Geoengineering Our Climate?

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Solar Geoengineering and the Problem of Liability

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The prospect of solar geoengineering, or methods of reducing incoming solar radiation in order to offset the effects of climate change, raises a number of significant governance challenges that are likely to be far more difficult to overcome than the technical barriers to development. Who decides when to use solar geoengineering? Who decides when to test it? How should these decisions be made? What climatic targets should guide an intervention? How should geoengineering be tied to mitigation and adaptation? What if something goes wrong?

This last question points to the issue of liability, that is, how society resolves cases in which parties suffer unfairly from the consequences of activities carried out by others. If solar geoengineering were deployed, it would yield both benefits and harms because even if it could perfectly compensate for greenhouse gas-driven climate change—and it could not—it would harm those who stand to gain from a warming world. Such harms would be expected in that they would arise from the intended effect of geoengineering. Unintended damages might occur if geoengineering acted unexpectedly. A just and stable governance regime will require some way to compensate countries for damages incurred. A system of liability and compensation would need to be based on sovereign states, since even if private actors undertook geoengineering, national governments would likely be held ultimately accountable for their actions. Undoubtedly, it will be more difficult to get widespread agreement to conduct geoengineering without a liability mechanism.

Take the following hypothetical situation. Twenty years from now, the United Nations (UN) decides to authorize and endorse a large-scale stratospheric aerosol injection program headed by the United States (US). The program is intended to create a thin aerosol "sunshade" in the upper atmosphere that will block a small fraction of sunlight from reaching the Earth's surface, thereby reducing global temperatures to counteract increased greenhouse gas concentrations. Within months of deployment, an unusually severe drought strikes Russia, its annual grain harvest falls far below expectations, and millions of Russians are threatened with hunger and malnutrition. The Russian government blames these events on the UN-sponsored, US-led solar geoengineering program initiated months earlier, and demands restitution. How would the international community deal with this?

Many scenarios like this can easily be imagined. In this case, the available scientific evidence may not allow for definitive answers to the question of what caused such extreme weather. Despite weak evidence, the Russian government may feel pressured by its populace to hold geoengineering responsible. More cynically, the government may suspect—or know—that there is no causal linkage between geoengineering and the drought in Russia, but may publicly blame the former anyway in an attempt to extract international reparations. Or Russian scientists may sincerely believe that a strong causal connection exists, leading the government to make the charge in good faith.

The real possibility of such situations arising means that any workable solar geoengineering governance regime will need to include some arrangement for assessing liability for alleged damages and awarding compensation when appropriate. Furthermore, major world powers would be unlikely to accept a geoengineering deployment in the absence of a well-designed liability system. Therefore, a credible liability and compensation mechanism will be essential to any future use of solar geoengineering techniques, and arguably to any future field research with the potential for substantial cross-border effects.

Precedents for International Liability

Researchers have identified many possible effects of solar geoengineering that could pose risks across international borders. Disruptions to regional hydrological cycles, like droughts, are one widely discussed risk. Others include damage to the ozone layer, increased acid rain, negative effects on plant ecology, and reduced effectiveness of solar power generation.[1] If implementation is ever seriously considered, these and other risks associated with stratospheric aerosols, marine cloud brightening, and possibly other forms of solar geoengineering will need to be adequately managed via a system of international legal liability.

Fortunately, the international community has considerable experience crafting and executing liability regimes, and legal scholars have developed an impressive body of knowledge about the theory and practice of international liability. In international law, liability systems vary in two key ways. First, the standard of liability, or principle by which culpability is assigned, can be either "fault-based," according to which a country must have caused cross-border damages *and* must have done so intentionally, or "strict," for which cause alone is sufficient to establish liability. Second, accountability for damages can be structured as either "civil," under which private parties are held responsible, or "state," in which case governments are responsible. Liability regimes also differ in terms of exemptions allowed, the extent of damages third parties may claim, the extent of compensation responsible parties must provide, and in other ways.

In practice, most liability regimes have been based on strict, civil liability, and the majority of regimes have been developed in the environmental field. Starting in the 1950s, international liability regimes have been adopted to address oil spills, movements of hazardous wastes, nuclear accidents, protection of the Antarctic environment, genetically modified organisms (GMOs), and other environmental hazards, as well as non-environmental issues such as aircraft accidents and space debris.[2] The histories of some of these regimes provide useful insights into the sorts of institutional features that would be appropriate to a future system of liability for solar geoengineering.

