International legal framework for geoengineering: Managing the risks of an emerging technology

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Part II – Applying Contemporary International Law to Geoengineering

Chapter 2 Contemporary International Law and Geoengineering – A General Approach

2.1 Introduction

To date, there is no single international legal framework governing geoengineering. However, a number of treaties are applicable to geoengineering in a wide range of fields. For instance, the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol (KP)[214] and Paris Agreement (PA) encourage the development of new methods to increase carbon sinks; the Convention on Biological Diversity (CBD) aims to prevent species loss and habitats degradation; the London Convention on the Prevention of Marine pollution by Dumping of Wastes and Other Matter (LC) and its 1996 Protocol (LP) prevent marine pollution from dumping wastes and other matters;[215] and the 1982 Convention on the Law of the Sea (UNCLOS) regulates activities in different zones at sea and controls marine pollution.[216] Part II addresses contemporary international laws applicable to geoengineering by examining general rules and principles applicable to all techniques in this Chapter and specific rules applicable to each individual technique in Chapter 3.[217]

As concluded in Chapter 1, not all geoengineering techniques need to be governed at the international level; instead, only the techniques for which the implementation[218] thereof

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[214] Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, adopted 10 December 1997, entered into force 16 February 2005, *United Nations Treaty Series* (2005), vol. 2303, no. 30822, p.162.

[215] Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London, adopted 29 December 1972, entered into force 30 August 1975, *United Nations Treaty Series* (1984), vol. 1046, no. 15749, p. 120 (hereafter "London Convention" or "LC").

[216] United Nations Convention on the Law of the Sea, Montego Bay, adopted 10 December 1982, entered into force16 November 1994, *United Nations Treaty Series* (1998), vol. 1833, no. 31363, p.3.

[217] "All geoengineering techniques" refer to the six techniques selected in Chapter 1; A technique-by technique research correlates with Sections 1.4 and 1.5 concerning environmental risks of each technique.

[218] Here and elsewhere, the term "implementation" refers to local-, regional-, continental- or global-scale geoengineering experimental activities and geoengineering activities for the purpose of

may cause interference in the areas beyond the limits of national jurisdiction or control of the acting state require to be governed at the international level. This Chapter and Chapter 3 concentrate on the six geoengineering techniques selected in Chapter1.

This Chapter examines the contemporary international legal rules and principles that apply to all geoengineering techniques. The international climate change regime and the Convention on the Prohibition of Military or Any Hostile Use of Environmental Modification Techniques (ENMOD Convention) are the main treaties that will be examined in this Chapter. Regarding customary international law and general principles of international law, the obligation to prevent and abate significant transboundary harm or the harm to the global commons as well as the precautionary approach will be addressed in Sections 2.4.1 and 2.4.2 respectively. Note that the CBD, also as a treaty that applies to all geoengineering techniques, will be examined in Section 2.4.2.4 concerning the moratorium on geoengineering.

2.2 The International Climate Change Regime

2.2.1 UNFCCC

Article 2 of the UNFCCC stipulates that the ultimate objective of the Convention is to achieve "stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The UNFCCC is applicable to geoengineering primarily because the implementation of geoengineering is consistent with the ultimate objective of the UNFCCC. The manner in which the ultimate objective of the UNFCCC applies to CDR techniques and to SRM techniques varies because of the distinct attributes of the two modalities. Actions aiming at stabilizing greenhouse gas concentrations do not exclude CO_2 removal activities aiming at reducing *in situ* CO_2 concentrations in the atmosphere.[219] Hence, the implementation of CDR techniques contributes to achieving the ultimate objective of the UNFCCC. Besides,

counteracting global warming, whereas the term "deployment" only refers to regional-, continental- or global-scale activities for the purpose of counteracting global warming.

[219] CBD Technical Series No. 66, supra note 43, 127.

the UNFCCC encourages state Parties to take measures to mitigate climate change by protecting and enhancing sinks and reservoirs, which include biological CDR methods.[220]

The aim of implementing SRM techniques is not explicitly in line with the ultimate objective of the UNFCCC of stabilizing greenhouse gas concentration, but the ultimate objective might not necessarily limit States' implementation of SRM techniques. Although the implementation of SRM techniques does not aim at "stabilization of greenhouse gas concentrations in the atmosphere", such novel techniques are able to "prevent dangerous anthropogenic interference with the climate system", i.e. preventing dangerous global warming by reducing solar radiation. At the very least, the UNFCCC encourages new technological and technical research to combat climate change, which means research activities regarding the feasibility and potential effects of SRM techniques could be logically included therein.[221]

In addition, the UNFCCC is applicable to geoengineering in terms of three principles. First, the UNFCCC incorporates the prevention principle that aims to prevent transboundary environmental harm. Although the prevention principle is contained in the Preamble rather than in an operative provision, some procedural obligations relating to the prevention principle, including cooperation, information exchange and impact assessments, are addressed among the commitments of Parties.[222] In particular, the UNFCCC requires all Parties to employ appropriate methods to minimize adverse effects of "projects or measures undertaken by them to mitigate or adapt to climate change".[223] To the extent that some geoengineering techniques are considered to be measures that mitigate or adapt to climate change, all Parties should also minimize adverse effects caused by such geoengineering techniques.

Second, the UNFCCC incorporates the precautionary principle: "The parties should take precautionary measures to anticipate, prevent or minimize the cause of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such

[220] UNFCCC, Art. 4.1; See Section 1.3.2.
[221] UNFCCC, Art. 4.1(c) & 4.1(g).
[222] UNFCCC, Art. 4(c), (d), (e), (f), (h) & (j).
[223] UNFCCC, Preamble & Art. 4, para. 1 (f).

measures."[224] It has been argued that geoengineering would make a great contribution in counteract the cause of climate change and mitigate its adverse impacts, given that CDR can "minimize the cause of climate change" and SRM has the potential to "mitigate its adverse effects".[225] In this context, scientific uncertainty is not a reason to postpone geoengineering if "threats of serious or irreversible damage" of climate change exists. However, taking into account the significant environmental risk created by or scientific uncertainty contained in some techniques, it might still not be appropriate to treat geoengineering techniques as precautionary measures to deal with global warming. If an activity that may threaten the climate should be undertaken with precaution, why not the risky measure *per se*?[226]

Third, developed countries and developing countries should make efforts to prevent dangerous anthropogenic climate change in accordance with their common but differentiated responsibilities and respective capabilities:[227] "The parties should protect the climate system […] on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities."[228] This principle underpins that developed countries should take the lead in modifying longer-term trends in anthropogenic emissions and combating climate change,[229] which means that developed countries should make greater contributions to developing new technologies to counteract climate change and the adverse effects thereof. Developing countries *might* also benefit from the increased knowledge of new possibilities in response to climate change.[230]

The last point that merits attention is the UNFCCC's prioritization of mitigation by addressing anthropogenic emissions by sources and removals by sinks. It remains to be

[224] UNFCCC. Art. 3(3).
[225] Bodle, R. (2010-2011). Geoengineering and international law: The search for common legal ground. *Tulsa Law Review,* 46(305), 322, at 310.
[226] The precautionary principle under the UNFCCC will be further addressed in Section 2.4.2.4.
[227] UNFCCC, Arts. 3(1) & 4. This principle is also listed in Principle 7 of Rio Declaration.
[228] UNFCCC, Arts. 3(1) & 4.
[229] UNFCCC, Arts. 3(1) & 4(2)(a).
[230] Reynolds, J. (2014). Climate engineering field research: The favorable setting of international environmental law. *Washington and Lee Journal of Energy, Climate, and the Environment, 5*(2), 417-486, at 439. Here the word "might" implies that it is very difficult for developing countries, especially the most vulnerable countries, to obtain the benefit. It depends on the design and operation of the benefit-sharing mechanism.

answered by the policymakers whether the deployment and even the research of SRM techniques would be permitted due to the risk of "moral hazard". In other words, whether geoengineering, as Plan B, would weaken the commitment of mitigation as Plan A if SRM were to be addressed in the UNFCCC.[231] It has been argued that the UNFCCC prohibits a policy approach that would lessen Parties' main commitments.[232]

2.2.2 Kyoto Protocol

The KP is aimed at facilitating the achievement of the ultimate objective of the UNFCCC. Article 2(1) (a) (ii) and (iv) of the KP could be considered as a legal impetus for developing CDR techniques: Each Party included in Annex I to the UNFCCC, in achieving its quantified emission limitation and reduction commitments under Article 3 of the KP, shall "implement and/or further elaborate policies and measures in accordance with its national circumstances, such as: (ii) Protection and enhancement of sinks and reservoirs of greenhouse gases […]; promotion of sustainable forest management practices, afforestation and reforestation"; "(iv) Research on, and promotion, development and increased use of […] carbon dioxide sequestration technologies and of advanced and innovative environmentally sound technologies[.]" It is notable that the Kyoto Protocol calls on Parties to develop research on "advanced and innovative environmentally sound technologies", thus excluding "unsound" techniques.[233]

One limitation of applying the KP to CDR is that, although the KP calls on Parties to protect and enhance sinks and reservoirs of greenhouse gases (GHGs), only the changes in GHGs resulting from afforestation and reforestation can be measured as verifiable changes to meet Parties' commitments of GHG emissions reduction.[234] Another limitation concerns the fact that the KP may be terminated at some point in the next decade.[235] In light of this,

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[231] Reynolds, J. (2014), supra note 230, 441.
[232] Winter, G. (2011). Climate engineering and international law: Last resort or the end of humanity? *Review of European Community & International Environmental Law, 20*(3), 277-289, at 288.
[233] Scott, K. N. (2012-2013). International law in the Anthropocene: Responding to the geoengineering challenge. *Michigan Journal of International Law, 34*, 309-358, at 331.
[234] Kyoto Protocol, Art. 3(3).
[235] Pursuant to paragraph C of the Doha Amendment to the KP, the second commitment period is from 2013 to 2020, but the KP will not be terminated on the last day of 2020. According to XIII of the Annex to Decision 27/CMP.1, Procedures and Mechanisms relating to Compliance under the Kyoto Protocol,

the KP might not play a significant role in the governance of CDR techniques in the long run.

2.2.3 Decisions of COP and CMP

Numerous decisions of the Conference of the Parties (COP) and Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) directly or indirectly touch upon issues within the scope of CDR techniques. In 2007, COP 13 adopted the Bali Road Map, which includes the Bali Action Plan. In the Action Plan, Parties agreed to cooperate long-termly and enhanced national/international actions on mitigation of climate change, especially considering differentiated appropriate mitigation actions in developed and developing countries.[236]

In addition, the Cancun Agreements adopted by COP 16 made a reference to keeping the increase of the global average temperature below 2 °C and could be seen as catalysing the proposition of geoengineering. As introduced in Chapter 1, the main background of proposing geoengineering is the emission gap between the 2 °C goal and the reality, which cannot be filled by conventional mitigation methods. The Cancun Agreements recognize the need for deep cuts in global greenhouse gas emissions to meet this long-term goal of holding the increase in global average temperature below 2 °C above preindustrial levels, and also recognize the need to consider strengthening the long-term global goal, including in relation to a maximum temperature rise of 1.5 °C.[237]

The CMP approved carbon capture and storage (CCS) projects for greenhouse-gas offsets under the Clean Development Mechanism (CDM). As explained in Chapter 1, CCS is different from CDR techniques, but the modalities and procedures of carbon sequestration

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the default would be for activities relating to the second commitment period of the Kyoto Protocol to continue until the completion of the review of the true-up period reports. In light of this, it is better to keep the projection of KP's termination more open-ended.

[236] UNFCCC Decision1/CP.13. Bali Action Plan, UN Doc. FCCC/CP/2007/6/Add.1 (14 March 2008), para. 1(b).

[237] Cancun Agreements, supra note 16, para. 4.

are similar. Hence, the CMP decisions concerning CCS could provide a reference notwithstanding that they are not directly applicable to CDR techniques under the KP.[238]

2.2.4 Paris Agreement

The Paris Agreement (PA) adopted at at the twenty-first session of the Conference of the Parties to the UNFCCC in December 2015 opens a new chapter in the global governance of climate change. The PA does not explicitly warrant the implementation of any specific mitigation technologies or techniques, but the PA encourages Parties to take actions on conserving and enhancing sinks and reservoirs of GHGs.[239] Such a general character of the PA implies that it would be possible to implement CDR techniques when discussing how to achieve the long-term temperature goal and how to undertake intended nationally determined contributions (INDCs)[240] and nationally determined contributions (NDCs).[241]

The long-term temperature goal set out in the PA can be traced back to the Cancun Agreements in 2010.[242] The long-term temperature goal under the Cancun Agreements has been incorporated into the PA as a means towards the achievement of the ultimate objective of the UNFCCC. Although not in the language of a commitment or an obligation, Article 2(a) of the PA has reiterated the long-term temperature goal through strengthened wording. In enhancing the implementation of the Convention, the PA aims to hold "the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change". Compared to the long-term goal formulated in the Cancun Agreements, the word "well"

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[238] UNFCCC Decision7/CMP.6. Carbon Dioxide Capture and Storage in Geological Formations as Clean Development Mechanism Project Activities, UN Doc. FCCC/KP/CMP/2010/12/Add.2 (15 March 2011); UNFCCC Decision 10/CMP.7. Modalities and Procedures for Carbon Dioxide Capture and Storage in Geological Formations as Clean Development Mechanism Project Activities, UN Doc. FCCC/KP/CMP/2011/10/Add.2 (15 March 2012).

[239] Paris Agreement, Art. 5.1

[240] Intended Nationally Determined Contributions (INDCs) refers to the mitigation contributions that Parties to the UNFCCC initiate or intensify towards achieving the objective of the UNFCCC prior to joining the PA.

[241] Nationally Determined Contributions (NDCs) refers to the mitigation contributions that all Parties to the PA initiate or intensify towards achieving the objective of the UNFCCC.

[242] Cancun Agreements, supra note 16, para. 4.

has been added before "below 2 °C" and the significance of strengthening the goal to 1.5 °C above pre-industrial level has been confirmed. The goal of limiting global temperature rise under the PA entails enhanced emission reductions before 2020 and ambitious and stringent emission reductions over later decades.[243]

Considerable efforts will be required to achieve the 2 °C goal. As described in the Synthesis Report on the Aggregate Effect of the Intended Nationally Determined Contributions, *several* Parties to the Convention have indicated in their submitted INDCs that their expected level of emissions in the future would fall within a global emission pathway that is consistent with the 2 °C goal, while *a few* Parties referred to 1.5 °C as the objective that they were aiming for with their INDCs.[244] The achievement of the 2 °C goal depends on how ambitious Parties' mitigation efforts are. It has been widely pointed out that achieving the 2 °C goal would rely heavily on the large-scale use of negative emission technologies, i.e. CDR techniques.[245] Article 5 of the PA requires Parties to take actions to enhance, as appropriate, sinks and reservoirs of GHGs. The implementation of CDR techniques seems to echo the encouragement of enhancing sinks under the PA, as biological CDR methods (e.g. large-scale afforestation and ocean fertilization), chemical CDR techniques (e.g. enhanced weathering) or a combination of biological and physical methods (e.g. BECCS) would enhance either natural or artificial carbon sinks. Notably, adverse impacts on the environment arising from some CDR techniques, inter alia, ocean fertilization[246] and remaining scientific uncertainties in such techniques should not be ignored when assessing the feasibility of implementing such techniques.

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[243] The Emissions Gap Report 2015, xvii.

[244] Synthesis Report on the Aggregate Effect of the Intended Nationally Determined Contributions, UN Doc. FCCC/CP/2015/7, para. 29. Italic added.

[245] See e.g. Farber, D. (2015, December 14). Does the Paris agreement open the door to geoengineering? Retrieved from: http://blogs.berkeley.edu/2015/12/14/does-the-paris-agreement-open-the-door-to-geoengineering/; Shepherd, J. (2016, February 17). What does the Paris Agreement mean for geoengineering? Retrieved from: http://blogs.royalsociety.org/in-verba/2016/02/17/what-does-the-paris-agreement-mean-for-geoengineering/. Regarding negative emission technologies, see McLaren, D. (2011). Negatonnes–an initial assessment of the potential for negative emission techniques to contribute safely and fairly to meeting carbon budgets in the 21st century. *Report for Friends of the Earth, UK*.

