Climate Change Geoengineering

PHILOSOPHICAL PERSPECTIVES, LEGAL ISSUES, AND GOVERNANCE FRAMEWORKS

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Political Legitimacy in Decisions about Experiments in Solar Radiation Management

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1. INTRODUCTION

For better or for worse, geoengineering has moved from the fringes of the climate change debate to the halls of Capitol Hill[1] and Westminster.[2] Of course, a great deal of research remains to be done before the world decides whether to introduce geoengineering as a complement to mitigation and adaptation; academics and policy makers are still wrestling with the scientific, political, legal, social, and ethical questions surrounding the intentional modification of the climate. Here we address the institutional aspects of some of the ethical issues raised by research on geoengineering.

The most ethically challenging form of geoengineering research involves solar radiation management (SRM),[3] which attempts to reduce the earth's absorption of incoming solar radiation. One proposed mechanism for SRM is the injection of aerosols into the stratosphere, which would deflect more solar radiation back into space. In contrast to research into carbon dioxide removal (CDR), which is the other main category of proposed geoengineering activities, SRM research is particularly challenging ethically because studying and testing SRM technologies can require deployment at scales that could have significant regional or global climatic effects.[4] For instance, testing the effects of stratospheric aerosol injection would require lofting enough aerosols into the atmosphere, over a long enough period of

[1] *See* Geoengineering III: Domestic and International Research Governance, 111th Cong. (2010).

[2] *See* Science & Technology Committee, The Regulation of Geoengineering, 2010, H.C. 221 at 3.

[3] Some earlier work, including ours, refers to SRM as "short-wave climate engineering." We regard these two terms as synonymous. *See* David R. Morrow, Robert E. Kopp & Michael Oppenheimer, *Toward Ethical Norms and Institutions for Climate Engineering Research*, 4 ENVTL. RES. LETTERS 045106, 2 (2009). *See also* J.J. BLACKSTOCK ET AL., CLIMATE ENGINEERING RESPONSES TO CLIMATE EMERGENCIES 2 (2009).

[4] BLACKSTOCK et al., *supra* note 3, at 25.

time, to distinguish the effect of the aerosols from normal climatic variation.[5] The consequences of such large-scale testing could cause serious harm to millions of people. For instance, SRM could change regional precipitation patterns, threatening water supplies and agriculture.[6] Moreover, whereas CDR aims to return the atmosphere to an earlier, familiar state, SRM aims to create a new state – one of high greenhouse gas (GHG) concentrations and reduced insolation – about which we know much less.

In an earlier paper we suggested three ethical principles for SRM research based on established principles for biomedical research with human subjects.[7] The analogy between SRM and biomedical research is, like all analogies, imperfect. In this chapter, we consider some of the ethical implications of one limitation of that analogy – namely, the fact that decisions to participate in biomedical experiments are made individually, whereas the decision to "participate" in an SRM experiment is a collective decision. Specifically, we explore the possibility of designing an international institution that would have the moral authority to make collective decisions about SRM experiments. We consider the requisite features of such an institution and examine the characteristics of other global governance institutions as comparable cases.

[5] Morrow et al., *supra* note 3, at 6.

[6] Alan Robock et al., *A Test for Geoengineering?* 327 SCI. 530, 531 (2010). *See also* Govindasamy Bala, K. Caldeira & R. Nemani, *Fast versus Slow Response in Climate Change: Implications for the Global Hydrological Cycle*, 35 CLIMATE DYNAMICS 423, 433 (2010); A. Jones et al., *Geoengineering by Stratospheric SO_2 Injection: Results from the Met Office HadGEM Climate Model and Comparison with the Goddard Institute for Space Studies ModelE*, 10 ATMOS. CHEM. PHYS. 5999, 6005 (2010).

[7] Jones et al., *supra* note 6; *Id.* at 1.

[8] Morrow et al., *supra* note 3, at 3–6.