The Space Liability Convention of 1972, for instance, set up a system for compensating third parties who suffer damage from spacecraft, satellites, or other "space objects," whether the damage occurs in outer space, in the atmosphere, or on the ground. The Convention carves out a special role for "launching states" as potentially liable parties, a designation with obvious application to solar geoengineering activities. In 1981, the claims procedure prescribed by the Convention helped lead to an amicable settlement between Canada and the Soviet Union after the Soviet nuclear-powered satellite Cosmos 954 accidentally broke up over Canadian territory.

[1] Royal Society 2009

[2] Secretariat of the International Law Commission 1995

Another useful example is the international oil spill regime, which consists of a series of interlocking agreements adopted beginning in 1969. The core functions of this arrangement are provided by the International Oil Pollution Compensation (IOPC) Funds, a collection of independent financial bodies responsible for providing indemnification to parties who suffer damage as a result of oil spills at sea. The IOPC Funds are governed multilaterally but funded exclusively by mandatory levies on oil companies; to date, the Funds have paid out more than $700 million in compensation.[3] Such a financing mechanism, built explicitly on the "polluter pays" principle, might serve as a model for solar geoengineering liability, since climate interventions like stratospheric aerosols would be staged in response to carbon pollution largely traceable to the fossil fuel industry.

The Problem of Attribution

When considering liability in the context of solar geoengineering, an especially problematic issue has to do with the difficulty of demonstrating causal attribution. Traditionally, proving legal liability has required showing a direct cause-effect relationship between an action committed by an alleged wrongdoer, and damages suffered by the victim. Determining the source of an oil spill is a relatively straightforward task. However, establishing an unambiguous direct causal connection between a solar geoengineering intervention and damages alleged to have occurred as a result is impossible due to the highly complex nature of the climate system. Instead, interventions in the climate system (*including* greenhouse gas emissions) affect the *likelihood* of particular weather events or other outcomes occurring, by shifting the systemic parameters within which discrete events take place.

The inapplicability of traditional notions of attribution in the climate field presents obvious obstacles to constructing a workable system of liability and compensation, with regard to both climate engineering and climate change more broadly. Yet this problem has been successfully overcome in other fields such as tobacco litigation, "toxic torts" (including pharmaceuticals), and radiation exposure, where statistical evidence based on probabilistic models has served as the basis for findings of liability and damage awards. Probabilistic approaches such as Fraction Attributable Risk (FAR) are currently being developed and refined by climate researchers, and are increasingly being used to assert causation and liability in the growing body of climate law.[4] In the US, for instance, claims of climate damage based on statistical models have featured in high-profile cases including *American Electric Power Company v. Connecticut*, *Kivalina v. ExxonMobil Corporation*, and *Comer v. Murphy Oil*. In the UN Framework Convention on Climate Change (UNFCCC), attribution is an important focus of the ongoing Work Programme on Loss and Damage.[5]

Design Principles

A careful consideration of existing liability regimes and evolving approaches to attribution using statistical methods points toward a small set of first-order design principles for any future solar geoengineering liability regime:

[3] IOPC Funds 2011

[4] Lord et al. 2012

[5] http://unfccc.int/adaptation/workstreams/loss_and_damage/items/6056.php.

1. Strict liability—This has become the accepted standard for international liability.
2. State accountability— Governments, rather than private parties, would be primarily responsible for staging an intervention.
3. Compensation fund—Similar to the IOPC Funds, potentially financed by the fossil fuel industry (because the underlying climate risk for which geoengineering is a partial and imperfect fix derives from fossil fuel emissions).
4. Attribution based on probabilistic models—FAR (or preferably more sophisticated methods) would be needed to demonstrate causation.
5. Inclusiveness—A wide range of governments, businesses, and other actors involved with the regime would help ensure adequate resources as well as political legitimacy.
6. Flexibility—Institutional flexibility would be key to coping with the multiple uncertainties associated with climate science and geoengineering, in addition to geopolitical unknowns.

These principles, while high-level, are informed by historical practice, established jurisprudence, and current scientific understanding, and would surely serve as useful guideposts in any effort to design a liability mechanism for solar geoengineering. A successful effort would also need to reflect an underlying ethical framework that is generally regarded as just and fair.[6] A liability mechanism, however, can only be effective to the extent it rests on prior political agreement that the activity in question, in this case geoengineering, is permissible. At the same time, a credible liability mechanism enhances the chances that a political agreement is reached. In this way, relatively narrow questions of liability and more general political and diplomatic questions about the desirability of geoengineering are closely bound to each other, and responses to them are likely to develop in tandem.

[6] Bunzl 2011

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