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Item 7.3 of the provisional agenda*

REGULATORY FRAMEWORK FOR CLIMATE-RELATED GEOENGINEERING RELEVANT TO THE CONVENTION ON BIOLOGICAL DIVERSITY

Note by the Executive Secretary

1. The Executive Secretary is circulating herewith, for the information of participants of the sixteenth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice, the study on the regulatory framework for climate-related geoengineering relevant to the Convention on Biological Diversity.

2. The study describes the current regulatory and legal framework that may apply to climate-related geoengineering, and, taking into account the possible need for science based global, transparent and effective control and regulatory mechanisms, attempts to identify gaps in such existing mechanisms. The study was prepared in response to paragraph 9 (m) of decision X/33. Related scientific and technical matters are treated in a separate study (UNEP/CBD/SBSTTA/16/INF/28). In addition, a separate consultation process has been undertaken by the Secretariat of the Convention on Biological Diversity in order to seek the views of indigenous peoples and local communities on the possible impacts of geoengineering techniques on biodiversity and associated social, economic and cultural considerations (UNEP/CBD/SBSTTA/16/INF/30).

3. This study has been prepared for the Convention on Biological Diversity by a lead author, with review comments and additional contributions from a group of experts as well as the Secretariat of the Convention.[1] The study also takes into account comments from two rounds of review by Parties, experts and stakeholders.

4. The key messages are available in all United Nations languages in section III of the note by the Executive Secretary on the technical and regulatory matters on geoengineering in relation to the Convention on Biological Diversity (UNEP/CBD/SBSTTA/16/10).

5. The study has not been formally edited. It will be edited prior to publication in the CBD Technical Series.

* UNEP/CBD/SBSTTA/16/1.

[1] This study has been prepared by Ralph Bodle with contributions from Gesa Homan, Simone Schiele, and Elizabeth Tedsen. It has been reviewed by a group of experts comprising the following, many of whom have made additional contributions: Michael Shewchuk, Edward Kleverlaan, Dan Bondi-Ogolla, Gerardo Gúnera-Lazzaroni, Alexander Proelss, Elisa Morgera, Diana Bronson, Joshua Horton, Atty. Elpidio Ven Peria, René Coenen, Chris Vivian, and Lyle Glowka. The CBD Secretariat has provided some further comments and editing (Jaime Webbe, Annie Cung and David Cooper).

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Regulatory Framework for Climate-related Geoengineering relevant to the Convention on Biological Diversity

Study carried out in line with CBD Decision X/33

The report describes the current regulatory and legal framework that may apply to climate-related geoengineering, and, taking into account the possible need for science based global, transparent and effective control and regulatory mechanisms, attempts to identify gaps in such existing mechanisms. The report was prepared in response to CBD Decision X/33, paragraph 9(m).

Key Messages

The Conference of the Parties to the Convention on Biological Diversity, taking into account *the possible need for science based global, transparent and effective control and regulatory mechanisms*, requested a study to be undertaken on gaps in such existing mechanisms for climate-related geoengineering relevant to the Convention on Biological Diversity (decision X/33, paragraph 9 (m)). This request was made in the context of the CBD decision on geoengineering which provides guidance for Parties and other Governments to ensure, "*in the absence of science based, global, transparent and effective control and regulatory mechanisms for geoengineering*", that no climate-related geoengineering activities that may affect biodiversity take place, until certain conditions are met, with some exceptions for small scale research (decision X/33, paragraph 8(w)). (*Section 1.1*)[2]

"Climate-related geoengineering" is a general term that encompasses several different geoengineering concepts, techniques or technologies. The CBD COP10 adopted a preliminary definition for climate-related geoengineering in 2010 and will further discuss the matter in 2012. In the study on the potential impacts on biodiversity, climate-related geoengineering is defined as a deliberate intervention in the planetary environment of a nature and scale intended to counteract anthropogenic climate change and/or its impacts through, *inter alia*, sunlight reflection methods or removing greenhouse gases from the atmosphere. However, there is no universal and uniform use of the term "geoengineering". Thus, the definition will need to be analysed for its suitability for governance in a normative context. (*Section 1.3*)

The need for science-based global, transparent and effective control and regulatory mechanisms may be most relevant for those geoengineering concepts that have a potential to cause significant adverse transboundary effects, and those deployed in areas beyond national jurisdiction and in the atmosphere. For example, injection of aerosols into the atmosphere would have transboundary effects that may be deleterious, while ocean fertilization would be carried out in areas that extend beyond national jurisdiction. Some activities such as afforestation, reforestation and terrestrial biomass production, when carried out within a single country, might be deemed to be adequately governed through domestic regulations. (*Section 1.3*)

The existing regulatory framework includes general customary rules of international law and specific international treaties. The rules of customary international law and other general principles of international law apply to all activities and therefore would, in principle, be relevant to geoengineering. In addition, some international treaties have provisions that may be relevant to particular categories of activities. (*Section 1.5*)

[2] Information in parentheses indicates where full details, with references, can be found in the study

General rules of customary international law

State responsibility describes the rules governing the general conditions under which a state is responsible for wrongful actions or omissions, and the resulting legal consequences. Although the rules on state responsibility provide a general framework for addressing breaches of international law, they do not address under which conditions geoengineering activities would be permitted or prohibited. They require a breach on an obligation without defining these obligations. States are not as such responsible for acts of private actors. However, a state might have to address private actors in order to fulfil its own obligation. A state could be in breach of an obligation if it fails to take necessary measures to prevent effects caused by private actors. (*Section 2.1*)

All states are under a general obligation to ensure that activities within their jurisdiction or control respect the environment of other States or of areas beyond national jurisdiction or control. This duty to respect the environment does not mean, however, that *any* environmental harm, pollution, degradation or impact is generally prohibited. The duty prohibits a state from causing *significant transboundary* harm and obliges a state of origin to take adequate measures to control and regulate in advance sources of such potential harm. States have to exercise "due diligence" before carrying out potentially harmful activities. What constitutes "due diligence" would largely depend on the circumstances of each case. Establishing state responsibility for any harm from a geoengineering activity would require that (i) the geoengineering activity can be attributed to a particular state and (ii) can be associated with a significant and particular harm to the environment of other States or of areas beyond national jurisdiction or control. (*Section 2.2*)

States have the duty to carry out an environmental impact assessment for activities that may have a significant adverse impact in a transboundary context, in particular, on a shared resource. Among others, the CBD includes a provision for environmental assessment in Article 14 that is referred to in its decision on geoengineering (decision X/33 8(w)). An environmental impact assessment (EIA) is required in many domestic legal orders and the International Court of Justice has recently recognised that the accepted practice among states amounts to "a requirement under general international law". Thus, where there is a risk that a proposed industrial activity may have a significant adverse impact in a transboundary context, the requirement to carry out an environmental impact assessment applies even in the absence of a treaty obligation to this effect. However, this does not necessarily extend to a requirement to undertake strategic environmental assessments. (*Section 2.3*)

The precautionary principle or approach is relevant but its legal status and content in customary international law has not yet been clearly established, and the implications of its application to geoengineering are unclear. Under the CBD, the precautionary approach has been introduced recognizing that "where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat". This has been invoked in its decision on geoengineering which invites Parties and others to ensure (with some exceptions and until certain conditions are met) that no geoengineering activities take place (Decision X/33 paragraph 8(w)). Under the London Protocol, Article 3.1 requires the application of the precautionary approach. Under the United Nations Framework Convention on Climate Change (UNFCCC), the precautionary approach is generally considered as intending to prevent states from postponing mitigation measures by referring to scientific uncertainty about climate change. However, an interpretation in support of geoengineering or pursuing further geoengineering research would not be evidently contrary to the wording. (*Section 2.4*)

Other relevant general concepts include sustainable development, common but differentiated responsibilities, and concepts addressing international interest in the protection of areas beyond national jurisdiction and shared resources as well as issues of common concern such as biodiversity. However the status of these concepts as customary international law is not clearly established. (*Section 2.6*)

Specific treaty regimes and institutions

The Convention on Biological Diversity has adopted a decision on geoengineering that covers all technologies that may affect biodiversity. The Convention contains many provisions that are relevant but not specific to geoengineering, including provisions on environmental assessment. Additional relevant guidance has been developed under the Convention. The CBD decision on geoengineering invites Parties and others to ensure (with some exceptions and until certain conditions are met) that no geoengineering activities take place (Decision X/33 paragraph 8(w)). The decision refers specifically to "the precautionary approach and Article 14 of the Convention. While not expressed in legally binding language, the decision is important for a global governance framework because of the wide consensus it represents. The Parties to the Convention have also recognized that while science-based global transparent and effective control and regulatory mechanism for geoengineering may be needed, they may not be best placed under the CBD. The CBD has referred to and incorporated the work of the London Convention and London Protocol (LC/LP) on ocean fertilization in its own decisions, thus widening the application of this work beyond the smaller number of Parties to the LC/LP. (*Section 3.1*)

The United Nations Convention on the Law of the Sea (UNCLOS) sets out the legal framework within which all activities in the oceans and seas must be carried out, including relevant geoengineering activities, such as ocean fertilisation, modification of downwelling and/or upwelling, maritime cloud albedo enhancement, and altering ocean chemistry through enhanced weathering. Under the Convention, States have the general obligations to protect and preserve the marine environment and to take all measures necessary to prevent, reduce and control pollution of the marine environment from any source, including pollution by dumping. While states are allowed to pursue a range of activities under the "freedom of the high seas", these activities must be exercised in accordance with the provisions of UNCLOS and with due regard for the interests of other States. Rules and standards established under LC/LP are considered to be relevant for the implementation of UNCLOS. (*Section 3.2*)

The London Convention and London Protocol (LC/LP) have provided detailed guidance on ocean fertilization, as well as carbon storage, and are considering wider application to other marine geoengineering activities within their mandate. Disposal of CO_2 in the water column or on the seabed is not allowed under the LP. The LC/LP are global instruments that address marine pollution from dumping of wastes and other matter at sea. In 2010 the Parties adopted the "Assessment Framework for Scientific Research Involving Ocean Fertilization". This non-binding Assessment Framework, which has been recognized by the CBD, guides Parties as to how proposals they receive for ocean fertilization research should be assessed and provides criteria for an initial assessment of such proposals and detailed steps for completion of an environmental assessment, including risk management and monitoring. The LP has also adopted amendments to regulate CO_2 sequestration in sub-seabed geological formations supported by a risk assessment and management framework and additional guidelines. (*Section 3.3*)

The UNFCCC and Kyoto Protocol have not addressed geoengineering concepts as such or its governance[3]. The objective of both instruments as stated in Article 2 UNFCCC is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent

[3] However have addressed carbon capture and storage, which may have some relevance for CO_2 storage

dangerous anthropogenic interference with the climate system. Under these instruments, guidance has been developed that address afforestation, reforestation and enhancement of soil carbon. Beyond these techniques, the obligations on Parties to take measures to limit emissions and protect carbon sinks do not promote or prohibit geoengineering measures as such. (*Section 3.4*)

The Vienna Convention for the Protection of the Ozone Layer requires Parties, inter alia to take measures to protect human health and the environment against likely adverse effects resulting from human activities that modify or are likely to modify the ozone layer. The Montreal Protocol requires Parties to phase down certain substances that deplete the ozone layer. Activities such as aerosol injection could raise issues under these agreements, particularly if they involve a substance covered by the Montreal Protocol. The Vienna Convention defines "adverse effects" as changes in the physical environment or biota, including changes in climate, which have significant deleterious effects on human health or on the composition, resilience and productivity of natural and managed ecosystems, or on materials useful to mankind. (*Section 3.5*)

The Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD) would only apply directly to geoengineering if it were used as a means of warfare. The main substantial obligation is that listed Parties "undertake not to engage in military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party". However, the Convention could be a possible source of ideas, concepts and procedures useful for addressing geoengineering. (*Section 3.6*)

The deployment of shields or mirrors in outer space to reflect or block solar radiation would fall under Space Law. The international legal regime regulating environmental aspects of outer space includes the Outer Space treaty, four other main treaties and several resolutions of the United Nations General Assembly. The Outer Space Treaty provides that experiments that "would cause potentially harmful interference with activities of other States" are subject to prior appropriate international consultation. Activities such as aerosol injection in the stratosphere would not be regarded as falling under the purview of space Law because they would be below 80km. (*Section 3.7*)

The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) prohibits CO_2 storage in the water column or on the seabed and has developed rules and guidance for the storage of CO_2 in geological formations under the seabed. The amendments allowing sub-surface CO_2 storage were adopted in 2007 but have not yet entered into force. (*Section 3.9*)

The Convention on Long Range Transboundary Air Pollution (LRTAP) may be relevant for geoengineering concepts such as aerosol injection, which introduce sulphur or other substances into the atmosphere. It is a regional convention covering most states in Europe and North America. Although the LRTAP Convention requires Parties to make efforts at limiting, gradually reducing and preventing air pollution including long-range transboundary air pollution", the wording of these obligations and the definition of air pollution soften its content considerably. The same goes for the obligation on Parties to develop policies and strategies for combating the discharge of air pollutants. These general obligations do not require specific legal measures to prevent air pollution or to restrict aerosol injection. Apart from this obligation, LRTAP requires the sharing of data on pollutants and stipulates procedural obligations that may apply to certain geoengineering activities. Several protocols under the LRTAP impose specific obligations to reduce sulphur emissions or transboundary fluxes, but at most only up to 2010. (*Section 3.10*)

The Antarctic treaty system would apply to geoengineering activities carried out in the Antarctic. (*Section 3.8*)

Human rights law would be relevant if a particular geoengineering activity violates specific human rights. Which human right could be impacted would depend on how a particular geoengineering activity would be carried out and which effects it might actually have. In addition, impacts on human rights might be justified in a particular case. Most human rights are not absolute and are subject to restrictions under certain conditions, e.g. that the restrictions are provided by law, address specific aims and are necessary to achieve a legitimate purpose. (*Section 3.11*)

International institutions such as the United Nations General Assembly, United Nations Environment Programme (UNEP), World Meteorological Organization (WMO) and Intergovernmental Oceanographic Commission (IOC) of UNESCO are relevant to the governance of geoengineering. The UN General Assembly has addressed ocean fertilization and could address additional issues related to geoengineering. It has also encouraged the further development of EIA processes. In 1980, UNEP developed guidelines on weather modification. The mandate of WMO covers meteorology, the atmosphere and hydrology and could, in principle, address sunlight reflection methods. It has issued non-binding guidance on weather modification. UNESCO's IOC has assessed the potential impact of ocean fertilization. In addition, depending on the impacts and activity in question, states might argue that geoengineering activities constitute a threat to or breach of the peace or aggression under Article 39 UN Charter. However, the current state of knowledge concerning geoengineering reveals a great deal of uncertainty. In any event, the Security Council has wide discretion in determining whether the requirements of Article 39 of the UN Charter are met and deciding on its response. (*Section 4.2; Section 4.4; Section 4.5; Section 4.6; Section 2.5*)

Research is generally not specifically addressed under international law as distinct from the deployment of technology with known impacts or risks, apart from special rules in certain areas. In a few cases, certain types of research might be prohibited, for instance if it would encourage nuclear weapons test explosions prohibited by the Partial Test Ban Treaty or the Comprehensive Nuclear-Test-Ban Treaty. While the CBD decision on geoengineering invites Parties and others to ensure (until certain conditions are met) that no geoengineering activities take place, it excludes from this limitation small scale scientific research studies that are conducted in a controlled setting, scientifically justified and subject to prior environmental impact assessments (Decision X/33 paragraph 8(w)). UNCLOS has provisions that address marine scientific research. The LC/LP assessment framework on ocean fertilization provides guidance that is applicable to research studies. A major gap concerns sunlight reflection methods. (*Section 5.1; Section 5.2*)

Gaps in the current regulatory framework

The current regulatory mechanisms that could apply to climate-related geoengineering relevant to the CBD do not constitute a framework for geoengineering as a whole that meets the criteria of being science-based, global, transparent and effective. While the CBD decision on geoengineering provides a comprehensive non-binding normative framework, there is no legally-binding framework for geoengineering as a whole. With the possible exceptions of ocean fertilisation experiments and CO_2 storage in geological formations, the existing legal and regulatory framework is currently not commensurate with the potential scale and scope of the climate related geoengineering, including transboundary effects. (*Section 6*)

Some general principles of international law such as the duty to avoid transboundary harm, and the need to conduct an environmental impact assessment (EIA), together with the rules of state responsibility provide some guidance relevant to

geoengineering. However, they are an incomplete basis for international governance, because of the uncertainties of their application in the absence of decision-making institutions or specific guidance and because the scope and risks associated with geoengineering are so large-scale. As an overarching concept including several distinct concepts and technologies, geoengineering is currently not as such prohibited by international law. Specific potential impacts of specific geoengineering concepts might violate particular rules, but this cannot be determined unless there is greater confidence in estimates of such potential impacts. (*Section 6*)

Some geoengineering techniques are regulated under existing treaty regimes, while others are prohibited:

