art. 58(3).

37 High-seas freedoms must be “exercised by all states with due regard for the interests of other states in their exercise of the freedom of the high seas.” LOSC, 21 ILM (1982), *supra*, note 5, Art. 87(2).

38 Fisheries Jurisdiction Case (United Kingdom/Iceland), Judgment, 25 July 1974, ICJ Reports (1974), pp. 167–168. The ICJ required parties “to take full account ... of any fishery conservation meas-

under special conventions, with respect to protection and preservation of the marine environment, should be carried out in a manner consistent with the general principles and objectives of this Convention.”

The LOSC arguably complements and reinforces these conventions. This conclusion results from the following elements in the LOSC:<sup>43</sup>

- the unqualified obligation on States to protect and preserve the marine environment;<sup>44</sup>
- the unqualified obligation on States to “take all measures consistent with ... [the LOSC] ... to prevent, reduce and control pollution of the marine environment from any source ...”<sup>45</sup> and to ensure that the measures taken “deal with all sources of pollution of the marine environment;”<sup>46</sup>
- the incorporation by reference into the LOSC’s obligations of more detailed global or generally accepted international rules and standards (GAIRS) established by “competent international organizations” or “diplomatic conference;”<sup>47</sup>
- the requirement that national laws and regulations “shall be no less effective than” or “shall at least have the same effect as that of” such GAIRS.<sup>48</sup>

As Oxman points out: “with considerable detail, [the LOSC] sets forth the obligations of states to work with ... (competent international) organization(s) and to respect the results of that work. To an extraordinary degree, the duty to cooperate in and respect the work of these international organizations is anything but hortatory...”<sup>49</sup>

At least where the marine environment is concerned, the LOSC appears to establish an exception to or at least qualify the general rule<sup>50</sup> that a treaty does not create obligations or rights for a third State without its consent, as LOSC parties have consented to be bound by GAIRS adopted as set out in

the LOSC, which should therefore also apply to GAIRS set out in a multi-lateral treaty so adopted. The LOSC prevails over other conventions related to the marine environment where the latter, even if concluded afterwards, are inconsistent or incompatible with the LOSC.<sup>51</sup>

## 2. The London (Dumping) Convention and the London Protocol

### a. LOSC Context of LC/LP

The LOSC places the unqualified obligation on states to adopt laws and regulations to prevent, reduce and control pollution of the marine environment by dumping.<sup>52</sup> Dumping is “any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures” and of “vessels, aircraft, platforms or other man-made structures” themselves.<sup>53</sup> Dumping does not include “placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of this Convention.”<sup>54</sup> For dumping, “states, acting especially through competent international organizations or diplomatic conference, shall endeavour to establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control such pollution.”<sup>55</sup> These international rules, once adopted, are *minimum* standards, because national rules, *regardless of individual national capacities or other national considerations*, must be established and they must be at least as effective as the global rules.<sup>56</sup>

In this context, and further to the argument set out in Part III (1)(f) *supra*, it is arguable that LOSC parties which are not parties to either the LC or the

43 Bernard Oxman, “The Duty to Respect Generally Accepted International Standards”, 24 New York University Journal of International Law and Politics (1991), 109–159; ILA, “Formation of General Customary International Law”, *supra*, note 16.

44 LOSC, 21 ILM (1982), *supra*, note 5, Art. 192.

45 *Ibid.* Art. 194(1).

46 *Ibid.* Art. 194(3).

47 *Ibid.* Arts. 207, 208, 210–212.

48 *Ibid.* Arts. 208–211.

49 Bernard Oxman, “The Role of the International Maritime Organization”, in Mochtar Kusuma-Atmadja, Thomas Mensah and Bernard Oxman (eds), *Sustainable Development and Preserva-*

*tion of the Oceans: The Challenges of UNCLOS and Agenda 21*, Proceedings of the 29th Annual Conference of the Law of the Sea Institute (Honolulu: The Law of the Sea Institute, 1995), 266–284.

50 Vienna Convention on the Law of Treaties, 8 ILM (1969), Art. 34.

51 LOSC, 21 ILM (1982), *supra*, note 5, Arts. 237 and 311(3).

52 *Ibid.* Art. 210.

53 *Ibid.* Art. 1(5)(a).

54 *Ibid.* Art. 1(5)(b)(ii); also excluded are “operational wastes” (Art. 1(5)(b)(i)).

