The International Legal Framework for Climate Engineering

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Several of the key, recurring questions which loom over climate engineering concern how countries would interact when some of them undertake or approve actions that might impact other countries. May a state intentionally alter the climate? What would its obligations be before, during, and after doing so? What if a potentially affected country protests or claims that is had been harmed? What if the implementing country believed that its existence was at risk due to impending climate change? What about private actors attempting climate engineering, perhaps for profit? Is there an existing legal instrument under which field tests with potential transboundary impacts could be regulated? Are countries obligated to research or implement climate engineering in order to prevent dangerous climate change? May states claim credit for greenhouse gases (GHG) removed from the atmosphere via carbon dioxide removal (CDR)?

Countries prevent and resolve international disputes through a variety of mechanisms. One particularly important mechanism is international law. This chapter describes some international law that is applicable to climate engineering, with a focus on international environmental law. It closes with a brief synthesis and some recommendations for future developments. First, though, it introduces international law, and suggests why climate engineering is such a challenge for international environmental law and its scholars.

International Law

International law is a collection of authoritative rules governing countries' actions, especially those that may impact other countries. That is, sovereign states are its subjects. With limited exceptions, international law governs neither the actions of individual persons nor those of national governments that have only domestic impacts. These governments may be, however, obligated to require, regulate, or prevent certain actions by their citizens and residents, although the states are not necessarily responsible for the actions of their persons.

Scholars offer a wide range of explanation for how and why international law operates, and this often shapes their conclusions as to what it can accomplish (Dunoff and Pollack, 2012). Some assert that it is an outgrowth of the shared values and intersubjective understandings of those individuals who craft it, and that it thus carries strong normative power. Others claim that national leaders develop and implement international law in response to the domestic constituencies who support them. Finally, a third group argues that states with differing levels of power and capabilities rationally use international law to coordinate, cooperate, and coerce because it furthers their diverse interests.

The most important characteristic of international law is that there is neither a central legislator nor central enforcement. This is unlike the national law with which we are most familiar, which is developed through legislative processes and enforced through the state's threat of force. In contrast, international law is a set of promises, customary behaviours, and principles among purportedly equally sovereign states. These rules are of varying explicitness, detail, and "firmness", in the sense of their rhetorical strength, associated expectations, and possible consequences of their violation. Although these consequences are sometimes explicit in a treaty, most often international law is enforced in three general, indirect ways (Guzman, 2008). A victim country might reciprocate with the same violation back at the violator. States may also retaliate in other, unrelated areas. Finally, the violator frequently suffers in its reputation, and states are consequently less likely to engage with it in ways that would have been beneficial. Notably, enforcing international law is often costly for the enforcers, compounding the challenge.

International law traditionally has three primary sources. Treaties are explicit agreements among states that choose to participate. Most treaties (or similar terms, such as agreements or conventions) are between two countries, although some have many participants, called parties. Customary international law is what all countries consistently do out of an apparent sense of legal obligation, and applies to all states who do not explicitly object. Finally, general principles are the guiding ideas upon which treaties and customs are based, but are not themselves binding on their own. The precise substance of customs and principles are not centrally codified and thus sometimes disputed. Beyond these, the rulings of international tribunals and intergovernmental organizations have become important secondary sources within the international legal system.

Regardless, trying to make a sharp distinction between binding and nonbinding international law is mostly unproductive, even though certain components of it are clearly intended to be one or the other. Instead, there is something of a gradient. Furthermore, countries, particularly the powerful ones, sometimes violate explicitly binding agreements with little consequence, especially if there is a widely shared sense that the action was justified. Likewise, other countries, particularly the weak ones, sometimes face sanction for actions that are not contrary to international law. Although this implies that politics trumps international law at the end of the day, the latter still has an impact by altering the incentives that states face. Indeed, countries generally abide by international law. This can be explained variously by its genuine effectiveness, its ambiguity, or its mere embodiment of what countries would have done in its absence.

The international law of the environment is relevant when a state's actions pose risks to the environment of other states or of areas beyond national jurisdiction and control, such as the high seas, Antarctica, or outer space. For the most part, international environmental law is anthropocentric, in that it protects the environment for people's health and for their natural resources (Birnie et al., 2009, p.7). Notably, it is intertwined with efforts to overcome uneven economic development.[1] That is, all countries want their own environments to be clean, but there are divisions of international priorities: wealthy states generally emphasize global environmental protection, while the poorer ones wish to develop economically and are concerned that stringent international environmental law could interfere with this (Najam, 2005).