(a) **Disposal of CO_2 in the water column or on the seabed is not allowed under the LP**. It is also prohibited under OSPAR;

(b) **Ocean fertilization experiments are regulated under the LC/LP's provision on dumping and additional non-binding guidance including a risk assessment framework**; and

(c) **CO_2 storage in sub-surface geological formations is regulated under the LC/LP and the OSPAR Convention**. Further guidance has been developed under the UNFCCC based on IPCC assessments. (*Section 6.1*)

Some other geoengineering techniques would be subject to general procedural obligations within existing treaty regimes, but, to date, no specific rules governing these particular techniques have been developed:

(d) Storage of biomass in the ocean would be subject to the LC/LP and UNCLOS;

(e) Altering ocean chemistry through enhanced weathering would be subject to the LC/LP and UNCLOS;

(f) LRTAP might impose procedural obligations on the use of aerosols in the atmosphere; and

(g) Deployment of mirrors in space would be subject to space law (Outer Space Treaty). (*Section 6.1*)

Most, but not all treaties, potentially provide for mechanisms, procedures or institutions that could determine whether the treaty in question applies to a specific geoengineering activity and address such activities. In legal terms, the mandate of several major treaties or institutions is sufficiently broad to address some or all geoengineering concepts. However, this could lead to potentially overlapping or inconsistent rules or guidance. From a global perspective, the different regimes and institutions have different legal and political weight, depending, for instance, on their legal status, particular mandate or their respective levels of participation. (*Section 1.3; Section 6*)

The lack of regulatory mechanisms for sunlight reflection methods is a major gap, especially given the potential for significant deleterious transboundary effects of techniques such as stratospheric aerosols and maritime cloud albedo enhancement. In principle, existing institutions, such as the World Meteorological Organization have a mandate that could address such issues. (*Section 4.5; Section 6*)

Most regulatory mechanisms discussed in the report were developed before geoengineering was a significant issue and, as such, do not currently contain explicit references to geoengineering approaches. However, many of the treaties examined impose procedural obligations on geoengineering activities falling within their scope of application. Moreover, the international regulatory framework comprises a multitude of

treaties, actual and potential customary rules and general principles of law, as well as other regulatory instruments and mechanisms, that could apply to all or some geoengineering concepts. As a minimum, it is suggested that states engaged in geoengineering field activities have a duty to inform other states prior to conducting them e.g., as required in the London Convention/Protocol Ocean Fertilization Assessment Framework. Few rules provide for public participation beyond the representation of the public by delegates, except for the usual rules on observer participation in treaty regimes and institutions. The treaties examined provide few *specific* rules on responsibility and liability, but the International Law Commission's articles on state responsibility provide general rules in cases where geoengineering would be in breach of an international obligation. (*Section 1.3; Section 6*)

Contents

1 Introduction

1.1 Mandate and scope

1. At the tenth meeting of the Conference of the Parties (COP-10) to the Convention on Biological Diversity (CBD), Parties adopted a decision on climate-related geoengineering and its impacts on the achievement of the objectives of the CBD. Specifically, in decision X/33 (paragraph 9(m)) the COP requested the Executive Secretary, taking into account the possible need for science based global, transparent and effective control and regulatory mechanisms, subject to the availability of financial resources, to undertake a study on gaps in such existing mechanisms for climate-related geoengineering relevant to the Convention on Biological Diversity, bearing in mind that such mechanisms may not be best placed under the Convention on Biological Diversity, for consideration by the Subsidiary Body on Scientific Technical and Technological Advice prior to a future meeting of the Conference of the Parties and to communicate the results to relevant organizations.

2. Accordingly, this study has been prepared for the Secretariat by a lead author, with review comments and additional contributions from a group of experts as well as the CBD Secretariat.[4]

3. This study evaluates the global control and regulatory framework for climate-related geoengineering with regards to its current and potential coverage of issues relevant to the Convention on Biological Diversity (CBD). It provides a summary of existing international regulatory frameworks and mechanisms as background material to inform further consideration of this issue under the Convention on Biological Diversity.

4. The report has been developed in order to facilitate the consideration of gaps in global control and regulatory frameworks by the advisory group on the international legal regulatory framework on geoengineering and biodiversity. Preparation of the report has been made possible thanks to the kind financial contribution of the Government of the United Kingdom of Great Britain and Northern Ireland.

1.2 Criteria for identifying gaps

5. In order to assess gaps in existing international regulatory mechanisms, the report examines the extent to which current mechanisms already address geoengineering either explicitly or implicitly and discusses gaps in terms of both scope, scale and coverage, based on the criteria below. The following criteria are taken from decision X/33:

- **"Relevant to the CBD"**: Because of the potential wide-ranging effects of geoengineering, this study does not exclude any geoengineering technique on the grounds that it is not relevant for the CBD. In fact, the parallel group considering the impacts of geoengineering on biodiversity and related social, economic and cultural

[4] This paper has been prepared by Ralph Bodle with contributions from Gesa Homan, Simone Schiele, and Elizabeth Tedsen. It has been reviewed by a group of experts comprising the following, many of whom have made additional contributions: Michael Shewchuk, Edward Kleverlaan, Dan Bondi-Ogolla, Gerardo Gúnera-Lazzaroni, Alexander Proelss, Elisa Morgera, Diana Bronson, Joshua Horton, Atty. Elpidio Ven Peria, René Coenen, Chris Vivian, and Lyle Glowka. The CBD Secretariat has provided some further comments and editing (Jaime Webbe, Annie Cung and David Cooper). Others who provided input or comments are listed in Annex 6.5.

considerations has identified potential impacts (positive and / or negative) from all currently proposed or modelled approaches to geoengineering.

- **"Global"**: This may include two sub-criteria:
  - Geographical or spatial scope of application (e.g., global, or regional)
  - Degree of participation including the number of Parties (within the intended scope) and balance in representation (e.g. developed and developing countries, participation of least developed countries, small island developing States).

- **"Science-based":** Role of any associated scientific or technical body or provision of clear scientific information in considering and/or developing advice or guidelines for relevant research activities, noting that in the case of some approaches to geoengineering, it is difficult to differentiate between large scale scientific experiments and deployment and that, as such, close links with policy mechanisms are required.

- **"Transparent":** Due to the technical nature of geoengineering or confidentiality concerning the research, special attention must be paid to transparency, especially for developing countries with fewer scientists involved in the research and fewer delegates at international meetings where this is discussed. Considerations could include:
  - Ensuring that the rule or guidance is sufficiently clear for states to apply a case by case analysis of whether a geoengineering activity would be permitted or not,
  - Access to funding details, recognizing that private funding may be protected by other laws,
  - Facilitating clear mechanisms for consultation with any potentially affected countries,
  - Involving all major stakeholder groups in decision making,
  - Informing all major stakeholder groups of potential and realized impacts,
  - Ensuring accountability for decisions.

- **"Effective":** Whether a framework is effective depends on what it is supposed to achieve. Considerations could include:
  - In one sense, "effective" could mean that the framework meets its aims. For the purposes of this study, effectiveness could also refer to the objectives of the CBD, in particular whether or not the framework is consistent with efforts towards the conservation and sustainable use of biodiversity and ensuring the equitable sharing of its benefits. Generally, existing frameworks and rules need to be evaluated in terms of their coverage of the geoengineering approaches currently being considered. In particular, there is a need to assess effectiveness against technologies, materials, intent and impacts, all of which are relevant elements of geoengineering. An additional consideration could be that the framework is able to deal with evolving research and potential new geoengineering concepts.
  - Further considerations of effectiveness in this regard include: (i) mechanisms aimed at ensuring implementation, compliance with rules, decisions and other guidance, including non-legally binding approaches where such approaches are most appropriate and (ii) the presence of a compliance mechanism.

6. It should be noted, throughout the analysis, that with the exception of recent developments under the LC/LP, the CBD, and the ENMOD treaty, the mechanisms discussed in the report were developed before geoengineering was a significant issue and,

as such, do not currently contain explicit references to geoengineering approaches. Rather, the report considers, in addition to the above, a number of international instruments which could apply to certain geoengineering approaches. They could address, for instance:

- the substances used by various geoengineering technologies (e.g. sulphur compounds),
- the activity or technology (e.g. "dumping" of substances at sea),
- the area in which the activity takes place (e.g. the high seas or outer space),
- the purpose of an activity (e.g. military or hostile purposes).

1.3 Definition of geoengineering

7. There is no universal and uniform use of the term "geoengineering".[5] At the tenth meeting of the Conference of the Parties, the CBD adopted the below interim definition:

> Without prejudice to future deliberations on the definition of geoengineering activities, understanding that any 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) should be considered as forms of geoengineering which are relevant to the Convention on Biological Diversity until a more precise definition can be developed. It is noted that solar insolation is defined as a measure of solar radiation energy received on a given surface area in a given hour and that carbon sequestration is defined as the process of increasing the carbon content of a reservoir/pool other than the atmosphere.

8. Subsequently, a parallel group under the CBD has been requested to develop proposals on definitions for the consideration of Parties during the sixteenth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice. Based on the above, and consistent with other widely used definitions, options for a concise definition are included in the following formulation:

> Climate-related Geoengineering: a deliberate intervention in the planetary environment of a nature and scale intended to counteract anthropogenic climate change and/or its impacts through, inter alia, solar radiation management or removing greenhouse gases from the atmosphere.

9. The group considered that the above definitions would include both solar radiation management (SRM) and carbon dioxide removal (CDR) techniques. It should be noted, however, that opinions differ on the inclusion or exclusion of large scale mitigation activities such as afforestation, reforestation and biochar. Furthermore, different geoengineering approaches are in different states of readiness with some having already been experimented *in situ* (e.g. ocean fertilization) while others remain largely theoretical (most solar radiation management approaches) or at this stage appear to be technically possible but not economically viable or scalable (e.g. air capture)[6].

[5] Keith (2000) p. 248; Sugiyama (2010) p. 2-3; ETC Group, Geopiracy: The Case Against Geoengineering, Manila, 2010 pp. 4-7.

[6] See American Physical Society, Direct CO2 capture with Chemicals, June 2011, available at http://www.aps.org/policy/reports/popa-reports/loader.cfm?csModule=security/getfile&PageID=244407; US Government Accounting Ofifice (2011), p. 21.

10. The wording of the two proposals for a definition is quite broad. It needs to be analysed to what extent these definitions would be suitable for governance in a normative context although such a discussion is beyond both the scope and mandate of this report.

11. The need for science-based global, transparent and effective control and regulatory mechanisms may be most relevant for those geoengineering concepts that have a potential to cause significant adverse transboundary effects, and those deployed in areas beyond national jurisdiction and the atmosphere. For example, injection of aerosols into the atmosphere would have transboundary effects that may be deleterious, while ocean fertilization would be carried out in areas beyond territorial waters. Activities such as afforestation, reforestation or terrestrial biomass production, on the other hand, may be governed primarily through domestic institutions.

1.4 Method and structure

12. Geoengineering is a general term comprising several different concepts. Except for the efforts by the LC/LP and the CBD, the international regulatory framework has not addressed geoengineering as such. The ENMOD treaty is also of relevance, although it was designed to deal with environmental modification techniques for a different purpose, namely military or any other hostile use. However, the international regulatory framework comprises a multitude of treaties, actual and potential customary rules and general principles of law, as well as other regulatory instruments and mechanisms, that could apply to all or some geoengineering concepts[7].

13. Any of these rules could apply to any geoengineering concept if it falls within its scope of application. One approach would be to analyse for each geoengineering concept separately, which international rules could apply. Another approach would be to take the rules as a starting point and analyse to which geoengineering concept they could apply.

14. This study primarily follows the second approach. However, it is not feasible within the scope of this study to go through every single rule of the whole of international environmental law or even international law as a whole. The study focuses on the international rules and mechanism that could reasonably apply. A choice is made based on experience and initial assessments. The study addresses only those rules and institutions that apply to geoengineering or which could reasonably be expected to apply[8].

15. The study will also look at international rules governing science and research, an area that has been frequently overlooked.

16. This study draws on published literature as well as original research.

[7] For instance, at some stage geoengineering might be considered as environmental goods or services within the scope of the WTO. However, as the WTO is still in the process of defining environmental goods and services, this topic was not analysed by this study. In addition, the regulatory techniques regarding marine pollution, in particular oil pollution, and nuclear accidents, may be interesting in terms of aspects such as insurance and compensation schemes, but are not considered within the scope of this study.

[8] For instance, there does not seem to be a general rule in international law that establishes restrictions or conditions on the geoengineering concept of painting rooftops and other surfaces such as roads white or light-coloured. Generally, states appear free to do so if they wish. However, there could be international rules banning, for instance, the use of certain chemicals in white paint for health reasons. Although such rules might indirectly affect this geoengineering concept, this level of detail and remoteness remains outside the scope of this study.

17. For the purpose of this study, references to "states" also include subjects of international law such as the EU.[9]

1.5 Elements of the current international regulatory framework

18. The main elements of the current international regulatory framework as discussed in this study include:

a. international laws and other principles that are generally applicable to all states[10], and by virtue of their universal nature, are relevant to all geoengineering concepts; and

b. treaty regimes that may provide more specific norms as well as additional general norms applicable to the Parties to the regime.

19. Some aspects of the current international legal framework constitute binding rules within the meaning of Article 38 ICJ Statute. Binding rules include: treaties; customary law; and general principles of law. Other aspects are not legally binding but nonetheless provide guidance to states.

20. Modern treaties often establish institutions and procedures in order to ensure implementation. This usually includes quasi-legislative bodies such as a regular meeting of the Parties to the treaty which has the mandate to decide on details not set out in the treaty and expert bodies which offer interpretations of treaty articles. Decisions taken by such quasi-legislative bodies are, as such, not binding unless the treaty so provides. However, the distinction between binding and non-binding has become difficult to draw in treaty regime practice and COP decisions may be referred to as an aid when interpreting the provisions of a treaty. COP decisions decide on technical details that are unresolved by the treaty, and specify how Parties are to implement and develop the regime. In practice, Parties usually implement the decisions even if they are not legally enforceable as Parties consider the matters dealt with in the decision a practical necessity.

21. Apart from existing rules and guidelines, it is important to keep in mind that many international regimes and institutions have a potential mandate that would allow them to address geoengineering, or some aspects of the topic, even if they have not done so to date.

22. Additional guidance may be provided by relevant institutions, e.g. the UNEP 1980 guidelines on weather modification. [11]

23. In addition, there are other aspects that could be of interest or relevance, regardless of their legal status. These could include, for instance, self-organised standards by the scientific community[12] or recommendations by relevant civil society organisations.[13]

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[9] Following the entry into force of the Treaty of Lisbon, cf. Articles 1, 3(2) and 47 Treaty of European Union (TEU), 216 Treaty on the Functioning of the Union (TFEU). According to Article 1 TEU, the EU replaced and succeeded the European Community (EC), which had entered into treaties prior to the Treaty of Lisbon.

[10] Customary international law may not bind all states if they are a persistent objector

[11] *Provisions for Co-operation between States in Weather Modification,* Decision 8/7/A of the Governing Council of UNEP v. 29.04.1980 - nachfolgend: UNEP-Provisions.

[12] S. Rayner et al., Memorandum on draft principles for the conduct of geoengineering research. House of Commons Science and Technology Committee inquiry into The Regulation of Geoengineering. (2009), http://www.sbs. ox.ac. uk/ centres/ insist /Documents/regulation-of-geoengineering.pdf.

[13] E.g. Open Letter to the Climate Response Fund and the Scientific Organizing Committee, 4 March 2010, available at http://www.etcgroup.org/en/node/5080

2 International law and principles applicable to all states and all geoengineering concepts

24. There are some *overarching* rules of international law that are common legal ground and might apply to *all* concepts currently discussed as "climate-related geoengineering".

25. The fundamental pillars of international law include state sovereignty on the one hand, and the maintenance of international peace, security and cooperation (or "good-neighbourliness")[14] on the other.

26. Treaties only apply to those states that are Party to them. Moreover, since there is no specific treaty on geoengineering, the regulatory scope of potentially applicable treaties is limited to their material scope. In contrast, customary law applies to all states regardless of whether they are a Party to, and bound by, a particular treaty.[15] Some aspects of customary law, reviewed here, have a scope that is relevant, or may be relevant, to geoengineering concepts in general.

27. The legal meaning of "principles" is not clear or agreed in international law. It is suggested that for the purpose of this study, the question of whether classification as a "principle" has specific legal implications is not decisive. It may be more useful to focus on the distinction between binding and non-binding rules and principles and on interpreting their specific content in each case. However, besides the academic side of this debate, the concept of "principles" is relevant in practice, even if its implications are not fully agreed.[16]

28. The following section identifies rules and principles that could apply to geoengineering as part of a governance framework. However, the status of some concepts as *legal* principles or rules is disputed or their precise meaning is unclear.

2.1 State responsibility and liability of private actors

29. State responsibility describes the rules governing the general conditions under which a state is responsible for wrongful actions or omissions, and the resulting legal consequences. The rules on state responsibility presuppose a breach of an international obligation by a state. However, the rules on state responsibility do not define the requirements of the obligation which is said to have been breached. Instead, they deal with the consequences of such breach. In this sense, the International Law Commission (ILC) uses the term "secondary rules".