[9] Roughly tens to hundreds of kilotons per year if the injectant is SO_2 as a precursor of sulfate aerosols, based on calculations using previously published significance thresholds and radiative forcing

4.2 *Institutions for Managing Global Commons*

A stable planetary climate represents a type of global commons – a global public good that no single country is capable of controlling.[55] SRM experiments involve a rapid, deliberate change in the climate – a change that could have negative conse-

[54] *See* Morrow et al., *supra* note 3, at 3–6.

[55] Marvin S. Soros, *Garret Hardin and Tragedies of Global Commons*, *in* HANDBOOK OF GLOBAL ENVIRONMENTAL POLITICS 35, 45 (Peter Dauvergne ed., 2006).

quences for some persons and ecosystems. Thus, GGIs designed to manage global commons provide another type of model for an SRM GGI.

Like a stable climate, Antarctica is viewed by many as a global commons. The Antarctic Treaty System (ATS), established in 1959 by the twelve countries active in Antarctica during the International Geophysical Year, sought to ensure the peaceful use of this commons for scientific exploration.[56] Today, the Treaty has forty-eight parties. Twenty-eight of these parties are active in Antarctica and therefore have decision-making authority as Consultative Members; the remaining twenty have observer status as Non-Consultative Members.[57]

The original Antarctic Treaty focused primarily on freezing territorial claims and establishing a legal framework for exploration. Environmental issues entered the ATS through later protocols, the most comprehensive of which is the 1991 Protocol on Environmental Protection (the Madrid Protocol). The Madrid Protocol, which entered into force in 1998, is perhaps most broadly known for establishing a fifty-year moratorium on exploiting mineral resources in the Antarctic; more relevant to our analysis, it also established a set of principles regarding environmental protection, an intergovernmental body of scientific experts to offer advice on environmental issues, a procedure for environmental impact assessment of activities in Antarctica, and a consultative process regarding these activities.[58]

Article 3 of the Protocol lays out a set of principles that gives primacy both to ethical concerns and scientific research. These principles require that activities in the Antarctic be planned and executed "so as to limit adverse impacts on the Antarctic."[59] The article also mandates monitoring of risky activities and requires that such activities be modified or stopped if monitoring reveals adverse impacts.[60] In principle, this article requires states parties to give significant weight to environmental, ethical, and even aesthetic values in regulating governmental and nongovernmental activities in the Antarctic. Among the ethical principles recognized are those akin to our Principles of Minimization and Respect.[61]

Article 11 establishes the Committee for Environmental Protection (CEP). The CEP consists of representatives from each Party to the Protocol, along with their advisors. Parties to the ATS who are not Parties to the Protocol, as well as relevant NGOs invited by the CEP, may attend meetings as observers. The Protocol instructs the CEP to provide technical advice on the implementation of the Protocol, including

[56] Antarctic Treaty, 1 Dec., 1959, 402 UNTS 71.

[57] Secretariat of the Antarctic Treaty System, "Parties" (2008), http://www.ats.aq/devAS/ats_parties.aspx.

[58] Madrid Protocol on Environmental Protection to the Antarctic Treaty, 4 Oct., 1991, 30 ILM 1455 [hereinafter Madrid Protocol].

[59] *Id.* at Art. 3, para. 2. (See the Appendix to this chapter for the complete text of Article 3.)

[60] *Id.* at Art. 3, para. 2(d)–(e), 4(b).

[61] *See* Morrow et al., *supra* note 3, at 3–6.

advice on the effectiveness of parties' efforts to comply with the Protocol.[62] Because the CEP must release reports on its sessions to states parties and to the public,[63] it could alert interested states and members of civil society to activities that run contrary to the Protocol. Ultimately, however, the CEP's role is strictly advisory; it has no power to affect decisions directly.