[246] Ocean fertilization may disturb the marine ecosystem and cause marine pollution.

Substantively, the main connection between the PA and the governance of CDR is NDCs made by all Parties.[247] Under the PA, all Parties are to undertake and communicate ambitious NDCs to the global response to climate change.[248] Parties are free to choose the methods of mitigation to be counted as their NDCs and there is no obligatory amount of emission reductions. As the PA encourages all Parties to include all categories of removals in their NDCs,[249] it is reasonable to infer that Parties have the freedom to implement any CDR technique as part of its NDC in order to to strengthen the global response to the threat of the climate change unless the CMA provides otherwise in the future.[250]

It is unclear whether the PA is applicable to SRM. Pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels would be more challenging.[251] For every state, such efforts entail considerable investment in decarbonisation of its economy, rapid development of low-emission and even zero-emission technologies as well as intensive collaboration with other states. Notably, the PA also aims to achieve a *balance* between anthropogenic emissions by sources and removals by sinks of greenhouse gas in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.[252] This aim encompasses both the ambitious mitigation efforts required and the practical limitations due to states' distinct capacities. At first sight, it seems to be reasonable to assume that the temperature goal under the PA may require the implementation of SRM: when extraordinarily ambitious mitigation efforts are not realistic, a compromise could be to limit the temperature increase by implementing SRM in order to achieve the temperature goal. However, limiting the temperature increase to 1.5 °C above pre-industrial levels is not so much an objective by itself, but a means to achieve the ultimate objective of the UNFCCC, i.e. limiting the concentration of greenhouse gas emissions at a level that would prevent

[247] Paris Agreement, Art. 3.
[248] Paris Agreement, Art. 3.
[249] UNFCCC Decision 1/CP 21, Adoption of the Paris Agreement, UN Doc. FCCC/CP/2015/10/Add.1, para. 31(c).
[250] Paris Agreement, Art. 4.13.
[251] According to the IPCC AR5 WGI, global surface temperature changes in the end of the 21st century is likely to exceed 1.5 °C relative to 1850 to 1900 for all RCP scenarios except RCP2.6. ("RCPs" is short for representative concentration pathways, and RCP 2.6 refers to the emission scenario by 2100 with the most ambitious reductions efforts. See more explanation in IPCC AR5 WGI, Glossary, RCPs).
[252] Paris Agreement, Art. 4.1. Italic added.

dangerous climate change. As a result, whether the PA is applicable to SRM depends on the interpretation of the ultimate objective of the UNFCCC[253].

2.3 The ENMOD Convention

In the 1970s, weather modification techniques raised particular concern. In the Vietnam War, the U.S. military used cloud seeding over the Ho Chi Minh Trail, increasing the rainfall and thereby impeding traffic along the Trail. The concern about weather warfare led to the adoption of the Convention on the Prohibition of Military or Any Hostile Use of Environmental Modification Techniques (ENMOD Convention) in 1977.[254] The ENMOD Convention restricts the use of geoengineering for military or hostile use. Article II of the ENMOD Convention defines the term "environmental modification techniques" as "any techniques 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". Several examples are provided by the ENMOD to better explain the phenomena that could be caused by the use of environmental modification techniques: earthquake, change of weather patterns (clouds, precipitation, cyclones of various types and tornadic storms), changes in climate patterns, changes in ocean currents and changes in the state of the ozone layer.[255] Pursuant to the definition, and in view of the examples, the characteristics of SAI, MCW and ocean upwelling fall within the term "environmental modification techniques".[256] Article I of the ENMOD Convention stipulates that parties to this Convention undertake not to engage in and not to assist, encourage or induce any state, group of states or international organization 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".[257] Consequently, the ENMOD Convention prohibits any

[253] As stated in the second paragraph of Section 2.2.1.

[254] Convention on the Prohibition of Military or Any Hostile Use of Environmental Modification Techniques, New York, adopted 10 December 1976, entered into force 5 October 1978, *United Nations Treaty Series* (1986), vol. 1108, no. 17119, p. 151. Bodansky, D. (1996). May We Engineer the Climate? Climate Change, 33, 309-321.

[255] ENMOD, Annex, Understanding relating to article II.

[256] "Understanding relating to article II" states that the examples listed are not exhaustive. Therefore, other geoengineering techniques might also be taken into account if the intervention is great enough to "change the dynamics, composition or structure of the Earth".

[257] ENMOD Convention, Arts. I & II.

climate intervention with a military or hostile purpose if it is has long-lasting, widespread or severe effects.

However, the ENMOD Convention stipulates that Parties "shall not hinder the use of environmental modification techniques for peaceful purposes."[258] Activities carried out for peaceful purposes that cause "widespread, long-lasting or severe effects" are allowed by the ENMOD Convention if they are in accordance with generally recognized principles and applicable rules of public international law.[259] Furthermore, the ENMOD Convention requires Parties to exchange scientific and technological information on the peaceful use of environmental modification techniques.[260] Therefore, geoengineering techniques for peaceful uses are allowed, as long as they are in accordance with applicable international rules and principles, notably the prevention principle. This mandate is of particular significance in terms of sharing information about negative consequences with other states.[261]

In sum, the ENMOD Convention applies to geoengineering in terms of exchanging information on the peaceful uses of of SAI, MCW and ocean upwelling. The prohibition to make use of environmental modification techniques under the ENMOD Convention is not applicable to geoengineering unless SAI, MCW and ocean upwelling were applied for hostile purposes and would have widespread, long-lasting or severe effects.

2.4 Prevention and Precaution – Coping with Environmental Harm, the Risk of Harm and Uncertainty

2.4.1 Coping with Environmental Harm and the Risk of Harm - The Prevention Principle

When conducting geoengineering activities, states are required to comply with the obligation to prevent significant transboundary harm or to minimize the risk thereof. In a broad sense, the prevention principle, or the obligation to prevent transboundary harm, refers to the rule that one state must ensure that an activity undertaken within its

[258] ENMOD Convention, Preamble.
[259] ENMOD Convention, Art. III (1) I & Understanding relating to article III.
[260] ENMOD Convention, Art. III (2)
[261] Winter, G. (2011), supra note 232, 280.

jurisdiction or control does not cause significant harm beyond its national jurisdiction or control. The harm may occur under the jurisdiction or control of another state or beyond the limits of national jurisdiction or control (the global commons).[262] In some legal instruments, "transboundary harm" may merely refer to the harm occurring in areas under the jurisdiction or control of another state.[263] For the convenience of discussion, this book uses the term "transboundary harm" in a narrow sense, viz. the harm to the environment of other states, as opposed to the harm to the global commons.

The prevention principle is one of the fundamental principles in contemporary customary international law pursuant to which states have the responsibility to prevent damage to the environment of other states or of areas beyond national jurisdiction. Since the prevention principle was firstly enunciated in the *Trail Smelter* arbitration[264] in 1938, it has gradually evolved into customary international law after the reiterations in international and regional conventions,[265] declarations, and judicial and arbitral decisions.

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[262] E.g. The definition of the global commons is introduced in Section 2.4.1.3(ii); Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, adopted by the International Law Commission at its fifty-third session, 2001, *Official Records of the General Assembly*, Fifty-sixth Session, Supplement No. 10 (A/56/10), Art. 2(c). (hereafter "2001 Draft Articles on Prevention")

[263] E.g. Convention on Long-Range Transboundary Air Pollution, Geneva, adopted 13 November 1979, entered into force 16 March 1983, *United Nations Treaty Series* (1992), vol. 1302, no. 21623, p. 217, Art. 1(b).

[264] *Trail Smelter Case (United States v. Canada),* 16 April 1938 and 11 March 1941, Report of International Arbitral Awards, volume III, pp. 1905-1982.

[265] E.g. International conventions: CBD, Art. 3; UNCLOS, Art.194. 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Art. 3. Regional conventions: ASEAN (Association of Southeast Asian Nations) Agreement on the Conservation of Nature and Natural Resources, Kuala Lumpur, adopted 9 July 1985, not yet entered into force, Art. 20. Retrieved from http://environment.asean.org/agreement-on-the-conservation-of-nature-and-natural-resources/; Convention on the Protection of the Rhein, Berne, adopted 12 April 1999, entered into force 1 January 2013, Art.4. Retrieved from http://www.iksr.org/en/international-cooperation/legal-basis/convention/index.html
Non-binding legal instruments: UNGA, Development and International Economic Co-operation: Environment, Report of the World Commission on Environment and Development: Our Common Future, UN Doc. A/42/427 (4 August 1987), Annex 1: Summary of Proposed Legal Principles for Environmental Protection and Sustainable Development Adopted by the WCED Experts Group on Environmental Law, para. 10 (hereafter "Our Common Future, Annex 1"); Convention on the Law of the Non-navigational Uses of International Watercourses, adopted 21 May 1997, entered into force 17 August 2014, UN Doc. A/51/49 (vol. III) (UNTS volume number has yet been determined), Art. 7.

Originally, the prevention principle applied only to acts within one state's territory that cause transboundary harm to the territory of another state. In the *Trail Smelter* arbitration, the Tribunal held that

> no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence.[266]

In 1949, the ICJ judgement in the *Corfu Channel* case concluded that "the laying of the minefield which caused the explosions […] could not have been accomplished without the knowledge of the Albanian government."[267] Therefore, every state has "[the] obligation not to allow knowingly its territory to be used for acts contrary to the rights of other States".[268] Furthermore, in 1957, the *Lac Lanoux* arbitration confirmed that France should take Spanish interests into sufficient consideration in the utilization of the water of Lake Lanoux.[269]

Principle 21 of the 1972 Stockholm Declaration broadens the scope of the prevention principle, providing that states must ensure that activities within their jurisdiction or control do not cause damage not only to "the environment of other States" but also to the environment of "areas beyond the limit of national jurisdiction".[270] Principle 21 of the 1972 Stockholm Declaration has become a classic formulation of the prevention principle and is incorporated in conventions as well as cited in academic literature.[271] Later, the ICJ

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[266] *Trail Smelter Case*, pp. 1965.

[267] *The Corfu Channel case (United Kingdom of Great Britain and Northern Ireland v. Albania)*, Judgment of April 9th 1949, ICJ Reports, 1949, p. 4, at p. 22.

[268] Ibid.

[269] *Lac Lanoux (France/Spain)*, Report of International Arbitral Awards, 16 November 1957, Volume XII, pp. 281-317, p. 27. (Here and below, the page number is based on the translated version of this case (from French to English), which is available on ECOLEX: http://www.ecolex.org/.)

[270] 1972 Stockholm Declaration of the United Nations Conference on the Human Environment. See also: Rio Declaration on Environment and Development, Principle 2.

[271] Examples of Conventions: Art. 3 of the CBD; Art. 194(2) of the UNCLOS. Examples of academic literatures: Birnie, P., Boyle, A. & Redgwell, C. (2009), supra note 213, 143; Lefeber, R. (1996*). Transboundary Environmental Interference and the Origin of State Liability* (1st ed.). The Hague: Kluwer Law International, 23.

endorsed the prevention principle as a rule of customary international law in the *Nuclear Weapon Advisory Opinion*: "The existence of the general obligation of States to ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control is now part of the corpus of international law relating to the environment."[272] More recently, in 2013, *Indus Waters Kishenganga* arbitration, an arbitral tribunal looked back upon the development of this fundamental principle of customary international environmental law when it acknowledged India's commitment to ensure a minimum environmental flow downstream of the Kishenganga hydro-electric project.[273]

In contrast to the aforementioned cases which refer to this principle as a general norm, the ICJ judgment in the *Pulp Mills* case translated the prevention principle into a series of procedural and substantive obligations.[274] The *Pulp Mills* case, between Argentina and Uruguay, concerns the obligations related to two pulp mills constructed in Uruguay on the River Uruguay. The procedural obligations include, but are not limited to: the obligation to inform CARU (Administrative Committee of the River Uruguay) (paras. 94-111) and Uruguay's obligation to notify the other party about their plans (paras. 112-122). With respect to the substantive obligations, the judgment examined four aspects, *viz.* the obligation to the optimum and rational utilization of the river (paras. 170-177); the obligation to ensure that the management of the soil and woodland loss does not impair the regime of the river or the quality of its waters (paras. 178-180); the obligation to co-ordinate measures to avoid changes in the ecological balance (paras. 181-189); and the obligation to prevent pollution and preserve the aquatic environment (paras. 190-266).

[272] *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion of 8 July 1996, ICJ Reports 1996 (I), pp. 241-242, para. 29.
[273] *In the Matter of the Indus Waters Kishenganga Arbitration (The Islamic Republic of Pakistan vs. The Republic of India)*, Partial Award, The Permanent Court of Arbitration,18 February 2013, para. 448-454.
[274] *Case Concerning Pulp Mills on the River Uruguay (Argentina v. Uruguay)*, Judgment of 20 April 2010, ICJ Reports 2010, p. 14.

2.4.1.1 The Threshold of Harm

The prevention principle does not imply that *any* environmental harm is prohibited.[275] Instead, the principle entails a legal obligation when activities "could *significantly* diminish the enjoyment" of the environment by others.[276] The term "significant" has been formulated in different ways. For instance, in the *Trail Smelter Case*, the Tribunal was of the opinion that a claim is justified when "the case is of *serious* consequence"[277] and the threatened impairment of rights is of "serious magnitude and it must be established by clear and convincing evidence".[278] The 1992 Convention on the Transboundary Effects of Industrial Accidents also uses "*serious* effect" to describe the "transboundary effects" resulting from an industrial accident.[279] The 2001 Draft Articles on Prevention of Transboundary Harm from Hazardous Activities (hereafter 2001 Draft Articles on Prevention), adopted by the International Law Commission (ILC) elaborates the term "significant" as "something more than 'detectable' but the harm need not be at the level of 'serious' or 'substantial'".[280] However, the ILC also notes that a number of conventions have used "significant", "serious" or "substantial" to describe the threshold. Considering that the vague threshold may hinder the application of the prevention principle to specific cases, an authoritative interpretation of the words used to determine the threshold, such

[275] In exceptional circumstances "zero transboundary impact" might be appropriate. An example is groundwater. Due to the special vulnerability of groundwater, a "zero tolerance threshold" ought to inform a state's obligation to avoid transboundary effects. Bodansky, D., Brunnée, J., & Hey, E. (Eds.). (2008). The Oxford handbook of international environmental law (1st ed.). Oxford: Oxford University Press, 535.

[276] Environment, Justitia et Pace Institut de Droit International, Session of Strasbourg, 1997. Art.9. See also Our Common Future, Annex 1, supra note 265: Summary of proposed legal principles for Environmental Protection and Sustainable Development Adopted by the WCED Experts Groups on Environmental Law, para. 10; Convention on the Protection and use of Transboundary Watercourses and International Lakes, Art. 1(2); Convention on the Law of the Non-navigational Uses of International Watercourses, Art. 7.

[277] *Trail Smelter Case*, pp. 1965. Italic added.

[278] *Trail Smelter Case*, pp. 1964.

[279] Convention on the Transboundary Effects of Industrial Accidents, Helsinki, adopted 17 March 1992, entered into force 19 April 2000, *United Nations Treaty Series* (2002), vol. 2105, no. 36605, p. 457, Art. 1 (d). Italic added.

[280] Draft Articles on Prevention of Transboundary Harm from Hazardous Activities, with commentaries, *Yearbook of the International Law Commission*, 2001, vol. II, Part Two, commentary on Article 2, (4). (hereafter "2001 Draft Articles on Prevention, with commentaries")

as "significant", "substantial" and "serious", is required. Those words could be either interchangeable or refer to differing levels of harm.[281]

The measurement of "significant harm" is not "without ambiguity".[282] On the one hand, the obligation excludes "de minimis" harm. The United Nations Environmental Programme (UNEP) defines the term "significantly effect" as "any appreciable effects on a shared natural resource and excludes 'de minimis' effects",[283] which means that "significant effects" contain a level of risk that must be more than too small to be concerned with. On the other hand, in the 2001 Draft Articles on Prevention, the ILC defined the "risk of causing significant transboundary harm" as "risks taking the form of a high probability of causing significant transboundary harm and a low probability of causing disastrous transboundary harm".[284] The definition provided by the UNEP addresses the minimum limitation, whereas the definition provided by the 2001 Draft Articles on Prevention addresses both maximum and minimum limits.