[14] See Art. 2 and 74 UN Charter.
[15] Except for so-called "persistent objectors".
[16] The two concepts of "ius cogens" and "obligation erga omnes" also exist as two distinct categories of obligations, the former being more narrow than the latter. Generally speaking, a ius cogens rule describes peremptory a norm accepted and recognized by the international community of States as a whole as a norm from which no derogation is permitted and which can be modified only by a subsequent norm of general international law having the same character. However, there are very few rules that are likely to be universally recognised as ius cogens, such as the prohibition of genocide or slavery. An obligation erga omnes is an obligation of a State towards the international community as a whole (as opposed to individual states), and all States can be held to have a legal interest in its protection. Further details on the legal implications of theses concepts have been under debate for a long time. This study suggests that the two concepts of ius cogens and obligatons erga omnes do not have practical relevance for geoengineering at this stage.

30. The rules on state responsibility were codified and developed by the International Law Commission's Articles on Responsibility of States for Internationally Wrongful Acts, which for the most part reflect customary law (Annex to UNGA Res. A/RES/56/83 of 12.12.2001, "Articles on State Responsibility"). The rules relevant to this study are customary law, although some other concepts in the Articles on State Responsibility may not be universally accepted.

31. Previous drafts of the Articles on State Responsibility had introduced the concept of "international crimes", which included serious breaches of certain environmental obligations. However, that concept was subsequently dropped and does not appear in the final outcome of the ILC's work.[17]

32. It is also notable that "a State may be responsible for the effects of the conduct of private parties, if it failed to take necessary measures to prevent those effects."[18]

33. The rules on state responsibility do not define the obligations relating to geoengineering in the sense that they determine which activities are permitted or prohibited. Instead, the rules on state responsibility provide a basic legal framework for geoengineering activities that breach international law. In the absence of specific rules, the rules on state responsibility provide a general framework that sets out the legal consequences of geoengineering activities that breach international obligations.

34. State responsibility does not as such require fault or negligence of the state. The conduct required or prohibited and the standards to be observed depend on the obligation in question. A regulatory regime may consider developing specific rules and standards for all or particular geoengineering activities in this regard.

35. The consequences of state responsibility include legal obligations to cease the activity, to offer appropriate assurances and guarantees of non-repetition, if circumstances so require, and to make full reparation for the injury caused.[19] In view of the diverse geoengineering concepts and their potentially extensive and global impacts, a regulatory regime may consider specific legal consequences flowing from breaches of international obligations regarding geoengineering.

36. There is no uniform terminology in international law on the meaning of "liability". In this study, the term "liability" refers to legal obligations on private actors - in contrast to the concept of and rules on state responsibility.

37. States are not as such responsible for acts of private actors. However, a state might have to address private actors in order to fulfil its own obligation.[20] A state could be in breach of an obligation if it fails to take necessary measures to prevent effects caused by private actors (see above on state responsibility). It depends on the obligation in question to what extent a state has to address private actors in order to fulfil its own obligation. For instance, the duty to prevent transboundary harm (see below) requires the state to exercise due diligence. A state may be failing to exercise due diligence and thus be in breach of this obligation if it fails to exercise any legal or factual control over its private actors regarding transboundary harm.

[17] In its work on state responsibility, the International Law Commission had considered whether a breach of a ius cogens rule should be referred to as a separate category of "international crime", as opposed to mere "international delicts". In the 1970s it proposed that an international crime should include "a serious breach of an international obligation of essential importance for the safeguarding and preservation of the human environment, such as those prohibiting massive pollution of the atmosphere or of the seas".[17] However, it subsequently dropped the concept of international crimes.

[18] ILC, Draft articles on Responsibility of States for Internationally Wrongful Acts, with commentaries 2001, 39.

[19] Articles 30 and 31 of the Articles on State Responsibility.

[20] Cf. Article 139 UNCLOS.

38. In addition, a state can be under an explicit and specific obligation to address private actors. Specifically, international law can impose a duty on states to provide in their internal law that non-state actors are liable for certain acts. For instance, the 2010 Nagoya-Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety requires states to address private actors through domestic rules on liability. However, there is no general obligation on states to do this.

39. There are also international compensation schemes where non-state actors pay into a pool (e.g. oil pollution compensation schemes). However, there is no general obligation on states to do this.

40. Given the potential impact of such activities, the existing obligations on states might be insufficient in requiring states to address private actors.

2.2 Prevention of Transboundary harm to the Environment

41. All states are under a general obligation to ensure that activities within their jurisdiction or control respect the environment of other States or of areas beyond national jurisdiction or control. Listed as principle 2 of the Rio Declaration,[21] and as article 3 of the CBD, the rule has become customary international law.[22] A state in breach of this rule could be held responsible by other states under the customary rules of state responsibility (discussed below).

42. The duty to respect the environment of other States or of areas beyond national jurisdiction or control does not mean that any environmental harm, pollution, degradation or impact is for that reason generally prohibited.[23]Although the rule has been long established, it has so far very rarely been subject of disputes which could have clarified its precise content. In case of an alleged breach of the duty to not harm the environment, establishing responsibility of a state for geoengineering would require several elements:

- The geoengineering activity has to be attributable to the state in question. Depending on the particular geoengineering activity and its scale, attribution to a state may be possible using global information systems and technology such as satellite observation.
- The particular geoengineering activity has to cause a particular harm to the environment of other States or of areas beyond national jurisdiction or control. The causal link would most likely be very difficult to establish: For instance, alleged environmental harm could include changes in precipitation patterns[24] followed by floods or droughts. A potential claimant state would have to establish a causal link between the particular geoengineering activity and changes in precipitation, as well as between those changes in precipitation patterns and specific environmental harm.[25] Procedural obligations on transparency and global observation and monitoring systems could play an important role in this respect.

[21] 31 ILM 876 (1992); cf. principle 21 of the preceding 1972 Declaration of the UN Conference on the Human Environment (Stockholm Declaration), 11 ILM 1416 (1972).
[22] ICJ, Legality of the Threat or Use of Nuclear Weapons (Advisory Opinion - General Assembly), ICJ Rep. 1996, 22, para 29; ICJ, Case concerning the Gabcikovo-Nagymaros Project (Hungary v. *Slovakia)*, ICJ Rep. 1997, 7, para 53; ICJ, *Case concerning pulp mills on the river Uruguay (Argentia v. Uruguay)*, judgment of 20 April 2010, para 193 <www.icj-cij.org>. Note that the ICJ's formulation is "activities within their jurisdiction *and* control".
[23] Cf. Birnie/Boyle/Redgwell (2009) p. 142.
[24] Policy Statement of the American Meteorological Society on geoengineering the climate system, adopted by the AMS Council on 20.07.2009, <http://www.ametsoc.org/policy/2009geoengineeringclimate_amsstatement.html>.
[25] Bodle (2010) p. 103.

43. In view of the extent of the potential damage, reversing the burden of proof is being discussed on the basis of the precautionary principle/approach (see also section 2.4). For instance, a state to which a geoengineering activity is attributable would have to rebut the assumption that it changed the earth's albedo and that this caused the alleged environmental harm. In the recent *Pulp mills on the river Uruguay* case, the ICJ accepted that a precautionary approach "may be relevant" in the interpretation and application of the treaty in question. However, the court also stated that "it does not follow that it operates as a reversal of the burden of proof".[26] The wording of the court is not clear as to whether this applies to the specific case or generally excludes a reversal. Some national laws and cases do make this shift in the burden of proof. For example, in Australia, the case of Telstra Corp v Hornsby Shire Council[27] applied the precautionary principle to this effect. Preston CJ found that, where there is a threat of serious or irreversible environmental damage and there is the requisite degree of scientific uncertainty, the precautionary principle will be activated and "a decision maker must assume the threat of serious or irreversible environmental damage is… a reality [and] the burden of showing this threat… is negligible reverts to the proponent…" The EU approach to pesticide regulation[28] is an additional example of where this shift of burden of proof has occurred, since it requires pesticides to be proven safe before being registered for use.

44. It has recently been stated that the duty to respect the environment of other States or of areas beyond the limits of national jurisdiction enshrined in the 'no harm' concept "entails prohibitive and preventive steering effects on states. In its prohibitive function, it forbids any state from causing <u>significant</u> transboundary environmental harm. According to this view, in its preventive function, the "no harm" concept obliges every state of origin to take adequate measures to control and regulate <u>in advance</u> sources of <u>potential</u> significant transboundary harm."[29] While a state will generally not be in breach of the obligation relevant here unless *it fails to apply due diligen*ce,[30] the fact remains that if a significant damage occurs, the responsible State can, depending on the circumstances, arguably be obliged to pay compensation. Having said that, the prohibitive function of the obligation concerned is inappropriate to prevent the occurrence of environmental damage. This is why the situation of ***<u>likeliness</u>*** of environmental harm, which could become particularly relevant also with regard to geoengineering, is addressed by the preventive function of the no harm concept, embodied in the principle of prevention.[31] In this respect, the ICJ clarified, in the Pulp Mills case, that "the principle of prevention, as a customary rule, has its origins in the due diligence that is required of a State in its territory."[32] Which diligence is "due", however, depends on the circumstances of the particular case, which leaves considerable legal uncertainty.

45. The obligation not to cause transboundary environmental harm and the rules on state responsibility do not explicitly distinguish between research and deployment with regard to technologies. It could be considered whether the level of diligence required is different. International coordination could provide guidance in this regard.

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[26] ICJ, *Pulp mills on the river Uruguay,* para 164.
[27] New South Wales Land and Environment Court, 2006
[28] *Directive 91/414/EC*
[29] Beyerlin, Ulrich, and Thilo Marauhn, *International environmental law*. 2011, p. 40 et seq.
[30] Cf. ILC, *Articles on State Responsibility*, UN Doc. A/56/10, para 77, Chapter III para 2; ILC, *Draft articles on prevention of transboundary harm from hazardous activities*, UN Doc. A/56/10, para 98, Article 3 para 8.
[31] Note that the exact relationship between the two dimensions of the no harm concept is still subject to a significant degree of unclarity. All sources seem to agree though that the obligation to prevent represents an essential aspect of the obligation not to cause significant harm. Cf. Handl, Günther, Transboundary impacts. In: Bodansky, Daniel, Brunnée, Jutta, and Ellen Hey (eds.), *Oxford Handbook of International Environmental Law*, 2007, p. 531, 539.
[32] ICJ, *Case concerning pulp mills on the river Uruguay (Argentia v. Uruguay)*, judgment of 20 April 2010, para. 101 <www.icj-cij.org>.

46. States can avoid state responsibility by relying on "circumstances precluding wrongfulness", such as self-defence or force majeure.[33] One of these recognised circumstances is necessity as "the only way for the State to safeguard an essential interest against a grave and imminent peril". This relates to some arguments made in favour of geoengineering. For instance, a state causing transboundary environmental harm by geoengineering might argue that it is severely affected by climate change and claim distress or necessity as a legal defence. On the other hand, the defence would arguably be excluded for states who contributed to climate change and thus to the state of necessity (Article 25(2)(b) of the Articles on State responsibility).

47. In addition, and as a result of a separate stream of work, the International Law Commission has also drafted a separate set of articles regarding harmful effects of "hazardous" acts, even where such acts are not in breach of an international obligation, although such principles only refer to the allocation of loss.[34] This could include making private actors liable under domestic law.[35] In contrast to many of the Articles on State Responsibility, these draft articles do not reflect customary law. Although neither of these rules as such prohibit geoengineering, they could provide a basic framework for managing the risks involved in view of intended global and potentially irreversible consequences.

48. Gaps and limitations include:

- The obligation to prevent transboundary harm is retrospective. International law provides only very limited means to obtain advance provisional measures in order to stop activities that could be in breach of international obligations.[36]
- The burden of proof could be addressed and clarified. However: How could the attribution of harm hold up in cases of several concurrent geoengineering activities and given our still incomplete understanding of the complex climate system?
- The standard of care required for due diligence is not clear for geoengineering.
- Whether to address or clarify the potential defense on the basis that cooling the climate outweighs the harm caused.

2.3 Duty to undertake an environmental impact assessment

49. A further general rule is the duty to carry out an environmental impact assessment. Conceptually, environmental impact assessment (EIA) addresses individual projects, while strategic environmental assessment (SEA) takes into account the environmental consequences of programmes and policies. The duty to conduct an environmental assessment is included in several treaties such as Article 14 CBD,[37] to which COP decision X/33 refers, Article 206 UNCLOS and regional instruments such as the United Nations

[33] Article 25 of the Articles on State Responsibility.
[34] See for instance the work of the ILC on *Draft Articles on Prevention of Transboundary Harm from Hazardous Activities*, UN Doc A/56/10.
[35] Cf. ILC, *Draft principles on the allocation of loss in the case of transboundary harm arising out of hazardous activities,* UN Doc. A/66/10, para 66, in particular principle 4.2.
[36] In recent years the ICJ has only granted two applications for provisional measures, in cases involving the imminent execution of prisoners, *LaGrand Case (Germany v. United States of America)*, Provisional Measures, order of 03.03.1999; Avena and Other Mexican Nationals (Mexico *v.* United States of America), order of 05.02.2003. All other applications were rejected, see Armed Activities on the Territory of the Congo (New Application: 2002) (Democratic Republic of the Congo *v.* Rwanda), order of 10.07.2002; Certain Criminal Proceedings in France (Republic of the Congo *v.* France), order of 17.06.2003; Pulp Mills on the River Uruguay (Argentina *v.* Uruguay), orders of 13.07.2006 and 23.01.2007; Questions relating to the Obligation to Prosecute or Extradite (Belgium *v.* Senegal), order of 28.05.2009; Proceedings instituted by the Republic of Costa Rica against the Republic of Nicaragua, press release of 19.11.2010; all available at <http://www.icj-cij.org>.
[37] See also CBD COP decisions VII/16, VIII/28 and X/42 in this respect.

Economic Commission for Europe (UNECE) Espoo Convention, which also has a Protocol on Strategic Environmental Assessment (SEA).

50. According to Article 14 of the CBD, each Contracting Party shall, as far as possible and as appropriate:

- Introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures;
- Introduce appropriate arrangements to ensure that the environmental consequences of its programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account;
- Promote, on the basis of reciprocity, notification, exchange of information and consultation on activities under their jurisdiction or control which are likely to significantly affect adversely the biological diversity of other States or areas beyond the limits of national jurisdiction, by encouraging the conclusion of bilateral, regional or multilateral arrangements, as appropriate;
- In the case of imminent or grave danger or damage, originating under its jurisdiction or control, to biological diversity within the area under jurisdiction of other States or in areas beyond the limits of national jurisdiction, notify immediately the potentially affected States of such danger or damage, as well as initiate action to prevent or minimize such danger or damage; and
- Promote national arrangements for emergency responses to activities or events, whether caused naturally or otherwise, which present a grave and imminent danger to biological diversity and encourage international cooperation to supplement such national efforts and, where appropriate and agreed by the States or regional economic integration organizations concerned, to establish joint contingency plans.

51. Moreover, an EIA is required in many domestic legal orders. The requirement to carry out an environmental impact assessment has become customary international law and applies even in the absence of a treaty obligation to this effect.

52. The ICJ has recently recognised that the accepted practice amongst states amounted to “a requirement under general international law to undertake an environmental impact assessment where there is a risk that the proposed industrial activity may have a significant adverse impact in a transboundary context, in particular, on a shared resource”.[38] In the particular case before it, the ICJ also held that conducting an EIA was part of exercising due diligence.[39] The judgment refers to particular industrial activities and does not necessarily establish a general requirement for a SEA.

53. The ICJ left it to the states to determine the specific content of the impact assessment required. However, ICJ also specified some details, including:

- The duty involves “having regard to the nature and magnitude of the proposed development and its likely adverse impact on the environment as well as to the need to exercise due diligence in conducting such an assessment.”
- The impact assessment has to be carried out prior to the implementation of the activity.
- Continuous monitoring of the activity’s effect on the environment is required. As a legal rule in customary international law, it is an important development that might require clarification as to its precise implications.

[38] ICG, *Pulp mills on the river Uruguay*, para 204-206.
[39] ICG, *Pulp mills on the river Uruguay*, para 204-206.

54. There are cases in which the EIA process has been applied to geoengineering research with controversial outcomes. For example, the Lohafex ocean fertilization experiment carried out in January 2009 was conducted in spite of concern among non-governmental organisations and the German Federal Ministry of the Environment concerning the adequacy of the environmental risk assessment that was done, on the basis of the COP IX decision on ocean fertilization (see below section 3.1 on the London Convention / London Protocol).[40]

55. The complexity of the climate system will in some cases make it difficult to assess the environmental impacts of geoengineering activities in advance as well as afterwards (see the complementary CBD study on the impacts of climate-related geoengineering on biological diversity). However, this might be an inherent issue rather than a regulatory gap. It may be worth considering whether and to what extent this could be addressed through different or more specific guidance regarding EIA and SEA.

