LOSI Conference Papers, 2012

“Securing the Ocean for the Next Generation”

Papers from the Law of the Sea Institute, UC Berkeley–Korea Institute of Ocean Science and Technology Conference, held in Seoul, Korea, May 2012

Proceedings edited by Prof. Harry N. Scheiber, LOSI
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Assistant Editor: Emily A. Gardner

International Legal Challenges Concerning Marine Scientific Research in the Era of Climate Change

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This paper was presented at the tenth in a series of annual international conferences organized and sponsored or co-sponsored by the Law of the Sea Institute, School of Law, University of California, Berkeley, USA. The May 2012 conference was jointly sponsored and co-organized in collaboration with the Korea Institute of Ocean Science and Technology (KIOST, formerly KORDI), and hosted by KIOST on May 21-24, 2012 in Seoul, Korea. This was the third LOSI-KIOST collaboration in conferences and publications.

International Legal Challenges Concerning Marine Scientific Research in the Era of Climate Change

Alexander Proelss*

I. Introduction: Climate Engineering and International Law

In recent years, "climate engineering" (CE), or, alternatively, "geoengineering," collective terms referring to large-scale technical interventions into the Earth's climate system, have attracted widespread attention. Technologies covered by this concept aim at contributing to the fulfillment of the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) of May 9, 1992[1] to "achieve […] stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[2] The debate on these technologies initially originated from the field of natural sciences, but has increasingly been taken up by State governments, international organizations and non-governmental organizations (NGOs). It was fostered by the failure of the community of States to agree on stricter and globally applicable emission reduction standards following the expiration of the commitment period of the 1997 Kyoto Protocol on December 31, 2012.[3] As is well-known, the 17th Conference of the Parties (COP) to the UNFCCC held in Durban in 2011 could only agree on an interim continuation of the Kyoto Protocol of those State parties continuously willing to be bound by its terms, and, on a mandate for negotiating the terms of a comprehensive post-Kyoto treaty until 2015 that will become globally effective by 2020. This delay is frequently held to jeopardize the two degree Celsius target referred to by the Copenhagen Accord.[4]

According to a preliminary definition provided by the parties to the Convention on Biological Diversity of June 5, 1992 (CBD),[5] geoengineering

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1 1771 U.N.T.S. 107.

2 Id., Article 2.

3 I.L.M. 37 (1998), 32.

4 See UN Doc. FCCC/CP/2009/L.7 of 18. December 2009, para. 1.

5 1760 U.N.T.S. 143.

comprises "technologies that deliberately reduce solar insolation or increase carbon sequestration from the atmosphere on a large scale that may affect biodiversity (excluding carbon capture and storage from fossil fuels when it captures carbon dioxide before it is released into the atmosphere)."[6] This concept thus covers two categories of manipulation of the global climate system: (1) through interventions in the global carbon cycle (e.g., carbon dioxide removal – CDR), and (2) by shielding solar radiation (e.g., solar radiation management – SRM). Concerning *marine* climate engineering, most of the technologies that are presently debated aim at an increase of oceanic carbon uptake in upper seawater layers.[7] This could be done (1) by fertilizing the water with iron to stimulate algal growth and intensify the biological carbon pump in areas of the ocean where algal growth is limited due to a lack of nutrients or trace elements such as nitrate or iron (ocean iron fertilization), (2) by way of dissolution of calcium-containing material (e.g., silicates and limestone), or through electrolytic removal of hydrochloric acid in special water treatment facilities (increasing ocean alkalinity), or (3) by the deployment of flap-valve operated ocean pipes that pump up cold deep seawater into less fertile waters at the surface (ocean upwelling). All of these CE methods intervene in the global carbon cycle and are thus qualified as CDR technologies.

In contrast, another marine CE technology presently discussed, the modification of marine stratus clouds, is to be attributed to the category of SRM, as it aims at shielding solar radiation. According to this technology, sea salt particles are emitted by unmanned ships in order to increase aerosol salt concentrations as a means of changing the albedo in marine boundary layer clouds. It has been estimated that a global total of 23 m^3 of seawater per second would have to be atomized to achieve the desired effect of increasing the backscattering of shortwave radiation.[8] Against this background, large fleets of ships would be needed to distribute the sea salt aerosols in as uniform a manner as possible.[9]

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6 The definition is contained in a footnote to Decision X/33 on Biological Diversity and Climate Change adopted by the 10th Conference of the Parties (COP) to the CBD, available at: <http://www.cbd.int/decision/cop/?id=12299>.

7 A detailed assessment of the scientific background and prospects of feasibility of these technologies is provided by Wilfried Rickels et al., *Large-Scale Intentional Interventions into the Climate System? Assessing the Climate Engineering Debate* (Kiel, 2011): 39-49. The study is available at: <http://www.kiel-earth-institute.de/scoping-report-climate-engineering.html>.