55 LOSC, 21 ILM (1982), *supra*, note 5, Art. 210 (4).

56 *Ibid.* Art. 210(1) and (6).

LP are nevertheless bound under LOSC Art. 210 to observe their provisions at least insofar as what substances may be dumped in the ocean.<sup>57</sup>

## b. London Convention/London Protocol

Both instruments set out the specific global framework to protect the marine environment against pollution from dumping at sea, consistent with the overarching LOSC. Building on experience gained since 1975 with the LC, which it is intended to replace, the LP significantly strengthens and improves the LC and further implements and reinforces the LOSC. The LP supersedes the LC between LP parties which are also LC parties.<sup>58</sup>

The two instruments operate in parallel, and the annual meetings of the parties run concurrently, with a view to achieving the consistent evolution and development of the two instruments. This is a first in international treaty administration. In his welcome to the LC and LP parties at their first joint meeting, the Chairman of both meetings, Mr. Victor Escobar Paredes (Spain), stressed the importance of applying, in his words, the “two instruments – one family” approach.<sup>59</sup>

In this author's view, this concept has considerable potential for other constructive applications in the context of international marine environmental law, where many different instruments address the

marine environment, and where it is still too often forgotten that “the problems of ocean space are closely interrelated and need to be considered as a whole”.<sup>60</sup> It will be instructive to observe the implementation of this concept by the LC and LP parties.

Of these two instruments, the LP is primarily addressed here, because its parties are not only the first of the international bodies concerned with the law of the sea to actively consider the compatibility of certain proposed ocean-related geo-engineering projects<sup>61</sup> with its provisions, but they have also already twice revised its text accordingly<sup>62</sup> (see further *infra*).

The LP requires States to “individually and collectively protect and preserve the marine environment from all sources of pollution”.<sup>63</sup> It keeps the original categories<sup>64</sup> and adds two new<sup>65</sup> categories to the LOSC/LC dumping definition. It retains the LOSC/LC exclusion from the dumping definition of operational wastes<sup>66</sup> and placement,<sup>67</sup> as well as the LC exclusion of wastes related to seabed mineral resources.<sup>68</sup> The LP prohibits all dumping, except for originally seven,<sup>69</sup> now eight,<sup>70</sup> specified categories of wastes which may only be dumped with a permit and under certain conditions.<sup>71</sup> It mandates and defines a precautionary approach,<sup>72</sup> and encourages the application of the “polluter-pays” principle.<sup>73</sup> Although the precautionary principle is not

57 Rosemary Rayfuse, Mark Lawrence and Kristina Gjerd, “Ocean Fertilisation and Climate Change: The Need to Regulate Emerging High Seas Uses”, 23 *International Journal of Marine and Coastal Law* (2008), 297-326; Philomene Verlaan, “Overview of Opportunities under the Law of the Sea to Improve Marine Environmental Conservation Affected by Maritime Traffic”, in Nilüfer Oral and François Simard (eds), *Maritime Traffic Effects on Biodiversity in the Mediterranean Sea*, Vol. 2 (Legal Mechanisms to Address Maritime Impacts on Mediterranean Biodiversity), (Malaga: IUCN Centre for Mediterranean Cooperation, 2008), 9-48.

58 1996 Protocol (LP), 36 ILM (1997), supra, note 6, Art. 23. On 12 November 2009, LC: 86 parties; LP: 37 parties, of which 6 are LP-only parties.

59 Report of the 28th Consultative Meeting of Contracting Parties to the [London Convention 1972] and the 1st Meeting of Contracting Parties to the 1996 London Protocol, IMO Doc LC28/15, 6 December 2006, para. 20 (hereinafter LC28/LP1 Final Report).

60 LOSC, 21 ILM (1982), supra, note 5, Preamble.

61 CO<sub>2</sub> sequestration in sub-seabed geological formations (SSGFs) and ocean fertilization.

62 1996 Protocol (LP), 36 ILM (1997), supra, note 6, Annex 1 (amended 2 November 2006) and Art. 6 (amended 30 October 2009), both to accommodate CO<sub>2</sub> sequestration in SSGFs; see further *infra*.

63 1996 Protocol (LP), 36 ILM (1997), supra, note 6, Art. 2; Art. 1(10) reprises the LOSC's definition of pollution.

64 LC, 11 ILM (1972), supra, note 6, Art. III (1)(a)(i) and (.ii); 1996 Protocol (LP), 36 ILM (1997), supra, note 6, Art. 1(4)(1)(1) and (.2).