As a final note, international law as described arose when countries were considered the exclusive actors in the international arena. In recent decades, transnational nonstate actors have become increasingly important—or at least recognized as such—both as sources and subjects of a more broadly-defined system of international law (Biermann and Pattberg, 2008). Indeed, so-called "global governance" instruments and institutions that rely less on states than traditional law may be more effective in regulating transnational nonstate actors.

The Challenges of Climate Engineering

Climate engineering presents difficulties for international environmental law and its scholars. To some degree, this is due to its novelty: climate engineering proposals have been seriously discussed for only a decade or so. This situation is frequently seen with new technologies, as international law moves slowly by design. In these cases, scholars and practitioners are forced to interpret legal instruments that were developed for decidedly different purposes.

Climate engineering is especially challenging because it presents three novel dynamics for international environmental law. First, all climate engineering approaches—both CDR and solar climate engineering (solar radiation management, or SRM—could both prevent and cause environmental harm. Removing GHGs or increasing albedo could lower climate change risks while simultaneously creating new risks. For example,) SRM would unevenly compensate the temperature and precipitation anomalies of climate change, CDR methods may alter ecosystems, crowd out food production, and create new industries of massive scales (McNutt et al., 2015a; McNutt et al., 2015b). In short, these are proposed interventions to protect humans and the environment that may also harm humans and the environment. Indeed, both climate change (or GHGs) and climate engineering often satisfy the definitions of "pollution", "damage," or "adverse effects" that environmental treaties try to prevent and reduce (CLRTAP, 1979; UNCLOS, 1982; Vienna Convention for the Protection of the Ozone Layer, 1985; Madrid Protocol, 1991; UNFCCC, 1992; CBD, 1992; OSPAR, 1992). It is often unclear how international environmental law should balance such tension.

Second, SRM climate engineering does not fit the mould of typical environmental problem structures, which can usually be described economically as negative externalities or collective action problems with the environment as their medium. In the former, some actors engage in activities that are beneficial for them but have negative environmental consequences for others that are not taken into consideration by the former. In the latter, all would benefit if each were to take some action, but they would individually benefit more by not doing so and "free riding" on others' efforts. In contrast, SRM presently appears to offer a *positive* externality through the reduction of climate risks whose value would not be fully captured by the implementing actor, couple with some risks for others.[2] Further, instead of a need for collective action that brings a free rider problem, SRM calls for collective restraint that brings a "free driver" problem (Weitzmann, 2015). Therefore, although SRM would to some extent instigate traditional environmental law mechanisms such as preventing, remedying, and possibly compensating for harm, it appears that its research and possible implementation would primarily generate challenges such as coordination, mutual restraint, and prevention of misuse (Bodansky, 2012).

Finally, I suggest that there is a cultural barrier as well. The contemporary awareness of environmental degradation that arose in the 1960s and later provided a cultural foundation for modern environmental law is, at its core, a realization that we have not adequately accounted for the full environmental consequences of our actions. This usually includes a belief that certain large scale, high technology endeavours attempted to intervene in nature in ways that were dangerous and insufficiently understood. Most of the environmental movement has responded by calling for greater humility, increased scepticism of our knowledge and technology, and placing the natural world more centrally in our decision-making processes and value systems. In this context, climate engineering "runs afoul of almost every major trend in contemporary environmentalism" (Michaelson, 1998, p.81). To the extent that this is the narrative behind the rise of environmental law, a logical reaction has been to see climate engineering not as a potential means to reduce net climate risks but instead as the latest in a series of hubristic technological threats to a fragile global environment.

Applicable Existing International Law

Here, I briefly review the most relevant existing international law in the context of climate engineering. Unsurprisingly, most of this falls under the rubric of international environmental law, although other domains will be briefly touched upon at the section's end. Unless otherwise stated, these instruments and provisions apply to all climate engineering techniques that would pose transboundary risks. However, some proposed methods—especially some within SRM—are more likely to do so.