The states parties hold ultimate responsibility for assessing the environmental impact of their activities, although they must discuss their assessment of some activities with the other Parties and the CEP. As laid out in Article 8 and Annex I, the Protocol recognizes three tiers of activities in the Antarctic: those determined by national procedures to have "less than a minor or transitory impact," those "likely to have no more than a minor or transitory impact," and those likely to have "more than a minor or transitory impact."[64] Activities falling into the second category require an Initial Environmental Evaluation characterizing the activity, alternatives to the activity, and likely impacts.[65] Activities falling into the third category require a Comprehensive Environmental Evaluation (CEE), which describes the state of the environment prior to the activity; the activity and all relevant alternatives, including the alternative of not proceeding with the activity, along with the expected consequences of each alternative; the direct and indirect impacts of the proposed activity; the cumulative impact of the proposed activity, given existing and currently planned activities; the methodology and data used to forecast consequences; the measures that could be taken to monitor the effects of the activity and to minimize or mitigate them; a nontechnical summary of the above information; and the contact information for the author(s) of the CEE.[66]

The draft CEE must be circulated for review to the public, to the Antarctic Treaty parties, and to the CEP. In principle (although not always in practice), the activity cannot proceed until the draft CEE has been considered by the Antarctic Treaty Consultative Meeting on the advice of the Committee, and a final version of the CEE must respond to the comments raised in the review process. The draft and final CEE must be made publicly available.[67] Once the activity begins, its impacts must be monitored.[68]

Christopher Joyner highlights a number of potential weaknesses in the Madrid Protocol process.[69] The role of the Environmental Impact Assessment consultative

[62] Madrid Protocol, *supra* note 58, at Art. 11.
[63] *Id.* at Art. 11, para. 5.
[64] *Id.* at Art. 8, para. 1.
[65] Madrid Protocol, *supra* note 58, at Annex I, Art. 2.
[66] *Id.* at Annex I, Art. 3, para. (1)–(2).
[67] *Id.* at Annex I, Art. 3, para. (3)–(6).
[68] *Id.* at Art. 8.
[69] CHRISTOPHER C. JOYNER, GOVERNING THE FROZEN COMMONS: THE ANTARCTIC REGIME AND ENVIRONMENTAL PROTECTION 165–74 (1998).

process is fundamentally hortatory; although individual governments must respond to comments under the Protocol, they retain the final decision on whether to proceed with a specific activity. In addition, the boundaries between the different categories of activities are ill-defined, left to some combination of party judgment and the evolution of precedent. More broadly, the mechanism of enforcement of the Protocol in general is unclear: parties are to enforce it through laws and regulations, and shall exert "appropriate efforts, consistent with the Charter of the United Nations" to ensure that other parties do,[70] whereas an Arbitral Tribunal or the International Court of Justice is empowered to settle disputes, but again these are largely hortatory procedures.[71]

Despite these problems, the Madrid Protocol provides a GGI model that directly addresses elements of scientific research ethics and the Complex Standard. In particular, the consultative process for assessing proposed activities exemplifies the transparency and stakeholder engagement necessary for legitimacy. CEEs must contain nontechnical summaries, making them more easily digestible by states and civil society. Draft and final CEEs, along with reports on CEP sessions, are distributed to states parties and the public.[72] This increases the transparency of the international governance of Antarctic activity, as required by the Complex Standard.

The Madrid Protocol does not, however, provide an effective means for citizens of one state to hold another state or its citizens accountable for behavior that violates the Protocol. The hortatory nature of the EIA process would be even more problematic in the case of SRM, where the incentive to ignore the exhortations of other states might be much greater than in the Antarctic case. If an SRM GGI had no more power than the CEP does in Antarctica, then it could not deter even a moderately motivated state from conducting SRM experiments. Conversely, an SRM GGI that could, at its own discretion, prohibit certain experiments would be too powerful – too much like Baruch's proposed IADA – to be feasible, and a GGI that could prohibit experiments if and only if they violated constraints laid down in a treaty would be more like the CTBT than the CEP. Thus, replacing the hortatory model of the Madrid Protocol with something stronger brings us back to the nuclear weapons testing models.