8 See John Latham et al., "Global Temperature Stabilization via Controlled Albedo Enhancement of Low-level Maritime Clouds," *Philosophical Transactions of the Royal Society A*, 366 (2008): 3969-3987.

9 Stephen Salter/Graham Sortino/John Latham, "Sea-going Hardware for the Cloud Albedo Method of Reversing Global Warming," *Philosophical Transactions of the Royal Society A*, 366 (2008): 3989-4006.

It is important to note that all of the aforementioned technologies are characterized by a high degree of scientific uncertainty concerning their feasibility as well as their potential negative impacts on the environment. For example, modeling studies suggest that the redistribution of warm and cold water achieved by the deployment of pipes in ocean upwelling may lead to a disturbance of the global energy budget. The turning-off of the pumps could result in a rapid warming with average global temperatures that are higher than those in simulations in which artificial upwelling was not used.[10] Concerning ocean iron fertilization, potential adverse environmental effects range from increased acidification of the seabed ecosystems, impacts on the food chain of the ocean, and changes in marine trace gas emissions that may lead to potential changes in the ozone layer.[11] Taking into account that notwithstanding these risks, a future deployment of CE cannot be ruled out in light of the partial deadlock in international climate negotiations, scientific research for assessing the feasibility and effects of these CE technologies arguably becomes necessary prior to their implementation. Furthermore, taking into account the potential negative impacts on the environment, it is beyond controversy that any field research or implementation of marine CE technologies involves serious legal challenges.

Due to the largely transboundary and potentially global character of CE, and keeping in mind that the feasibility of some of the technologies concerned is limited to areas beyond the limits of national jurisdiction such as the high seas, the legality of the respective technologies must be examined in accordance with public international law. Consequently, States are, according to the principle of prevention,[12] obliged to select the most environmentally sound available technology when making recourse to technologies with the potential to damage the environment, and to respect the interests of other States and those of the global commons.[13] The procedural dimension of the due diligence requirement that forms the core of the principle of prevention also becomes manifest in the duty of States involved in activities that may

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10 Andreas Oschlies, "Climate Engineering by Artificial Ocean Upwelling: Channeling the Sorcerer's Apprentice," *Geophysical Research Letters*, 37 (2010): doi:10.1029/2009GL041961.

11 Rickels et al., *Large-Scale Intentional Interventions*, 48 with further references.

12 The principle of prevention has been considered as binding under customary international law by the International Court of Justice (ICJ); see ICJ, *Case Concerning Pulp Mills on the River Uruguay* (Argentina v. Uruguay), ICJ Reports 2010, 14, para. 101. In contrast to the precautionary principle, it does not aim at risk management but at preventing environmental harm.

13 See Commentary to Article 3 of the ILC Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, para. 7, reprinted in: *Yearbook of the ILC*, 2001/II-2, 154. See also ICJ, *Case Concerning Pulp Mills on the River Uruguay* (Argentina v. Uruguay), ICJ Reports 2010, 14, para. 228.

result in adverse environmental impacts to inform, notify and negotiate (with) those States that are potentially affected by the conduct in question.[14]

However, apart from the general rules and principles of customary international law (whose relevance vis-à-vis CE cannot be assessed here in detail),[15] public international law does currently not contain norms that were specifically developed and comprehensively made applicable to the research and deployment of CE. No international treaty has ever been adopted with the intention of regulating such activities.[16] This does not mean, though, that existing treaties would not be applicable to CE activities. In many instances, multilateral environmental agreements such as, e.g., the UNFCCC and the CBD are drafted in comparatively broad terms, or they contain general principles and rules that then ought to be implemented and substantiated on the regional or domestic level ('framework approach'). This often allows the rules contained in the agreement concerned, or in several agreements that are applicable in parallel respectively,[17] to be applied to new phenomena that were unknown at the time the treaty was negotiated.

It is particularly noteworthy that one of the two strategies provided by Article 3 (3) of the Kyoto Protocol that serve to operationalize the general objective of the UNFCCC to stabilize the atmospheric concentrations of greenhouse gases at a level to prevent dangerous disruptions of the climate system, is defined as a "process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere" (Article 1 No. 8 UNFCCC). If applied to CE, it cannot be doubted that that definition indeed covers CDR technologies as they pursue the objective of removing greenhouse gases from the atmosphere. Existing climate protection law thus cannot, as far as CDR technologies are concerned, be interpreted as establishing a categorical or even partial prohibition of CE.

A recent decision taken by the COP to the CBD arguably demonstrates that the same conclusion may be drawn with regard to the conservation of

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14 ICJ, *Case Concerning Pulp Mills on the River Uruguay* (Argentina v. Uruguay), ICJ Reports 2010, 14, paras. 80 et seq.

15 A brief survey is given by Alexander Proelss, "Geoengineering and International Law," *Security and Peace*, 30 (2012): 205-211; see also id., "Das Urteil des Internationalen Gerichtshofs im Pulp Mills-Fall und seine Bedeutung für die Entwicklung des Umweltvölkerrechts," in: Matthias Ruffert (ed.), *Liber Amicorum Meinhard Schröder* (Berlin, 2012): 611-625, at 616 et seq.