However, the abovementioned definitions of "significant harm" still have not answered the question of how to determine "significant harm", because adjectives, such as "serious" and "substantial", are still abstract and fail to provide a clear and practical threshold. In view of this, some concrete criteria function as complements to the threshold of "significant harm". First, certain types of transboundary effects involving, for instance, radiological, toxic, or other highly dangerous substances, or harm to human health and safety, are likely to be *a priori* deemed significantly harmful.[285] Second, technical standards are established for assessing the significance of adverse impacts on, for instance, air and water quality.[286] Third, geographical markers, such as the proximity of

[281] Knox, J. H. (2002). The myth and reality of transboundary environmental impact assessment. *American Journal of International Law*, 291-319, at 294.
[282] 2001 Draft Articles on Prevention, with Commentary, Art. 2 Commentary (4).
[283] UNEP/GC Decision 6/14. Principles of Conduct for the Guidance of States in the Conservation and Harmonious Exploitation of Natural Resources Shared by Two or More States, 19 May 1978. *UNEP Environmental Law Guidelines and Principles Series, no. 2.*
[284] 2001 Draft Articles on Prevention, Art. 2.
[285] Bodansky, D., Brunnée, J., & Hey, E. (Eds.). (2008). The Oxford handbook of international environmental law (1st ed.). Oxford: OUP Oxford, 536.
[286] Ibid. For instance, Annex I and II of the 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs), as amended on 18 December 2009, list the substances scheduled for elimination and

an activity to the border, are used to indicate the "significance" of the transboundary effects.[287] In addition, the determination of "significant harm" involves "more factual considerations than legal determination, which means comprehensive consideration should also cover scientific knowledge and social-economic conditions.[288]

2.4.1.2 Due Diligence

The concept of due diligence was discussed in 1999 by the International Law Commission in the context of the topic of prevention of transboundary damage from hazardous activities. The special rapporteur Pemmaraju Sreenivasa Rao stated that "[t]he duty of prevention, which is an obligation of conduct, is essentially regarded as a duty of due diligence."[289] In order to prevent significant transboundary harm or minimize its risk, the state shall exercise due diligence through the adoption of all appropriate methods. The 1997 Convention on the Law of the Non-navigational Use of International Watercourses implies an obligation of due diligence by referring to "appropriate measures" to be taken by states to prevent the causing of significant harm to other watercourse states.[290] In the *Pull Mills* case, the ICJ stated that parties have the obligation to ensure that the management of the soil and woodland does not impair the regime of the River Uruguay or the quality of its waters.[291] Hence, both parties are called upon to exercise due diligence to preserve the ecological balance of the river.[292] The necessity of conducting an environmental impact assessment is particularly emphasized: "the duty of due diligence would not be considered to have been exercised if a state planning activities liable to affect

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restricted on use respectively. It could be seen as an example of establishing different technical standards for substances that contain different levels of harm.

[287] Ibid. An example of using geological boundaries to indicate the scope of protected zones, see Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, Iran, on 2 February 1971, Art. 2.

[288] 2001 Draft Articles on Prevention, with commentaries, Art. 2 Commentary (4).

[289] Second Report on International Liability for Injurious Consequences Arising out of Acts Not Prohibited by International Law (Prevention of Transboundary Damage from Hazardous Activities) by Pemmaraju Screenivasa Rao, Special Rapporteur, UN Doc. A/CN.4/501 (5 May 1999), para. 18.

[290] Convention on the Law of the Non-navigational Use of International Watercourses, Art. 7.

[291] *Case Concerning Pulp Mills on the River Uruguay*, supra note 274, para. 178.

[292] Ibid., para. 187.

the river or the quality of its waters did not undertake an environmental impact assessment upon such activities".[293]

The duty of due diligence has been interpreted differently in accordance with the standard of care involved. The duty of due diligence is not intended to guarantee the total prevention of significant harm "if it is not possible to do so".[294] The intension of due diligence offers a "flexibility"[295] that the standard of adequate care should be determined with due regard to various *technological*, *regulatory* and *economic* capacities and the *nature* of the activity. The Advisory Opinion of the International Tribunal for the Law of the Sea (ITLOS) points to the variability of the standard of due diligence: "[i]t may change over time as measures considered sufficiently diligent at a certain moment may become not diligent enough in light, for instance, of new scientific or technological knowledge."[296]

Pertaining to technological standards, in the *Pulp Mills* case, Argentina claimed that Uruguay had failed to take all appropriate measures to prevent harm because Uruguay had not required one of the pulp mills to use the "best available techniques".[297] However, Uruguay asserted that the Orion (Botnia) mill, one of the mills, was in compliance with the 1975 Statute of the River Uruguay between Uruguay and Argentina, because the mill is, "by virtue of the technology employed there, one of the best pulp mills in the world, applying best available techniques and complying with European Union standards, among others, in the area."[298] The standard of "best available techniques" has been included in many conventions, *inter alia*, the 1982 UNCLOS and the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention).[299] With respect

[293] Ibid., para. 204. Kiss, A. & Shelton, D. hold the same idea. Kiss, A. & Shelton, D. (2007), *Guide to International Environmental Law* (1st ed.). Leiden: Martinus Nijhoff Publishers, 92.

[294] 2001 Draft Articles on Prevention, with commentaries, Art. 3, Commentary (7).

[295] Birnie, P., Boyle, A. & Redgwell, C. (2009), supra note 213, 149.

[296] *Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area.* Advisory Opinion of 1 February 2011, Seabed Dispute Chamber of the International Tribunal for the Law of the Sea, (hereafter "ITLOS Advisory Opinion on Activities in the Area"), para.117.

[297] Ibid., para. 220.

[298] *Case Concerning Pulp Mills on the River Uruguay*, supra note 274, 220.

[299] Convention for the Protection of the Marine Environment of the North-East Atlantic, Paris, adopted 22 September 1992, entered into force 25 March 1998, *United Nations Treaty Series* (2009), vol. 2354, no. 42279, p. 27, Appendix 1 (hereafter "OSPAR Convention", "OS" for Oslo and "PAR" for Paris);

to regulatory standards, according to the judgment in the *Pulp Mills* case, even though the pollutants discharged by the Orion (Botnia) mill exceeded a maximum limit according to the environmental impact assessment, "Uruguay has taken action in its Regulation on Water Quality and in relation to the Orion (Botnia) mill in the conditions stipulated in the authorization issued by MVOTMA[300]." This implies that Uruguay had fulfilled its due diligence obligation in terms of best available techniques, including both regulatory and technological aspects. As regards economic viability, "the degree of care expected of a state with well-developed economic human and material resources […] is not the same as for states which are not in such a position".[301] In addition, the required degree of care is commensurate with the degree of hazard of the activity involved. The more hazardous an activity is, the greater duty of care is required to prevent and abate significant transboundary harm.[302]

The due diligence obligation also closely relates to the precautionary approach.[303] In the *Advisory Opinion on Activities in the Area*, the Tribunal pointed out that the precautionary approach is an integral part of the general obligation of due diligence of sponsoring states.[304] The obligation of due diligence applies in situations where scientific evidence concerning the scope and potential adverse impacts of an activity is insufficient, but where there is a plausible indication of potential risks. Disregarding such "potential risks" would constitute a failure to fulfil the obligation of due diligence and amount to a failure to comply with the precautionary approach. In the *Southern Bluefin Tuna* case, the obligation of due diligence and the precautionary approach were combined to deal with uncertain risks. The Tribunal first declared that "the parties should in the circumstances act with

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UNCLOS, Art. 194(1) "best practical means". See also other examples: Antarctic Treaty, Art. III (1); Convention on the Protection of Marine Environment of the Baltic Sea Area, Helsinki, 1992, entered into force 17 January 2000. Retrieved from http://www.helcom.fi/about-us/convention/. (hereafter "1992 Helsinki Convention (Baltic Sea Area)"), Annex II, Regulation 2.

[300] MVOTMA is an acronym for "Ministerio de Vivienda, Ordenamiento Territorialy MedioAmbiente (Uruguay Ministry of Housing, Land-use Planning and Environmental Affairs)".

[301] Lefeber, R. (1996), supra note 271, 65.

[302] Lefeber, R. (1996), supra note 271, 68; ILC, Second Report on International Liability for Injurious Consequences Arising Out of Acts Not Prohibited by International Law (Prevention of Transboundary Damage from Hazardous Activities) by Pemmaraju Screenivasa Rao, Special Rapporteur, *Yearbook of the International Law Commission*, Vol. II Part One, 1999, 121.

[303] As to the precautionary approach, see Section 2.4.2.

[304] ITLOS Advisory Opinion on Activities in the Area, supra note 296, para. 131.

prudence and caution to ensure that effective conservation measures are taken to prevent serious harm to the stock of southern Bluefin tuna".[305] This sentence implied that due diligence, namely "prudence and caution", should be exercised by the parties. The Tribunal then considered the scientific uncertainty regarding conservation measures to be taken to conserve the stock of southern Bluefin tuna. "Although the Tribunal cannot conclusively assess the scientific evidence presented by the parties, it finds that measures should be taken as a matter of urgency to preserve the rights of the parties and to avert further deterioration of the southern Bluefin tuna stock."[306]

2.4.1.3 Activities That Cause Significant Harm

(i) Significant Harm between States

Theoretically, the obligation to prevent transboundary harm encompasses the obligation to prevent or minimize transboundary environmental interference causing significant harm, and the obligation to prevent the materialization of a significant risk that may cause transboundary harm.[307] For some activities, the harm to the environment is technically or economically unavoidable in their normal operation[308]. In such circumstances, an activity that causes transboundary harm to an area within the jurisdiction or control of other states is unlawful, unless the affected state consents to it.

With the affected state's consent, the transboundary interference would still violate international law if the activities "transgressed" the limit of admissible behaviour agreed by the potentially affected states.[309] In the case of the *Gabčíkovo-Nagymaros Project*, the ICJ concluded that the operation of Variant C on the Danube constituted an internationally wrongful act, because Variant C is essential for Czechoslovakia's use and benefit, despite the fact that the Danube is a shared international watercourse. "Hungary had agreed to the damming of the Danube and the diversion of its waters into the bypass canal. But it was

[305] *Southern Bluefin Tuna Case (New Zealand v. Japan; Australia v. Japan)*, Request for provisional measures, International Tribunal for the Law of the Sea, Order of 27 August 1999, para. 77.
[306] Ibid, para. 79; ITLOS Advisory Opinion on Activities in the Area, supra note 296, para. 132.
[307] Lefeber, R. (1996), supra note 271, 30.
[308] Lefeber, R. (1996), supra note 271, 26.
[309] Ibid.

only in the context of a joint operation and sharing of its benefits that Hungary had given its consent."[310] The Court considered that "the fact that Hungary had agreed in the context of the original project to the diversion of the Danube […] cannot be understood as having authorized Czechoslovakia to proceed with a unilateral diversion of this magnitude without Hungary's consent".[311] Consequently, Czechoslovakia, in putting Variant C into operation violated the 1977 Treaty between Czechoslovakia and Hungary and this constituted an internationally wrongful act.

The rule of "consent" could be broken by invoking the "interest balancing" approach to assess the activities that cause significant transboundary harm. In cases where significant transboundary harm is unavoidable despite the exercise of due diligence by the state of origin, the states concerned should carry out bilateral or multilateral negotiations on the equitable conditions under which the activity can be undertaken after balancing all interests at stake. When transboundary harm arising from an activity is significant, but far less than the cost of preventing the harm or the socio-economic benefits that the activity could bring to the affected state, the activity is lawful and does not have to be subject to consent from the affected state.[312] In this case, the state of origin has the obligation to provide reparation and compensation to the affected state.[313]

However, the rule of "consent" and the "interest balancing" approach are applicable to activities that cause transboundary harm to an area within the jurisdiction or control of another state or a few states. For activities in areas covering a number of states, it is almost impossible to get consent from all affected countries. The balancing of interests becomes

[310] *Case concerning the Gabčikovo-Nagymaros Project (Hungary/Slovakia)*, Judgment of 25 September 1997, ICJ Reports 1997, p.7, para. 78.
[311] *Case concerning the Gabcikovo-Nagymaros Project*, para. 86.
[312] Lefeber, R. (1996), supra note 271, 27; Our Common Future, Annex 1, supra note 265, para.12; Draft articles on the law of the non-navigational uses of international watercourses and commentaries thereto and resolution on transboundary confined groundwater 1994, *Yearbook of the International Law Commission* 1994, vol. II, Part Two, commentary to Article 7; 1997 Convention on the Law of Non-navigational Uses of International Watercourses, Art. 7.2.
[313] E.g. Convention on the Law of Non-navigational Uses of International Watercourses. Art. 7.2.

complex as well, as interests vary from state to state. This would be case for some geoengineering activities.[314]

(ii) Significant Harm in the Global Commons

The term "global commons" is a "relative term, in juxtaposition with national territories or domains under state control".[315] Geographically, it refers to the high seas, the atmosphere, outer space, and arguably the polar regions. As stated in the previous Section, an activity that causes transboundary harm between states may still be lawful, if the affected state consents to it or the "interest balancing" approach can be met. However, these two exceptions do not exist in the case of significant harm to the global commons. Neither the rule of "consent" nor the approach of "interest balancing" between states is applicable to the activities undertaken in the global commons, because neither the high seas nor the common atmosphere[316] generally can act as a party[317] to negotiate with states. A practical question arises as to whether any state or institution has the right to take measures in response to an activity that may cause significant harm to the areas beyond national jurisdiction. The discussion starts with examining the term "collective interest".[318]

As Judge Weeramantry commented in the Case of the *Gabčíkovo-Nagymaros Project*, contemporary international environmental law subserves not only the interests of

[314] For further discussion, see Section 2.4.1.5(b)and Chapter 5.

[315] Xue, H. (2003). *Transboundary damage in international law* (Vol. 27). New York, the U.S.: Cambridge University Press, 192-193.

[316] The atmosphere is a global commons. In the absence of an international regime regulating use of the atmospheric commons, no nation will have an adequate incentive to limit its own use because it will have no assurance that others will do likewise. Stward, R. B. & Wiener, J. B. (1992). The comprehensive Approach to Global Climate Policy: Issues of Design and Practicality*. Arizona Journal of International & Comparative Law*,9, 83.

[317] This statement refers to general cases. However, there is an exception that International Seabed Authority (ISA) may act to represent the deep seabed on behalf of the international community as a whole.

[318] Brunnée, J. (2007). International Law and Collective Concerns: Reflections on the Responsibility to Protect. In Ndiaye, T. M. & Wolfrum, R. (Eds.). (2007). *Law of the Sea, Environmental Law and Settlement of Disputes: Liber Amicorum Judge Thomas A. Mensah* (pp. 35-52). Leiden: Martinus Nijhoff Publishers, 35.

individual states, but looks beyond to "the greater interests of humanity and planetary welfare".[319] Judge Weeramantry observed that

> [w]hen we enter the arena of obligations which operate *erga omnes* rather than *inter partes,* rules based on individual fairness and procedural compliance may be inadequate [....] International environmental law will need to proceed beyond weighing the rights and obligations of parties within a closed compartment of individual State self-interest, unrelated to the global concerns of humanity as a whole.

Prima facie, all states have access to common areas and have the freedom to use common resources. But the use of common areas and resources must be peaceful, and no state may carry out activities in the common areas or exploit common resources without due regard for the interests of other states. In addition, the freedom to use common resources must be subject to the general rule of not causing significant harm to the environment, which has been included in many multilateral environmental agreements (MEAs).[320]

To date, it is still a matter of controversy in international law whether every state has standing to invoke the responsibility of another state for breaches of obligations owed to the international community.[321] In the *Nuclear Tests* case between Australia and France, Australia claimed that the carrying out of further atmospheric nuclear weapon tests by France in the South Pacific Ocean infringes the freedom of the high seas. Several judges of the ICJ elaborated, in dissenting opinions, on "collective interests". Some judges opined that states have individual as well as common rights with respect to the freedoms of the high seas; such rights are "implicit in the very concept of such freedoms which involve rights of use possessed by every State".[322] In contrast, Judge de Castro noted that Australia has "no legal title authorizing it to act as spokesman for the international

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[319] *Case Concerning the Gabčikovo - Nagymaros Project*, Separate opinion of Vice-President Weeramantry, Part C(c).