56. Some geoengineering techniques such as artificial trees would require cumulative deployment of relatively small interventions in order to be effective. An EIA of a single unit may not address such cumulative impacts, while an SEA would only presuppose that the cumulative deployment is part of a plan or programme as defined by the provision in question.

57. In the context of trade and technologies, the International Assessment of Agricultural Knowledge, Science and Technology suggested to consider the option of an intergovernmental framework for the comparative assessment of the environmental impact of new technologies as they evolve from initial scientific discovery through to possible "commercialization".[41]

2.4 Precautionary principle or approach

58. There is no uniform formulation or usage for the precautionary principle or approach[42] and its legal status in customary international law has not yet been clearly established,[43] [44] [45] although it has been invoked several times.[46] Under the CBD, the precautionary approach

[40] http://www.bmu.de/english/press_releases/archive/16th_legislative_period/pm/42985.php and http://www.etcgroup.org/en/node/712

[41] Beverly D. McIntyre et al., Agriculture at the Crossroads: International assessment of agricultural knowledge, science and technology for development (IAASTD): global report, Washington D.C., Island Press, 2009, p. 467, available at http://www.agassessment.org/; see the NGO Declaration "Let's Look Before We Leap" available at http://www.etcgroup.org/en/node/4956 and ETC Group, "Why Technology Assessment?" at http://www.etcgroup.org.

[42] Cf. Principle 15 of the Rio Declaration; Article 3.3 UNFCCC; Article 3 LP; CBD Preamble; Birnie, Patricia W, Alan E Boyle, and Catherine Redgwell. *International Law and the environment*. 3rd ed. 2009, p. 160.

[43] cf. Virgoe, John. "International governance of a possible geoengineering intervention to combat climate change." *Climatic Change* 95, no. 1 (July 1, 2009): 103-119, p. 111; UK House of Commons Science and Technology Committee, The Regulation of Geoengineering. Fifth Report of Session 2009–10, 18.03.2010, para 85-86. Güssow et al. acknowledge a "considerable degree of unclarity (sic) as to its normative content and validity", but apply principle 15 of the Rio Declaration without further analysis as to legal status, "Ocean iron fertilization: Why further research is needed", Kiel Working Paper No. 1574, December 2009, p. 15, <http://ideas.repec.org/p/kie/kieliw/1574.html>.

[44] Cf. Art 11 of the 1982 World Charter for Nature and art 6 of the 2000 Earth Charter

[45] See generally Birnie, Patricia W, Alan E Boyle, and Catherine Redgwell. *International Law and the environment*. 3rd ed. 2009, p. 152 et seq.; UK House of Commons Science and Technology Committee, The Regulation of Geoengineering. Fifth Report of Session 2009–10, 18.03.2010, para 86. On the basis of the heading "principles" in Article 3.3 UNFCCC, this study uses the term "precautionary principle" without prejudice to this debate.

[46] In its judgment on the *Pulp mills on the river Uruguay* case, the ICJ considered that while a precautionary approach may be relevant in the interpretation and application of the provisions the treaty in question, but it rejected Argentina's argument that operates as a reversal of the burden of proof, cf. Memorial of Argentina of

has been introduced in the preamble recognizing that "where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat". The decisions of the CBD COP have frequently been based on and stressed the importance of the precautionary approach,[47] including decision X/33 on geoengineering (see section on CBD). Under the London Protocol, Article 3.1 requires the application of the precautionary approach.

59. Another legal formulation in the operative part of a treaty text with near universal application is Article 3(3) UNFCCC.[48] Almost all states have ratified the UNFCCC,[49] including the US.[50] While this renders the question of the precautionary principle/approach's legal status in customary law less relevant, the precise consequences remain unclear.

60. On the one hand, while all proponents of geoengineering stress that it is no substitute for reducing emissions, they would argue that it would contribute to fight climate change:[51] Extracting carbon dioxide from the atmosphere reduces greenhouse gases, and solar radiation management has the potential to limit temperature increases. On this basis, it might be argued that lack of full scientific certainty should not be used as a reason for postponing geoengineering, provided that there are threats of serious or irreversible damage. Geoengineering proponents would argue that such threats exist, in view of the slow progress in reducing global emissions at source and the short remaining time period during which emission trends need to be reversed (peaking).

61. On the other hand, faced with this same scenario, it may be argued that the precautionary approach would imply following the less risky action of implementing emission reductions. In fact, at the time it was drafted, Article 3(3) UNFCCC was generally viewed as having the intention of postponing mitigation measures by referring to scientific uncertainty about climate change. In this context, an interpretation in support of geoengineering would be unusual, but not evidently contrary to the wording. However, Article 3(3) UNFCCC could not be read as actually requiring geoengineering measures.[52]

62. In any event, Article 4(1)(f) UNFCCC requires all Parties to employ appropriate methods "with a view to" minimising adverse effects of their mitigation and adaptation measures on the economy, public health and the quality of the environment.[53] Impact assessments are explicitly mentioned as an example of such methods. However, this provision is not overly specific and would only apply to geoengineering techniques that are regarded as mitigation or adaptation measures.

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15 January 2007, para. 3.194-3.197 and 5.15. and the judgment, para 164. All documents available at <www.icj-cij.org>. See also dissenting opinions of Judges Weeramantry und *Palmer* in the ICJ cases *Nuclear Tests II*, para 342 and 412; dissenting opinion of Judge Weeramantry in the *Nuclear Weapons* opinion, para II.10.e); see also WTO Appellate Body, *EC Measures Concerning Meat And Meat Products (Hormones*), para. 16 and 120-125; ITLOS case No.17, "Responsibilities and obligations of States sponsoring persons and entities with respect to activities in the Area (Request for Advisory Opinion submitted to the Seabed Disputes Chamber)", <http://www.itlos.org>; separate opinion of Judge Wolfrum in the ITLOS case No. 10, *The MOX Plant Case (Ireland v. United Kingdom),* Provisional Measures, <www.itlos.org>; see also Marr, S. "The Southern Bluefin Tuna cases: the precautionary approach and conservation and management of fish resources." *European Journal of International Law* 11, no. 4 (January 1, 2000): 815 -831.

[47] See for instance CBD decisions IV/10 para 1; V/3 para 5; VI/3 Annex II section 3; VI/7 Annex I para 24, 31; VI/26 Annex para 1(e); VII/5 Annex I Appendix 3 para 2; VII/11 principle 6, guideline 6.2; VII/14 para 54, 75

[48] United Nations Framework Convention on Climate Change, of 09.05.1992, 31 ILM 849 (1992), in force 1994.

[49] Currently 194 parties, <http://unfccc.int/parties_and_observers/parties/items/2352.php>.

[50] The US is one of the major emitters and potential geoengineering states but not party to the Kyoto Protocol.

[51] All proponents of geoengineering acknowledge and stress that it does not reduce anthropogenic CO_2 emissions levels as the underlying cause of climate change.

[52] On the precautionary approach in this regard see Birnie, Patricia W, Alan E Boyle, and Catherine Redgwell. *International Law and the environment*. 3rd ed. 2009, p. 162, 164.

[53] Cf. Freestone, David, and Rosemary Rayfuse. "Ocean iron fertilization and international law." *Marine Ecology Progress Series* 364 (July 29, 2008): 227-233, p. 231; Bodansky, Daniel. "May we engineer the climate?." *Climatic Change* 33, no. 3 (July 1, 1996): 309-321, p. 313.

63. The legal role of the precautionary principle in Article 3(3) UNFCCC in the geoengineering debate remains ambiguous: Depending on how we assess the risk posed by geoengineering in relation to a scenario with substantial mitigation and in relation to a scenario of unmitigated climate change, the precautionary principle embodies the core arguments both for and against geoengineering.

2.5 Article 39 UN charter

64. Depending on the impacts of the geoengineering concept and activity in question, states might argue that geoengineering activities constitute a threat to or breach of the peace or aggression under Article 39 UN Charter. For instance, they could claim that the activity in question affects their agricultural economy or water supplies by interfering with local microclimates. However, the current state of knowledge concerning geoengineering reveals a great deal of uncertainty. In any event, the Security Council has wide discretion in determining whether the requirements of Article 39 UN Charter are met and deciding on its response.

2.6 Other concepts

65. The concept of **common but differentiated responsibilities** is listed in Principle 7 of the Rio Declaration. In many treaties, notably the UNFCCC, common but differentiated responsibilities (CBDR) are explicitly mentioned or implicit in differentiated obligations (often together with “and respective capabilities”).

66. The main practice has so far been the basis for differentiating obligations within a treaty, usually between developed and developing countries or sub-groups; frequently combined with support for developing countries.

67. However, the status as a legal customary principle and its precise content are disputed.[54] CBDR does not mean that international rules and governance have to differentiate obligations. In addition, the countries and groups between which obligations are differentiate vary from case to case.[55]

68. The concept of CBDR does not address whether or not countries are allowed to conduct geoengineering. The main notions that have been underpinned by CBDR in practice are that developed countries should take more stringent obligations than developing countries (or grant a time delay to developing countries), and that developing countries should receive financial and other support in order to be able to fulfil their obligations. Neither of these notions appears to address issues raised by geoengineering. Such issues could arise if certain geoengineering technologies will be available to certain countries only whereas other countries may be the most affected. However, there is no consensus or established practice that CBDR means a right to access to a specific technology or an obligation to pay for impacts of a specific technology.

69. The concept of **sustainable development** is fundamental not just for international environmental law. It is referred to in several treaties, including the Article 4 UNFCCC, and other instruments such as the Rio Declaration, Agenda 21[56], the 2002 World Summit on

[54] Cf. Stone, AJIL 2004, p. 276 et seq; Birnie, Patricia W, Alan E Boyle, and Catherine Redgwell. *International Law and the environment*. 3rd ed. 2009, p. 160..
[55] Michels, Umweltschutz und Entwicklungspolitik, p. 54.
[56] See www.un.org/esa/dsd/agenda21.

Sustainable Development in Johannesburg (the 2002 Earth Summit);[57] and the 2005 UN World Summit Outcome Document.[58] It is also central to the IUCN's 1995/2004 Draft Covenant on Environment and Development (e.g. Article 1). Sustainable development was first defined in the 1987 World Commission on Environment and Development report Our Common Future (the Brundtland Report) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[59] There are at least three "interdependent and mutually reinforcing pillars" of sustainable development: economic development, social development, and environmental protection,[60] and indigenous groups often argue that there is a fourth pillar of sustainable development, namely cultural diversity.[61] Whether and to what extent the concept of sustainable development has a specific normative legal content is still under debate. There is no consensus, for example, as to whether the concept would prohibit certain activities. However, it is of high political relevance and has to be taken into account in considering regulatory frameworks for geoengineering. This includes the concept of intergenerational equity, which is relevant in particular if certain SRM activities would have to be maintained by future generations in order to avoid severe impacts.

70. There are several concepts addressing international interest in the protection of areas beyond national jurisdiction and cross-cutting issues such as the atmosphere and biodiversity. The term of common goods may be used as an overarching general term for such concepts of global environmental responsibility. However, the concept of common goods is not as such a separate legal term or concept.[62] In practice, a variety of terms are used. For instance, the conservation of biological diversity as well as change in the Earth's climate and its adverse effects are each mentioned as a "common concern of humankind" in the CBD and the UNFCCC respectively.[63] The Moon and its natural resources, as well as the seabed and ocean floor and the subsoil thereof beyond the limits of national jurisdiction, as well as its resources, are mentioned as "common heritage of mankind" in the Moon Treaty and UNCLOS.[64] It has been also argued in this context that the atmosphere has become a distinct concern of the international community.[65] The legal status or content of these concepts is mostly unclear and needs to be assessed in each particular case.

2.7 Summary assessment of customary rules

71. Customary law provides few rules applicable to all states and all geoengineering concepts. Customary rules reflect other states' legitimate expectations. They provide common legal ground, but their actual content is not specific enough to provide clear guidance as to geoengineering.

72. The customary rules identified above are subject to and can be derogated from by special rules agreed between states. For instance, customary law prohibits transboundary environmental harm. Producing ozone depleting substance could be regarded as being in

[57] See www.un.org/jsummit/html/basic_info/basicinfo.html.
[58] See 2005 World Summit Outcome Document, 15 September 2005, UNGA Res A/RES/60/1.
[59] *Our Common Future, Report of the World Commission on Environment and Development,* Chapter 2: Towards Sustainable Development, Conclusion: http://www.un-documents.net/ocf-02.htm.
[60] 2005 World Summit Outcome Document, World Health Organization, 15 September 2005: www.un.org/summit2005/documents.html.
[61] See, eg, the UNESCO Universal Declaration on Cultural Diversity, 2001 http://unesdoc.unesco.org/images/0012/001271/127160m.pdf.
[62] Durner, Common Goods, p. 18 and p. 17 fn. 2 for the variety of terms used in practice.
[63] Preamble to the CBD and UNFCCC; cf. also UNGA Res. 43/53 of 6 December 1988 para 1: "Recognizes that climate change is a common concern of mankind, since climate is an essential condition which sustains life on earth."
[64] Article 11 Moon Treaty; preamble and Article 136 UNCLOS
[65] Wustlich, Die Atmosphäre als globales Umweltgut, p. 319 ff.

violation of that rule. However, the ozone regime (Vienna Convention and Montreal Protocol) provides special treaty rules regulating the production and consumption of certain ozone depleting substances. States that are Party to and comply with the ozone regime would therefore not be in breach of the customary rule on preventing transboundary environmental damage if they produce or emit ozone depleting substances consistent with that regime. The special rules of the ozone regime define the permitted conduct and transboundary effects in this regard.

73. The customary rules that apply to all states and all geoengineering concepts provide some guidance on principles that would need to be considered but they would be an incomplete basis for international governance, mainly because the geographic scope and the risks associated with geoengineering are so large-scale and because of the uncertain legal status and their unclear specific legal content.

3 Specific treaty regimes and institutions

3.1 The Convention on Biological Diversity

74. The CBD has nearly universal membership and a wide scope of application. The US is not a Party, although as a signatory, it is under an obligation not to defeat its object and purpose (Article 18 VCLT).

75. The CBD has referred to and incorporated the work of the LC/LP in its own decisions, thus widening their application beyond the smaller number of Parties to the LC/LP. In respect of ocean fertilization, the CBD COP10, in October 2010, reaffirmed the precautionary approach and provided guidance to Parties with a view to ensuring that no ocean fertilization takes place unless in accordance with its previous decision IX/16. It also invited Parties to act in accordance with the LC/LP Assessment Framework.[66]

76. The CBD COP10 also went beyond ocean fertilization and adopted a decision addressing geoengineering *in general* ("the CBD geoengineering decision").[67] This appears to be the only all-encompassing governance measure at this level to date: Decision X/33(w) "invites Parties and other Governments, according to national circumstances and priorities," to consider the guidance given by this decision, which includes:

> "Ensure, in line and consistent with decision IX/16 C, on ocean fertilization and biodiversity and climate change, in the absence of science based, global, transparent and effective control and regulatory mechanisms for geoengineering, and in accordance with the precautionary approach and Article 14 of the Convention, that no climate-related geoengineering activities that may affect biodiversity 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, with the exception of 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;"

77. The CBD geoengineering decision is not legally binding. However, the decision is important for a global governance framework because of the consensus of its 193 Parties it represents and the political signal it sends. It also addresses geoengineering in general, based on its own definition[68].

78. The text of the CBD decision refers specifically to "the precautionary approach and Article 14 of the Convention" when inviting Parties to establish limits on geoengineering.

79. The CBD geoengineering decision in paragraph 8(w) is intended to be an interim measure subject to further consideration and action, including in the CBD itself and in other fora. It is a transitional measure based on the need to establish whether there are science based, global, transparent and effective control and regulatory mechanisms in place for geoengineering, and whether geoengineering has been scientifically justified.

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[66] Decision X/29, para 13(e) and 57-62.
[67] UNEP/CBD/COP/DEC/X/33, <www.cbd.int/cop10/doc/>.
[68] ETC Group, What does the UN moratorium on geoengineering mean?" available at http://www.etcgroup.org/en/node/5236

80. In order to facilitate further consideration of geoengineering as additional scientific evidence and understanding becomes available, paragraph 8(w) allows for exceptions for small-scale, controlled scientific activities, for those activities for which there is an adequate scientific basis and for which appropriate consideration is given to the associated risks for the environment and biodiversity and associated social, economic and cultural impacts and for those activities for which a science-based global, transparent, and effective regulatory mechanism is in place. With regards to implementation, it appears to be subject to the determination of each Party as to whether an “adequate scientific basis” exists or whether such activities are small scale and controlled bearing in mind obligations under Article 3 of the Convention which reiterates the duty to prevent transboundary environmental harm.

81. The end of paragraph 8(w) requires that the studies mentioned above 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. Again, the determination of whether such criteria are met is subject to the determination of individual Parties subject to the additional obligations mentioned above.