65 “[A]ny storage of wastes or other matter in the seabed and the subsoil thereof ...” LP Art. 1(4)(1)(3); “any abandonment...at site of platforms...at sea...” LP Art. 1(4)(1)(4).

66 LC, 11 ILM (1972), supra, note 6, Art. III (1)(b)(i); 1996 Protocol (LP), 36 ILM (1997), supra, note 6, Art. 1(4)(1)(2) (.1).

67 LC, 11 ILM (1972), supra, note 6, Art. III (1)(b)(ii); 1996 Protocol (LP), 36 ILM (1997), supra, note 6, Art. 1(4)(1)(2) (.2).

68 LC, 11 ILM (1972), supra, note 6, Art. III (1)(c); 1996 Protocol (LP), 36 ILM (1997), supra, note 6, 1(4)(1)(2)(.3).

69 Dredge spoil, sewage sludge, fish waste, vessels, platforms and other man-made structures at sea, inert geological material, organic material of natural origin, and certain “bulky items” (1996 Protocol (LP), 36 ILM (1997), supra, note 6, Annex 1).

70 1996 Protocol (LP), 36 ILM (1997), supra, note 6, Annex 1 was amended to add “CO<sub>2</sub> streams from CO<sub>2</sub> capture processes for sequestration” (1.8).

71 *Ibid.* Art. 4.

72 *Ibid.* Art. 3(1).

73 *Ibid.* Art. 3(2).



stated as such in the LOSC, a precautionary approach and precautionary language such as “likely” and “may” are found in the LOSC’s environmental provisions.<sup>74</sup>

As in the LOSC, the LP prohibits the direct or indirect transfer of damage or likelihood of damage from one part of the environment to another or transforming one type of pollution into another,<sup>75</sup> as well as the export of wastes or other matter to other countries for dumping or incineration at sea.<sup>76</sup> Also, as in the LOSC, the mandatory “shall” is seldom qualified in the LP, and never qualified in the operative environmental protection provisions (Arts. 2-6).

### 3. Other Relevant Legally Binding Global Environmental Instruments

Particularly relevant in this context is the Convention on Biological Diversity (CBD).<sup>77</sup> The CBD is a “framework” treaty.<sup>78</sup> The relationship between the CBD and the LOSC is complex<sup>79</sup> and its discussion is beyond the scope of this paper. However, for geo-engineering projects affecting or involving the marine environment, the LOSC and CBD are complementary and mutually reinforcing.

The CBD requires “Contracting Parties [to] ... implement [it] ... with respect to the marine environment consistently with the rights and obligations of states under the law of the sea” and its provisions “shall not affect the rights and obligations of any Contracting Party deriving from any existing international agreement, except where the exercise of those rights and obligations would cause a serious damage or threat to biological diversity”.<sup>80</sup> For the marine environment, the LOSC may be invoked as valuably strengthening the comparatively qualified<sup>81</sup> protection the CBD extends to biological diversity.

Although the LOSC does not refer to or require the protection of “biological diversity” *per se*, its unqualified requirement to protect and preserve rare and fragile ecosystems and the habitat of depleted, threatened or endangered species and other forms of marine life, in addition to the marine environment as a whole and the requirement to combat pollution from all sources, would, if implemented, go far to achieve the biodiversity protection sought but less rigorously mandated by the CBD. Similarly, the LOSC provides a stronger foundation in international law on which to assert jurisdiction over and base measures for addressing geo-engineering projects that may affect marine biodiversity.<sup>82</sup>

74 LOSC, 21 ILM (1982), *supra*, note 5, Arts. 1(1)(4), 196, 198, 206.

75 1996 Protocol (LP), 36 ILM (1997), *supra*, note 6, Art. 3(3).

76 *Ibid.* Art. 6; amended 30 October 2009; see further *infra*.