[320] E. g, the UNFCCC, the UNCLOS, the Convention of the High Seas, the LC/LP, the Vienna Convention and its Montreal Protocol, and the Convention on Long-range Transboundary Air Pollution.

[321] Bodansky, D., Brunnée, J., & Hey, E. (Eds.). (2008). The Oxford handbook of international environmental law (1st ed.). Oxford: Oxford University Press, 556.

[322] *Nuclear Tests (Australia v. France)*, Joint dissenting opinion of Judges Onyeama, Dillard, Jiménez de Aréchaga and Waldock, para. 118.

community and the Court cannot determine in a general way what France's duties are with regard to the freedoms of the sea.[323]

According to the Draft Articles on Responsibility of States for Internationally Wrongful Acts, any state other than the injured state is entitled, to invoke the responsibility of the state of origin, to take lawful measures against the responsible state to ensure cessation of the breach and reparation of the interest of the injured state or of the beneficiaries of the obligation breached.[324] However, at present, there appears to be no clearly recognized entitlement of states other than the injured state to take countermeasures in favour of the collective interest.[325] The resolution of this matter is left to further development in international law.[326]

No legal rule so far entitles a state to representatively consent to an activity that causes significant environmental harm in the global commons, or to have the right to balance the risk between benefits and loss from such an activity. The International Seabed Authority (ISA) is the only example of an institution that may act to represent the global commons (in this case, the deep seabed). Should there be special conditions for geoengineering activities that cause significant harm in global commons to be exempted from a breach of international law? Take SAI as an example. Injecting sulphate aerosols to the stratosphere may be beneficial in terms of controlling the global temperature while also being hazardous to the atmosphere. There might be a time when air quality and the blue sky need to give way to climate stability, due to, for instance, the dangerous tipping point of temperature increase. Can such an emergent dangerous tipping point warrant significant harm to the atmosphere beyond national jurisdiction?[327]

2.4.1.4 Activities That Create a Risk of Causing Significant Transboundary Harm or Harm to the Global Commons

[323] *Nuclear Tests (Australia v. France)*, Dissenting opinions of Judge de Castro, 390.
[324] Draft Articles on Responsibilities of States for Internationally Wrongful Acts, with commentaries, *Yearbook of the International Law Commission*, 2001, vol. II, Part Two, Art. 48.2.
[325] Ibid., Art. 54, commentary (6). "Countermeasures" refer to the measures directed against "a State which has committed an internationally wrongful act, and which has not complied with its obligations of cessation and reparation". Supra note 324, Art. 49, Commentary (4).
[326] Ibid.
[327] See further discussions in Chapter 5.

The ILC defines "hazardous activities" as activities creating a risk of causing significant harm.[328] All of the six geoengineering techniques selected to be examined in this book contain risks of causing transboundary harm or the harm to the global commons, Thus, the implementation of those techniques fall under "hazardous activities". The concept of the risk of causing significant transboundary harm encompasses "a low probability of causing disastrous transboundary harm or a high probability of causing significant transboundary harm." "Risk" combines the probability of occurrence of an accident and the magnitude of its injurious impact.[329] The probability that an activity causes transboundary harm depends on various elements, for instance, the character of the source of energy, the location of the activity and its proximity to a border area.[330]

Pursuant to the definition of risk, the question arises as to whether a state may carry out or permit another to carry out an activity that creates a risk of causing significant transboundary harm. Lefeber had summarized the two opposing opinions: The dominate one is that the existence of a mere risk does not itself cause significant harm, thus the carrying out of the activities may be permitted by the source state. But the risk must be minimized, taking into account the probability of occurrence of the harm and the magnitude of the harm as well as the "cost of risk-reduction".[331] The other opinion, the minority one, is that activities that create a significant risk are not admissible, unless the consent from the potentially affected states is obtained.[332] According to the former opinion, the "consent" of potentially affected states, which is necessary if activities cause significant transboundary harm, is not necessary if activities create a mere risk of causing such harm. This opinion is reflected in the *Lac Lanoux Arbitration*. Spain and France had opposite opinions on the necessity of prior agreement. The Arbitral Tribunal examined the "essence" of the "necessity of prior agreement" and analysed the legality of France's work based on "reason" and "good faith". The Arbitral Tribunal stated that, "[i]n order to appreciate in its essence the necessity of prior agreement, one must envisage the

[328] Draft Principles on the Allocation of Loss in the Case of Transboundary Harm Arising out of Hazardous Activities, *Yearbook of the International Law Commission*, 2006, vol. II, Part Two, Principle 2.

[329] 2001 Draft Articles on Prevention, with commentaries, Art. 2, Commentary (2); Kiss, A. & Shelton, D. (2007), supra not 293, 117.

[330] 2001 Draft Articles on Prevention, with commentaries, Art. 7, Commentary (9).

[331] Lefeber, R. (1996), supra note 271, 30.

[332] Lefeber, R. (1996), supra note 271, 31.

hypothesis in which the interested States cannot reach agreement."[333] "France alone is the judge of works of public utility which are to be executed on her own territory," and "Spain should not demand that other works in conformity with her wishes should be carried out."[334] Since France has taken Spanish interests into sufficient consideration "either in the course of the dealings or in her proposals", France did not commit a breach when it acted without prior agreement.[335] Consequently, a prior agreement is not necessary when an activity undertaken in one state's jurisdiction or control contains merely a risk of causing significant harm.

In order to prevent the materialization of a significant risk that may cause significant transboundary harm, states are required to comply with procedural obligations to eliminate or minimize risks. In the *Pulp Mills* case, procedural obligations were breached by Uruguay, including but not limited to: The obligation of cooperation between parties to jointly manage the risks of damage to the environment; the obligation of Uruguay to inform CARU of the pulp mill project; and the obligation to notify the plan to other parties, particularly notifying the result of a full environmental impact assessment. In the *Lac Lanoux Arbitration*, the Tribunal held that the conflicting interests in the use of the river must be reconciled by mutual concessions.[336] Consultations, information exchange and negotiations must comply with the rule of reason and good faith, and must not be mere formalities.[337] The deployment of a project with a significant risk of creating significant transboundary harm must be subject to a thorough prior assessment of the potential impacts on the environment. The *MOX Plant* case dealt with a facility designed to recycle the plutonium that had been produced during the reprocessing of nuclear fuel. In order to avoid the international movement of radioactive materials and to protect the marine environment of the Irish Sea, the United Kingdom has the obligation to fully and properly assess the potential effects of the operation of the MOX Plant on the marine environment of the Irish Sea. Apart from monitoring the risks, Ireland and the United Kingdom should

[333] *Lac Lanoux (France/Spain)*, supra note 269, 18.
[334] Ibid, 26.
[335] Ibid, 27.
[336] Ibid, 24, para.13.
[337] Ibid, 12 below.

cooperate in exchanging information concerning the risks or effects of the MOX plant; and they should devise appropriate measures to prevent pollution and other harm.[338]

In practice, it is sometimes impossible to separate activities that cause significant transboundary harm from the activities that create risks of causing transboundary harm, because the likelihood of harm and the seriousness of the impacts on the environment are often very uncertain in advance. Generally, owing to the nature and scientific uncertainty of the six geoengineering techniques, it is very difficult if to tell one particular geoengineering activity will cause significant transboundary harm or merely create a risk of causing significant transboundary harm.

With regard to activities that create a risk of causing significant harm to the global commons, a similar problem as stated in Section 2.4.1.3(ii) arises, namely the lack of an institution to communicate with the implementing state. This problem brings challenges to the implementation of procedural obligations to minimize and control significant risks.

2.4.1.5 Procedural Obligations

(i) Planning Phase

(a) Obligation to Assess Transboundary Environmental Impacts

The obligation to assess transboundary environmental impacts is the first part of the procedural obligations to minimize and control risks of causing significant environmental harm. Environmental impact assessment (EIA) was initially used as a tool in environmental management in domestic law in order to identify environmental risks, integrate environmental considerations into social-economic development, and promote sustainable development.[339] Later, the obligation to conduct an EIA in the transboundary context was explicitly recognized as part of customary international law by the ICJ in the *Pulp Mills* case

[338] *The MOX Plant Case (Ireland/ United Kingdom)*, Request for provisional measures, International Tribunal for the Law of the Sea, Order of 3 December, 2001. Paras, 26, 72, 89.

[339] EIA was first adopted in the US National Environmental Policy Act in 1969, then grew steadily throughout the world. Craik N., *The International Law of Environmental Impact Assessment*, Process, Substance and Integration. Cambridge University Press, 2008, 23; Birnie, P., Boyle, A. & Redgwell, C. (2009), supra note 213, 165.

and the ITLOS in its *Advisory Opinion on Activities in the Area*.[340] In the *Pulp Mills* case, the ICJ recognized a requirement under general international law to undertake an environmental impact assessment of an industrial activity posing a risk of a significant adverse impact in a transboundary context, in particular on a shared resource. The ITLOS confirmed the customary rule mentioned by the ICJ with particular reference to the detrimental impacts of certain activities on the environment in an area beyond the limits of national jurisdiction, including the common heritage of mankind. More recently, in 2015, two cases in front of the ICJ between Costa Rica and Nicaragua touched upon the obligation to conduct an EIA in the transboundary context.[341] The Court found that, although the obligation to undertake an EIA in the *Pulp Mills* case "refers to industrial activities, the underlying principle applies generally to proposed activities which may have a significant adverse impact in a transboundary context".[342]

Moreover, this obligation has also been solidified in a considerable number of conventions and non-binding legal instruments.[343] The most notable and concrete one is the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) which was adopted under the auspices of the United Nation Economic

[340] *Case Concerning Pulp Mills on the River Uruguay*, supra note 274, para. 204; ITLOS Advisory Opinion on Activities in the Area, supra note 296, para.148.

[341] *Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua) and Construction of a Road in Costa Rica along the San Juan River (Nicaragua v. Costa Rica)*, Judgment, International Court of Justice, 16 December 2015, pp. 100-105 & 146-162.

[342] Ibid., para. 104.

[343] For instance, CBD Art 14; ASEAN Agreement, Art. 20 (3) (a); 1992 Helsinki Convention (Baltic Sea Area), Art. 7; Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, adopted 24 March 1983, entered into force 11 October 1986, *United Nations Treaty Series* (1997), vol. 1506, no. 25974, p. 157, Art.12; Convention for the Co-operation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region (Abidjan Convention), Abidjan, adopted in 1981, entered into force 5 August 1984, Art. 13. Retrieved from http://abidjanconvention.org/index.php; The Framework Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention), Kyiv, adopted May 2003, entered into force January 2006, Art. 5. Retrieved from http://www.carpathianconvention.org/; Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP Convention), Noumea, adopted 24 November 1986, entered into force 22 August 1990, Art. 16. Retrieved from https://www.sprep.org/legal/the-convention#text

Commission for Europe (UNECE). Pursuant to the Espoo Convention, EIA is a "procedure to evaluate the likely impact of a proposed activity on the environment."[344]

There are several sectoral legal instruments that are relevant to geoengineering insofar as certain types of environmental impacts that geoengineering techniques may cause are under their mandates. The CBD requires its Contracting Parties to undertake an EIA for any projects that are likely to have significant adverse effects on biological diversity in order to avoid or minimize such effects.[345] CBD COP Decision VI/7 provides guidelines for incorporating biodiversity-related issues into environmental-impact- assessment legislation or processes.[346] According to CBD COP Decision X/33, one of the requirements to end the moratorium on geoengineering is that the projects are "subject to a thorough prior assessment of the potential impacts on the environment".

Regarding ocean-based geoengineering techniques, Article 206 of the UNCLOS is applicable: "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". In addition, an EIA should also be undertaken if an ocean-based geoengineering activity impacts the environment in an area beyond the limit of national jurisdiction. The Seabed Disputes Chamber of the ITLOS extends the applicability of transboundary EIAs to an area beyond the limits of national jurisdiction and to resources that are the common heritage of mankind.[347] Parties to the LC and LP have adopted Resolution LC-LP.2 (2010) on the "Assessment Framework for Scientific Research Involving Ocean Fertilization" which guides Parties on how to assess

[344] Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention), Espoo, adopted 25 February 1991, entered into force 10 September 1997, *United Nations Treaty Series* (1997), vol. 1989, no. 34028, p.309, Article 1(vi). EIA is also defined as "an examination, analysis and assessment" in UNEP Goals and Principles of Environmental Impact Assessment. Retrieved from http://www.unep.org/regionalseas/publications/reports/RSRS/pdfs/rsrs122.pdf.
[345] CBD, Art.14.1 (a).
[346] CBD Decision VI/7, Identification, monitoring, indicators and assessments, UNEP/CBD/COP/6/20, Annex 1 (b).
[347] ITLOS Advisory Opinion on Activities in the Area, supra note 296, para.148.

proposals for ocean fertilization research and provides detailed steps for completing an environmental impact assessment, including risk management and monitoring.[348]

With respect to a SAI project that may create a risk of harm to the ozone layer, the Vienna Convention for the Protection of the Ozone Layer contains provisions on conducting an EIA.[349] Article 2.2(a) stipulates that "the parties shall assess the effects of human activities on the ozone layer and the effects on human health and the environment from modification of the ozone layer". However, detailed rules regarding EIAs are neither provided for in the Vienna Convention nor its Montreal Protocol.

Even though specific contents and procedures of an EIA vary from case to case, the fundamental components of an EIA would involve the following stages.[350] First, the state of origin should take necessary measures to ensure the establishment of an EIA for a proposed activity that meets the threshold of proceeding an EIA. How is one to judge the necessity of triggering an EIA? Principle 17 of the Rio Declaration clearly stipulates that an EIA, "as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment." Article 7 of the 2001 Draft Articles on Prevention uses the term "assessment of risk", which is broader than "environmental impact assessment" as a prerequisite for the authorization of an activity that may have the risk of causing transboundary harm. One consideration must be the examination of the "significance" of the risk in an activity. The "extent, nature or location" of a proposed activity should be considered in the examination of "significance".[351] For instance, the type of the source of energy used, the location of the activity and its proximity to the border.[352]

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[348] Resolution LC-LP.2 (2010) on the Assessment Framework for Scientific Research Involving Ocean Fertilization, adopted on 14 October 2010, not yet into force. Retrieved from http://www.imo.org/en/OurWork/Environment/LCLP/EmergingIssues/geoengineering/Documents/OFassessmentResolution.pdf.

[349] Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol, Vienna, adopted March 1985, entered into force 22 September 1988, *United Nations Treaty Series* (1997), vol. 1513, no. 26164, p. 293.

[350] Referring to, among others, Espoo Convention; Antarctic Environment Protocol; Resolution LC-LP.2 (2010); and new Annex 5 of the LP under Resolution LP.4(8) on the Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and Other Marine Geoengineering Activities.

[351] UNEP Goals and Principles of Environmental Impact Assessment, January 16 1987, Principle 1.

[352] 2001 Draft Articles on Prevention, with commentaries, Art. 7, Commentary (9).

As risk combines the magnitude of harm and the probability of occurrence, activities that have a low probability of serious harm may meet the threshold for conducting an EIA as well.

Notably, the threshold of triggering an EIA is lowered if an activity is proposed to take place in the Antarctic Treaty area. The Protocol on Environmental Protection to the Antarctic Treaty provides procedures for prior assessment of the impacts of those activities on the Antarctic environment or on dependent or associated ecosystems.[353] A proposed activity may proceed only if it is determined as having less than a minor or transitory impact. An initial environmental evaluation should be prepared when the activity has a minor or transitory impact; a comprehensive environmental evaluation should be prepared when the activity is likely to have more than a minor or transitory impact. The lower threshold under the Antarctic Environmental Protocol is reasonable, considering the intrinsic value of Antarctica and the fragile Antarctic environment.