Some elements of the Madrid Protocol could be readily adapted to the context of SRM research governance. Article 3 in particular would need just one major addition – impact on human populations – and a suite of minor contextual adaptations to address the global climate commons instead of the Antarctic "frozen commons." The conditions and processes for conducting environmental impact assessments

[70] Madrid Protocol, *supra* note 58, at Art. 13, para. 1–2.

[71] JOYNER, *supra* note 69, at 166.

[72] Madrid Protocol, *supra* note 58, at Annex I, Art. 3.

APPENDIX: ARTICLE 3 OF THE MADRID PROTOCOL

The complete text of Article 3 of the Madrid Protocol reads:

1 The protection of the Antarctic environment and dependent and associated ecosystems and the intrinsic value of Antarctica, including its wilderness and aesthetic values and its value as an area for the conduct of scientific research, in particular research essential to understanding the global environment, shall be fundamental considerations in the planning and conduct of all activities in the Antarctic Treaty area.

2 To this end:

(a) activities in the Antarctic Treaty area shall be planned and conducted so as to limit adverse impacts on the Antarctic environment and dependent and associated ecosystems;

(b) activities in the Antarctic Treaty area shall be planned and conducted so as to avoid:

(i) adverse effects on climate or weather patterns;

(ii) significant adverse effects on air or water quality;

(iii) significant changes in the atmospheric, terrestrial (including aquatic), glacial or marine environments;

(iv) detrimental changes in the distribution, abundance or productivity of species of populations of species of fauna and flora;

(v) further jeopardy to endangered or threatened species or populations of such species; or

(vi) degradation of, or substantial risk to, areas of biological, scientific, historic, aesthetic or wilderness significance;

(c) activities in the Antarctic Treaty area shall be planned and conducted on the basis of information sufficient to allow prior assessments of, and informed judgements about, their possible impacts on the Antarctic environment and dependent and associated ecosystems and on the value of Antarctica for the conduct of scientific research; such judgments shall take account of:

(i) the scope of the activity, including its area, duration and intensity;

(ii) the cumulative impacts of the activity, both by itself and in combination with other activities in the Antarctic Treaty area;

(iii) whether the activity will detrimentally affect any other activity in the Antarctic Treaty area;

(iv) whether technology and procedures are available to provide for environmentally safe operations;

(v) whether there exists the capacity to monitor key environmental parameters and ecosystem components so as to identify and provide early warning of any adverse effects of the activity and to provide for such modification of operating procedures as may be necessary in the light of the results of monitoring or increased knowledge of the Antarctic environment and dependent and associated ecosystems; and

(vi) whether there exists the capacity to respond promptly and effectively to accidents, particularly those with potential environmental effects;

(d) regular and effective monitoring shall take place to all assessment of the impacts of ongoing activities, including the verification of predicted impacts;

(e) regular and effective monitoring shall take place to facilitate early detection of the possible unforeseen effects of activities carried on both within and outside the Antarctic Treaty area on the Antarctic environment and dependent and associated ecosystems.

3 Activities shall be planned and conducted in the Antarctic Treaty area so as to accord priority to scientific research and to preserve the value of Antarctica as an area for the conduct of such research, including research essential to understanding the global environment.

4 Activities undertaken in the Antarctic Treaty area pursuant to scientific research programs, tourism and all other governmental and nongovernmental activities in the Antarctic Treaty area for which advance notice is required in accordance with Article VII (5) of the Antarctic Treaty, including associated logistic activities, shall:

(a) take place in a manner consistent with the principles in this Article; and

(b) be modified, suspended or cancelled if they result in or threaten to result in impacts upon the Antarctic environment or dependent or associated ecosystems inconsistent with those principles.[73]

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[73] *Id.* at Art. 3.