16 The sole partial exception is the case of ocean iron fertilization, with regard to which the States parties to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter of November 13, 1972 (I.L.M. 11 [1972], 1294) and the Protocol thereto of November 7, 1996 (I.L.M. 36 [1997], 7) have meanwhile established an informal regime for the regulation of ocean iron fertilization experiments.

17 For example, taking into account the potential negative impacts, marine CE will usually have to be assessed against the requirements of the United Nations Convention for the Law of the Sea of December 10, 1982 (LOS Convention – 1833 U.N.T.S. 397), the UNFCCC, the CBD and, as the case may be, the London Convention and Protocol.

biodiversity. While the parties to the Convention stressed that no climate-related geo-engineering activities that may affect biodiversity should take place "until there is an adequate scientific basis on which to justify such activities and appropriate consideration of the associated risks for the environment and biodiversity and associated social, economic and cultural impacts,"[18] it accepted that an exception may be made for "small scale scientific research studies that would be conducted in a controlled setting in accordance with Article 3 of the Convention, and only if they are justified by the need to gather specific scientific data and are subject to a thorough prior assessment of the potential impacts on the environment."[19] Notwithstanding the fact that decisions of the COP to the CBD are not formally binding in terms of law,[20] the aforementioned statement suggests that CE may, depending on the circumstances, be considered as lawful under international biodiversity conservation law, provided that the actions concerned can be qualified as scientific research. It is perhaps not without relevance that the duty to thoroughly assess the potential impacts on the environment to which the COP also referred in its decision fully reflects the present state of customary international law.[21] In light of the fact that the CBD is generally applicable in areas both within and beyond the limits of national jurisdiction (cf. Article 4), the recent clarification made by the COP is also meaningful with regard to marine CE technologies. All the more, the question begs to be asked how these technologies are to be assessed on the basis of the international law of the sea.

II. Marine Climate Engineering under the LOS Convention

The compatibility of marine CE with the requirements of the international law of the sea cannot be analyzed categorically. Rather, the assessment ought to differentiate between the specific technologies, depending on: (1) the mode of operation of the technology concerned, (2) the objectives pursued with it, (3) the area where the technology is deployed, and (4) the environmental risks involved in the technology. For example, as far as the legality of ocean iron fertilization in areas beyond the limits of national jurisdiction is concerned, the

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18 Decision X/33 on Biological Diversity and Climate Change adopted by the 10th Conference of the Parties (COP) to the CBD, available at: <http://www.cbd.int/decision/cop/?id=12299>, para. 8 lit. w.

19 Ibid.

20 See Kerstin Güssow et al., "Ocean Iron Fertilization: Why further Research is Needed," *Marine Policy*, 34 (2010): 911-918, at 915.

21 ICJ, *Case Concerning Pulp Mills on the River Uruguay* (Argentina v. Uruguay), ICJ Reports 2010, 14, para. 204.

central question to be addressed is whether the introduction of iron into the marine environment can be considered as a placement of matter for a purpose other than the mere disposal thereof that is not contrary to the aims of the pertinent agreements.[22] If this question would have to be answered in the affirmative, ocean iron fertilization would not constitute dumping in terms of the LOS Convention[23] and the London Convention/Protocol[24] and would, thus, not be subjected to the specific regulatory mechanisms established by these agreements. Whether or not such a positive answer can be given is not fully clear, though, as it cannot be ruled out according to the present state of science that ocean fertilization has potentially damaging effects on human health, living resources or marine species.[25]

1. Ocean Upwelling under the LOS Convention

As has recently been demonstrated in a publication co-authored by this author,[26] the deployment of oceanic pipes (e.g., for use in ocean upwelling) gives rise to completely different legal questions, including (1) issues of jurisdiction, (2) deployment requirements, and (3) removal requirements.

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22 See Rosemary Rayfuse/Mark Lawrence/Kristina Gjerde, "Ocean Fertilisation and Climate Change: The Need to Regulate Emerging High Sea Uses," *International Journal of Marine and Coastal Law*, 23 (2008): 297-326, at 312-317; Güssow et al., "Ocean Iron Fertilization," at 914 et seq.

23 Cf. Article 1 (5) (b) (ii) and Article 210 LOS Convention.

24 Cf. Art. III (1) (b) (ii) London Convention and Art. 1 (4) No. 2.2 London Protocol.

25 See only Richard Lampitt et al., "Ocean Fertilization: A Potential Means of Geoengineering?," *Philosophical Transactions Of The Royal Society A*, 366 (2008): 3919-3945.

26 Alexander Proelss/Chang Hong, "Ocean Upwelling and International Law," *Ocean Development and International Law*, 3 43 (2012): 371-385.