82. Besides the CBD, there are other biodiversity-related conventions such as the Ramsar Convention on Wetlands, the Convention on Migratory Species (CMS) and the World Heritage Convention. Geoengineering techniques such as enhanced weathering in the form of spreading base minerals, afforestation, reforestation, soil carbon enhancement, land-based albedo enhancement, biomass and charcoal production and storage have land-use change impacts. While no general regulation of land use or land use change appears to exist under international law, specific international regimes might potentially apply to certain areas, which could be affected by large-scale land use changes. In particular, rules on nature and habitat protection could restrict land-use changes that would be part of certain geoengineering techniques. Such regimes include for instance the CMS Convention regarding the habitat of migratory species or the World Heritage Convention regarding specific areas defined as cultural or natural heritage. However, the consideration of such potentially affected specific provisions would fall beyond the scope of this study.

3.2 UNCLOS - United Nations Convention on the Law of the Sea

83. The 1982 United Nations Convention on the Law of the Sea (UNCLOS), which has been very widely raitified, sets out the legal framework within which all activities in the oceans and seas must be carried out, including geoengineering activities, such as ocean fertilisation, maritime cloud albedo enhancement, altering ocean chemistry through enhanced weathering, as well as projects such as ocean mixing (enhanced upwelling and downwelling through technological means). UNCLOS provides for a number of maritime zones within which States have specific rights and obligations. These rights and obligations differ within each zone.

84. UNCLOS contains specific obligations relating to the protection and preservation of the marine environment (Part XII). These obligations apply to areas within and beyond national jurisdiction. UNCLOS also provides for a number of obligations related to marine scientific research (part XIII), which are relevant in the context of geoengineering experiments.

85. States have the general obligations to protect and preserve the marine environment (article 192) and to take all measures necessary to prevent, reduce and control pollution of the marine environment from any source, including pollution by dumping (articles 1, 194 and 210). In addition, States are required to take all measures necessary to ensure that activities under their jurisdiction or control do not cause damage by pollution to other States and their environment (article 194). In taking measures to prevent, reduce and control pollution of the

marine environment, States shall act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another (article 195).[69] UNCLOS also provides that dumping within the territorial sea and the exclusive economic zone or onto the continental shelf shall not be carried out without the express prior approval of the coastal State (article 210).

86. With regard to pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, States are required to "take all measures necessary to prevent, reduce and control" such pollution (article 196). Furthermore, when States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results of such assessments (article 206).

87. It has been argued that an activity is permitted in principle by the freedom of the high seas unless it is specifically excluded by a rule of international law.[70] As the freedoms described in article 87(1) are indicative only, these activities must be exercised in accordance with the provisions of UNCLOS, as described, and with due regard for the interests of other States.

88. States are also responsible under UNCLOS for the fulfilment of their international obligations concerning the protection and preservation of the marine environment and they shall be liable in accordance with international law (article 235).

89. Ocean fertilisation could arguably be seen as "placement of matter for a purpose other than the mere disposal thereof" and therefore excluded from the definition of dumping under article 1 para. 5(b)(ii) of UNCLOS. However, such placement must not be contrary to the aims of UNCLOS.

90. The legal framework established by UNCLOS to prevent, reduce and control pollution by dumping reflects the approach adopted in the London Convention in 1972 and has been developed further by the London Protocol in 1996 consistent with article 210(4). The definitions provided in UNCLOS are very similar to those that have been incorporated into the London Convention and the London Protocol and, as noted above, the Contracting Parties to these instruments have concluded that the scope of the London Convention and the London Protocol includes ocean fertilization activities. In addition, the reference to "global rules and standards" in article 210(6) UNCLOS is generally understood to include the London Convention, which thus serves as minimum standard with regard to Part XII of UNCLOS.[71]

91. Ocean based geoengineering approaches such as ocean fertilization, maritime cloud albedo enhancement, ocean based weathering, and ocean mixing have not been explicitly addressed in UNCLOS, but such activities may, where applicable, be subject to general

[69] It has been suggested that some geoengineering technologies may involve a transfer of one form of pollution (excessive greenhouse gas concentrations in the atmosphere) into another (excessive greenhouse gasses in the oceans). See Verlaan (2009) for elaboration of this argument.

[70] Scott (2010) p. 7, citing Churchill and Lowe (1999) p. 206.

[71] Cf. IMO Doc LEG/MISC/3/Rev.1 of 6 January 2003, Implications of the Entry into Force of the United Nations Convention on the Law of the Sea for the International Maritime Organization, p. 48: "At their Seventeenth Consultative Meeting held in 1994, the Contracting Parties expressed their opinion that States Parties to UNCLOS would be legally bound to adopt laws and regulations and take other measures to prevent, reduce and control pollution by dumping. In accordance with article 210(6) of UNCLOS, these laws and regulations must be no less effective than the global rules and standards contained in the London Convention."; Report of the Secretary-General on the Law of the Sea, 1995, UN Doc. A/50/713, paras. 107 and 108.

provisions dealing with, for example, the rights, jurisdiction and duties of States, the protection and preservation of the marine environment and marine scientific research and other applicable rules.

3.3 London Convention & London Protocol

92. The LC and LP[72] address marine pollution from dumping of wastes and other matter at sea. They apply to all marine areas and cover a significant part of global shipping.[73] Article 7 LP also addresses internal waters by requiring Parties to either apply the LP or to adopt other effective permitting and regulatory measures to control dumping. Article 3(1) LP provides that Parties shall apply a precautionary approach to environmental protection from dumping of wastes or other matter. The LC/LP have done significant work regarding a regulatory framework for ocean fertilization.

93. In 2008 the treaty bodies agreed that the scope of the LC/LP includes ocean fertilization activities.[74] From a legal perspective, this can be seen as in accordance with Article 31(3) VCLT, which provides for Parties collectively interpreting the meaning of a treaty. To the extent that ocean fertilization activities thus involve “dumping” within the meaning of the LC/LP, they are subject to the binding permitting regime required of Parties to the LC or LP. In 2010, the Parties adopted resolution LC-LP.2(2010) on the "Assessment Framework for Scientific Research Involving Ocean Fertilization", which had been developed since May 2007, as required under resolution LC-LP.1(2008). This Assessment Framework guides Parties as to how proposals they receive for ocean fertilization research should be assessed and provides criteria for an initial assessment of such proposals and detailed steps for completion of an environmental assessment, including risk management and monitoring.[75]

94. The LC/LP Assessment Framework is not legally binding in form or in wording. In addition, participation in the London Convention and London Protocol is not comparable to, for instance, the CBD or the UNFCCC in terms of number of Parties. However, the LC/LP Assessment Framework was incorporated by reference in the CBD COP10 decision on ocean fertilization (see section 3.1 on the CBD).

95. In 2009, the Parties to the London Convention and Protocol considered whether the scope for regulation should be widened to cover emerging “marine geoengineering” proposals, or to focus solely on ocean fertilization activities, which is a sub-set of marine geoengineering. It was stated in the report that the focus should remain on the latter, while some delegations were of the view that an exploration of marine geoengineering and its possible impacts on the marine environment was desirable and should be planned in the future. Following this meeting, the terms of reference for the Intercessional Working Group on Ocean Fertilization were adopted including “flexibility and adaptability to address emerging issues that fall within the scope of the LC/LP and have the potential to cause harm to the marine environment.”[76]

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[72] The later LP entered into force in 2006 and eventually replaces for its Parties the earlier LC. The two instruments will continue to apply in parallel for the time being.

[73] There were 87 Parties to the London Convention and 41 Parties to the London Protocol as of 28.02.2012, <www.londonprotocol.imo.org>. The parties represent about two thirds and one third of global merchant shipping tonnage respectively, IMO press briefing 50/2010 of 20 October 2010

[74] Resolution LC-LP.1 (2008), para 1. For views on the legal implications of the LC/LP statements and decisions as well as the LOHAFEX experiment carrying out ocean fertilisation in 2009, see Freestone/Rayfuse (2008); Verlaan (2009); Ginzky (2010).

[75] Resolution LC-LP.2(2010) on the assessment framework for scientific research involving ocean fertilization, adopted on 14 October 2010. For the Assessment framework see the draft elaborated by the Scientific Group of the London Protocol and the Scientific Group of the London Protocol, LC/SG/32/15, Annex 2.

[76] Annex 7 of LC32/15

96. Subsequently, in 2010, the LC/LP agreed to continue its work towards providing "a global, transparent and effective control and regulatory mechanism for ocean fertilization activities and other activities that fall within the scope of the London Convention and London Protocol and have the potential to cause harm to the marine environment".[77]

97. There has also been a considerable amount of regulatory work under the LC/LP on carbon capture and storage (CCS) in sub-seabed geological formations. While CCS is not included in the CBD's working definition of geoengineering, the guidance concerning the risk assessment framework for storage in sub-surface geological formations may be relevant to CO_2 storage in general. However, it is not clear whether the rules for CCS under the LC/LP would apply to CO_2 captured after release into the atmosphere.

3.4 Framework Convention on Climate Change and the Kyoto Protocol

98. The UNFCCC / Kyoto Protocol is a multilateral legal regime with universal participation in the UNFCCC and almost universal participation in the Kyoto Protocol (the US is not a Party to the KP; however, participation in the second commitment period of Kyoto is very likely to be reduced[78]). The regime has a strong institutional structure and a scientific underpinning with formally established links to the work of the Intergovernmental Panel on Climate Change (IPCC). There have been suggestions outside the climate negotiations to revise the UNFCCC or adopt a new protocol to it on geoengineering governance.[79]

99. However, the UNFCCC and Kyoto Protocol have not addressed geoengineering concepts or governance.[80] Nevertheless, in view of the slow progress on the climate negotiations for a post-2012 regime, the Executive Secretary of the UNFCCC has recently warned that carbon dioxide removal techniques might have to be developed.[81]

100. The objective of the climate regime, according to Article 2 UNFCCC, is to stabilise greenhouse gas concentrations in the atmosphere. Article 2 also states that a level that would prevent dangerous anthropogenic interference with the climate system "should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner." However, the "ultimate" aim of stabilising greenhouse gas concentrations does not necessarily mean that the UNFCCC or the KP prohibit other measures intended to prevent global warming. Neither the UNFCCC nor the KP prohibit geoengineering as such. The UNFCCC "principles" (Article 3) and obligations such as Article 3(1) UNFCCC are quite general.

101. The objective of both instruments, as stated in Article 2 UNFCCC, is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous

[77] Resolution LC-LP.2(2010), para 5; IMO note to UNFCCC COP16, available at http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Documents/COP%2016%20Submissions/IMO%20note%20on%20LC-LP%20matters.pdf

[78] Canada's formal withdrawal from the KP on 15 December 2011 will become effective on 15 December 2012; Russia and Japan have announced that they would not participate in a second commitment period.

[79] Barrett (2010) 10-11; Scott (2010) at 11.

[80] Cf. the report by the technical subsidiary body SBSTA on future financing options for technology transfer, FCCC/SB/2009/2, p. 79. The IMO mentioned ocean fertilisation as an example of its efforts to address climate change in its report to the UNFCCC, cf. IMO, Information on the work on greenhouse gas emissions from ships being carried out by the International Maritime Organization (IMO). Note to the AWG-KP session 31 March to 4 April 2008, http://unfccc.int/files/kyoto_protocol/application/pdf/imo.pdf.

[81] "Global warming crisis may mean world has to suck greenhouse gases from air", Guardian, 5 June 2011, <www.guardian.co.uk>

anthropogenic interference with the climate system. Carbon dioxide removal techniques would reduce greenhouse gas concentrations and would as such not be contrary to this objective. Solar radiation management techniques would not change greenhouse gas concentrations. However, both sets of technologies may have effects that, in themselves, could be considered as "(dangerous) anthropogenic interference in the climate system".

102. Article 3(3) UNFCCC incorporates the precautionary principle into the UNFCCC. However, the wording is ambiguous regarding geoengineering (see above under precautionary principle or approach).

103. The obligations on all Parties in Article 4(1) UNFCCC aim at mitigation and adaptation measures in a general way. They do not explicitly or by implication prohibit or permit measures such as geoengineering.

104. The obligations in Article 4(2)(a) UNFCCC require developed countries to take measures on mitigation by limiting their anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs. These obligations do not by implication prohibit geoengineering measures.

105. The KP's provisions do not address or prohibit geoengineering. Geoengineering techniques such as enhanced weathering in the form of spreading base minerals, afforestation, reforestation, soil carbon enhancement, land-based albedo enhancement, biomass and charcoal production and storage have land-use change impacts. The Kyoto Protocol addresses land use change only in that the removal or emission of greenhouse gases are concerned. Specifically, the Kyoto Protocol regulates the way in which Parties account for the removal of greenhouse gases from the atmosphere and emissions reduced or generated by land use changes. Only for this purpose, decisions under the Kyoto Protocol define certain forms of land use.

106. However, the potential relevance of geoengineering for the flexible mechanisms under the KP, e.g. as carbon offsets, has attracted attention.[82] So far only carbon capture and storage in geological formations has been considered for inclusion in the KP's Clean Development Mechanism (CDM).[83] The inclusion of geoengineering concepts in the flexible mechanisms can be addressed by the KP even if geoengineering is otherwise addressed elsewhere by a different instrument or institution.

3.5 Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol

107. It is not clear at this stage to what extent particular geoengineering concepts, e.g. aerosol injection, would modify or be likely to modify the ozone layer. This has to be established by science.[84] Although the impacts of proposed geoengineering approaches on ozone are uncertain with mixed result from models, some proposed approaches may impact the ozone layer, at least seasonally and regionally. Therefore, geoengineering activities could fall within the scope of the Vienna Convention for the Protection of the Ozone Layer (Vienna Convention) and the Montreal Protocol, which both are instruments with near

[82] Virgoe 2009; Bertram 2009

[83] Decision 7/CMP.6, paragraph 1-3; Decision 2/CMP.5, paragraph 29 identifying specific issues. See also decision 10/CMP.7, Modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities.

[84] The potential ozone depleting effect of sulphur aerosols would be expected to be primarily in the polar regions and occur only for a period each year in the polar spring (refer to the complementary CBD study on the impacts of climate-related geoengineering on biological diversity).

universal ratification.[85] However, the Vienna Convention is mainly a basic framework with few specific obligations.[86] Apart from general provisions on research, cooperation and exchange of information, the only substantive obligations that could govern geoengineering activities are general obligations under Article 2 (1) and 2 (2)(b) of the Vienna Convention.

108. The general obligations under the Vienna Convention require its Parties to take "appropriate measures" to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer.

109. The general obligation is further specified in Article 2 (2)(b) as to include policies "to control, limit, reduce or prevent human activities" if they are at least likely to have adverse effects resulting from modification or likely modification of the ozone layer.

110. Annex I to the Vienna Convention lists substances which "are thought to" have the potential to modify the chemical and physical properties of the ozone layer, but it does not impose specific obligations regarding these substances. The list includes water vapor in relation to the *stratospheric* effects of hydrogen substances.[87] It does not mean that geoengineering concepts for creating clouds or artificial vapour trails in lower atmospheric areas would be covered. Annex I does not cover other substances such as sulphur or its compounds. However, Annex I is non-exhaustive, and the effect of materials and processes used in particular geoengineering concepts on the ozone layer would have to be assessed.

111. Geoengineering approaches that modify or are likely to modify the ozone layer would not, on this basis alone, be contrary to the Vienna Convention. They would also have to result or be likely to result in "adverse effects", which are defined in Article 1 (2) as "changes in the physical environment or biota, including changes in climate, which have significant deleterious effects on human health or on the composition, resilience and productivity of natural and managed ecosystems, or on materials useful to mankind"[88].

112. The term "significant deleterious effects" (emphasis added) would suggest that a considerable intensity of the effects is required – as opposed to just any deleterious effects. Article 2 (2) (b) refers to effects that are "likely to" result, which does not require that these effects are proven. It is important to note that this provision requires a double link: The geoengineering activity has to result in a (at least likely) modification of the ozone layer, and this modification has or is likely to have adverse effects as defined by the Vienna Convention.

113. The essence of the obligation on Parties is to "take appropriate measures […]", further specified in para 2 (2)(b) as "appropriate legislative or administrative measures and co-operate in harmonizing appropriate policies to control, limit, reduce or prevent human activities under their jurisdiction or control...". This implies a wide discretion regarding which measures are considered to be "appropriate". For instance, a Party could argue that it fulfils its obligation by "controlling" geoengineering activities that affect the ozone layer, rather than preventing them.

114. Although Article 2 contains a legal obligation, its content is general and it appears not to sufficiently impose specific for obligations regarding the regulation of geoengineering activities. On this basis, it can be argued that the Vienna Convention does not ban or clearly

[85] The Vienna Convention and the original 1987 Montreal Protocol have 197 parties. Subsequent amendments to the Montreal Protocol have slightly fewer parties; cf. http://ozone.unep.org/new_site/en/treaty_ratification_status.php.
[86] Birnie/Boyle/Redgwell (2009) p. 350.
[87] Annex I para 4(e).
[88] Art. 1.2.

impose specific restrictions on geoengineering activities. However, it provides a framework under which geoengineering could be further regulated. It would appear to be within the mandate of the COP to establish further knowledge and provide guidance in this regard under Article 6(4). However, it may be unusual for it to do so given the limited role the Vienna Convention has so far played regarding specific activities. The Montreal Protocol is the instrument in which states have agreed on specific obligations.