International Environmental Law

International environmental law is the logical starting point for considering how international law may be able to prevent and resolve disputes arising from climate engineering. International environmental law is not a distinct domain but instead merely the subset of international law that relates to how states may impact each other via the environment. Although what is and is not an environmental matter is unclear (e.g., is liability for harm from space activities an environmental issue?), this need not be resolved here.

As a starting point, states' sovereignty means that they are free to govern their people and to manage their resources within their territory as they deem appropriate, provided that such actions do not harm other countries (Rio Declaration, 1992). Per customary law, if an activity poses a risk of significant transboundary harm—including a high chance of typical harm and a low chance of "disastrous" harm—then the country of origin is obligated to take appropriate measures to prevent or reduce the harm; to review and (if appropriate) to authorize risky activities; to assess potential environmental impacts; to notify, consult, and cooperate with those countries likely to be affected; to notify the likely affected public; to develop plans in case of an emergency; and to monitor an activity's ongoing effects (International Law Commission, 2001a). In other words, the source state is to act with due diligence. Importantly, this is not to be done solely to minimize transboundary environmental harm but instead to equitably balance states' interests (including the benefits, importance, and risks of the activity), those of available alternatives, and the costs of prevention. If an incident has caused or is likely to cause transboundary harm from a hazardous activity, the source state should notify, consult with, and cooperate with the likely affected countries in order to take appropriate response measures, while the likely affected countries are to take all feasible measures to mitigate the damage (International Law Commission, 2006). Afterwards, those states that have caused transboundary harm through an action that was contrary to international law must stop the activity; assure that it will not reoccur; make reparations for the harm through restitution, prompt and adequate compensation (possibly by strict liability on the operators of hazardous activities), and satisfaction such as an apology; and provide access to legal remedies for victims (ibid.; International Law Commission, 2001b).

Several environmental agreements would be relevant in the case of climate engineering. Only a handful of treaties and treaty systems are discussed here; others would be applicable only in limited geographical areas and/or with particular climate engineering methods (Bodle et al., 2014; Reynolds, 2014). The most important is the UN Framework Convention on Climate Change which now includes essentially all countries as parties (UNFCCC, 1992). Its objective of stabilizing GHGs at safe levels and its binding commitments clearly indicate that CDR lies within its purview. Among the commitments are two that call for the enhancement of sinks and reservoirs. The UNFCCC's Kyoto Protocol is more explicit, requiring its parties to research and promote “carbon dioxide sequestration technologies and... advanced and innovative environmentally sound technologies” (Kyoto Protocol, 1997, art. 2.1(a)(iv)). The questions as to whether particular CDR methods could be included toward a country’s accounting of its net GHG emissions and whether they could be eligible for credit under international emission trading systems are important yet remain unresolved. The debates concerning the effects of forests, agriculture, and land use on GHG concentrations have dragged on for decades due in part to the complexity and uncertainty of their net long term impacts; CDR methods will likely face a similarly difficult path. More recently, the Paris Agreement more explicitly points toward CDR in its goal “to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases” (Paris Agreement, 2015, art. 4.1).

The relationship between the UNFCCC and SRM is less clear. On one hand, these methods would not contribute toward its objective of GHG stabilization. On the other hand, there are several references among its principals, priorities, and commitments that imply at least the consideration of SRM, perhaps through research. For example, the document’s aspirational language calls for the prevention of dangerous climate change in a rapid and inexpensive manner “so as to ensure global benefits at the lowest possible cost” (art. 3.3), for anthropocentric reasons, and in balance with objectives such as economic development and food production. SRM may allow this to be done. Several commitments are to undertake research and to develop and diffuse new technologies in order to reduce uncertainty, including that of “various response strategies” (arts. 4.1(g) and (h)). Nevertheless, the mandate for the UNFCCC is unclear with regard to SRM, and whether its institutions will address the matter is ultimately a political matter (Reynolds, 2017).