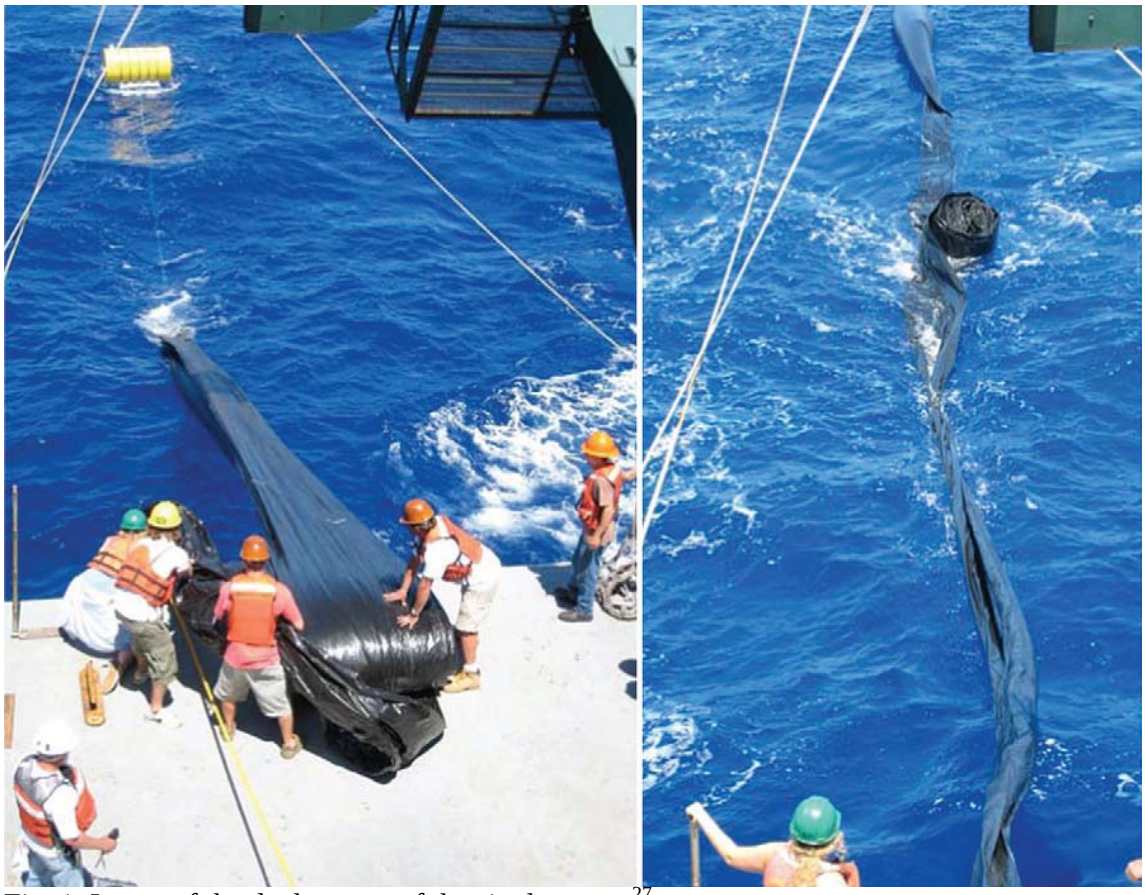

Fig. 1: Image of the deployment of the single pump.[27]

a) Issues of Jurisdiction and Deployment Requirements

Concerning the first set of questions, Part XIII, section 4 of the LOS Convention contains five articles (Arts. 258 to 262) dealing with scientific research installations or equipment in the marine environment that are potentially applicable to oceanic pipes. However, their qualification as installations or equipment in terms of these provisions presupposes that their deployment would constitute marine scientific research (MSR). In the absence of an authoritative legal definition contained in the LOS Convention, MSR shall, for the purposes of the present contribution, be understood as any study and experimental work designed to increase human knowledge of the seabed

[27] Source: Angelicque White et al., "An Open Ocean Trial of Controlled Upwelling Using Wave Pump Technology," *Journal of Atmospheric and Oceanic Technology*, 27 (2010): 385-396, at 389. In most instances, oceanic pipes are attached to free-floating surface buoys. A valve that opens and closes at opposite phases of a wave cycle is installed at the bottom end of each pipe. The plastic tubes attached to the buoys can be up to 300 m long or even more.

or the subsoil, the water column, or the atmosphere directly above the water.[28] Upwelling pipes are primarily envisaged to enhance biological production, sequester atmospheric CO_2 and lower the sea surface temperature. Given these purposes, it seems difficult to regard ocean upwelling as MSR in terms of the aforementioned working definition, since upwelling's primary goal of CDR, as well as the development of fisheries, is not to increase human knowledge of the marine environment. Having said that, obtaining knowledge of the marine environment constitutes the initial stage of both kinds of activities, as seawater temperature, density, ingredient of nutrients and water currents are investigated at the proposed sites. Thus, it is submitted that while the deployment of upwelling pipes for CDR or enhancement of fishery production on a large and/or commercial scale cannot be regarded as MSR, assessing the preconditions for ocean upwelling as well as testing artificial pipes meets the requirements of that concept.