Second, the proponent of the proposed project together with relevant experts and authorities determine the key issues for assessment and prepare all relevant information. Principle 4 of the UNEP Goals and Principles of Environmental Impact Assessment provides for the minimum documentation needed, encompassing descriptions and indications of the proposed activity or alternatives, the potentially affected environment, the available mitigating measures as well as an assessment of the likely or potential impacts. A similar but more comprehensive list of EIA documentation is formulated in Appendix II of the Espoo Convention.[354]

Third, competent bodies that have the relevant expertise assess and evaluate the impacts of the proposed project and its alternatives, and report their results. The competent authority should ensure public access to the resulting documents and provides opportunities of public participation. Throughout the assessment process, the state of

[353] Protocol on Environmental Protection to the Antarctic Treaty, Madrid, adopted 4 October 1991, entered into force 14 January 1998. (UNTC volume number has yet been determined), Art. 8 & Annex I. Retrieved from https://treaties.un.org/doc/Publication/UNTS/No%20Volume/5778/A-5778-080000028006ab63.pdf

[354] Espoo Convention, Appendix II (h).

origin should notify, consult and exchange information with potentially affected states.[355] Very often, the environmental assessment results should be subject to peer review, and the result of peer review should be publicly available.

Fourth, the competent decision-making body makes a decision upon the outcome of the EIA as well as the comments collected from the public and the outcome of consultation. In addition to the final decision of authorizing or refuse the proposed project, decision-making also takes place throughout the process of an EIA from the early stage of determining whether a project should be subject to an EIA to making choice between the proposed project and the alternatives.[356]

Fifth, the competent authority should monitor whether the predicted impacts and mitigating measures occur as indicated in the environmental assessment report.[357]

The abovementioned obligation to conduct an EIA refers to a project-based EIA that is aimed to minimize and control the risk of causing significant environmental harm at an early stage of project-planning and design. In addition to the traditional project-level EIA process, another type of impact assessment, systematic environmental assessment (SEA), has rapidly developed in the last two decades.

SEA refers to the formalized, systematic and comprehensive evaluation of the likely significant environmental effects of proposed plans, programmes and other strategic initiatives in order to identify and evaluate the environmental consequences at the earliest possible stage of decision-making.[358] The 2001 EU SEA Directive and the Protocol on Strategic Environmental Assessment to the Espoo Convention are two examples of

[355] See Section 2.4.1.5(i)(b) concerning the obligations to notify, exchange information and consult with potentially affected states.
[356] CBD Decision VIII/28 on Impact Assessment. Annex: Voluntary Guidelines on Biodiversity-inclusive Impact Assessment, UN Doc. UNEP/CBD/COP/DEC/VIII/28 (15 June 2006), para. 5.
[357] Ibid. See Section 2.4.1.5 (ii)(a) concerning the obligation to monitor activities.
[358] Abaza, H., Bisset, R., & Sadler, B. (2004). *Environmental impact assessment and strategic environmental assessment: towards an integrated approach*. UNEP/Earthprint, 86. Retrieved from http://www.unep.ch/etu/publications/textONUbr.pdf

practices in SEA.[359] According to the SEA Protocol to the Espoo Convention, SEA comprises a three-stage framework: screening, scoping and in-depth EIA assessments. The process starts with "screening", which determines whether plans and programmes are likely to have significant environmental effects either through a case-by-case examination or by specifying types of plans and programmes or by combining both approaches.[360] Unless a project is determined not requiring an SEA by "screening", "scoping" will follow to define the focus of the assessment and to identify key issues of the assessment.[361]

Compared to EIA, SEA is carried out on a policy, plan and programme level, and thus, by its nature, covers a wider range of activities, a broader area and over a longer time span. SEA extends the aims and principles of EIA to the higher levels of decision-making when major alternatives are still open, various uncertainties still remain and there is much greater scope than at the project level to integrate environmental considerations into development goals.[362] In addition, SEA can be undertaken to assess the cumulative impacts of multiple implementation of a specific technology in a systematic and anticipatory way.[363] Such attributes of SEA would bring added value to the assessment framework for geoengineering activities at the level of policies and plans. The possible application of SEA to geoengineering will be addressed in Chapter 5.

(b) Obligation to Notify the Risks, Exchange Information, Consult and Negotiate with Potentially Affected States

Notifying the Risks

[359] Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment, *Official Journal of the European Communities*, L 197/30 (21 July 2001); Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context.

[360] Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context, Art. 5.

[361] Ibid, Art. 6.

[362] Abaza, H., Bisset, R., & Sadler, B. (2004), supra note 358, 86.

[363] Ibid.

If a plan is likely to cause significant transboundary harm, the party of origin shall notify the affected party about the plan.[364] Article 8 of the 2001 Draft Articles on Prevention states that:

> If the assessment referred to in article 7 indicates a risk of causing significant transboundary harm, the State of origin shall provide the State likely to be affected with timely notification of the risk and the assessment and shall transmit to it the available technical and all other relevant information on which the assessment is based.

Principle 19 of the Rio Declaration provides the time requirement for the notification. Pursuant to this Principle, the notification with all relevant information shall be provided timely. The 1992 Convention on the Protection of the Marine Environment of the Baltic Sea Area expresses the time requirement as notification "without delay".[365] In the *Pulp Mills* case, the ICJ observes that "if the CARU decides that the plan might cause significant damage to the other party or if a decision cannot be reached in that regard, 'the party concerned shall notify the other party of this plan'", and the notification must take place "[*before*] the State concerned decides on the environmental viability of the plan".[366] Uruguay breached its obligation to notify Argentina about its plans, because it did not transmit the environmental assessments to Argentina prior to having issued the initial environmental authorizations.

The time requirement seems to be more significant in situations of emergency in the operational phase.[367] An example of an emergency situation in geoengineering is CO_2 leakage during the process of CO_2 injection or transport. States have the obligation to notify relevant states the emergency and to take action in cases of accidental transboundary environmental impact. This obligation is addressed in several legal instruments. For instance, Principle 18 of the Rio Declaration provides that "any natural disasters or other emergencies that are likely to produce sudden harmful effects on the environment" lead to an obligation to immediately notify the likely affected states. This

[364] Espoo Convention, Art. 3.
[365] 1992 Helsinki Convention (the Baltic Sea Area), Article 13.
[366] *Case Concerning Pulp Mills on the River Uruguay*, supra note 274, paras. 112 & 120. Italic added.
[367] See Section 2.4.1.5 (ii).

notification shall be "without delay and by the most expeditious means".[368] In *the Corfu Channel* case, Albania had the obligation to provide notice to other states and specifically, an obligation to warn approaching British warships of the danger of explosion after a minefield had been laid in Albanian territory. Although a "general notification" might be impossible because of the short time between the minelaying and the explosion, Albania had no excuse for omitting to notify the British warship to prevent the disaster.[369]

Exchanging Information

Exchanging information is an important means of furnishing initial information to as well as updating potentially affected states with new knowledge, as well as receiving receive feedback from these states in order to control or minimize significant transboundary harm at an early stage. Available information and data with regard to,[370] *inter alia*, the plan of the proposed activity, the condition of the natural surroundings or resources, the possible impacts on the environment and all measures taken for fear of significant transboundary harm or the risks thereof, should be exchanged widely and in a timely manner. The information related to biological diversity, for instance, contains results from technical, scientific and socio-economic research, as well as specialized, indigenous and traditional knowledge.[371] The requirement to exchange data and information can also be found in the regulation of using transboundary watercourses.[372] The condition of the watercourse, including a hydrological, meteorological, hydrogeological and ecological nature, and the

[368] 2001 Draft Articles on Prevention, Art. 17. See also: Convention on the Law of the Non-navigational Uses of International Watercourses, 1997, Art. 28; CBD Art. 14 (d); UNCLOS, Art.198.
[369] *The Corfu Channel case*, p.22-23.
[370] The scope of the information is interpreted in different ways. Article 13 of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes addresses it as "reasonably available data"; Article 17 of the CBD states "all publicly available sources"; Article 13 of the Convention on the Law of the Non-navigational Uses of International Watercourses provides "readily available data and information"; Article 12 of the 2001 Draft Articles on Prevention expresses the scope as "all available information concerning that activity"; Article 199 of the UNCLOS stipulates "information and data acquired about pollution of the marine environment".
[371] CBD, Art.17 (2).
[372] International Law Association, The Helsinki Rules on the Uses of the Waters of International Rivers, Helsinki, adopted in August 1966, International Law Association, Report of the fifty-second Conference, 477. Art. XXIX. "[E]ach basin State furnish relevant and reasonable available information..."; International Law Association Berlin Conference, Water Resources Law, Fourth Report, 2004, Art. 56.

water quality is the basic information to be exchanged.[373] In addition, riparian states must also exchange the results of research, experience from the application and operation, emission and monitoring data, and measures to prevent, control and reduce transboundary impacts.[374] One more example of the obligation to exchange information can be found in the 1979 Convention on Long-range Transboundary Air Pollution (CLRTAP). Pursuant to the CLRTAP, Parties shall exchange available information on, among other things, data on emissions, control technologies for reducing air pollution, and physic-chemical and biological data relating to the effects of land-range transboundary air pollution.[375]

The "best available technology" standard mentioned in Section 2.4.1.2 is applicable to the obligation to exchange information. The quality of the information provided should not be less than the best available technology standard, particularly through commercial exchange of available technology, technical assistance as well as industrial contacts and cooperation.[376]

Actually, the obligation to provide information should be fulfilled not only in the planning phase, but also during the whole process of a project, including the post-operational phase. Article 12 of the 2001 Draft Articles on Prevention provides that the exchange of information "shall continue until such time as the States concerned consider it appropriate even after the activity is terminated." It is important to continue to exchange information even after the termination of geoengineering projects, because some adverse impacts might not occur until decades later. A typical example is the leakage of CO_2 after the closure of the storage site.

[373] Convention on the Law of the Non-navigational Uses of International Watercourses, Art. 9.
[374] Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Helsinki, adopted 17 March 1992, entered into force 6 October 1996, *United Nations Treaty Series* (2001), vol. 1936, no. 33207, p. 209, Arts. 6 &13.
[375] The CLRTAP, Art. 8.
[376] Ibid., Art.13 (4). Similar obligation can be found in the Antarctic Treaty, Art. III (1): In order to promote international cooperation in scientific investigation in Antarctica…to the greatest extent feasible and practicable.

Consultation & Negotiation

Once the environmental impact assessment as well as notification and information exchange has taken place, the source state shall enter into consultations with potentially affected states regarding the potential transboundary impacts arising from the proposed activity as well as regarding measures to prevent the transboundary harm or minimize the risks of causing significant transboundary harm.[377] There is a time requirement for the consultation that the consultation must be conducted without "undue delay" after the assessment and must be prior to the authorization of the proposed activity.[378] Such consultation may be conducted in a "joint body", which is established by neighbouring states for cooperatively preventing significant transboundary harm or the creation of risks.[379] Under the obligation to negotiate, parties enter into negotiations with a view to arriving at an agreement, or at least to contemplate some modification from their previous position. The negotiation is not merely a "formal process […] as a sort of prior condition for the automatic application of a certain method of delimitation in the absence of agreement"; the negotiation should be conducted meaningfully and in good faith.[380]

The obligation of prior consultation and negotiation is discussed in the *Lac Lanoux* Arbitration with respect to a shared watercourse. The Tribunal held that "consultation and negotiations between the two States must be genuine, must comply with the rules of good faith and must not be mere formalities."[381] The rule of good faith negotiation is indispensable to the obligation of consultation and negotiation. In order to prevent significant transboundary harm or the risk thereof, the party of origin must consult with the potentially affected states faithfully and explore mutually acceptable solutions. During the process of consultation and negotiation, the extent of agreement achieved by the states

[377] Espoo Convention, Art. 5; 2001 Draft Articles on Prevention, Art. 9; Montreal Guidelines for the Protection of the Marine Environment Against Pollution from Land-Based Sources, Decision 13/18/II of the Governing Council of UNEP, 24 May 1985, 15.
[378] Espoo Convention, Art. 5; 2001 Draft Articles on Prevention, with commentaries, Art. 9, commentary (1).
[379] 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Art. 9; Espoo Convention, Art. 5.
[380] *North Sea Continental Shelf (Federal Republic of Germany v. Denmark; Federal Republic of Germany v. Netherlands)*, Judgment of 20 February 1969, ICJ Reports 1969, p. 3, para.85.
[381] *Lac Lanoux* (France/Spain), 12.

depends on an equitable balance of interests.[382] States concerned shall take into account all relevant factors and circumstances, including the degree of risk of significant transboundary harm and the means of preventing such harm or minimizing the risk, the importance of the activity, the risk of significant harm to the environment, the means of preventing that harm or minimizing the risk, magnitude of the likely lost benefits, and the willingness of the source state and states likely to be affected to contribute to the cost of preventive measures.[383] The factors that are taken into account for the balance of interests in the planning phase are not identical with the factors for the balance of interests in the operational phase. In the planning phase, states consider the risks of significant harm. In contrast, the materialization of significant harm, if it occurs, should be taken into consideration in the operational phase.

However, negotiations do not imply that an agreement must be achieved, and consultations do not mean that neighbouring states are given a veto over the potentially harmful activity.[384] As discussed in Section 2.4.1.4, it is not necessary to obtain the "consent" of the potentially affected state if the activity creates a risk of causing such harm. The state of origin can implement its activity even if the potentially affected state is against the activity. Of course, the state of origin should take into full account of the interests of the neighbouring states. Pursuant to the decision in the *Lac Lanoux* Arbitration, France must consult with Spain over the project and its potential effects on Spain. France should give reasonable weight to Spanish interests, but considering Spanish interests does not mean that France cannot act without consent from Spain on the work on Lake Lanoux.

(ii) Operational Phase

(a) Obligation to Authorize Activities and Monitor Their Environmental Impacts

Referring to the definition of authorization in the 2001 Draft Articles on Prevention, the term 'authorization' in this context means the granting of permission by governmental

[382] 2001 Draft Articles on Prevention, Art.9(2); *Lac Lanoux (France/Spain)*, 22.
[383] 2001 Draft Articles on Prevention, with commentaries, Art.10 and the commentary.
[384] Birnie, P., Boyle, A. & Redgwell, C. (2009), supra note 213, 178.

authorities to conduct geoengineering activities.[385] The authorization should take into account the result of the risk assessment, particularly the environmental impact assessment.[386]

The state government or the competent authority should not authorize any activity that may significantly harm another state. The state of origin shall adjust or terminate the activity if the transboundary environmental impact appears to be significant. In the *MOX Plant* case, Ireland took the view that United Kingdom breached it obligations in relation to the authorization of the MOX Plant, because the United Kingdom failed to take the necessary measures to prevent, reduce and control pollution of the marine environment of the Irish Sea.[387] The Tribunal opined that the United Kingdom was required to monitor the risks of the operation of the MOX Plant for the Irish Sea.[388] An example of an authorization related to CDR activities is the EU Directive on the geological storage of carbon dioxide. Chapter 2 and Chapter 3 of the Directive address exploration permits and storage permits, respectively. The provisions encompass the application procedure, conditions for storage permits, contents of storage permits as well as changes, review, update and withdrawal of the permits.[389] Note that prior authorization is required not only at the commencement of a CO_2 storage operation, but also for any proposed changes. The competent authority must be informed of any changes planned in the operation. The operation as adjusted cannot be implemented until a new or updated permit is issued.

Environmental standards and monitoring are set as a general principle for environmental protection and sustainable development. "States shall establish adequate environmental protection standards and monitor changes in and publish relevant data on environmental quality and resource use".[390] States shall notify the potentially affected states about the

[385] 2001 Draft Articles on Prevention, with commentaries, Art. 6, Commentary (1).
[386] 2001 Draft Articles on Prevention, Art. 7.
[387] *The MOX Plant Case*, para. 26.
[388] Ibid., para. 89.
[389] Directive 2009/31/EC of the European Parliament and of the Council, on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No. 1013/2006, *Official Journal of the European Union,* I.140/114 (5 June 2009), Chapters 2 & 3.
[390] Our Common Future, Annex 1, supra note 265, para. 4.

dangerous changes and shall adjust or even terminate the ongoing operation if the transboundary environmental impact appears to be significant.