77 Convention on Biological Diversity (CBD), Rio de Janeiro, 5 June 1992, in force 29 December 1993, 31 ILM (1992), 818 et sqq. Other international Conventions relevant to achieving the LOSC’s environmental objectives that are also arguably strengthened by the LOSC, and whose purposes and objectives must also be taken into account when assessing proposed geo-engineering projects include: Convention Concerning the Protection of the World Cultural and Natural Heritage, Paris, 16 November 1972, in force 17 December 1975, 11 ILM 1358 et sqq.; Convention on Environmental Impact Assessment in a Transboundary Context, Espoo, 25 February 1991, in force 10 September 1997, 30 ILM (1991), 802 et sqq.; Convention on the Conservation of Antarctic Marine Living Resources, Canberra, 20 May 1980, in force 7 April 1982, 19 ILM (1980), 837 et sqq.; Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 23 June 1979, in force 1 November 1983, 19 ILM (1980), 15 et sqq.; Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Basel, 22 March 1989, in force 5 May 1992, 28 ILM (1989), 657 et sqq.; Convention on the Prohibition of Military or Other Hostile Use of Environmental Modification Techniques, New York, 10 December 1976, in force 5 October 1978, 16 ILM (1977), 88; Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar, 2 February 1971, in force 21 December 1975, 11 ILM (1972), 963 et sqq.; Framework Convention on Climate Change,

New York, 9 May 1992, in force 21 March 1994, 31 ILM (1992), 849 et sqq. and its Protocol, Kyoto, 11 December 1997, in force 16 February 2005, 37 ILM (1998) 22 et sqq.; Protocol on Environmental Protection to the Antarctic Treaty, Madrid, 4 October 1991, in force 14 January 1998, 30 ILM (1991), 1461 et sqq., as well as the marine environmental conventions adopted under the auspices of IMO; the latter are listed and their relationship to the LOSC discussed in Verlaan, “Overview of Opportunities”, *supra*, note 57.

78 A framework treaty “sets overall goals, not precisely defined obligations, and establishes guiding principles.” Birnie et al., *International Law and the Environment*, *supra*, note 15.

79 See, e.g., Boyle, “Mechanisms for Change”, *supra*, note 12; Birnie et al., *International Law and the Environment*, *supra*, note 16.

80 CBD, 31 ILM (1992), Art. 22.

81 In the CBD the mandatory “shall” is usually followed by the qualifier “as far as possible and as appropriate” or “in accordance with [a party’s] particular conditions and capabilities,” or weakening verbs, such as “endeavour.” Nowhere in the CBD is biological diversity protected without qualification, a weakness also noted in, e.g., Birnie et al., *International Law and the Environment*, *supra*, note 16.

82 As noted in Birnie et al., *International Law and the Environment*, *supra*, note 16, “any meaningful attempt to regulate marine biodiversity depends on [LOSC] parties, not CBD parties.”

## IV. Applicability of International Law of the Sea to Geo-engineering Projects

### 1. The LOSC

Where these projects “[introduce] directly or indirectly...substances or energy” (LOSC) or “wastes or other matter” (LP) ...“likely to result in ... deleterious effects to the marine environment,”<sup>83</sup> they are likely to cause pollution as defined by the LOSC and the LP and thus trigger the application of international law of the sea, in particular as embodied in the LOSC. The actual and potential adverse marine environmental effects of the four types of proposed geo-engineering projects addressed in this paper have been described at length elsewhere.<sup>84</sup> Even the Intergovernmental Panel on Climate Change (IPCC), perhaps the most conservative – and politically constrained – of the respected authoritative bodies pronouncing on this issue, has stated that “options to remove CO<sub>2</sub> directly from the air, for example, by iron fertilization of the oceans, or to block sunlight, remain largely speculative and may have a risk of unknown side effects”.<sup>85</sup> Other respected authoritative bodies and eminent scientists have expressed their reservations about the environmental effects of these and other geo-engineering project proposals more robustly.<sup>86</sup>

Given the precautionary language of the LOSC and the precautionary approach subsequently articulated in later instruments, such as the LP, the minimum criteria set out in the LOSC to at least require the assessment of the four representative types of proposed geo-engineering projects addressed here for their compatibility with the environmental obligations imposed by the international law of the sea are met. In summary, these projects are caught by the LOSC and must satisfy its requirements before

being allowed to proceed, and prohibited from doing so otherwise.