Given that ocean pipes used for artificial upwelling are comparatively small objects made of plastic whose life span is likely to expire within weeks after deployment,[29] an application of the relevant criteria of size, duration and function[30] leads to the conclusion that ocean upwelling pipes, as long as their use has not entered the commercial deployment phase, are to be considered as MSR equipment. Consequently, while the right to establish safety zones only exists in respect of scientific research installations,[31] Article 261 LOS Convention emphasizes the general requirement of non-interference with shipping routes, which is also applicable to equipment. This provision clearly corresponds with Article 240 (c) according to which MSR is not to unjustifiably interfere with other legitimate uses of the sea compatible with the Convention. Furthermore, Article 262 LOS Convention provides that installations or equipment are to bear identification markings indicating the State of registry or international organization to which they belong, and warning signals. This suggests that scientific research installations and equipment, similar to vessels, have to be registered with a State or an international organization.[32]

Concerning jurisdiction over upwelling pipes in the territorial sea, the coastal State is generally free to deploy such devices. This freedom is not

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28 Alfred A.H. Soons, *Marine Scientific Research and the Law of the Sea* (The Hague, 1982): 124. See also UNCLOS, Off. Rec., Vol. VI, 89 (A/CONF.13/42). Cf. also *Edward Duncan Brown*, The International Law of the Sea, Vol. I, (Dartmouth, 1994): 418 et seq.

29 Angelicque White et al., "Wave Pump Technology," at 390.

30 Soons, *Marine Scientific Research*, 235; see also Katharina Bork, *Der Rechtsstatus von unbemannten ozeanographischen Messplattformen im internationalen Seerecht* (Baden-Baden, 2011): 66-67; Florian H. Th. Wegelein, *Marine Scientific Research: The Operation and Status of Research Vessels and other Platforms in International Law* (The Hague, 2005): 138.

31 See Article 260 LOS Convention.

32 See Wegelein, *Marine Scientific Research*, 148-150.

unlimited, though, as the coastal State is, if the pipes are used for MSR, obliged to adhere to the general rules and principles contained in Arts. 238-241 LOS Convention as well as those codified in Arts. 260-262 LOS Convention. Furthermore, according to Article 24 (1) LOS Convention, the coastal State "shall not hamper the innocent passage of foreign ships through the territorial sea […]," which is why the deployment of ocean pipes, irrespective of their purpose, ought not to interfere with the right of innocent passage of other States. Having said this, it has been submitted that the coastal State is, based on Article 21(1) (b) and (g) LOS Convention, entitled to request foreign ships to avoid certain areas of its territorial sea where ocean pipes have been deployed, provided that this measure does not make innocent passage impossible, or hamper innocent passage in an unjustifiable manner respectively.[33] In contrast, other States do not have the right to deploy ocean pipes in a foreign territorial sea without the coastal State's permission, no matter for what the pipes are actually used (cf. Article 245 LOS Convention). Similar to the situation in the internal waters, the jurisdiction of the coastal State thus enjoys priority over the jurisdiction of the State of registry of the installations or equipment.

The situation is more complicated in the Exclusive Economic Zone (EEZ), where the coastal State enjoys sovereign rights, *inter alia*, for the purpose of "exploring and exploiting, conserving and managing the natural resources" and for the "economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds" (Article 56 (1) (a) LOS Convention). The fact that testing and deploying ocean upwelling pipes involves some kind of exploration of ocean energy and living organisms provokes the question whether this suffices to conclude that the sovereign rights of the coastal State are affected. Arguably, a closer examination of Article 56 (1) (a) LOS Convention ("for the purpose of") reveals that the purpose of the deployment, rather than the means, must be regarded as the decisive factor for assessing whether or not the sovereign rights or jurisdiction of the coastal State are affected. Having said that, Article 56 (1) (b) (i) and (ii) LOS Convention clarifies that the coastal State also has jurisdiction with regard to the establishment and use of installations and structures on the one hand and in respect of MSR on the other. Concerning these basis of jurisdiction, the criteria mentioned above governing the differentiation between installations and equipment in the context of MSR as provided for in Article 258-262 LOS Convention (size, duration of deployment, function) are applicable also to Articles 56 and 60,[34] which is why ocean pipes used in upwelling cannot be qualified as "installations" or "structures." Ocean pipes are comparatively small objects with an average diameter of one meter, whose life span is likely to expire within weeks after

[33] Proelss/Chang, "Ocean Upwelling," at 375 et seq.

[34] See Proelss/Chang, "Ocean Upwelling," at 376 et seq.; Bork, *Rechtsstatus*, 66 et seq.

deployment, and their single function is to pump cold, nutrient-rich water to the ocean surface.