(b) Obligation to Balance Interests

In a broad sense, the balancing of interests is an element of "sustainable development", i.e. to integrate environmental considerations into the development process and to equitably treat economical or other social needs and environmental needs.[391] In the *Gabčíkovo-Nagymaros Project* case, the Court referred to the concept of "sustainable development". The Court was mindful that the growing risks from the interference with nature prompt mankind to develop new norms and standards that "reconcile economic development with protection of the environment".[392]

To be more specific, regarding the prevention of significant transboundary harm, the obligation to balance interests concentrates more on the various interests between states, such as balancing the interests between economic benefits from industrial operations in one state and environmental interests in the other. In the *Trail Smelter Arbitration*, in order to "reach a solution just to all parties concerned", the Tribunal endeavoured to adjust the conflicting interests by some "just solution" that would allow the continuance of the operation of the Trail Smelter but under such restrictions and limitations as would prevent damage in the United States, and as would enable indemnify the United States if damage occurs in the future.[393]A similar approach can be found in the *Lac Lanoux* arbitration, in which th Tribunal indicated that a just balance between French interests of the work on Lake Lanoux and Spanish interests in agriculture and environment should be maintained.[394]

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[391] Sands, P., Peel, J., & MacKenzie, R. (2012). *Principles of International Environmental Law* (3rd ed.). Cambridge University Press, 215; Rio Declaration, Principles 3 & 4.

[392] *Case Concerning the Gabcikovo-Nagymaros Project*, para. 140; see also Award in the Arbitration regarding the Iron Rhine ("Ijzeren Rijn") Railway (the Kingdom of Belgium v. the Kingdom of the Netherlands), Decision of 24 May 2005, Reports of International Arbitral Awards, volume XXVII, pp. 35-125, para. 59.

[393] *Trail Smelter Arbitration*, pp.1939.

[394] See also the *MOX Plant Case*.

States should enter into consultations and seek solutions on the basis of an equitable balance of interests.[395] Various factors should be taken into consideration so as to achieve an equitable balance of interests: the severity of the harm (if it were to occurred), the degree of the risk of significant harm, the significant harm or the risk of significant harm to the environment, the magnitude of the lost benefit or the likely lost benefit, the importance of the activity, and the cost of the preventive measures.[396]

(iii) Post-operational Phase

Sometimes, the implementation of procedural obligations may continue after the termination of operation. The "post-operational" phase, as called in most legal instruments, is formulated as the "post project" phase. However, the present author prefers the term "post-operational" because this stage is an integral part of the project instead of a stage thereafter. The Espoo Convention provides that a post-project EIA shall be carried out if any concerned party requests it and the post-project analysis is determined to be necessary.[397] Any post-project analysis undertaken shall include particularly surveillance of the activity and a determination of any adverse transboundary impact.[398] Appendix V of the Espoo Convention provides three objectives of post-project analysis, viz. monitoring compliance with the authorization or approval of the activity and the effectiveness of mitigation measures, review of an impact for proper management, and verification of past predictions.

In addition, the obligation to monitor the occurrence of adverse environmental impacts may also continue after the termination of an activity. Besides, states concerned should cooperate with respect to monitoring and information exchange in the post-operational phase and may continuously exchange information if necessary.

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[395] 2001 Draft Articles on Prevention, Art. 9 (2).

[396] See also Lefeber , R. (1996), supra note 271, 35: "Relevant factors include the nature of the activity (degree of hazardousness), the nature of potentially affected interests (sensitivity of interests), the nature and the expected value of the potential harm (technical capability and costs of cleaning up), and the cost of prevention and abatement."

[397] Espoo Convention, Art.7.

[398] Ibid.

2.4.2 Addressing Uncertain Risks – The Precautionary Approach

Precaution is a strategy for addressing future risks.[399] Essentially, precaution entails thinking ahead and taking pre-emptive actions to avoid the materialization of uncertain future risks. Since the 1970s, the idea of precaution has been incorporated into regulations and policies at the national level in relation to human activities that may threaten human health (food safety, medication, nuclear power, terrorism, weapons, etc.), natural resources (fisheries), and the environment.[400] In international environmental law, the precautionary principle has been adopted in a growing number of treaties dealing with climate change, marine pollution, air pollution, biodiversity degradation, biosafety, etc.[401] As has been argued, the precautionary principle may be the most innovative, persuasive, and significant new concept in international environmental law in the latest two decades; meanwhile, it is also "the most reckless, arbitrary and ill-advised" one due to its unclear legal status.[402] Some assert that the wide endorsement of the precautionary principle is an indication that it is emerging as a principle of customary international law.[403] Others argue that the precautionary principle is not ripe to be a tenet of customary international law, because state practice in different instances is diverse and inconsistent, and the

[399] Wiener, J. B. (2008). Precaution. In Bodansky, D., Brunnée, J., & Hey, E. (Eds.), *The Oxford handbook of international law*, 597-612. Oxford: Oxford University Press.

[400] It is widely agreed that the precautionary principle originated from the German concept of *Vorsorgeprinzip*. Cameron, J. & Abouchar, J. (1991). The Precautionary Principle: A Fundamental Principle of Law and Policy for the Protection of the Global Environment. *Boston College International and Comparative Law Review*, *14*(1), 1; Wiener, J. B. (2008), supra note 399, 599-600; Hammitt, J. K., Wiener, J. B., Swedlow, B., Kall, D., & Zhou, Z. (2005). Precautionary regulation in Europe and the United States: A quantitative comparison. *Risk Analysis, 25*(5), 1215-1228. doi:10.1111/j.1539-6924.2005.00662.x.

[401] E.g. UNFCCC, Art. 3; 1992 Helsinki Convention (Baltic Sea area), Art. 3(2); London Protocol, Art. 3(1);1994 Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Further Reduction of Sulphur Emissions, Preamble; 1998 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Heavy Metals, Preamble; CBD, Art. 3; 2000 Cartagena Protocol on Biosafety, Arts. 1, 10(6) & 11(8).

[402] Marchant, G. E., & Mossman, K. L. (2005). *Arbitrary and capricious: The Precautionary Principle in the European Union Courts* (1st ed.). Washington D.C.: The AEI Press, 1.

[403] ITLOS Advisory Opinion on Activities in the Area, supra note 296, para. 135; Cameron, J., & Abouchar, J. (1991), supra note 400; Trouwborst, A. (2002). *Evolution and status of the precautionary principle in international law*. The Hague: Kluwer Law International, 34.

precautionary principle has not yet been incorporated into legal instruments with uniform formulation and unequivocal connotation.[404] Main disagreements include:

- What is the distinction between the "precautionary principle" and the "precautionary approach", and is one more appropriate than the other?
- Does the precautionary principle belong to the traditional risk management process which is a procedural obligation of the prevention principle or, alternatively, is it an independent principle in international environmental law?
- What degree of risk is necessary to invoke the precautionary principle? It may vary from "possible risk" to "serious" or "irreversible" risk.[405]
- What is the exact meaning of "full scientific certainty"? When is the appropriate time to start and terminate a precautionary action?[406]
- What kind of action should be taken in the face of uncertainty? Some documents impose no affirmative duty on states, but merely indicate that the precautionary principle is not an excuse to postpone precautionary measures.[407] Other documents formulate the precautionary principle as an affirmative duty that states should take actions to tackle environmental risk.[408] A few instruments formulate the precautionary approach as shifting the burden of proof, viz. prohibiting risky activities until the proponents of the activity prove that the activity poses no significant risk.[409]

All the disagreements above reflect the present ambiguity of the precautionary principle, and the ambuguity may hinder the operationalization of the precautionary principle. Regardless of the ongoing debate surrounding its formal legal status, the precautionary principle has been widely incorporated into national, regional and international regulations

[404] Wiener, J. B. & Rogers, M. D. (2002). Comparing precaution in the United States and Europe. *Journal of Risk Research, 5*(4), 317-349, at 343.
[405] Marchant, G. E., & Mossman, K. L. (2005), supra note 402, 10.
[406] Commission of the European Communities, Communication from the Commission on the Precautionary Principle, Brussels, 2000, COM (2000)1, 17.
[407] E.g. CBD Preamble; 1990 Bergen Declaration, para. 6; Rio Declaration, Principle 15.
[408] E.g. Ministerial Declaration of the Third International Conference on the Protection of the North Sea, The Hague, 8 March 1990, Preamble.
[409] E.g., London Protocl, Art. 3.

and policies, and has increasingly precise legal implications in international law.[410] As suggested by Daniel Bodansky, it would be better to spend less time debating a norm's legal status and more time attempting to translate general norms into concrete and enforceable treaties and actions.[411] In view of this, this Section will not examine the legal status of the precautionary principle in detail, but rather, seeks to figure out why the precautionary principle has not yet been effectively operationalized to govern geoengineering.

Despite the lack of a clear, consistent and commonly agreed-upon definition, three common elements can be extracted from diverse formulations of the precautionary approach in a wide range of legal documents as well as academic publications: risk of harm, scientific uncertainty, and precautionary action.[412] As noted above, the debate on the precautionary approach surrounds the degree of risk, the meaning of uncertainty and the types of actions. The degree of risk varies from "possible", "significant" to "serious or irreversible". The meaning of scientific uncertainty is still very imprecise and is associated with a question of time, namely the time to wait or act. With respect to the element "action", it varies largely in terms of strength, range of application and form. Some commentators have identified more elements than the three above. For instance, Sandin has found substantial variations along four different dimensions, which are formulated as

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[410] ILA Resolution No. 7/2012, Annex: 2012 Sofia Guiding Statements on the Judicial Elaboration of the 2002 New Delhi Declaration of Principles of International Law Relating to Sustainable Development, para.7.

[411] Bodansky, D. (1995); In paragraph 9 of the *Separate Opinion of Judge Treves* to the Order of the International Tribunal for the Law of the Sea in the *Southern Bluefin Tuna Case*, Judge Treves also opines that "in order to resort to the precautionary approach for assessing the urgency of the measures to be prescribed in the present case, it is not necessary to hold the view that this approach is dictated by a rule of customary international law".

[412] For a list of various formulations of the precautionary approach, see Sandin, P. (1999). Dimensions of the precautionary principle. *Human and Ecological Risk Assessment: An International Journal, 5*(5), 889-907, at 902-905. Examples of legal instruments: Principle 15 of the Rio Declaration; ILA New Delhi Declaration of Principles of International Law Relating to Sustainable Development (ILA New Delhi Declaration below), 2 April 2002. Examples of academic publications: Matthee, M., & Vermersch, D. (2000). Are the precautionary principle and the international trade of genetically modified organisms reconcilable? *Journal of Agricultural and Environmental Ethics, 12*(1), 59-70, at 61; Freestone, D., & Hey, E. (Eds.). (1996). *The precautionary principle and international law: The challenge of implementation*. The Hague: Kluwer Law International, 45; Trouwborst, A. (2006). *Precautionary rights and duties of states*. Leiden: Martinus Nijhoff Publishers, 4.

threat, uncertainty, action and command.[413] Cameron and Abouchar have summarized the key elements as the evidentiary threshold of serious or irreversible of damage, the burden of proof, the positive obligation to establish principles and procedures to avoid environmental degradation, and a policy for action in the face of uncertainty.[414]

This Section starts with clarifying the difference between the "precautionary approach" and the "precautionary principle", and the reason for using the "precautionary approach" in this book. Then this Section briefly analyses the three elements of the precautionary approach: risk of harm, scientific uncertainty and precautionary actions. Among them, the first two elements are seen as the trigger of the precautionary approach whereas the third acts as the response. At last, the moratorium incorporated by international institutions, as an application of the precautionary approach to geoengineering, is analysed.

2.4.2.1 Use of Terms

There is no uniform formulation of the precautionary approach, which is also referred to as the term "precautionary principle" or "precautionary measures". An early example of expressing the "precautionary principle" is Paragraph 7 of the 1990 Bergen Ministerial Declaration on Sustainable Development (Bergen Declaration):

> In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the cause of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

Principle 15 of the 1992 Rio Declaration is considered the global endorsement of the precautionary principle. Although it uses the wording "precautionary approach", Principle 15 presents a similar stipulation as Article 7 of the Bergen Declaration, only limiting the measures to "cost-effective" ones. The 1995 Agreement on Straddling and Highly Migratory Fish Stocks addresses the precautionary *approach* as one of the general

[413] Sandin, P. (1999), supra note 412.
[414] Cameron, J., & Abouchar, J. (1991), supra note 400, 22.

principles for the conservation and management of straddling fish stocks and highly migratory fish stocks.[415] Similarly, the Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Persistent Organic Pollutants refers in its Preamble to the precautionary approach and in Annex V to "the principle of precaution".[416] All the examples above indicate that the term "precautionary principle" and "precautionary approach" may be interchangeable. Some scholars therefore regard the two terms as equivalents,[417] or view that the distinction in terminology is insignificant.[418]

On the contrary, others perceive these two terms differently in terms of the legal status and triggers for applying the "approach" or "principle". Typical examples can be found in the fisheries arena. In the separate opinion to the Order in the *Southern Bluefin Tuna Case*, Judge Laing opined that the Tribunal "adopting an *approach*, rather than a principle, appropriately imports a certain degree of flexibility and tends, though not dispositively, to underscore reticence about making premature pronouncements about desirable normative structures".[419] In contrast, the term "principle" offers less flexibility and refers to widely-recognized legal practices. Another distinction is that the precautionary approach applies to activities that may lead to adverse impacts that are mostly reversible, and the level of uncertainty and potential costs of such activities are significant, whereas the term "principle" is more restrictive, applying merely in situations of high uncertainty with a risk of irreversible harm entailing high costs.[420]

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[415] United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish stocks and Highly Migratory Fish Stocks, entered into force 11 December 2011, UN Doc. A/CONF.164/37 (8 September 1995), Art. 5(c) (hereafter "1995 Agreement on Straddling and Highly Migratory Fish Stocks"). Italic added.

[416] Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Persistent Organic Pollutants, Aarhus, adopted 26 April 1998, entered into force 23 October 2003, *United Nations Treaty Series* (2004), vol. 2230, no. 21623, p. 79. Annex V**,** Best Available Techniques to Control Emissions of Persistent Organic Pollutants from Major Stationaer Sources, para. 2.

[417] See e.g. Trouwborst, A. (2002), supra note 403, 5.

[418] Birnie, P., Boyle, A. & Redgwell, C. (2009), supra note 213, 155.

[419] Separate Opinion of Judge Laing to the Order of the International Tribunal for the Law of the Sea in the *Southern Bluefin Tuna Case (New Zealand v. Japan; Australia v. Japan)*, Requests for provisional measures, 27 August, 1999, para.19.

[420] Birnie, P., Boyle, A. & Redgwell, C. (2009), supra note 213, 155.

This book does not use the two terms as equivalents, and prefers the more neutral term "approach". First, as long as the divergence in the interpretation of the "precautionary approach" and the "precautionary principle" still exists, the distinction in terminology should not be ignored. Second, regardless of the legal status of the precautionary principle or approach, it indeed plays a significant role in contemporary international environmental law and has great potential on making a contribution to the governance of geoengineering. The strict interpretation of the precautionary principle may impede its application. In view of this, it is more meaningful to set aside the ambiguity of the legal status, and to concentrate on operationalizing the precautionary approach in the context of geoengineering. More importantly, taking into account the huge differences between geoengineering techniques, the triggers of applying the precautionary approach to each technique may be different as well. The term "precautionary approach" therefore can be more flexibly applicable to each technique by setting up diverse thresholds.[421]

2.4.2.2 The Trigger of the Precautionary Approach

In the Communication of the European Commission on the Precautionary Principle, two constituent aspects are identified: the factors triggering recourse to the precautionary approach and the measures resulting from the application of the precautionary approach.[422] In this Communication, scientific uncertainty, identification of potentially negative effects and scientific evaluation are "three factors triggering recourse to the precautionary principle". Considering the three core elements of the precautionary approach noted above, this Section will examine the risk of harm and the uncertainty that trigger the recourse to the precautionary approach, and Section 2.4.2.3 will examine various types of action in terms of strength and form.

[421] See Section 5.4.
[422] Communication from the Commission on the Precautionary Principle (2000), supra note 406, 13-14.