The Convention on Biological Diversity (CBD, 1992) may be the most important general environmental treaty due to its broad provisions to protect biodiversity—which is affected by many large scale human activities—and to its near-universal participation.[3] Among other things, its parties commit to several procedural duties concerning activities that are likely to have “significant adverse impacts” on biodiversity, which some climate engineering methods would (art. 7(c)). Perhaps more importantly, its Conference of Parties has taken an interest, agreeing to three statements regarding climate engineering (CBD 2008; 2010; 2012, 2016). These are the only statements on climate engineering in general that originated in a near-universal international legal forum. The 2010 one is a nonbinding statement of caution, asking the parties to refrain from climate engineering that may affect biodiversity until there is scientific basis for such work and “appropriate consideration of the associated risks”. This request is to continue “in the absence of science based, global, transparent and effective control and regulatory mechanisms.” It makes an exception for small scale scientific activities. The 2016 decision reaffirms previous ones while calling for more research to improve understanding of climate engineering’s potential impacts on biodiversity

The Environmental Modification Convention is a less well-known multilateral agreement that prohibits the military application of weather modification methods (ENMOD, 1976). Its definition of “environmental modification techniques” would include most proposed large scale forms of climate engineering, and its parties may not use these for any “military or any other hostile use” (arts. I.1, II). Notably, the agreement explicitly “shall not hinder the use of environmental modification techniques for peaceful purposes” (art. III.1) and encourages peaceful applications of environmental modification. Although ENMOD includes most industrialized countries among its parties, it has no supporting infrastructure and is essentially dormant.[4]

The comprehensive UN Convention on the Law of the Sea (UNCLOS, 1982), with near-universal participation, would govern climate engineering activities that take place at sea or that would affect the marine environment.[5] Under it, states' obligation to protect the marine environment is without qualification. As noted in the previous section, its definition of "pollution" that states are obligated to "prevent, reduce, and control" includes climate change, GHGs, and climate engineering activities that are likely to be harmful (art. 1.1(4)). UNCLOS strongly supports scientific research provided that, among other things, it does not interfere with other states' legitimate uses of the sea and it is consistent with protection of the marine environment. The seas are divided into three zones, in which the first twelve miles are the territorial waters of the coastal states, up to 200 miles are the quasi-territorial "exclusive economic zone", and beyond that are the high seas, without national jurisdiction. Ships are the responsibility of their flag state, whose national laws apply to their crews.

The CDR method of ocean fertilization warrants particular attention. It is the exception to the general rule that CDR would present well-characterized, low environmental risks and can mostly be regulated by domestic law. It also the only (thus far) potentially high-risk climate engineering method to be repeatedly tested in the open environment. These outdoor experiments were conducted by universities and other public research institutions during the 1990s and 2000s. However, in reaction to private actors which intended to fertilize the oceans to try to obtain marketable carbon credits, the parties to the London Convention (1972) and London Protocol (1996)—which govern dumping in the high seas—developed two regulatory systems for its parties.[6] The first is a nonbinding process under which the states' national environmental regulatory agency review and, if appropriate, approve an ocean fertilization field test if it is legitimate scientific research, has undergone adequate environmental impact assessment, and satisfies other procedural requirements (London Convention and London Protocol, 2010).[7] The second is an amendment—approved but not yet in force—to the London Protocol. Under this, its parties could either prohibit or regulate various forms of "marine geoengineering." To date, only ocean fertilization has been so categorized by the parties, in its case as a regulated activity (London Convention and London Protocol, 2013).

In addition to treaties, countries regularly approve statements that are not intended to be legally binding but, like the statements of the CBD's parties, indicate a sense of the international community. One of particular relevance is the Provisions for Co-operation between States in Weather Modification, approved by the UN Environmental Programme in 1980 (UNEP, 1980). Despite the name, its relevant definition clearly includes SRM. It is supportive of weather modification "dedicated to the benefit of mankind [sic] and the environment" (para 1.(a)), asks states to not use it to cause harm to the environment of other states and areas beyond national jurisdiction, and calls for cooperation and communication among states.

The final source of traditional international environmental law is its general principles. These remain weakly defined and not legally binding until they are operationalized in a particular agreement. For the case of climate engineering, the most relevant principles (among those that are not yet embodied as customary international law) are those of sustainable development (states should develop their resources in a sustainable manner), polluter pays (the polluter rather than the victim should pay for environmental harm and its prevention), common but differentiated responsibilities (all countries have responsibilities to prevent environmental harm but these responsibilities differ, largely based on a state's stage of economic development), and precaution (when confronting a risk of serious or irreversible harm, scientific uncertainty should not be used as a reason to postpone precautionary measures). Reasonable arguments could be made that the research or implementation of climate engineering is supported by or is contrary to each of these (Reynolds, 2014).[8] This should not be surprising, considering the principles' inchoate character and the peculiar challenges that climate engineering presents for international environmental law, described above.