### 2. The LC/LP

The applicability of the LC/LP to these proposed projects is still subject to some debate. The difference of opinion centers primarily on the interaction of the definitions of “dumping” and “placement” in these instruments. Briefly stated, the issue is whether the activity is dumping or placement, and if it is the latter, is it “contrary to the aims of the [LC/LP]”<sup>87</sup>? If it is the latter, and if it is not contrary to the aims of the LC/LP, it may arguably not be caught by these instruments, or their scope of regulatory action may be diminished. The merits have been extensively argued elsewhere<sup>88</sup> and will not be reprised here. The scholarly literature so far and this author favour the view that at least the disposal at sea of CO<sub>2</sub> and ocean fertilization fall within the competence of both the LC and the LP.<sup>89</sup>

The LC and LP parties themselves also now consider that both these activities at least fall within their purview and, without as yet having reached a final decision on the dumping versus placement issue, they are already acting thereon to such an extent that this issue may well risk becoming moot at least as far the disposal at sea of CO<sub>2</sub> and ocean fertilization under the LP are concerned.

With regard to the disposal at sea of CO<sub>2</sub>, the LP parties amended Annex 1 of their instrument within less than a year of its coming into force<sup>90</sup> in order to permit the disposal of CO<sub>2</sub> in SSGFs, which would otherwise have been prohibited at least under the LP.<sup>91</sup> The LP was amended again in 2009,<sup>92</sup> in order to enable the export of CO<sub>2</sub> for sequestration in SSGFs, which otherwise would have been prohibited under LP Article 6.

83 LOSC, 21 ILM (1982), *supra*, note 5, Art. 1(1)(4).

84 See, e.g., the documents cited *supra*, note 2 and references therein.

85 IPCC, Climate Change 2007: Mitigation, *supra*, note 2.

86 See, e.g., the documents cited *supra*, note 2 and references therein.

87 LC, 11 ILM (1972), *supra*, note 6, Art. III(1)(b)(i); 1996 Protocol (LP), 36 ILM (1997), *supra*, note 6, Art. 1(4)(.2).

88 See, e.g., Freestone and Rayfuse, “Ocean Iron Fertilization and International Law”, *supra*, note 15; Rayfuse et al., “Ocean Fertilization and Climate Change”, *supra*, note 57.

89 *Ibid*.

90 In force 22 March 2006; amendment agreed 2 November 2006.

91 LC28/LP1 Final Report, *supra*, note 60, paras. 66-109 and Annex 6. The amendment entered into force 10 February 2007.

92 Resolution LP .3(4), Amendment to Article 6 of the London Protocol at the 4th Meeting of Contracting Parties to the 1996 Protocol, 30 October 2009, available on the Internet at <[http://www.imo.org/dynamic/mainframe.asp?topic\\_id=1844](http://www.imo.org/dynamic/mainframe.asp?topic_id=1844)> (last accessed 23 November 2009). The amendment will enter into force for the Contracting Parties which have accepted it on the 60th day after two-thirds of the Contracting Parties have deposited their instruments of acceptance of the amendment with IMO (LP Article 21.3).

With regard to ocean fertilization, in 2007 the LC and LP parties:<sup>93</sup>

- “endorsed the Statement of Concern issued by the [LC/LP] Scientific Groups;<sup>94</sup>
- agreed that the scope of work of the [LC/LP] included ocean fertilization, as well as iron fertilization;
- agreed that the [LC/LP] were competent to address this issue due to their general objective to protect and preserve the marine environment from all sources;<sup>95</sup>
- agreed that they would further study the issue from the scientific and legal perspectives with a view to its regulation; and
- recognizing that it was within the purview of each State to consider proposals on a case-by-case basis in accordance with the London Convention and Protocol, urged States to use the utmost caution when considering proposals for large-scale ocean fertilization operations. The governing bodies took the view that, given the present state of knowledge regarding ocean fertilization, such large-scale operations were currently not justified”.

In 2008<sup>96</sup> the LC/LP parties issued a non-binding resolution stating, *inter alia*: “Given the present state of knowledge, ocean fertilization activities other than legitimate scientific research should not be allowed,” and “ocean fertilization activities other than legitimate scientific research, should be considered as contrary to the aims of the Convention and Protocol and not currently qualify for any exemption from the definition of dumping”. The parties also agreed to consider further a potential legally binding resolution or amendment to the London Protocol at their next session (LC31/LP4) in 2009. At this meeting<sup>97</sup> it was agreed, *inter alia*, that an intersessional Working Group would be set up and it should focus “on deepening the understanding of the implications of legally binding options to allow the informed consideration and discussion of the governing bodies”.<sup>98</sup>

### 3. Assessment

It will be clear from the foregoing that international law of the sea, as embodied particularly in the LOSC and the LC/LP, is applicable to geo-engineering proposals that involve or affect the ocean. The

LC/LP parties, through their efficient secretariat and meetings of the parties, have developed an effective mechanism for addressing those geo-engineering projects that fall within their special purview. The LC/LP parties have provided the international legal community with a constructive step forward not only in the regulation of CO<sub>2</sub> disposal and ocean fertilization, but also in developing a useful approach to the evaluation and management of geo-engineering projects that affect or involve the oceans in general, which could be emulated elsewhere.