115. The Montreal Protocol is widely acknowledged as one of the most successful multilateral environmental agreements. It imposes specific obligations, especially to phase down certain substances that deplete the ozone layer with respect to certain activities, i.e. the import, export, production and consumption of a number of ozone depleting substances. Geoengineering activities such as aerosol injection could raise issues if they involve a substance, the consumption of which (production and import) is covered by the Montreal Protocol.

3.6 ENMOD Convention

116. The ENMOD Convention is a treaty that addresses severe environmental harm as a military or any other hostile use. It was a reaction to deliberate attempts at weather modification by the US during the Vietnam war,[89] and was intended to restrict such means of warfare.[90] Considering the ENMOD Convention has to take into account that participation is limited[91] and the rules have not been invoked in practice.[92] The ENMOD Convention provides rules and procedures that could apply to geoengineering when used for hostile or military purposes as well as definitions, such as on environmental modification, which may be useful to consider as precedents for other processes.

117. The main substantial obligation under ENMOD is that the Parties in Article I ENMOD “undertake not to engage in military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party”. Article II ENMOD provides a broad definition of environmental modification techniques comprising “any technique for changing - through the deliberate manipulation of natural processes - the dynamics, composition or structure of the Earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space”. An interpretative understanding[93] provides definitions on (a) "widespread": encompassing an area on the scale of several hundred square kilometres; (b) "long-lasting": lasting for a period of months, or approximately a season; (c) "severe": involving serious or significant disruption or harm to human life, natural and economic resources or other assets. The definition would apply to at least some geoengineering concepts, in particular as an interpretative understanding to Article II ENMOD explicitly listing changes in climate patterns.

118. However, the ENMOD Convention is part of the international law of armed conflict and only applies to military or any other hostile use of environmental modification techniques. It

[89] Weather Modification: Hearings before the Subcommittee on Oceans and International Environment of the Committee on Foreign Relations, United States Senate, 1974, *Vietnam Center and Archive,* <www.virtualarchive.vietnam.ttu.edu/>.

[90] ENMOD preamble, first sentence: “Guided by the interest of [...] saving mankind from the danger of using new means of warfare”.

[91] It has 74 Parties, of which only few have acceded in recent years, <http://treaties.un.org> accessed on 31.10.2010.

[92] For instance, the ENMOD Convention was not applicable to actions in the 1991 Gulf war such as the burning of oil fields by Iraq, because Iraq had not ratified it, United States Department of Defense report to Congress on the conduct of the Persian Gulf conflict. Appendix O: The Role of the law of war, 31 ILM 612 (1992): 616.

[93] The understanding is not part of the treaty but is part of the negotiating record and was included in the report of the negotiating Committee to the United Nations General Assembly. It can guide interpretation in accordance with Art. 31 (2) and (4) of the Vienna Convention on the Law of Treaties.

clearly distinguishes hostile and peaceful purposes. The text and the interpretative notes explicitly clarify that the Convention is without prejudice to the use for peaceful purposes.[94] The distinction between the law applying in peacetime and the law of military or any other hostile use is crucial, although it can be difficult to draw. Whether each case is considered hostile would have to be determined in accordance with the principles and criteria used in the law of armed conflict. Consideration of the ENMOD Convention should not erode this distinction.

119. Although the ENMOD Convention is not directly applicable in non-military and non-hostile cases and was not designed to govern contemporary geoengineering technologies, it contains ideas and concepts which will likely need to be considered by other processes addressing geoengineering. For instance, Article V provides for a rudimentary procedure for addressing potential problems which may arise in relation to the objectives of, or in the application of the provisions of, the Convention through a Consultative Committee of Experts. It also envisages dispute resolution through a complaint procedure to the UN Security Council[95].

3.7 Space law

120. The main framework and rules of space law was developed at a time where exploration of the outer space was at its beginning and not all activities and their impacts foreseen.[96] Space law essentially comprises the international rules on outer space that have been designed and adopted since the 1960s. The international legal regime regulating environmental aspects of outer space includes mainly five treaties:

- The Outer Space Treaty,
- The Space Registration Convention,
- The Moon Treaty,
- The Liability Convention,
- The Rescue Agreement, which is of marginal relevance to geoengineering governance.

121. In addition, there are a number of UN General Assembly Resolutions. These are not per se legally binding, but they can have legal relevance for interpreting binding rules, and they can reflect or evolve into binding customary law.[97] The Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space was adopted in 1963 and contains most of the principles elaborated later in the four main treaties on outer space.[98] Subsequent resolutions elaborate further principles and deal with issues such as direct broadcasting by satellites, remote sensing and the use of nuclear power sources in outer space. In addition, there are other institutions dealing with space activities under their particular mandate, e.g. the International Telecommunication Union (ITU), the Inter-Agency Space Debris Coordination Committee (IADC) or the Committee on the Earth Observation Satellites (CEOS).

122. A number of geoengineering technologies are intended to be carried out in the atmosphere or space. These mainly include the release of sulfur aerosols into the stratosphere to reflect the sun's radiation, the seeding of clouds with seawater particles to

[94] Preamble, Article III and Understanding relating to Article III ENMOD; Bodansky, Daniel. "May we engineer the climate?." Climatic Change 33, no. 3 (July 1, 1996): 309-321, p. 311.
[95] Article V(3)-(6) ENMOD.
[96] Lafferranderie (2005) p. 6
[97] Hobe (2009) page 27.
[98] UNGA Res 1962 (XVIII) of 13 December 1963.

increase their reflectivity as well as the deployment of mirrors or shields of various sizes to block solar radiation. Space law does not necessarily apply to all of these geoengineering concepts. Under international law, airspace and outer space are different areas subject to different rules. The main difference is that, under international law, states generally enjoy sovereignty in the air space above their territories, whereas outer space is not subject to the sovereign jurisdiction of any one state. Whether space law generally applies to a geoengineering concept depends on the scope of application of space law.

123. Space law does not provide any precise definition of its scope of application or its key concepts 'outer space' and 'space objects'. The question of the legal "delimitation" of outer space from airspace has been discussed for decades without a clear agreed outcome. It has been on the agenda of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), the main institution in this area, since the 1960s.[99] There are a number of conceptual approaches on defining the application of space law, including the view that many years of practice had shown that there is no need for a clear definition. The area at 110 km above sea level is generally regarded as being part of outer space,[100] but the status of the zone between 80 and 110 km is controversial.[101] However, this lack of clarity in the boundary is not material here. Solar radiation measures would be carried out either below 80 km, i.e. in the mesosphere or lower, or clearly above 110 km. Only the latter would be subject to space law. This would only include the deployment of shields or mirrors of various sizes in outer space to reflect or block solar radiation before it is able to reach lower atmosphere levels.

124. The main basis for international space law is the Outer Space Treaty**.** Its 100 Parties include the main space nations.[102] In literature, the legal status of outer space and the celestial bodies, as provided for in the treaty, are generally considered to be customary international law (see below).[103] However, the treaty has weaknesses such as the lack of important definitions on outer space, objects and damage, and the lack of a dispute settlement mechanism.[104]

125. Article III clarifies that general international law applies in outer space. This includes at least all customary international law.[105] Therefore, the general duty to prevent transboundary environmental harm and the customary rules on state responsibility apply to activities in outer space, except to the extent that space law takes priority by virtue of being more specific (*lex specialis).*

126. Article I of the Outer Space Treaty lays down the rights to access, usage and exploration of outer space. Generally, exploration and use of outer space is free for all states. Article I links these freedoms with the notion of the 'province of all mankind.' Thus, outer space is a common space in which states do not enjoy sovereign rights. The exploration and use of outer space 'shall be carried out for the benefit and in the interests of all countries.' The concept "province of all mankind" thus limits the freedoms of outer space in the sense that neither exploration nor use of outer space shall be undertaken for the sole advantage of one country, but done only for the benefit of the international community.[106] The precise

[99] Committee on the Peaceful Uses of Outer Space, 'Historical summary on the consideration of the question on the definition and delimitation of outer space', Report of the Secretariat of 18 January 2002, A/AC.105/769.
[100] Some authors argue that this line has become accepted as customary international law, cf. Vitt, E (1991) p. 46; Hobe (2009) p. 32 suggest the following definition: '*Outer space encompasses the terrestrial and the interplanetary space of the universe, whereby the delimitation of the Earth space around the Earth to outer space starts at least 110 km above sea level.*'
[101] Hobe (2009) p. 31
[102] cf. http://treaties.un.org/pages/UNTSOnline.aspx?id=1
[103] Durner (2000) p. 146.
[104] Lafferranderie (2005) p. 10.
[105] Hobe (2009) p. 67.
[106] Hobe (2009) p 32

contours of this concept and of its restricting effect, however, remain unclear. The use of military observation satellites, for instance, does not seem to be contrary to the Outer Space Treaty, although they arguably only serve the country they belong to.

127. Deployment of space mirrors or shields would qualify as 'use' of outer space. The question of whether such geoengineering would be in the interest of all countries goes to the heart of the debate around geoengineering. Opponents would point to the known and unintended side effects and the need to address the cause of global warming; proponents would argue that global cooling effects are in the global interest and they would outweigh the side effects at least in the short term. However, it is unresolved who would determine, from which perspective and on what basis, whether an activity was for the benefit of all countries. Although it has been argued that Article I could justify the side effects of geoengineering as long as it is globally beneficial,[107] it is suggested that it is unclear whether Article I legally operates in terms of such a cost-benefit-analysis. As with other obligations of a general nature, the uncertainty about their legal operation and effect in a concrete case is a gap in the current regulatory framework.

128. Article IX of the Outer Space Treaty could also apply to geoengineering in space, as it addresses environment, contamination and interference in the activities of other states. It imposes obligations regarding co-operation, mutual assistance, non-harmful interference, non-contamination as well as consultation. However, the obligation to respect the interests of other Parties in the first sentence merely refers to the space activities of other Parties to the Outer Space Treaty. Whether the geoengineering concept in space would interfere with other states' space activities - e.g. communication channels - would depend on the specific case. In any event, the last sentence of Article IX merely envisages appropriate international consultations in the event of potential interference. The environmental obligations in the second sentence refer to the contamination of space or celestial bodies as well as to adverse changes to the earth's environment resulting from introduction of extraterrestrial matter. Geoengineering concepts in space do not introduce extraterrestrial matter. However, an argument could be made that reflecting material used for geoengineering ought to be considered as space debris and thus as "contamination of space" if it did not function properly and if such reflective material poses a concrete danger for other objects which have lawfully been introduced into outer space.[108] So far there have been no cases on the basis of Article IX that could provide guidance.[109]

129. Article VI and VII of the Outer Space Treaty provide rules on state responsibility and liability for damage. Article VI clarifies that states are responsible for their national activities in outer space and have to authorise and continuously supervise any non-governmental activities. Article VII provides for liability for damage caused "by" space objects to another Party. The classic environmental problems in outer space include orbital space debris, environmental damage caused on or to other planets and environmental damage caused on earth as a result of space objects falling from space.[110] Geoengineering is different in that the mirrors etc. deployed in space are unlikely to cause direct damage themselves - unless they would physically impact with other objects. The potential damage would be the result of the mirrors reducing incoming solar radiation and, for instance, causing weather modifications. It is not entirely clear whether this would be damage "by" the space object. Article VII does not appear to restrict any particular form of damage - material or immaterial, loss suffered as well as gain or loss of profit.[111] In the absence of express wording, arguably Article VII requires an adequate level of causation between the placing of mirrors in space and the reduction of

[107] Zedalis (2010) p. 24
[108] However, it could be argued that geoengineering is neither carrying out studies nor exploration and would thus not be covered by the second sentence, cf. Zedalis (2010) p.25
[109] Kerrest/Smith (2009) p. 144.
[110] Sands (2003) p. 382.
[111] Kerrest/Smith (2009) p. 141

solar radiation as well as between the reduced sunlight and the damage.[112] This can be difficult to prove. In addition, Article VII is silent on whether any fault or negligence is required.

130. In order to address these shortcomings, the general principle of liability imposed by Article VII on a launching State was further developed by the Liability Convention. For those states which are Parties to it, as well as to the Outer Space Treaty, it provides special rules that take priority over Article VII of the Outer Space Treaty.[113] It provides for absolute liability for damage caused by space objects, irrespective of any fault or negligence. However, the problem of proving causation remains[114] and there is virtually no practice to draw from.[115]

131. Even the Cosmos 954 incident, in which a Soviet satellite went out of control and crashed on Canadian territory, is inconclusive. Canada's claim for damages was based on the Liability Convention and general principles of international law, but it is debated whether the final settlement and payment was an acknowledgment of an international obligation.[116]

132. The other space treaties are relevant only to the extent that they provide for procedural obligations such as registering space objects.[117]

133. As indicated above, a great number of General Assembly Resolutions have been adopted concerning outer space. Although not binding as such, they can have political impact and can be of legal relevance as interpretative guidance or by evolving into customary law. However, the resolutions adopted so far do not seem to add to the findings based on the space treaties. The 'Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries',[118] overlaps with Article I and IX of the Outer Space Treaty and could thus be relevant for states that are not Party to that treaty.

134. Space law is relevant only for geoengineering concept of positioning reflecting objects in space in order to block solar radiation.

135. States that are Party to the Liability Convention may be liable for damage caused by the reflecting objects placed in space. If the damage occurs to the surface of the Earth or aircraft flight, State Parties are liable irrespective of any fault or negligence however, if the damage is to another space-based object fault must be proven. The problem of proving causation remains and there is virtually no practice to draw from. However, obtaining insurance for such space activity could be difficult and *de facto* restrict such activities.

136. So far, geoengineering does not seem to be of the agenda of the relevant institutions addressing international space law. Climate change is one of the topics addressed by the UN Office for Outer Space Affairs and the Committee on the Peaceful Uses of Outer Space. However, the focus has been on using space applications such as monitoring to facilitate climate modelling and disaster mitigation.[119]

[112] Kerrest/Smith (2009) p. 141
[113] As of 01 April 2008, there were 86 ratifications and 3 acceptances of obligations of the Liability Convention, see http://www.oosa.unvienna.org/oosa/en/SpaceLaw/Treaties.html.
[114] Malanczuk (1991) p. 792
[115] Kerrest /Smith (2009) p 143.
[116] See references in Malanczuk (1991) p 775.
[117] The register is operated by the United Nations Office for Outer Space Affairs (UNOOSA), <http://www.oosa.unvienna.org/oosa/en/SORegister/index.html>.
[118] UNGA Res. A/RES/51/122, Annex.
[119] http://www.oosa.unvienna.org/oosa/en/climatechange/index.html

3.8 Antarctic treaty system

137. The Antarctic is subject to a regime of several treaties, with the Antarctic Treaty and recommendations adopted under its auspices at its core.[120] The Antarctic regime, including the Protocol on Environmental Protection to the Antarctic Treaty (1991) regulates the Antarctic as an area beyond national jurisdiction, albeit without prejudice to sovereign claims maintained by seven states. The regime is only relevant to geoengineering activities and associated scientific research that takes place in the Antarctic (cf. Article 3 of the 1991 Antarctic Environment Protocol).

3.9 OSPAR Convention

138. The OSPAR Convention of 1992 is a regional convention with 16 Parties, including the EU, to protect the marine environment of the North-East Atlantic.

139. Amendments to the OSPAR Convention were adopted in 2007 to allow storage of carbon dioxide in geological formations under the seabed.[121] Annexes II and III of the OSPAR Convention were amended to permit carbon dioxide injection.[122] In 2007, OSPAR also adopted decisions to ensure environmentally safe storage of carbon dioxide streams in geological formations and prohibit carbon dioxide storage in the water column and on the seabed. [123] The OSPAR Guidelines for Risk Assessment and Management were adopted, also in 2007, to assist in management of carbon dioxide storage by assessing injection sites, identifying measures for hazard reduction, examining remediation and mitigation, characterizing risks to the marine environment, and monitoring.[124] The amendments must be ratified by at least seven Parties before entering force and as of May 2011, only six Parties had done so.[125]

140. Furthermore, OSPAR has also adopted the OSPAR Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area[126]. This code of conduct considers, *inter alia,* impacts on species, habitats, and marine protected areas and may apply to certain marine geoengineering research activities.