Other International Law

A handful of international legal instruments outside of the environmental domain warrant brief reference. Numerous observers have asserted that disagreements regarding SRM could heighten tensions among states. The UN Charter requires international disputes to be settled peacefully. Of course, if there were actually full compliance with this, then interstate hostilities would cease. Disputes are primarily political matters that may be settled through a variety of means such as negotiation, mediation, arbitration, and, in some cases, international legal forums. The legal forum with the broadest mandate is the UN General Assembly, which can take up almost any matter but issue only nonbinding statements. In contrast, the UN Security Council is limited to the "maintenance of international peace and security" and can issue binding, non-consensual (i.e. majoritarian) resolutions, although five of the most powerful countries have veto power. These resolutions can be backed by the threat of force, including sanctions and military action, which would then need to be carried out by willing UN member states. The International Court of Justice is another forum for dispute resolution. Although its rulings may be enforced by the Security Council, states must consent to the court's jurisdiction in the case at hand before the trial of a contentious issue for its later ruling to be binding. Finally, some treaties contain dispute resolution forums that are applicable within their scope.

Human rights agreements provide an exception to the rule that international law governs actions that may impact other states. Under these, parties agree to treat their own citizens and residents in a manner consistent with various norms. Human rights could influence climate engineering in diverse ways. For example, states are to protect scientific freedom, and to help people enjoy the benefits thereof. Climate engineering field research and, or the withholding of them in the face of dangerous climate change, could affect the human rights to the highest attainable standard of health, to an adequate standard of living, and to be free from hunger.

The development of climate engineering could lead to patented inventions. Patents, which grant their holder the exclusive right to commercially utilize an invention, are domestically issued, while patent policy is to some degree internationally coordinated and harmonized. National governments may take two notable actions regarding patents as potentially controversial and important as those for climate engineering techniques. First, they may decide to exclude certain climate engineering methods from patentability because they would be contrary to public morality, including "to avoid serious prejudice to the environment" (TRIPS, 1994, art. 27.2). They may also choose to compel a patent holder to license the patent due to public interest considerations, such as on the grounds of national defence or public health.[9]

Finally, as described in the previous section, nonstate instruments and institutions can be effective in regulating transboundary actors such as scientists. The contours of such global governance may be emerging in the case of climate engineering. Most notable has been the development of explicit, nonbinding norms. Their sources are somewhat disparate: the Oxford Principles from a handful of British academics, the Asilomar Principles from the committee of a large meeting of climate engineering researchers and others, the report from a task force assembled by the US Bipartisan Policy Center, and a report issued by a think tank affiliated with the German Green Party (Bipartisan Policy Center's Task Force on Climate Remediation, 2011; Leinen, 2011; Kössler, 2012; Rayner et al., 2013; see also Hanafi and Hamburg, 2017). There is remarkable overlap among these four sets, and there are no clear disagreements among them. Among other things, these variously call for public participation in decision making, for open publication and independent assessment of results, and for climate engineering to be developed in a manner that benefits the collective public.

Synthesis and Next Steps

Some observers argue that because existing international law does not address all potential scenarios of conflict and harm from climate engineering, the solution is universal binding regulation of climate engineering through legal instruments. However, it may be beneficial to first take stock of extant law, the urgency of filling the legal gaps, and the limits of international law. In general, the UNFCCC regime establishes a framework for how CDR could contribute to the goal of stabilizing GHG concentrations, and it might eventually offer a forum for addressing the governance of SRM as well (but see Reynolds 2017). ENMOD and the UNEP Provisions for Weather Modification point toward the international community's support of using large scale interventions in weather and climatic systems for the benefit of humans and the environment. The CBD decisions provides its sense of caution regarding climate engineering's potential negative environmental impacts while noting the need for further research. Further, universal duties concerning potential transboundary harm are well-established in customary international law, and in some cases by specific agreements.[10] The areas beyond national jurisdiction and control each have agreements with sufficient participation and that detail their parties' rights and obligations.[11] Of these areas, the seas are the most likely site for climate engineering experimentation and implementation, and there there are detailed agreements, including one with near-universal participation and a tribunal to resolve disputes. In fact, it is ocean fertilization—the method that poses relatively large environmental risks and has seen the most progress in outdoor research—for which a detailed international regulatory regime is emerging. Finally, unilateral implementation of SRM by "rogue" countries could, in extreme scenarios, be tackled by the UN Security Council. Although not comprehensive, this is far from a legal vacuum.