The coastal State is thus not entitled to exercise jurisdiction over these objects on the basis of Article 56 (1) (b) (i) in conjunction with Article 60 LOS Convention. Rather, its jurisdiction stems from Article 56 (i) (b) (ii) in conjunction with Article 246 LOS Convention. Consequently, while the coastal State has the right to regulate, authorize and conduct the deployment of ocean pipes used for MSR in its EEZ or on its continental shelf (cf. Article 246 (1) LOS Convention), its scope of discretion concerning the decision to grant consent to third State activities is limited by Article 246 (3) LOS Convention. This limitation applies if and to the extent to which the deployment of ocean pipes is not of direct significance for the exploration and exploitation of natural resources, or touches upon any other of the motives mentioned in Article 246 (5) of the UNCLOS.

However, if ocean pipes are deployed for the purpose of CDR following the initial MSR stage, the sovereign rights and jurisdiction of the coastal State in terms of Article 56 LOS Convention are not affected. The fact that ocean upwelling is also not included in the rights of third States according to Article 58 (1) LOS Convention renders Article 59 LOS Convention applicable to ocean upwelling. Article 59 LOS Convention covers economic uses other than those mentioned in Article 56 (1) and Article 58 (1), as well as other non-economic uses of the EEZ, such as, e.g., the operation of ocean data acquisition systems.[35] Given that Article 59 LOS Convention constitutes a mere conflict rule instead of assigning sovereign rights or jurisdiction to any of the groups of States concerned, activities covered by its terms are, in absence of a user conflict, generally to be considered as lawful. Consequently, the deployment of ocean pipes for the purpose of CE in a State's EEZ is not subject to the jurisdiction of either the coastal State or third States, and it ought to be done in a way that takes due regard to the interests of other States. Furthermore, the State deploying the pipes is entitled to regulate their emplacement and operation, and it is the addressee of the rules governing State responsibility and liability in case damage occurs.

Finally, Article 87 (1) LOS Convention clarifies that irrespective of the purpose pursued with these devices, all States are generally free to deploy ocean upwelling pipes in the high seas, as long as the deployment is exercised under the conditions laid down in the LOS Convention and by other rules of international law. Similar to the situation in the EEZ (cf. Article 59 LOS Convention),[36] this freedom ought to be exercised with due regard for the

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[35] Robin R. Churchill/A. Vaughan Lowe, *The Law of the Sea* (Manchester, 1999): 414; see also Bork, *Rechtsstatus*, 105-106.

[36] It is a matter of controversy whether the regime of the EEZ, as far as the resolution of user conflicts is concerned, is based on the notion of a shift of emphasis in favour of the coastal State; see David Joseph Attard, *The Exclusive Economic Zone in International Law* (Oxford, 1987): 63, 73-75; Alexander Proelss, "The Law on the Exclusive Economic

interests of other States in their exercise of their rights under the LOS Convention (cf. Articles 56 (2), 59, 87 (2) LOS Convention). In this respect, it has been submitted that the most realistic and transparent way for avoiding potential conflicts between the deployment of ocean upwelling pipes and other legitimate maritime activities such as, say, shipping, ought to be seen in the development of non-binding guidelines for the deployment of ocean pipes, and that in light of the fact that ocean upwelling is at least related to MSR, or constitutes MSR respectively, the Advisory Board of Experts on the Law of the Sea (ABE-LOS) of the UNESCO's Intergovernmental Oceanographic Commission (IOC) could constitute a competent forum for the drafting of such guidelines.[37]

b) Removal Requirements

It remains to be observed what is required from the employing State if ocean pipes float (or perhaps "straddle") into an area under another State's jurisdiction, or, if the purpose pursued with the deployed devices has been achieved.

Concerning the first issue, as the entry into a foreign State's EEZ or territorial sea could affect that State's sovereign rights or jurisdiction, or sovereignty respectively, avoidance of unauthorized and unheralded entrance of upwelling pipes into an area under another State's jurisdiction should be a priority followed by the emplacing State. Having said this, the international law of the sea remains silent on how this objective can be met, and whether the employing State as well as the affected State are subject to legal obligations and rights in such a situation. It has been submitted that the Draft Convention on the Legal Status of Ocean Data Acquisition Systems, Aids and Devices (ODAS)[38] explicitly sets forth conditions on the recovery and return of ODAS and could thus serve as a model for guidelines specifically dealing with ocean upwelling pipes.[39] This text aims at obliging a coastal State to inform the State of registry about ODAS found in areas within its jurisdiction, and to either return the ODAS or permit the owner or operator to recover it. In contrast, ODAS that have entered the internal or territorial waters of a State would not need to be returned. It should be noted, though, that the Draft Convention has virtually remained untouched since 1993, and no indications exist whatsoever that this "treaty ruin" could ever enter into force.

Zone in Perspective: Legal Status and Resolution of user Conflicts Revisited," *Ocean Yearbook*, 26 (2012): 87-112, at 91-109.