3.10 LRTAP - Convention on Long Range Transboundary Air Pollution

141. The LRTAP Convention addresses air pollution and is mainly relevant for geoengineering concepts such as aerosol injection, which introduce sulphur or other substances into the atmosphere. It is a regional convention with 51 Parties covering almost all UNECE states.[127] In addition to the general obligations of the LRTAP Convention, its eight

[120] See www.ats.aq
[121] Amendments of Annex II and Annex III to the Convention in relation to the Storage of Carbon Dioxide Streams in Geological Formations, ANNEX 4 (Ref. §2.10a), OSTEND: 25-29 JUNE 2007
[122] Annex II, art 3; annex III, art. 3.
[123] OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations; OSPAR Decision 2007/1 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Sea-bed
[124] OSPAR Guidelines for Risk Assessment and Management of Storage of CO2 Streams in Geological Formations, *(Reference Number: 2007-12),* OSTEND: 25-29 JUNE 2007
[125] IEA (2011) p. 16.
[126] OSPAR 08/24/1, Annex 6 on the Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area
[127] as of May 2011, see "Status of Ratification" http://www.unece.org/env/lrtap/status/Status%20of%20the%20Convention.pdf.

protocols provide concrete obligations addressing specific pollutants or issues. The implementing protocols to the LRTAP Convention are separate international treaties, not all Parties to the Convention became Parties to all protocols. The following text addresses first the LRTAP Convention and then describes the relevant content of individual protocols.

142. The material scope of the LRTAP Convention covers air pollution defined in Article 1 as "the introduction by man, directly or indirectly, of substances or energy into the air resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems and material property and impair or interfere with amenities and other legitimate uses of the environment."[128]

143. Some geoengineering concepts, such as the use of aerosols to block incoming sun rays, fulfill the first and second element of this definition. The nature and intensity of effects which such activities may have is difficult to predict at present. However, the term "deleterious effects" has a broad scope that includes effects on ecosystems and, as such, some geoengineering techniques could have such effects. Furthermore, it is important to note that the LRTAP is only applicable if and to the extent to which it is established that the substances or energy introduced into the air results in deleterious effects. In contrast to other instruments, it therefore does not cover situations in which the introduction of a certain substance may have or is likely to have any negative impact on the environment. While LRTAP is in that sense not based on the precautionary approach, some of its protocols explicitly are.[129]

144. In the context of geoengineering and the rationale behind it, the question could be raised whether LRTAP is open to the possibility of determining "deleterious effects" as "net" effects, i.e. negative impacts of the activity weighed against future negative impacts of climate change avoided by that activity.[130] The text of the LRTAP Convention does not provide for such a consideration of the overall "net" effects on the broader environment in comparison to harm avoided. LRTAP refers to specific effects resulting from the introduction of substances or energy into the air.

145. The LRTAP Convention covers air pollution whose "physical origin is situated wholly or in part within the area under the national jurisdiction of one State and which has adverse effects in the area under the jurisdiction of another State at such a distance that it is not generally possible to distinguish the contribution of individual emission sources or groups of sources."[131] The Convention can therefore apply to air pollution to which geoengineering concepts at least contributed, even if the pollution cannot be clearly attributed to certain geoengineering activities.

146. The LRTAP Convention does not require any minimum scale of effect. However, the broad definition does not mean that the LRTAP Convention prohibits any introduction of polluting substances into the air. Under the LRTAP Convention, Parties are only required to "endeavour to limit and, as far as possible, gradually reduce and prevent air pollution including long-range transboundary air pollution".[132] Although this is a legally-binding obligation, the terms "as far as possible" and "gradually" soften its content considerably. The same goes for the obligation on Parties to develop, "by means of exchanges of information, consultation, research and monitoring, […] without undue delay policies and strategies which

[128] Art. 1(a).
[129] Cf. the preambles of the 1994 Oslo Protocol on Further Reduction of Sulphur Emissions; 1998 Aarhus Protocol on Heavy Metals; 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs); 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone.
[130] On the weighing or netting of risks see also the section on precautionary principle.
[131] Art. 1(b).
[132] Art. 2.

shall serve as a means of combating the discharge of air pollutants".[133] This general obligation does not require specific legal measures to prevent air pollution or to restrict aerosol injection.

147. In Article 6 of the LRTAP Convention, Parties are obliged "to develop the best policies and strategies including air quality management systems and, as part of them, control measures compatible with balanced development, in particular by using the best available technology which is economically feasible […]". While the development of "control measures" could imply a substantive, concrete obligation, it is softened significantly by the addition "compatible with balanced development" and economical feasibility.[134]

148. The LRTAP Convention also requires its Parties in Art. 8(a) to exchange information on "Data on emissions […] of agreed air pollutants, starting with sulphur dioxide, […] or on the fluxes of agreed air pollutants, starting with sulphur dioxide, across national borders, […]". This could be relevant for geoengineering involving sulphur dioxide in terms of providing transparency. The information exchange is complemented by the procedural obligation on Art. 5 that requires consultations between polluting states and states that are actually affected by pollution or exposed a significant risk.

149. The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent (first Sulphur Protocol)[135] imposed specific obligations to reduce sulphur emissions or transboundary fluxes.[136] However, the reduction obligation refers to 1993 and is outdated. The Protocol also established obligations to report on sulphur emissions,[137] which would include emissions in the context of geoengineering activities.

150. The 1994 Oslo Protocol on Further Reduction of sulphur Emissions (Second Sulphur Protocol), requires from its 29 Parties[138] to not exceed individual sulphur emission ceilings listed in Annex II.[139] However, that "depositions of oxidized sulphur compounds in the long term do not exceed critical loads for sulphur" as listed in Annex I to the Protocol as "critical sulphur depositions in accordance with present scientific knowledge".[140] To achieve this objective, Parties are, as a first step, required not to exceed annually the individual sulphur emission ceilings listed in Annex II.[141] Reduced ceilings are established for the years 2000, 2005 and 2010.[142] Geoengineering activities of Parties to this protocol which involve the emission of sulphur dioxide would have to be in accordance with this provision. Article 5 requires Parties to periodically report information on the levels of sulphur emissions with temporal and spatial resolution. An Implementation Committee under Article 7 has the mandate to address implementation and cases of potential non-compliance.

151. The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone was ratified by 26 Parties, including most EU member states and the USA.[143] The protocol sets emission ceilings for 2010 for four pollutants, including sulphur. In contrast to the Helsinki and the Oslo Protocols, which directly aim at the reduction of sulfur emissions,

[133] Art. 3.
[134] See also Birnie et al (2009) p. 345.
[135] 25 Parties, which do not include some EU member states and the United States, see http://www.unece.org/env/lrtap/status/85s_st.htm.
[136] Art. 2.
[137] Art. 4 and Art. 5.
[138] Besides EU member states: Canada, Norway, The FYR of Macedonia see "Status of Ratification" http://www.unece.org/env/lrtap/status/94s_st.htm.
[139] Art. 2.2. See also the definitions on Article 1(11) and 1(12).
[140] Art. 2.1. However, the obligation is softened by qualifications referring to „critical sulphur depositions", and „as far as possible, without entailing excessive costs"
[141] Art. 2.2. See also the definitions on Article 1(11) and 1(12). See also Beyerlin and Marauhn (2011), p. 152.
[142] In addition, some Parties only have a ceiling for some of these years.
[143] See http://www.unece.org/env/lrtap/status/99multi_st.html.

the Gothenburg Protocol addresses three effects through controlling the pollutants causing them.[144] At the moment, negotiations on emission ceilings for 2020 are ongoing under the Gothenburg Protocol.

152. In sum, the LRTAP Convention as such arguably does not prohibit or constitute significant restrictions on geoengineering. However, it contains procedural obligations on information exchange and consultation among Parties, which could generally apply to certain geoengineering activities. Regarding sulphur, Parties are subject to reporting obligations under the protocols relating to sulphur. The Second Sulphur Protocol, to some extent, limits the depositions of oxidized sulphur compounds, which Parties to the Protocol would have to comply with when conducting geoengineering activities. Geoengineering covered by Art. 1 of the LRTAP Convention could generally be further regulated under the LRTAP Convention.

3.11 Human rights law

153. Human rights law would be relevant if a particular geoengineering activity violates specific human rights. There is no rule in the body of international human rights law that prohibits geoengineering concepts per se.

154. However, geoengineering activities could implicate human rights law, including because of their impacts and consequences. They could also implicate human rights law if carried out in a way that violates obligations regarding, for example, non-discrimination or participation and prior informed consent (where legally established).

155. For example, geoengineering techniques such as enhanced weathering in the form of spreading base minerals, afforestation, reforestation, soil carbon enhancement, land-based albedo enhancement, biomass and charcoal production and storage have land-use change impacts. As many of these techniques need to be applied on a large scale in order to be effective, they could entail significant, large-scale land use changes. Potentially, such land use changes could create conflicts with other forms of land-use, such as food production and therefore potentially with the right to food, as recognized in the International Covenant on Social, Economic and Cultural Rights (article 11). Any violation of social, economic and cultural rights related to food, housing and water would have to be assessed considering specific cases and circumstances.

156. Some have argued that there is, or should be, a human right to a healthy environment. However, no such right is currently recognized in any human rights treaty. Although there have been regional developments in this direction, to date there is no global common ground on a binding and individually enforceable right to this effect.[145]

157. In recent years, human rights bodies have addressed environmental issues in terms of their impacts on certain human rights that are widely recognized, for instance through the rights to life, property and private and family life. The European Court of Human Rights, for instance, held that severe environmental pollution could violate the right to private and family life even where their health is not seriously endangered.[146]

158. Which human rights could be implicated would depend on how a particular geoengineering activity would be carried out and which effects it might actually have. In addition, impacts on human rights might be justified in a particular case. Although human

[144] See UN Economic Commission for Europe (2006), p. 36.
[145] Cf. the comprehensive review by Boyle, Alan, Human Rights and the Environment: A Reassessment (2010)
[146] Cf. for instance ECHR, *Lopez Ostra v Spain*, judgment of 23.11.1994; *Guerra v Italy*, judgment of 19.02.1998; Hatton v. UK, judgment of 02.10.2001; Hatton v. UK (Grand Chamber), judgment of 08.07.2003, *Kyrtatos v. Greece*, judgment of 22.05.2003, <http://www.echr.coe.int/>.

rights are agreed to be universal as per the Vienna World Conference on Human Rights, in practice it may be necessary to weigh geoengineering impacts on human rights against each other (e.g. geoengineering might protect the livelihoods of one group of people threatened by climate change while endangering another). Such an analysis would require further understanding of the impacts of the activity. Furthermore, certain human rights protections allow for the possibility of restrictions

4 Institutions

159. Rules and institutions do not necessarily go hand in hand. In theory, governance could be conceived of in terms of only rules or only institutions. A simple form of geoengineering governance could consist of merely one rule with an outright prohibition, without any special institution dealing with it. In contrast, governance could also consist of an institution with a mandate, for instance, to collect and disseminate information on geoengineering, without material obligations on states. However, there already are institutions with a mandate that would allow them to address at least some geoengineering concepts, and there already are rules.

160. Governance of geoengineering in all likelihood requires institutions: a forum for exchanging views or agreeing on permissions or restrictions on geoengineering, for monitoring implementation and compliance with expectations and rules, for exchanging and pooling scientific information, etc.

161. This section looks at institutions that were created independent of material treaty obligations.

4.1 United Nations Security Council

162. The Security Council has so far not addressed geoengineering although it has taken up related issues such as peace and security. An initial special session on the security implications of climate change provided no outcome and some countries expressed doubt as to whether the Security Council was the appropriate forum.[147] Following another debate in July 2011, the Security Council could not agree on a resolution but instead issued a Presidential Statement that in weak wording acknowledged possible security implications of climate change, without recommending particular steps for addressing that potential threat.[148]

4.2 United Nations General Assembly

163. The United Nations General Assembly has directly addressed ocean fertilization in the context of its annual resolution on oceans and the law of the sea by noting the work undertaken by the LC/LP and CBD.[149] Previously, in resolution 62/215 of 22 December 2007, the General Assembly also encouraged States to support the further study and enhance understanding of ocean iron fertilization.[150] The General Assembly has also considered the importance of the application of the precautionary approach.[151]

164. In regards to the development of environmental impact assessment processes, in resolution 65/37 A of 7 December 2010, the General Assembly encouraged States, directly or through competent international organizations, to consider the further development of environmental impact assessment processes covering planned activities under their

[147] U.N. Security Council, open debate on “Energy, security and climate” on April 17, 2007, 5663rd meeting.
[148] Security Council press release SC/10332 of 20 July 2011, http://www.un.org/News/Press/docs/2011/sc10332.doc.htm.
[149] Resolution 65/37 A paras. 149-1512Cf. UNGA Res. A/RES/62/215, GA Res. A/RES/63/111, para 115-116, GA Res. A/RES/64/71, para 132-133, GA Res. A/RES/65/37 , para 149-152 (draft doc. A/65/L.20 adopted); GA Res. A/66/231, para 154-156.
[150] Resolution 62/215, para. 98.
[151] See, for example, resolution 65/37 A paras. 132 and 173.

jurisdiction or control that may cause substantial pollution of, or significant and harmful changes to, the marine environment.[152]

165. Issues relating to ocean fertilization, the precautionary approach and environmental impact assessment processes have also been discussed by the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea (the "Informal Consultative Process"), which was established by the General Assembly to facilitate its annual review of developments in ocean affairs.[153] During discussions at the twelfth meeting of the Informal Consultative Process, geoengineering was noted as a significant emerging issue and concerns were expressed over the possible impact on the marine environment of ocean fertilization.[154]

166. Issues relating to environmental impact assessments have also been a focus of the meetings of the Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction, which was established by the General Assembly pursuant to resolution 59/24.[155] At its second meeting in 2008, the Ad Hoc Open-ended Informal Working Group recognized the importance of environmentally sound climate change mitigation strategies, but particular concerns were raised over large-scale ocean iron fertilization activities. The view was expressed that the scientific understanding of the role of oceans in regulating climate as well as of the impacts of both climate change on the marine environment and the technologies used for climate mitigation purposes should be improved.[156]

4.3 Intergovernmental Panel on Climate Change

167. Geoengineering was mentioned in the IPCC's second[157], third and fourth assessment reports, but mainly in a descriptive way.[158]

168. Geoengineering and its potential effects will also be part of the IPCC's fifth assessment report, including the possible role, options, risks and status of geoengineering as a response option.[159] In June 2011 the IPCC convened a Joint IPCC Expert Meeting of Working Group I, Working G roup II, and Working Group III on geoengineering[160].

4.4 United Nations Environment Programme

169. The United Nations Environment Program (UNEP) coordinates environmental activities for the United Nations and works with countries and agencies to create solutions and implement environmental policies and practices. UNEP's broad mission is to "provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations."[161] With such a broad mandate, UNEP's scope covers geoengineering

[152] Resolution 65/37 A para. 132.
[153] See reports of the meetings of the Informal Consultation Process at: http://www.un.org/Depts/los/consultative_process/consultative_process.htm.
[154] A/66/186 paras. 23 and 63.
[155] See A/61/65, A/63/79, A/65/68, A/66/119.
[156] A/63/79 para. 14.
[157] IPPC (1995) Working Group II, Chapter 25 on Mitigation: Cross-Sectoral and Other Issues, Section 4.
[158] IPCC AR4 had mentioned geoengineering in WGII 19.4.3 and WGIII 11.2.2
[159] Scope, Content and Process for the Preparation of the Synthesis Report (SYR) of the IPCC Fifth Assessment Report (AR5), p.3 .
[160] http://www.ipcc-wg3.de/meetings/expert-meetings-and-workshops/em-geoengineering
[161] http://www.unep.org/

activities, and has addressed it in major reports.[162] However, apparently the agency has not taken specific steps to directly address it with a regulatory objective. In 1980, UNEP issued a set of non-binding guidelines for cooperation between states on weather modification, covering information exchange, impact assessment and prior notification.[163] This was long before geoengineering became an issue, but might provide a starting point.

4.5 World Meteorological Organization

170. The World Meteorological Organization (WMO) is a specialized agency of the UN covering meteorology, the atmosphere, and hydrology.[164] The WMO's agenda easily covers solar radiation management techniques such as, for instance, stratospheric sulphur aerosols or cloud whitening. Thus far, the WMO has only addressed the related area of weather modification and issued non-binding guidelines.[165]

4.6 Inter-governmental Oceanographic Commission

171. UNESCO's Inter-governmental Oceanographic Commission (IOC) has been involved in research on ocean fertilization and blue carbon and has produced a report on ocean fertilization[166].

[162] UNEP (2009), p. 51 et seq.
[163] UNEP, *Provisions for Cooperation Between States in Weather Modification*, Dec. 8/7/A of the Governing Council (1980), *available at* http://www.unep.org/Law/PDF/UNEPEnv-LawGuide&PrincN03.pdf.
[164] See http://www.wmo.int/pages/about/index_en.html
[165] World Meteorological Organization, Weather Modification Statement and Guidelines of September 24-26, 2007, WMO Doc. CAS-MG2/Doc 4.4.1 Appendix C, http://www.wmo.int/.
[166] http://ioc-unesco.org/index.php?option=com_content&view=article&id=290:new-ocean-fertilization-publication

5 Rules governing research

5.1 The regulatory framework for research

172. It has been suggested that governance for research should be addressed separately from governance for deployment.[167] However, once the modelling and laboratory stage is left behind, the distinction between research and deployment could become increasingly difficult to draw for regulatory purposes. At some stage and for some geoengineering approaches there can be no clear borderline between field testing as part of research and actual deployment if scale alone is considered.[168] The risks and physical impacts would be the same. If different rules were to apply, the distinction would require clear criteria for determining the difference. It should be noted, however, that if research occurs at a scale that doesn't impact the global climate, then is actually falls outside the proposed definition of geoengineering.