In terms of urgency, most climate engineering proposals—especially relatively early field experiments—would affect the local environment first and foremost. That is the domain of national law, which is well-developed in most states, and especially in those that are likely to carry out tests. Those proposed methods that might be effective and have regional or global impacts appear decades away from implementation. In contrast, large scale field research is a more pressing matter. There, activities, risks, and effective precautions will be highly dynamic. Binding, detailed rules would quickly become obsolete, particularly in the international domain, which moves more slowly. Finally, international law has limits, and not all potential international conflicts should be subject to specific legal rules. International politics—another important means to manage conflicts—may appear sloppy, improvised, and sometimes unjust, but it is adaptive and flexible. This may be precisely what's needed as climate engineering emerges.

At the same time, there are some gaps in the current international legal system that are relatively urgent but also resolvable. First, an international hub of scientific research could fulfil multiple beneficial functions (Ghosh, 2017). It could coordinate research and foster international collaboration, a low cost means to increase transparency and trust as well as to combat the nationalization and fragmentation of research. An international body could also serve as an open repository of experiments' methodologies and results. And it could provide a site for the operationalisation of emerging research norms and possibly even their enforcement through both "carrots" and "sticks". Second, special approaches to intellectual property in climate engineering should be developed. There appears to be a consensus that patents on SRM technologies could be problematic, and alternative mechanisms should be considered before such patents become "facts on the ground" (Reynolds et al., 2017). Third, international institutions should resolve to what extent the various CDR methods could qualify toward countries' GHG emissions and for marketable credits. Lastly, a system of compensation for transboundary harm from climate engineering—particularly its field research—should be seriously considered (Reynolds, 2015; Horton et al, 2017).

Legal scholarship can also contribute to better understanding of climate engineering regulation. It is more than twenty years since the first academic article on climate engineering and international environmental law (Bodansky, 1996). This area has been further—and fruitfully—explored in numerous publications, especially during the last five to ten years. Yet national laws are more detailed and better enforced than international law, and most effects of early climate engineering projects will likely be experienced locally. Explorations of the implications of national law for climate engineering are an opportunity for work in the near future.

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[1] The Rio Declaration—arguably the most important general document in international environmental law—attempts to balance environmental and development goals under the rubric of "sustainable development" and the principle of common but differentiated responsibility. This latter principle is also seen in obligations to take action to prevent dangerous climate change in the UNFCCC.

[2] Indeed, current modelling indicates that some forms of it could greatly reduce net climate risks at low cost and in a short time. The Intergovernmental Panel on Climate Change concluded that: "Models consistently suggest that SRM would generally reduce climate differences compared to a world with elevated greenhouse gas concentrations and no SRM…" (Boucher et al., 2013, p. 575; see also Kravitz et al., 2014).

[3] The US is not a party.

[4] The treaty neither creates standing institutions nor calls for a regular meeting of its parties. Review conferences were held in 1984 and 1992, but in 2014 there was insufficient interest in a third. No complaints have ever been filed under it, and its Consultative Committee of Experts has never been convened.

[5] The US is not a party but recognizes most of it as customary international law.

[6] Note that the London Protocol, presently with 48 parties, is indented to replace the London Convention, with 87 parties, although both are in force. Most industrialized and transitional countries are parties to at least one.

[7] This was approved by a joint meeting of Parties to both the London Convention and Protocol.

[8] In this paper, I argue that at least the latter three of these principles supports climate engineering field research.

[9] TRIPS, the European Patent Organization, and the North American Free Trade Agreement all permit their parties both patent exclusions and compulsory licenses..

[10] E.g. the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention, 1991).

[11] UNCLOS; Madrid Protocol; Outer Space Treaty (1966).