37 See Proelss/Chang, "Ocean Upwelling," at 380.

38 The text of the 1993 Ocean Data Acquisition Systems, Aids and Devices (ODAS) Draft Convention to is available at: <unesdoc.unesco.org/images/0009/000979/097992eb.pdf> (last visited 20 September 2012).

39 Proelss/Chang, "Ocean Upwhelling," at 380.

With regard to removal requirements coming into effect after the objectives pursued with the upwelling pipes have been achieved, the obligations arising from Part XII LOS Convention deserve particular attention. Given that the pipes are introduced into the marine environment "for a purpose other than the mere disposal thereof" (Article 1 (1) No. 5 (b) (ii) LOS Convention), the deployment of such objects cannot be regarded as "dumping" in terms of Article 209 in conjunction with Article 1 (1) No. 5 LOS Convention. Despite this, it is submitted that Articles 60 (3), 248 (d) and 249 (1) (g) LOS Convention are specific expressions of the general notion that manmade objects intentionally introduced into the marine environment have to be removed once the objective pursued with them has been achieved, or abandoned due to expiry of their life span respectively.[40] This submission is reinforced by the fact that abandonment of disused or damaged pipes ought to be regarded, comparable to plastic garbage, as pollution of the marine environment in terms of Article 1 (1) No. 4 LOS Convention.

2. Marine Stratus Cloud Modification and International Law

Concerning the second marine CE technology addressed above, the compatibility of marine stratus cloud modification with the international law of the sea has so far not been dealt with in legal literature. Admittedly, given that the potential impacts of this technology will mainly affect the atmosphere, or the ozone layer respectively, injecting sea salt particles from ships to increase aerosol concentrations is primarily not a law of the sea problem. Rather, the legality of marine stratus cloud modification is to be assessed on the basis of the Vienna Convention for the Protection of the Ozone Layer of March 22, 1985[41] and the Convention on Long-Range Transboundary Air Pollution of November 13, 1979 (CLRTAP).[42] This assessment cannot be undertaken here.[43] Having said that, the international law of the sea is, indeed, affected by the need for large fleets of unmanned ships to distribute the sea salt aerosols.

In this respect, it is submitted that the deployment of vessels for the purpose of marine cloud modification in a foreign State's internal waters and territorial sea requires that State's approval. While in the territorial sea, one could *prima facie* consider to regard the deployment of such vessels as an exercise of the right of innocent passage, it should be noted that according to

40 Proelss/Chang, "Ocean Upwelling," at 380 et seq.

41 I.L.M. 26 (1987), 1529.

42 1302 U.N.T.S. 217.

43 An initial survey is provided by Rex J. Zedalis, "Climate Change and the National Academy of Sciences' Idea of Geoengineering: One American Academy's Perspective on First Considering the Text of Existing International Agreements," *European Energy and Environmental Law Review*, 2010: 18-32, at 21-23.

Article 18 (2) LOS Convention, "passage" can only be deemed to have taken place when it is continuous and without interruption. The CE technology relevant here is not limited to mere passage, but instead, due to the fact that seawater will be injected into the atmosphere to stimulate cloud modification, requires vessels to remain for longer periods of time at particular and appropriate locations in the territorial sea. Although Article 18 (2) LOS Convention acknowledges that passage can include stopping and anchoring, this can only take place as part of "ordinary navigation" or when necessary due to force majeure, distress or when assisting another ship. Judged against this definition, traversing the coast, or using a foreign State's territorial sea respectively, for the purpose of marine cloud modification does arguably not constitute passage in the sense of the LOS Convention. Even if one would consider the deployment of cloud modification vessels as passage in terms of Article 18 LOS Convention, foreign States may only rely on the right of innocent passage if the transit of their ships is innocent and does not disturb the peace, security or public order in the coastal State (cf. Article 19 (1) LOS Convention). Article 19 (2) LOS Convention clarifies that activities such as research and surveying (sub-part j) and other activities not directly related to transit (sub-part l) cannot be considered as innocent. Consequently, marine stratus cloud modification in a foreign territorial sea requires authorization of the coastal State even if it is conducted for research purposes.

Concerning the EEZ, the coastal State would be entitled to request authorization for foreign marine stratus cloud modification activities if the vessels to be used would have to be regarded as being operated for purposes of MSR (cf. Article 56 (1) (b) (ii) in conjunction with Article 246 LOS Convention). According to the working definition suggested above, MSR can be understood as any study and experimental work designed to increase human knowledge of the seabed or the subsoil, the water column, or the atmosphere directly above the water. As the introduction of seawater particles in order to modify marine clouds affects layers of the atmosphere at a height of 1 to 2 km above the earth surface, the deployment of vessels necessary for this technology, even when performed on an exploratory basis, cannot be qualified as MSR. For this reason, the coastal State's jurisdiction in terms of Article 56 (1) (b) (ii) in conjunction with Article 246 LOS Convention is not affected.