Where asserting their competence over ocean-related geo-engineering projects in general is concerned, the LC/LP parties seem to be interpreting the scope of their instruments to enable them to meet their shared objective “to protect and preserve the marine environment from all sources” as broadly as is consistent with their specific mandate to address dumping and placement at sea of wastes and other matter. In this context it is noted that the LC/LP parties have even begun to tackle the definition of marine scientific research,<sup>99</sup> treated at length<sup>100</sup> but left undefined in the LOSC, with particularly complex consequences not only for geo-engineering projects affecting or involving the ocean, but also for marine scientific research projects that seek to manipulate marine environment or its processes,<sup>101</sup> and especially in areas beyond national jurisdiction.

93 Report of the 29th Consultative Meeting of Contracting Parties to the [London Convention 1972] and the 2nd Meeting of Contracting Parties to the 1996 London Protocol, IMO Doc LC29/17, 14 December 2007, paras. 4.14-4.29 (hereinafter LC29/LP2 Final Report).

94 “Statement of Concern”, *supra*, note 2.

95 LC, 11 ILM (1972), *supra*, note 6, Art. 1, 1996 Protocol (LP), 36 ILM (1997), *supra*, note 6, Art. 2.

96 Report of the 30th Consultative Meeting of Contracting Parties to the [London Convention 1972] and the 3rd Meeting of Contracting Parties to the 1996 London Protocol, IMO Doc LC30/16, 9 December 2008, paras. 4.1-4.18 and Annexes 5 and 6 (hereinafter LC30/LP3 Final Report).

97 LC 31/LP4 met 26-30 October 2009. The author attended the meeting. As of 10 November 2009, no published documents were available. The information presented here is from the author’s notes and documents produced at the meeting.

98 Doc LC/31/J/19, issued at LC 31/LP4. Available from the author.

99 “Legitimate scientific research ... should be regarded as placement of matter for a purpose other than the mere disposal thereof under [LC] Article III.1(b)(ii) and [LP] Article 1.4.2.2”. LC30/LP3 Final Report, *supra*, note 96, Annex 6.

100 Part XIII is entirely devoted to marine scientific research, and it is also addressed in other Parts.

101 See Verlaan, “Experimental Activities that Intentionally Perturb the Marine Environment”, *supra*, note 2, which examines, *inter alia*, ocean fertilization from this perspective.

The attention by the LC/LP parties to this issue is welcomed because the status of marine scientific research as a “high seas freedom” under the LOSC<sup>102</sup> is often misunderstood as meaning that it can be undertaken without any restrictions on the high seas.<sup>103</sup> In the geo-engineering context, there is some anecdotal evidence that a geo-engineering project involving ocean fertilization may have sought to legally escape the applicability of the LOSC and the LC/LP by casting the project as marine scientific research to be conducted on the high seas on a vessel that is not flagged to a LOSC or LC/LP party. As extensively argued *supra*, this approach is invalid under the law of the sea and the work so far by the LC/LP parties supports this view. Further discussion of the relationship of marine scientific research and ocean-related geo-engineering is beyond the scope of this paper. It is flagged here as an important emerging issue that will have wide-ranging ramifications in the geo-engineering debate.

Although the willingness of the LC/LP parties to tackle geo-engineering is applauded, it is essential that the carefully constructed, clear, mandatory and powerful marine environmental protection structure of these two instruments is not undermined by the growing pressure to address climate change. Nowhere in the LC/LP are exceptions to its marine environmental protection rules justified for climate change mitigation purposes. Nor is such an exception to be found in the marine environmental protection architecture of the LOS Convention, with which the LC/LP must remain compatible.