(i) The Risk of Harm

What degree of risk is necessary to invoke the precautionary approach? The common way of describing the risk is through the magnitude of adverse impacts: non-negligible,[423] significant,[424] serious or irreversible.[425] Some descriptions are from the perspective of probability: potentially damaging[426] or possibly damaging[427]. Cameron and Wade-Gery have noted that not all environment impacts should be mitigated by the imposition of environmental regulation; the recourse to the precautionary approach requires a threshold of non-negligible risk.[428] Trouwborst has identified that under customary international law the precautionary approach is applicable only when the risk of harm is, at minimum, significant.[429] According to the dictionary definition, "significant" means "not insignificant or negligible". [430] Therefore, the term "non-negligible" as used by Cameron and Wade-Gery is regarded as equivalent to "significant". [431] The meaning of the term "significant" that has been discussed in Section 2.4.1.1 regarding the threshold of harm under the prevention principle is also applicable here. Basically, the term "significant" refers to the degree of harm that is "appreciable", "tangible" or "measurable", as opposed to "trivial".[432] By contrast, the term "serious" or "irreversible" embodies a higher threshold than "significant".[433] Because risk can be defined as a unity that integrates the magnitude

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[423] Cameron, J., & Wade-Gery, W. (1995). Law, policy and the development of the precautionary principle. *Environmental Policy in Search of New Instruments*, 95.

[424] ILA New Delhi Declaration of Principles of International Law Relating to Sustainable Development, *Netherlands International Law Review 49(2)*, 211–216.

[425] UNECE, Ministerial Declaration on Sustainable Development in the ECE Region, Bergen, May 1990, para. 7.

[426] Ministerial Declaration of the Third International Conference on the Protection of the North Sea, The Hague, 8 March 1990, Preamble.

[427] Ministerial Declaration of the Second International Conference on the Protection of the North Sea, London, 24-25 November 1987, para. VII

[428] Cameron, J., & Wade-Gery, W (1995). Addressing uncertainty: Law, policy and the development of the precautionary principle, CSERG Working Paper GEC 92-43, 8.

[429] Trouwborst, A. (2006), supra note 412, 50.

[430] *Concise Oxford Dictionary*. Referring to Trouwborst, A. (2006), supra note 412, 50, footnote 82.

[431] Trouwborst, A. (2006), supra note 412, 50.

[432] ILC, Draft Articles on the law of the non-navigational uses of international watercourses and commentaries thereto and resolution on transboundary confined groundwater, 1994. Commentary to Art. 3, paras. 13-15.

[433] ILC, 2001 Draft Articles on Prevention, with commentaries, Commentary to Article2(a). See Section 2.4.1.1.

of harm and the probability of occurrence,[434] the term "potentially damaging" or "possible damaging" implies the degree of risk that combines a non-trivial level[435] (could be significant or serious) of harm and the uncertain likelihood of a given effect.[436] Trouwborst submitted that the precautionary approach is applicable when the adverse effects of an activity are significant, but it would then merely create a *right* for a state to take such measures; it would only create a *duty* for a state to take precautionary measures if an activity poses a risk of serious or irreversible harm.[437]

There is also a minority view that a "probable" risk, without expressing the severity of risk, may trigger the precautionary approach.[438] In order to find an appropriate role of the precautionary approach in the protection of the North Sea, Gündling submitted that environmental impacts hould be reduced or prevented "even before the threshold of risks is reached".[439] Interestingly, Article 3 of the LP describes the risk as "likely to cause harm" and does not address the severity of harm either. It might be inferred that, in some situations, the threshold of risks could be lower than "significant". Arguably, the smaller the threat that triggers the precautionary approach, the more cautious the principle is.[440]

In sum, three categories will be discussed in this book: potential risk (regardless of the magnitude), the risk of causing significant/non-negligible harm[441], and the risk of causing serious/irreversible harm[442]. Taking into account the different degrees of risk between geoengineering techniques, and also taking into account the different degrees of risk in the phases of research, fieldwork and large-scale deployment of geoengineering, a preliminary

[434] Trouwborst, A. (2006), supra note 412, 27.
[435] The wording "damaging" apparently presents a degree higher than "trivial".
[436] The issue of uncertainty will be further examined in Section 2.4.2.2(b).
[437] Trouwborst, A. (2006), supra note 412, 62. See Section 5.4.3 relating to the threshold for implementing the precautionary approach to geoengineering.
[438] Gündling, L. (1990). Status in international law of the principle of precautionary action, *International Law Journal of Estuarine & Coastal Law, 5*, 23.
[439] Gündling, L. (1990), 26.
[440] Sandin, P. (1999), supra note 412, 895.
[441] These two terms are interchangeable.
[442] These two terms are interchangeable.

hypothesis is that there is no single threshold to invoke the precautionary approach in every geoengineering activity; a multi-threshold mechanism would be appropriate.[443]

Regarding the certainty of the risk that may invoke the precautionary approach, the risk need not be "certain", but rather reasonably foreseeable, which means the existence has not been conclusively proved by science but it is not unthinkable.[444] Otherwise, a certain risk should be eliminated or minimized by the prevention principle. Note that a hypothetical risk resting on purely speculative considerations without any scientific foundation should be excluded from the precautionary approach.[445]

Another question that merits consideration is whether the precautionary approach aims at zero risk, which means that strong and strict precautionary measures, such as a ban, should be taken until full scientific proof is established. The European Commission explicitly objects to the search for zero risk, because it is rarely to be found in reality.[446] However, in some cases, a standard of (almost) zero risk might be necessary due to the inherent irreversible harm. This standard would lead to a (temporary) ban on activities that pose any uncertain risk.

(ii) Uncertainty

From almost all formulations of the precautionary approach, it is clear that the uncertainty in question refers to scientific uncertainty, which expresses our lack of knowledge of the state of the world.[447] Typical phrases of scientific uncertainty are "the lack of scientific

[443] See Section 5.4.2.
[444] De Chazournes, L. B. (2007). Precaution in International Law: Reflection on Its Composite Nature. In Ndiaye, T. M., & Wolfrum, R. (Eds.). (2007). *Law of the Sea, Environmental Law and Settlement of Disputes: Liber Amicorum Judge Thomas A. Mensah* (pp. 21-34). Leiden: Martinus Nijhoff Publishers, 22; ILA, Legal Principles Relating to Climate Change, Draft Articles, Art. 7B.
[445] Ibid.; Trouwborst, A. (2006), supra note 412, 118.
[446] Communication from the Commission on the Precautionary Principle (2000), supra note 406, 9.
[447] Sandin, P. (1999), supra note 412, 892.

certainty"[448] or "the inconclusive evidence of a causal link between an activity and adverse consequences".[449]

Before examining the types of uncertainty, the distinction between prevention and precaution needs to be briefly clarified. The mainstream view on the distinction is that uncertainty is the core element that distinguishes the precautionary approach from the prevention principle. If an activity results in pollution or is known to create a pollution risk, the prevention principle applies to controlling and regulating the substances that cause pollution; the precautionary approach is not applicable because no element of uncertainty is involved. As stated previously, the risk could be defined as the combination of the magnitude of the adverse consequence and its probability of occurrence. Risks are always quantifiable because both the magnitude and the probability are certain or can be estimated. If either the magnitude or the probability or both are unknown, the risk becomes unknown and thus the precautionary approach is applicable. In contrast, Trouwborst submits that the precautionary approach has absorbed the prevention principle, or, alternatively, should be seen as its most developed form.[450] He argues that the presence of uncertainty is not the precondition for the application of the precautionary approach but rather acting as a reasonable ground to trigger proportionally precautionary measures that correspond to the risk. In other words, the action is taken in spite of uncertainty, but not because of it.

Typologically, uncertainty can be categorized as epistemological and ontological uncertainty in terms of cause.[451] The Commission of the European Communities describes scientific uncertainty as follows:

> Scientific uncertainty results usually from five characteristics of the scientific methods: the variable chosen, the measurements made, the samples drawn, the models used

[448] Rio Declaration, Art. 15.
[449] E.g. Ministerial Declaration of the Second International Conference on the Protection of the North Sea, London, 1987, para. VII; Ministerial Declaration of the Third International Conference on the Protection of the North Sea, The Hague, 1990, Preamble.
[450] Trouwborst, A. (2007). The precautionary principle in general international law: Combating the babylonian confusion. *Review of European Community & International Environmental Law, 16*(2), 185-195.
[451] Trouwborst, A. (2006), supra note 412, 71.

> and the causal relationship employed. Scientific uncertainty may also arise from a controversy on existing data or lack of some relevant data. Uncertainty may relate to qualitative or quantitative elements of the analysis.[452]

Epistemological uncertainty corresponds to lack of knowledge, such as lack of measurements, scientific theories, or historical records.[453] It is sometimes referred to as parameter uncertainty. For instance, climate change can hardly be measured if information of baseline conditions is absent. Likewise, it is impossible to estimate the loss of species if the number of the total amount of species is uncertain.[454] The lack of information may result from the limitation of available tools for measurement and calculation or the limitation of analysis capability.[455] Gathering more information or improving research techniques can diminish some epistemological uncertainties; however, some knowledge deficiencies cannot be made up due to infeasibility of research, such as counting the number of phytoplankton in the ocean.

Ontological uncertainty refers to the uncertainty due to complexity and variability. Complexity of nature stems from the properties and functioning of each component of nature – biosphere, hydrosphere, atmosphere and lithosphere as well as the intricate web that all these components interrelate. Variability is the other cause of ontological uncertainty, as nature is capricious rather than linear, regular and periodical.[456] The uncertainty due to complexity and variability might not ever be overcome.[457]

In reality, very often, it is impossible to attain conclusive scientific proof of the likelihood or the severity of a risk. It is also hardly possible to conclusively establish the cause-effect relationship between an activity or a substance and any feared consequences. In other words, decisions are rarely made under full certainty.

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[452] Communication from the Commission on the Precautionary Principle, supra note 406, 14.
[453] Trouwborst, A. (2006), supra note 412, 72, referring to, *inter alia*, UK Department of the Environment, Transport and the Regions, Guidelines for Environmental Risk Assessment and Management: Revised Department Guidance, 2000, para. 1.6.
[454] Trouwborst, A. (2006), supra note 412, 72.
[455] Ibid.
[456] Trouwborst, A. (2006), supra note 412, 77.
[457] Trouwborst, A. (2006), supra note 412, 117.

2.4.2.3 Precautionary Action

Among the three elements of the precautionary approach, risk and uncertainty are collectively considered the trigger for the precautionary approach, whereas action is the response to the risk of harm in spite of the uncertainty. Actions are taken in accordance with the integrated consideration of the severity of harm and uncertainty as to the likelihood of harm. Actions are formulated in various ways in different instruments: "cost-effective measures",[458] "preventive measures",[459] "conservation and management measures",[460] etc. Based on the strength of the action, scholars have summarised different versions of the precautionary approach.

Wiener categorized the precautionary approach into three main versions.[461] The weak version of the precautionary approach suggests that the absence of complete evidence about a particular risk scenario does not preclude regulation. The common phrasing of this version is that "the lack of full scientific certainty shall not be used as reason for postponing (cost-effective) measures to prevent environmental degradation".[462] The second version suggests that uncertainty justifies action. This is a stronger version of the precautionary approach insofar as it impels proactive actions rather than that it merely rebuts the inaction. The common phrasing of this version is that the precautionary approach should be followed to avoid potentially damaging impacts even before a conclusive causal link between emissions and effects has been established.[463] Proactive actions are, for instance, taken to avoid or reduce potentially damaging impacts of hazardous chemicals.[464] The strong version of the precautionary approach suggests that uncertainty requires shifting the burden and standard of proof. It requires prohibiting the potentially risky activity until the proponents of the activity can prove that it poses no significant risk. Wiener pointed out

[458] Rio Declaration, Principle 15; 1990 Bergen Declaration, para. 6.
[459] OSPAR Convention, Art. 2(2)(a).
[460] 1995 Agreement on Straddling and Highly Migratory Fish Stock, supra note 415, Art 6 (2).
[461] Wiener, J. B., & Rogers, M. D. (2002), supra note 404, 320-321.
[462] Under the Rio Declaration and the UNFCCC, "measures" should be "cost-effective".
[463] Examples: Ministerial Declaration of Second International Conference on Protection of the North Sea, London, 24-25 November 1987, para. VII; 1992 Helsinki Convention (Baltic Sea area), Art. 3.2; OSPAR Convention, Art.2(2)(a).
[464] Protocol to the 1979 Convention on Long-range Transboundary Pollution on Persistent Organic Pollutants, Annex V, para. 2.

that, in the first and second versions of the precautionary approach, it is not clear what kind of action should be taken, given the uncertainty.[465]

Sunstein differentiated the precautionary approach into weak and strong versions.[466] The weak version also suggests that a lack of decisive evidence of harm should not be grounds for refusing to regulate. Sunstein referred to the assertion from the Wingspread Consensus Statement on the Precautionary Principle[467] and identified that the strong version of the precautionary approach impels both pre-emptive measures and the reversal of the burden of proof.[468] "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof."[469]

Stewart summarized four versions of the precautionary approach:

1. *Non-preclusion*. Regulation should not be precluded by the absence of scientific certainty about activities that pose a risk of substantial harm.

2. *Margin of Safety.* Regulation should incorporate the maximum "safe" level of an activity (the margin of safety), limiting activities to those below the level at which no adverse effect has been found or predicted. [470]

3. *Best Available Technology*. Activities that present an uncertain potential for significant harm should be subject to best-available-technology requirements to minimize the risk of

[465] Wiener, J. B. & Rogers, M. D. (2002), supra note 404, 321.
[466] Sunstein, C. R. (2003). Beyond the precautionary principle. *University of Pennsylvania Law Review*, 1003-1058.
[467] Wingspread conference refers to a conference took place in Wingspread, the U.S. in January 1998 where 32 participants from the U.S., Canada and Europe reached an agreement on the necessity of the precautionary principle in public health and environmental decision-making.
[468] The Wingspread Consensus Statement on the Precautionary Principle, Wingspread conference on the precautionary principle, 26 January 1998. Retrieved from: http://www.sehn.org/wing.html.
[469] Ibid.
[470] See also, Trouwborst, A. (2006), supra note 412, 169. (The use of safety margins in the implementation of the precautionary approach with regard to the exploitation of living natural resources.)

harm, unless the proponents of the activity can show that they present no appreciable risk of harm.

4. *Prohibitions and the Reversal of the Burden of Proof*. This version is the same as Wiener's strong version.

Versions 1 and 2 are weak versions because, unlike Versions 3 and 4, "they do not mandate regulatory action and do not make uncertainty regarding risks an affirmative justification for such regulation".[471]

All the regulations and commentaries above provide guidance on the applicability of the precautionary approach. First, in the case of potentially irreversible harm to the environment and human health, a (temporary) ban may be necessary. Take some examples from state practice. When commercial whaling posed a risk of causing serious or irreversible harm to living resources, a provisional ban was imposed on it.[472] In order to avoid the further depletion of the ozone layer, precautionary actions have been taken in the form of the phase-out of CFCs "with the ultimate objective of their elimination".[473] In European practices of regulating genetically modified organisms (GMOs), "decisions should be made so as to prevent such activities from being conducted unless and until scientific evidence shows that the damage will not occur".[474] In the case of a worst-case scenario, "even a small amount of doubt as to the safety of that activity is sufficient to stop it taking place" in order to protect the marine environment.[475] The reversal of the burden of proof is always required in such scenarios.