173. While the CBD decision on geoengineering invites Parties and others to ensure (until certain conditions are met) that no geoengineering activities take place, it excludes from this limitation small scale scientific research studies that are conducted in a controlled setting, scientifically justified and subject to prior environmental impact assessments (Decision X/33 paragraph 8(w)). The LC/LP assessment framework on ocean fertilization provides guidance that is applicable to research studies. A major gap concerns solar radiation management technologies.

174. The Royal Society, together with the Environmental Defense Fund and the Third World Academy of Sciences is currently facilitating discussions among a select group on governance of research for solar radiation management[169]. As a working framework the solar radiation management is exploring a framework with five categories (four categories of research: 1 (non hazardous studies including modelling), 2 (laboratory studies), 3 (small field trials), 4 medium and large research trials) as well as 5 (deployment).

5.2 Scientific research in international treaty law

175. Research, as distinct from the application of technology with known impacts or risks,[170] is generally not restricted under international law (apart from special rules in certain areas). In the marine environment, it is governed under UNCLOS by general principles to be followed in the conduct of marine scientific research (article 240), including that it shall be conducted exclusively for peaceful purposes and that it shall not unjustifiably interfere with other legitimate uses of the sea compatible with UNCLOS and that it shall be conducted in compliance with all relevant regulations adopted in conformity with UNCLOS including those for the protection and preservation of the marine environment. In the territorial sea, marine scientific research shall be conducted only with the express consent of and under the conditions set forth by the coastal State (article 245). In the exclusive economic zone and on the continental shelf, marine scientific research shall be conducted with the consent of the

[167] United States Government Accountability Office, Climate Change: A Coordinated Strategy Could Focus Federal Geoengineering Research and Inform Governance Efforts. 36 (2010).

[168] Alan Robock et al., *A test for geoengineering?*, 327 SCIENCE 530-531, 531 (2010); Martin Bunzl, *Researching geoengineering: should not or could not?*, 4 Environmental Research Letters 045104, 2-3 (2009). See also Martin Bunzl, Geoengineering Research Reservations (2010), http://sites.google.com/site/mbunzl/downloads.

[169] Solar radiation management: the governance of research. SMRGI. 2011.

[170] As governed, for instance, by the Cartagena Protocol on Biosafety to the Convention on Biological Diversity.

coastal State, which has the right to regulate, authorize and conduct marine scientific research (article 246). Freedom of scientific research is a high seas freedom (article 87). States and competent international organizations are responsible and liable pursuant to article 235 of UNCLOS for damage caused by pollution of the marine environment arising out of marine scientific research undertaken by them or on their behalf (article 263). The deployment of marine scientific installations or equipment shall also not constitute an obstacle to established international shipping routes (article 261).

176. There are a number of media-specific international treaties that cover research on certain technologies. Field research is fully prohibited only in exceptional cases. In most cases, the treaty recalls and addresses freedom of research by different means. Many treaties directly call for carrying out scientific research on their subject matter. Other treaties stimulate scientific knowledge by facilitating access of scientific exploration and research teams to areas that are not subject to the jurisdiction of states.[171] In a few cases, certain types of research might be prohibited, for instance if it would encourage nuclear weapons test explosions prohibited by the Partial Test Ban Treaty (PTBT) or the Comprehensive Nuclear-Test-Ban Treaty (CTBT) or the development of biological weapons[172].

177. In contrast, the ENMOD Convention, while prohibiting environmental modification techniques in armed conflict, is explicitly without prejudice to research for peaceful purposes. The Outer Space Treaty provides that experiments that "would cause potentially harmful interference with activities of other States" are subject to prior appropriate international consultation (Article IX).

178. The Antarctic Treaty provides for freedom of scientific investigation in Antarctica and that scientific observations and results from Antarctica shall be exchanged and made freely available "to the greatest extent feasible and practicable".[173] The Antarctic Environment Protocol explicitly mentions the value of the Antarctic as an area for the conduct of scientific research as a fundamental consideration in the planning and conduct of all activities in the Antarctic Treaty area.[174] At the same time, it subjects research to the principles of Article 3.[175]

179. Moreover, scientific research is frequently institutionally incorporated in treaty regimes by integrated scientific advisory bodies such as under the Subsidiary Body for Scientific and Technological Advice under Article 9 UNFCCC. These scientific bodies have been even established as more or less integral parts of the decision-making systems of their respective regimes.[176]

180. Besides these explicit references in binding law, international science is essentially self-organising through institutions and non-binding rules.[177]

181. In conclusion, there are generally no general restrictions of research, including *in situ* experimentation, in international law outside the marine environment. The existing rules are mostly specific to certain media or a territory.

[171] Livingston (1968)
[172] Art. I of the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction (1972)
[173] Articles II, III.
[174] Article 3.
[175] Article 3(4).
[176] Andresen et al (2008) p. 190.
[177] Cf. the UNESCO Declaration on Science and the Use of Scientific Knowledge, http://www.unesco.org/science/wcs/eng/overview.htm;

6 Conclusions

182. As an overarching concept including several distinct concepts and technologies, geoengineering is currently not as such prohibited by international law. Specific geoengineering activites and potential impacts of specific geoengineering concepts might violate particular rules however additional information on geoengineering impacts would assist in the evaluation of such applicability and support the identification of gaps.

183. It has been argued that at present, no international treaties or institutions exist with a sufficient mandate to regulate the full spectrum of possible geoengineering activities.[178] However, there are existing rules that would apply to some geoengineering activities and institutions with at least a partial mandate to address it. Table 6.1 provides a summary of the applicability of the various treaties examined in this report to several geoengineering techniques.

184. Most, but not all treaties potentially provide for mechanisms, procedures or institutions that could determine whether the treaty in question applies to a specific geoengineering activity and address such activities. In particular, most relevant treaties already have in place a COP or other institution that can determine to what extent geoengineering can be addressed by the treaty in question and its bodies

185. For instance, space law does not have the features of more modern environmental treaty regimes. It remains to be seen whether COPUOS would be suitable for elaborating specific guidance.

186. Some rules analysed in this study could apply to particular geoengineering concepts and restrict them depending on specific impacts. Whether such impacts would actually occur is difficult to assess or predict at this stage. Some rules do not require actual impacts but let potential or likely impacts suffice.

187. Some general rules such as the prevention of transboundary environmental harm may be intended to cover subsequent developments. In contrast, other rules may not be applicable or not provide a clear permission or prohibition of geoengineering. This study follows a cautious approach in applying or drawing conclusions from existing legal rules:[179] In accordance with established methods of legal interpretation[180], it considers that rules that were adopted without considering geoengineering, and the normative content of which is general or vague, are open to interpretation and do not on the face of it speak in favour or against geoengineering as such.

188. One gap in international environmental governance is the lack of mechanism or treaty to deal with the assessment of technologies before they are commercialized. This gap was pointed out, for example, by the International Assessment of Agricultural Knowledge, Science and Technology.[181] It has also been referred to repeatedly by civil society

[178] Richard Lattanzio & Emily C Barbour, International governance of geoengineering 3 (2010), http://science.house.gov/publications/requested_reports_detail.aspx?NewsID=2783. Scott Barrett, *The Incredible Economics of Geoengineering*, 39 Environmental and Resource Economics 45-54, 9 (2008).

[179] As suggested by Bodansky as early as 1996, Bodansky (1996) p. 316

[180] Cf. Article 31 and 32 of the Vienna Convention on the Law of Treaties.

[181] Beverly D. McIntyre et al., Agriculture at the Crossroads: International assessment of agricultural knowledge, science and technology for development (IAASTD): global report, Washington D.C., Island Press, 2009, p. 467, available at http://www.agassessment.org/; see the NGO Declaration “Let’s Look Before We Leap” available at http://www.etcgroup.org/en/node/4956 and ETC Group, “Why Technology Assessment?” at http://www.etcgroup.org.

organizations concerned about the social and environmental impacts of new technologies in the context of the UNFCCC.[182]

189. Before CBD COP10, ocean fertilization (and CCS) were the only geoengineering concepts addressed as such at an international regulatory level, namely by the CBD and the London Convention/London Protocol.

190. Ocean fertilization is addressed by the LC/LP and CBD. The Assessment Framework established by the LC/LP provides an elaborate and comprehensive governance effort of scientific research projects.

191. In legal terms, the mandate of several major treaties or institutions is sufficiently broad to address some or all geoengineering concepts. This could lead to potentially overlapping or inconsistent rules or guidance.[183] It is worth noting that the IMO information on recent LC/LP activities states that the LC/LP Parties "*have declared themselves the competent international bodies* to regulate legitimate scientific research into ocean fertilization and to prohibit commercial activities in this field".[184] From a global perspective, the potential scale and scope of activities covered varies from one mechanism to the next, depending, for instance, on their respective levels of participation and relevance of the instrument.[185]

192. A distinction has been made in some processes between research and deployment. However, the distinction could be difficult to make from a regulatory point of view.

193. Virtually all treaties examined impose procedural obligations on geoengineering activities falling within their scope of application. These treaties have general provisions on exchange of information, cooperation and consultation. As a minimum it is suggested by multiple frameworks that states engaged in have a duty to inform other states prior to conducting geoengineering activities including field experiments.

194. Few rules provide for public participation beyond the representation of the public by delegates, except for the usual rules on observer participation in treaty regimes and institutions.

195. The treaties examined provide few specific rules on responsibility and liability. The ILC's articles on state responsibility are for the most part customary law that generally applies to breaches of international obligations.

196. In the context of geoengineering and the rationale behind it, the question could be raised whether relevant treaties are open to the possibility of determining negative impacts as "net" effects, i.e. negative impacts of the activity weighed against future negative impacts of climate change avoided by that activity.[186] The text of most treaties does not appear to provide for such a consideration of the overall "net" effects on the broader environment in comparison to harm avoided and there are no corresponding decisions on who would

[182] WN Info Service on Climate Change (Sept11/02), 6 September 2011, Third World Network, http://www.twnside.org.sg/title2/climate/info.service/2011/climate20110902.htm.

[183] Cf. on marine issues Scott, Karen N. "Marine Geoengineering: A New Challenge for the Law of the Sea." In *18th Annual Australia New Zealand Society of International Law (ANZSIL) Conference*. Canberra, Australia, 2010, <http://hdl.handle.net/10092/4878>, p.10 ; in general Scott, Karen N. "Conflation of, and Conflict Between, Regulatory Mandates: Managing the Fragmentation of International Environmental Law in a Globalised World," 2010, <http://ir.canterbury.ac.nz/handle/10092/4879>.

[184] IMO, Information on work on carbon capture and storage in sub-seabed geological formation and ocean fertilization under the London Convention and London Protocol. Note by the International Maritime Organization to the UNFCCC COP16, November 2010, p. 1, <www.imo.org/> (emphasis added).

[185] For instance, the US is party to the London Convention, but not the London Protocol, and not party to the CBD. However, the US did vote in favour of the UN GA resolutions which welcomed and took note of the LC/LP and CBD activities.

[186] On the weighing or netting of risks see also the section on precautionary principle.

evaluate such impacts and over what scale. Rather most treaties refer to specific effects resulting from the introduction of substances or energy into the air. A positive list of concepts or technologies that are considered to be geoengineering might be a useful regulatory approach. The list could be drawn up as a supplement to a general definition. It would need to allow for timely updating in order to provide the flexibility required for scientific and political developments.

197. Some key questions for designing a future governance framework:

- Is it preferable to have a centralised or decentralised governance structure for all or individual geoengineering concepts?
- How can regime conflicts be avoided ?
- What ist he most appropriate legal form?
- How should the forum be structured: mandate, flexibility?
- What aspects should be regulated?
- What is the most appropriate political and scientific level?
- How can research and deployment be distinguished: rationale and criteria?
- What are the most appropriate instruments and tools?
- How can participation and transparency be ensured?
- Do the rules and institutions allow for and incorporate scientific input in decision-making?
- Are scientific functions and a political decision-making functions separated?
- How can meaningful research results be achieved? Depending on the particular geoengineering concept, potential research activities might have to be to be coordinated at the international level in order to ensure that data can be correctly attributed to particular experiments and to ensure validity of results.
- How can potential regime conflicts (overlapping mandates) be avoided?
- How to ensure that precautionary principle is respected and that populations and ecosystems are not placed at undue risk without their prior knowledge or consent?
- How can proper inter-governmental oversight of relevant private initiatives be implemented?

6.1 Technologies and their potential regulation

Technology / Technique	**Potential significant trans-boundary harm**	**Potentially deployed or affects ABNJ** [187]	**Customary law principles apply**	**Relevant treaties and potential gaps**
Space-based reflectors	√	√	Yes	Space Law (Outer Space Treaty) , but no rules or guidance developed and governing body – Potential Gap
Stratospheric aerosols	√	√	Yes	Montreal Protocol could apply depending on gravity of actual impacts; otherwise global treaty applies specifically to this technique – Major Gap Procedural obligations under LRTAP
Cloud reflectivity	√	√	Yes	No global treaty applies specifically to this technique – Major Gap
Surface albedo (large scale)	√	√	Yes	No global treaty applies specifically to this technique – Major Gap
Ocean fertilization	?	√	Yes	UNCLOS applies; LC/LP working towards putting in place a regulatory mechanism for ocean fertilization, as well as for other marine geoengineering techniques.
Enhanced weathering (ocean)	?	√	Yes	UNCLOS and LC/LP apply
Ocean CO_2 storage	?	√	Yes	UNCLOS applies; Prohibited under OSPAR in the North-East Atlantic.
Ocean biomass storage	?	√	Yes	UNCLOS and and LC/LP has already developed guidance for dumping of “Organic materials of natural origin
Sub-surface CO_2 storage	?	√	Yes	Rules & guidance developed under LC/LP Rules & guidance developed under OSPAR (OSPAR amendments not yet in force)

[187] Area Beyond National Jurisdiction

Annex

6.2 Abbreviations and Acronyms

ABNJ	Area Beyond National Jurisdiction
CBDR	Common but differentiated responsibilities
CCS	Carbon Capture and Storage
CDR	Carbon Dioxide Removal
COPUOS	Committee on the Peaceful Uses of Outer Space
EC	European Community
EIA	Environmental Impact Assessment
EU	European Union
IPCC	Intergovernmental Panel on Climate Change
ICJ	International Court of Justice
ILC	International Law Commission
ILM	International Legal Materials
IOC	Intergovernmental Oceanographic Commission of UNESCO
SEA	Strategic Environmental Assessment
SRM	Solar Radiation Management
UNEP	United Nations Environment Programme
WMO	World Meteorological Organization

6.3 Treaties and instruments cited

Short form used	**Full title and reference**
Antarctic Treaty	Antarctic Treaty of 01.12.1959, in force 23.06.1961
Antarctic Environmental Protocol	Protocol to the Antarctic Treaty on Environmental Protection of 03.11.1991, in force 1998
CBD	Convention on Biological Diversity
ENMOD Convention	Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques
Espoo Convention	Convention on Environmental Impact Assessment in a Transboundary Context

Protocol on Strategic Environmental Assessment	
Kyoto Protocol	Kyoto Protocol to the United Nations Framework Convention on Climate Change
LC/LP	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters, 1972, 1046 UNTS 120, in force 1975; Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter of 07.11.1996, 36 ILM 1 (1997), in force 2006
Liability Convention	Convention on the International Liability for Damage Caused by Space Objects, 29 March 1972, 961 UNTS 187, in force 02 September 1972
LRTAP Convention	Convention on Long-range Transboundary Air Pollution
Montreal Protocol	Montreal Protocol on Substances that Deplete the Ozone Layer (as amended)
Moon Treaty	Agreement Governing the Activities of States on the Moon and other Celestial Bodies, 05 December 1979, 1363 UNTS 3, in force 11 July 1984
Outer Space Treaty	Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space Including the Moon and Other Celestial Bodies, 27 January 1967, 610 UNTS 205, in force 10 October 1967
OSPAR Convention	Convention of the Protection of the Marine Environment of the North-East Atlantic
Vienna Convention	Vienna Convention for the Protection of the Ozone Layer
Space Registration Convention	Convention on Registration of Objects Launched into Outer Space[188]
UNCLOS	United Nations Convention on the Law of the Sea of 10.12.1982, 21 ILM 1261 (1982) 1833 UNTS 3, in force 1994; Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982 of 28.07.1994, 1836 UNTS 3, in force 1996

[188] Adopted by UNGA Resolution 3235, (12 November 1974), opened for signature on 14 January 1975, entered into force on 15 September 1976, 1023 UNTS 15

UNFCCC	United Nations Framework Convention on Climate Change
Universal Declaration of Human Rights; International Covenant on Economic, Social and Cultural Rights; UN Declaration on the Rights of Indigenous Peoples; UN Declaration on the Right to Development	UN General Assembly Resolution,1948
VCLT	Vienna Convention on the Law of Treaties,1969

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