The alacrity with which the LP, barely entered into force, was twice amended to permit not only the disposal of CO<sub>2</sub>, but also its transboundary transport, is worrying. With regard to the second

LP amendment, the parties recognized that despite the amendment to LP Annex I, the disposal of CO<sub>2</sub> in SSGFs remained inconsistent with LP Art. 6, the LC and the LOSC, in that it transfers pollution from one area to another; this is prohibited by all three instruments. Yet this is the effect of transboundary movement of CO<sub>2</sub> streams and their sub-seabed sequestration. Despite the parties’ wholly honourable and laudable intention to come to a legal solution, their subsequent amendment of LP Art. 6 does not cure the fundamental incompatibility of this amendment and that of LP Annex 1 with, especially, LOSC Articles 192, 195, and 210 and the objectives of the LC/LP themselves. Contributing to this unsettling tendency is the insertion of the word “currently” in the ocean fertilization resolution.<sup>104</sup> The lengthy battle for its removal was lost because many parties wanted to retain the option to fertilize the ocean if it demonstrably mitigates climate change.<sup>105</sup>

In the view of this author, climate change must not be permitted as a pretext to erode the hard-won marine environmental protection rules already on the books. Rather, climate change should be invoked as the reason to strengthen them even further, not least because the increased GHG emissions driving climate change are anthropogenic.

The LOSC, despite its high and mandatory standards for marine environmental protection and its status as the most powerful, legally binding global instrument available to the international community to assess and regulate geo-engineering projects that involve or affect the oceans, has not yet been implemented to anywhere near its full potential for marine environmental protection in general, let alone for ocean-related geo-engineering projects in particular. This is a pity, because the extensive scope and largely unqualified nature of its environmental provisions mean that it is at present also the only legally binding global instrument that could be invoked to challenge *any* proposed geo-engineering project on environmental grounds. Covering as it does 70% of the planet, the ocean is bound to be either affected or risk being so by any geo-engineering project, no matter where located, even in orbit around the earth. By the same token, the LOSC should arguably also be invoked to assess whether the two amendments to the LP are compatible with the marine environmental obligations imposed by the LOSC on its parties, and in particular with LOSC Article 195.

102 LOSC, 21 ILM (1982), *supra*, note 5, Art. 87(f).

103 This misconception is comprehensively discussed in Verlaan, “Experimental Activities that Intentionally Perturb the Marine Environment”, *supra*, note 2.

104 “NOTING that knowledge on the effectiveness and potential environmental impacts of ocean fertilization is currently insufficient to justify activities other than legitimate scientific research...” LC30/LP3 Final Report, *supra*, note 96, Annex 6.

105 For further details on this meeting see Philomene Verlaan, “Selected Summary Highlights from the 30th Consultative Meeting of the Contracting Parties to the London Convention and the 3rd Meeting of the Contracting Parties to the London Convention Protocol”, 28 Underwater Technology (2009), at 129–134.

LOSC Article 195 poses a particularly difficult hurdle for geo-engineering projects that seek to “mitigate climate change” by manipulating, affecting, or otherwise utilizing the marine environment and/or its processes in order to reduce the concentration in the atmosphere of CO<sub>2</sub> and other GHG. Applied to the present context, Article 195 requires States not to transfer, directly (e.g., by injection) or indirectly (e.g., by fertilization), damage or hazards (e.g., excessive atmospheric GHG) from one area (the atmosphere) to another (the ocean) or transform one type of pollution (e.g., potentially harmful concentrations of GHG in the atmosphere) into another (e.g., potentially harmful concentrations of GHG in the ocean). Proponents of geo-engineering projects must show, *inter alia*, why such projects do not violate Article 195. It is not clear why the LP parties should not do likewise.

## V. Conclusions

Geo-engineering projects, from the research stage onwards, must satisfy a formidable suite of mandatory international legal requirements under the law of the sea and related legally binding instruments

that are dedicated to the protection and preservation of the marine environment. The LOSC and the LP/LP are at present the most immediately relevant instruments available to the international community to assess and regulate geo-engineering projects that involve or affect the oceans. Between them, currently the LOSC is the most comprehensive and powerful and the LC/LP are the most effectively implemented. If the mandatory international legal requirements imposed by these instruments and the law of the sea are not satisfied, the projects cannot legally proceed.

Furthermore, geo-engineering projects are not the only climate change-related activities that must satisfy the LOSC’s marine environmental protection requirements. These requirements apply to all sources of marine pollution. It could therefore be argued that the adverse effect on the marine environment of anthropogenic increases in atmospheric GHG is now such that GHG are to be considered pollutants of the marine environment, and anthropogenic activities contributing to their production are caught by the LOSC. Hence the requirements of the LOSC for the protection and preservation of the marine environment legally oblige States to prevent, reduce and control GHG emissions at source.