Second, in a context where the risk is less serious or reversible, a ban is not necessary; less restrictive alternatives would be more proportionate. They could be "best available

[471] Stewart, R. B. (2002). Environmental regulatory decision-making under uncertainty. *Research in Law and Economics, 20*, 71-126.
[472] International Whaling Commission, International Convention for the Regulation of Whaling, Washington, adopted 2 December 1946, 10 November 1948, as amended by the Commission at the 64 Annual Meeting, Panama City, July 2012, para. 6.
[473] Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, adopted 16 September 1987, entered into force 1 January 1989, *United Nations Treaty Series* (1989), vol.1522, no. 26369, p. 3, Preamble.
[474] Sunstein, C. R. (2003), supra note 466, 1013.
[475] The Final Declaration of the First European Seas at Risk Conference, Copenhagen, 1994, Annex I.

techniques" or "best environmental techniques" to minimize or control the risk of pollution.[476] Measures could be even weaker, such as in the case of new or exploratory activities, where states should adopt cautious conservation and management measures, among others, setting up limits under which the activities are allowed.[477] More frequently, precautionary actions comprise a portfolio of several measures, including environmental impact assessment, economic evaluation, scientific and socio-economic research, and monitoring.[478]

Third, the weak version of the precautionary approach is not without significance.[479] This version is most widely adopted in international environmental conventions and non-binding documents.[480] In some cases, "the right answer may be not to act or at least not to introduce binding legal measures. A wide range of initiatives is available in the case of action, going from a legally binding measure to a research project or a recommendation".[481]

Owing to the differences between each geoengineering technique and different levels of risks and uncertainties involved in every single geoengineering research or deployment activity, the application of the precautionary approach needs to be tailored to each geoengineering technique.[482]

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[476] FAO, Code of Conduct for Responsible Fisheries, Art. 7.5.3. Stockholm Convention on Persistent Organic Pollutants, Stockholm, 22 May 2001, *United Nations Treaty Series* (2006), vol. 2256, no. 40214, p.119, Part 5, B; Protocol to the 1979 Convention on Long-range Transboundary Air Pollution on Persistent Organic Pollutants, Aarhus, adopted 26 April 1998, entered into force 23 October 2003, *United Nations Treaty Series* (2004), vol. 2230, no. 21623, p. 79, Annex V.

[477] FAO, Code of Conduct for Responsible Fisheries, Art.7.5.4. (Cautious conservation and management measures, including, inter alia, catch limits and effort limits)

[478] E.g. UNCED, Agenda 21, Rio de Janerio, Brazil, 3 to 14 June 1992, para. 17.21. Retrieved from https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf.

[479] Sunstein, C. R. (2003), supra note 466, 1016.

[480] Examples: 1990 Bergen Declaration, Art. 6; Rio Declaration, Principle 15; Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Helsinki, adopted 17 March 1992, entered into force 6 October 1996, *United Nations Treaty Series* (2001), vol. 1936, no. 33207, p. 269, Preamble; the CBD, Preamble; the UNFCCC, Art. 3(3).

[481] Communication from the Commission on the Precautionary Principle (2000), supra note 406, Summary, paras. 3-4.

[482] See further discussion in Section 5.4.

2.4.2.4 A Moratorium on Geoengineering

A temporary ban, or moratorium, was introduced by the LP on marine geoengineering activities (only including ocean fertilization so far) undertaken for non-research purposes (not yet entered into force).[483] This moratorium is an application of the precautionary approach to marine geoengineering techniques. According to the examination of precautionary actions in the previous Section, the imposition of a moratorium is a strong version of the precautionary approach. But it is not the strongest action, as it is not a permanent prohibition and does not require a reversal of the burden of proof.

As stated in Chapter 1, most geoengineering techniques, including all of the six selected geoengineering techniques, have adverse impacts on the environment and natural resources, and are still subject to scientific uncertainties in research and deployment. In 2008, a non-binding ban on ocean fertilization was first imposed by Decision IX/16 of the Conference of Parties to the CBD[484] and subsequently by Resolution LC-LP. 1 of the Contracting Parties to the LC/LP.[485]

In May 2008, the COP to the CBD recommended a temporary ban on ocean fertilization. Part C of Decision IX/16 of the 9th Meeting of the COP to the Convention on Biological Diversity:

> "[*R*]*equests* parties and *urges* other Governments, in accordance with the precautionary approach, to ensure that ocean fertilization activities do not take place until there is an adequate scientific basis on which to justify such activities, including assessing associated risks, and a global, transparent and effective control and

[483] Resolution LP.4(8), 2013 Amendments to the LP, supra note 48.
[484] CBD Decision IX/16, Biodiversity and climate change, UN Doc. UNEP/CBD/COP/DEC/IX/16 (9 October 2008).
[485] Resolution LC-LP. 1 (2008) on the regulation of ocean fertilization, 31 October 2008, Annex 6. Retrieved from: http://www.imo.org/en/OurWork/Environment/LCLP/EmergingIssues/geoengineering/Pages/default.aspx.

> regulatory mechanism is in place for these activities; with the exception of small scale scientific research studies within coastal waters."[486]

In October 2008, the 13th Meeting of the Contracting Parties to the London Convention and the 3rd Meeting of the Contracting Parties to the London Protocol reaffirmed, in a resolution on the regulation of ocean fertilization, the precautionary approach in CBD COP Decision IX/16. In addition, the Contracting Parties to the LC and the LP agreed that the LC and the LP apply to ocean fertilization activities, and that small scale scientific research of ocean fertilization should be regarded as placement of matter for a purpose other than the mere disposal thereof under the regulation of "dumping" by the LC and the LP.[487]

Two years later, in 2010, Decision X/33 of the CBD COP was adopted covering all geoengineering activities that are bigger than "small scale scientific research studies" and that may affect biodiversity:[488]

> [I]n the absence of science based, global, transparent and effective control and regulatory mechanisms for geo-engineering, and in accordance with the precautionary approach and Article 14 of the Convention, […] no climate-related geo-engineering 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.[489]

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[486] CBD Decision IX/16, Part C.

[487] Resolution LC-LP.1 (2008) on the regulation of ocean fertilization, Annex 6. The meaning of "dumping", see Article III.1(b)(ii) and Article 1.4.2.2 of the London Protocol.

[488] CBD Decision X/33, Biodiversity and climate change, UN Doc. UNEP/CBD/COP/DEC/X/33 (29 October 2010), para. 8(w);

[489] CBD Decision X/33, para. 8(w).

On 18 October 2013, the Contracting Parties to the LP adopted an amendment to regulate marine geoengineering. This amendment is the first binding document on geoengineering (but has not yet entered into force). The new Annex 4 provides that all ocean fertilization activities other than those referred to in the definition of ocean fertilization (i.e. small-scale, scientific research studies) shall not be permitted.[490] An ocean fertilization activity may only be considered for a permit if it is assessed as constituting legitimate scientific research after taking into account the specific assessment framework developed for an activity.[491] A new Article 6*bis* states that "Contracting Parties shall not allow the placement of matter into the sea from vessels, aircraft, platforms or other man-made structures at sea for marine geoengineering activities listed in Annex 4, unless the listing provides that the activity or the sub-category of an activity may be authorized under a permit".

The moratoriums regulated under the 2013 Amendments to the LP and the CBD Decisions are problematic in their implementation. Without playing due regard to the distinct characteristics of each technique and the scale of activities, the moratorium on geoengineering under the CBD Decision X/33 is a one-size restriction rather than regulating different techniques in accordance with their distinct features. It may lead to disproportionate precautionary actions, in particular, excessive precautionary actions that may impede legitimate geoengineering activities. With regard to the moratorium on ocean fertilization under the 2013 Amendment to the LP, the phrasing "small scale scientific research" is replaced by "legitimate scientific research", which means the scale of scientific research may not be the decisive factor to determine whether such a research activity is "legitimate". [492] Moreover, both documents stress the risks and uncertainties of geoengineering techniques, but downplayed the potential of geoengineering as a precautionary action to combat climate change.[493]

[490] Resolution LP.4(8), 2013 Amendments to the LP, supra note 48, Annex 4.
[491] Resolution LP.4(8), 2013 Amendments to the LP, supra note 48.
[492] See further discussion in Section 3.2.3.1.
[493] The moratorium on ocean fertilization will be further discussed in Section 3.2.3, and a more flexible operationalization of the precautionary approach in the context of geoengineering will be further discussed in Chapter 5.

2.4.2.5 Problems in Applying the Precautionary Approach to Geoengineering

Traditionally, we use the precautionary approach because 'safe is better than sorry'. However, in the case of geoengineering, it is very difficult to tell what is safe and what is sorry. Geoengineering is an unprecedented opportunity to which no example of the application of the precautionary approach is analogous. On the one hand, geoengineering activities can be considered hazardous activities that need to be controlled or even (temporarily) prohibited by precautionary actions due to its scientific uncertainty and the potential harm to the environment and human health. On the other hand, geoengineering techniques *per se* could also be seen as precautionary measures to avoid the potentially irreversible harm of climate change. It might not be safe to use geoengineering because the globe will be under the threat of environmental harm resulting from such a planetary intervention. However, facing the threat of climate change, it might not be safer if we refuse to use geoengineering techniques. This dilemma complicates the application of existing provisions regarding the precautionary approach to geoengineering. For instance, Principle 15 of Rio Declaration could be interpreted as constraining the use of geoengineering when lacking scientific certainty: "Where there are threats of serious or irreversible damages, lack of full scientific certainty [in geoengineering] shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation [caused by geoengineering]".[494] It is understandable and reasonable that geoengineering techniques should be properly regulated and very cautiously implemented.

In contrast, the precautionary approach from Article 3.3 of the UNFCCC should not be interpreted as to restrict the utilization of geoengineering by employing "precautionary measures". As shown in Article 3.3, "precautionary measures" refer to the actions to anticipate, prevent or minimize the cause of climate change and mitigate its adverse effects. Geoengineering is evidently not the cause of climate change; on the contrary, it consists of a host of measures aimed at counteracting climate change. Hence, Article 3.3 should not be applied to restrict geoengineering, because the deployment of geoengineering is consistent with the ultimate objective of the UNFCCC.

[494] See also: London Protocol, Art. 3.1; OSPAR Convention, Arts. 2.2 (a) & 2.3 (b).

To this extent, it seems plausible to treat geoengineering as precautionary measures in the context of Article 3.3: "The Parties should take [geoengineering techniques] to anticipate, prevent or minimize the cause of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty regarding the extent of potential effects [of using geoengineering techniques] to the environment should not be used as a reason for postponing [the use of geoengineering techniques]." However, Article 3.3 cannot be simply read as supporting geoengineering either. The "and" in the first sentence of Article 3.3 implies that the measures should be able to "anticipate, prevent or minimize the cause of climate change" as well as "mitigat[ing] its adverse effects". Such a reading would argue against the use of the precautionary approach to support the implementation of SRM techniques, because SRM techniques are not aimed at dealing with the cause of climate change. With regard to CDR, it may still not be appropriate to treat geoengineering techniques as precautionary measures, taking into account the significant environmental risk created by or scientific uncertainty contained in some techniques. It is not convincing to employ CDR techniques as precautionary measures when the impacts of developing such techniques are still scientifically uncertain.

Although the precautionary approach has proved an effective tool to control future risks, there are still problems which impede the effective and appropriate implementation of the precautionary approach in the context of geoengineering. In order to further operationalize the precautionary approach in the context of geoengineering, two main questions need to be answered:

Question 1: How long should a precautionary action be taken with respect to a particular geoengineering technique?

UNEP urged the application of the precautionary approach on the ground that "waiting for scientific proof regarding the impacts of pollutants discharged into the marine environment may result in irreversible damage to the marine environment and human suffering".[495] Likewise, the precautionary approach in numerous legal instruments and discourses merely articulate the triggers for a precautionary action, but none of them provides clear

[495] UNEP, Precautionary approach to marine pollution, including waste-dumping at sea, 12th meeting, 1989.

criteria to determine the timing for terminating a precautionary action. Once the precautionary approach for geoengineering has been used, for how long should a precautionary action stance be mintained? If not, under what circumstances can we terminate a precautionary action? The common formulations of the timing are "when more scientific information becomes available" or "when better understanding of risk becomes available". These formulations are unclear and lack implementability. Timing is an issue that is closely associated with scientific uncertainty. As discussed before, not all scientific uncertainties involved in geoengineering and climate change are conquerable, and decisions are always made with scientific uncertainty. Hence, in many cases the moment that an adequate scientific basis is available to justify a hazardous activity may never come.[496] Under such an approach, such an activity would likely never be permitted. The lack of the criteria for terminating a precautionary action, in particular terminating a ban, would unreasonably constrain the legitimate use of geoengineering techniques.

In the absence of scientific certainty, the decision of continuing or terminating a precautionary action could be made in the light of a trade-off analysis, which will be addressed in Chapter 5.

Question 2: How should one balance between the positive effect and the negative effect of geoengineering?

When considering the implementation of the precautionary approach, not only the risks related to geoengineering techniques but also the contribution made by geoengineering to counteract the serious consequences of climate change should be taken into account. In the case of geoengineering, the precautionary approach is not able to answer which outcome carries more weight.

The existing precautionary action on geoengineering is cautious and conservative. It can be seen from the decisions of the CBD stresses that the risks and uncertainties of geoengineering techniques but downplays the potential of geoengineering as a precautionary action to combat climate change. Actually, precaution does not necessarily

[496] A similar opinion, see Trouwborst, A. (2006), supra note 412, 189.

mean prohibition,[497] and excessive bans might hinder a legitimate use of geoengineering. In other words, it is necessary to identify criteria in order to exercise precautionary actions in a proportional way. An uncertain risk does not automatically imply the demand for a ban; the question is what kind of action to take, in a world of intricate uncertainties and multiple risks.

The balancing of risks is a core issue in response to both questions above. It will be further addressed in Chapter 5.

2.5 Conclusion

Chapter 2 has sought to elaborate rules and principles applicable to geoengineering techniques under contemporary international law. No current international framework is explicitly applicable to geoengineering in general, but a number of conventions may apply to all of the six geoengineering techniques identified in Chapter 1. First, the climate change regime provides provisions that support CDR techniques, but the role of SRM remains unclear under the climate change regime. The UNFCCC, the KP, the PA and decisions taken by the COP or CMP could be seen as supporting the use of CDR techniques because such techniques contribute to the achievement of the ultimate objective of the UNFCCC and enhancing the implementation of the UNFCCC. On the contrary, the implementation of SRM does not seem consistent with the ultimate objective of the UNFCCC. However, interpretation of the ultimate objective of the UNFCCC, i.e. whether measures do not aim at mitigation carbon emissions could be counted as measures that aim to "prevent dangerous anthropogenic interference with the climate system" would make the conclusion different. The role of the UNFCCC in the governance of geoengineering will be addressed in Chapter 4. Second, a permanent ban under the ENMOD Convention applies to geoengineering techniques only if they are undertaken for military or hostile purposes to change the climate of another state and have long-lasting, widespread and serious effects.

As long as geoengineering techniques are utilized for peaceful purposes, international law does not prohibit such activities. Those activities are not unfettered but rather subject to

[497] Wiener, J. B. & Rogers, M. D. (2002), supra note 404, 320-321.

the prevention principle and the precautionary approach. States should comply with the prevention principle to deal with the harm and known risks. States should adhere to a host of obligations concerning environmental protection and the reasonable use and conservation of natural resources when they conduct research on or deploy a geoengineering technique. These general obligations will be specified in Chapter 3 in relation to each geoengineering technique.

The precautionary approach applies to geoengineering techniques to deal with unknown risks. Currently, the precautionary approach has been implemented in the form of a moratorium on geoengineering, in particular on ocean fertilization. Pursuant to the moratorium, geoengineering activities are not allowed until an adequate scientific basis is available to justify such activities and to abate and eliminate associated risks to the environment. The moratorium is a strong version of the precautionary approach to preempt a hazardous activity, but it may hinder the legitimate development of new technologies. Taking into account the diversity of different geoengineering techniques and the complexity of the impacts caused by geoengineering on the environment and the climate, it is necessary to identify criteria in order to implement precautionary actions in a proportional way.[498]

The balancing of risks is a core issue in the discussion of geoengineering. Such balancing is between the adverse effects resulting from global warming without using geoengineering and long-term side effects resulting from climate intervention. How to weigh the risk of climate change against biodiversity loss or ocean acidification or land degradation? To solve this problem, sound risk assessment and risk management with due regard to scientific uncertainties are most important. Risk assessment should be exercised in order to compare the scenario of climate change with and without geoengineering. At some point, it might be worthwhile to sacrifice certain ecosystems for the climate stability when a geoengineering technique is proved to be very effective and efficient and the adverse effects of such a technique on the environment and human health are not likely to be irreversible. The criteria should be cautiously established.[499]

[498] See Chapter 5.
[499] See Chapter 5.