However, it must not be concluded from the foregoing that any CE operation conducted by ships of a third State would automatically be permissible in a foreign EEZ. Whether or not third States are to be considered as being privileged rather depends on whether the activity concerned is in sufficiently close connection with the freedoms of navigation, overflight or laying of submarine pipelines and cables mentioned in Article 58 (1) LOS Convention. This could be argued because cloud modification activities at sea must be carried out using ships. Having said that, navigation only constitutes the means by with marine stratus cloud modification shall be performed. In contrast, the CE activity itself is the dominant feature, i.e., the injection of

saltwater aerosols into the air. It is doubtful whether a sufficiently close connection with the freedom of navigation in terms of Article 58 (1) LOS can be seen in such a situation. Even in regard to military activities, for which the freedoms of navigation and overflight play a significantly stronger role than in the situation described above, it remains disputed whether Article 58 (1) LOS Convention is applicable. Furthermore, it is relevant that the results of marine stratus cloud modification activities are not intended to serve navigation.

As cloud modification activities are thus not included among the sovereign rights or jurisdiction of the coastal State and are also not covered by the freedom of navigation enjoyed by third States, the equity clause contained in Article 59 UNCLOS again becomes applicable.[44] That marine cloud modification activities in a coastal State's own EEZ as well as in a foreign EEZ can be permissible provided that the customary duty of due regard is respected, is supported by the wording of that provision. Article 59 LOS Convention states that the interests of the international community must be respected as a whole. It is submitted that these interests include the prevention of adverse consequences of climate change. On the other hand, it must be ensured through specific navigational standards that international shipping is not significantly disrupted as a consequence of CE operation. Article 211 (5) LOS Convention, which subjects coastal State measures for the prevention of pollution from foreign ships in its EEZ to the approval of the International Maritime Organization (IMO), indicates that the IMO would have to be considered as the appropriate forum also for ensuring safety in maritime navigation in light of marine stratus cloud modification activities.

Finally, cloud modification activities undertaken on the high seas would, similar to the case of ocean upwelling, have to be considered as being covered by the freedoms of the high seas. Article 87 LOS Convention makes clear, however, that the freedoms of the high seas are to be "exercised under the conditions laid down by this Convention and by other rules of international law." In addition to the freedom of navigation of other States, the provisions of Part XII LOS Convention are particularly relevant in this context. The influence of cloud modification activities on ocean circulation as well as the risk of marine pollution posed by non-seawater condensation nuclei[45] have been considered low until now, but have not been sufficiently researched. Thus, a potential conflict can be seen between the objectives pursued by the CE method to counteract climate change and the potential hazards of this activity for specific areas of the environment. How such conflicts of objectives can be resolved is a matter for future research.[46]

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44 See also Bork, *Rechtsstatus*, 105.

45 Cloud condensation nuclei are small particles of about 0.2 µm (approximately 1/100th of the size of a cloud droplet) about which cloud droplets coalesce.

46 See Alexander Proelss, "International Environmental Law and the Challenge of Climate Change," *German Yearbook of International Law*, 53 (2010): 65-88, at 81-84.

III. Conclusion

The example of marine stratus cloud modification shows that the question of legality of the new technologies examined here goes well beyond the scope of the international law of the sea and touches upon central aspects of public international law in general. Even if individual CE technologies should turn out to be compatible with the LOS Convention and other international agreements devoted to the protection of the marine environment, this does not automatically render their research or deployment lawful under other pertinent treaties, or, the principles of customary international law respectively. The multidimensional nature of the issue becomes particularly manifest when taking into account the cautious statements made by the COP to the CBD on the one hand, and, the limited approach on which the UNFCCC is based on the other. In light of the potentially adverse environmental effects of marine stratus cloud modification as well as its qualification as SRM, there is thus a good case to argue that this technology, if deployed on a broader scale, cannot be justified under international law as it stands today.

Despite this, CE is just one manifestation of the fact that technological progress is amongst the primary reasons that pose considerable challenges to the international law of the sea. While the LOS Convention was, according to its preamble, concluded in a spirit to "settle […] all issues relating to the law of the sea" and thus provides a legal framework that has been envisaged to be applicable also to modern developments, the examples of ocean iron fertilization, ocean upwelling and marine stratus cloud modification demonstrate that there is a clear need in the "post-codification era" (*Tullio Treves*) to substantiate the general requirements contained in the Convention by way of establishing specific sub-regimes. Whether this need is best accommodated by way of negotiating binding international agreements or by way of adoption of soft-law guidelines cannot be answered here in a definite manner. It should be noted, though, that recent years have shown that effective ocean governance does not necessarily require binding law. Within the legal framework established by the LOS Convention, rules of deployment and other guideline documents have quite often turned out to constitute functioning regimes and as such have helped to avoid the burdensome negotiation of a new treaty that might have ultimately turned out as lacking sufficient support of the international community. It remains to be seen whether this conclusion will hold true with regard to marine issues in the era of climate change.