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Climate Ethics

Ethical Analysis of Climate Science and Policy

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Ethical Issues Created by Geo-engineering Proposals - An Initial Analysis

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I. Introduction to ethics of geo-engineering of the climate system

Climate change raises profound challenges to justice, equity, and ethics for the entire human race. (See, Brown et al, 2006) For instance, governments, organizations, and citizens are called by justice to limit their greenhouse gas emissions to their fair share of global emissions. Further, most of the technical solutions to climate change have environmental, economic, and social impacts that raise additional issues about justice and ethics.

Several technologies have been proposed that call for intentionally intervening in the Earth's climate system to mitigate the effects of climate change. These projects are usually referred to under the term "geo-engineering." Most proponents of these technologies agree that geo-engineering projects raise serious ethical and legal issues that need to be examined before these technologies are deployed.

This note briefly looks at some of the ethical and legal issues raised by two very similar geo-engineering proposals. The first is by Tom Wigley and the second by Paul Krutzen (Wigley 2006; Krutzen 2006). Both of these proposals discuss cooling the planet by injecting aerosol particles into the stratosphere to counteract the warming effect of CO2 and other greenhouse gases (GHGs). The aerosol particles act as a shade that block the sun's energy from reaching the lower atmosphere and surface. As such, these proposals intend to create a "virtual Pinatubo" effect. On June 15, 1991, Mount Pinatubo in the Philippines violently erupted and released particles up into the stratosphere (approx +20km). This release caused an approximately -0.5 0C cooling of the Earth surface temperature in 1992--an effect that was observed into 1995.

In a manner similar to Mount Pinotubo, the Wigley and Krutzen proposals plan to intentionally inject aerosols into the stratosphere to reduce the global warming effect by blocking and reflecting some of the sun's incoming energy. Both of these proposals would create a negative temperature forcing of the climate system to offset part of the positive forcing due to increasing greenhouse gases concentrations. These proposals differ mainly in how the aerosols would be injected into the atmosphere.

Both the Wigley and Krutzn proposals do not advocate immediate deployment of these technologies and recognize problems and issues that need to be faced before such technologies should be deployed. However, the proponents of these technologies believe that since the catastrophic effects of rapid climate change might overwhelm impacts from the geo-engineering projects, it is desirable to proceed with additional research on these projects to be prepared in the case that the worse happens.

This note begins to identify the ethical issues that need to be considered by such geo-engineering proposals. Our analysis here is preliminary.

II. Ethical Questions Raised by These Proposals

This note looks at the following issues:

- What is the ethical significance of the differences between inadvertent and intentional interference with the climate system?
- What ethical issues are raised by the scientific uncertainties in the deployment of these technologies?
- What ethical issues are raised by the need of someone to determine the heating goal for the entire planet, as would be the case in these geo-engineering proposals?



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- Is further research on these proposals ethically warranted?

A. Intentionality of the geo-engineering projects.

The proposals under consideration would represent a large-scale intentional attempt to modify the environment. In this respect, it differs from the inadvertent climate change caused by release of greenhouse gases (GHGs) through activities such as burning fossil fuels, cutting down forests, or releasing methane from coal mines and landfills. Intentional actions have a different moral and legal significance than unintentional actions (Bodansky 2006). From an ethical perspective, once someone knows that their actions may create impacts on others, they have a stronger duty to consider the ethical implications of their actions. As a matter of morality, for instance, intentionally running over a pedestrian is generally considered worse than doing so accidentally (Jamieson 1996).

This is not to say, however, that inadvertent change in the climate system also might not be ethically problematic, particularly when an actor is put on notice of some potential risk to others from their behavior. However, intentional modification of the climate eliminates any defense or excuse that might be otherwise available when the actor has no reason to believe that their actions will harm others. In addition, intentional modification of the climate may create a number of legal problems with a number of international treaties in ways that inadvertent modification of the climate system may not (Bodansky 2006).

B. What ethical issues are raised by the scientific uncertainty about the effects of these technologies?

Geo-engineering projects such as those proposed entail significant scientific uncertainties about their impacts for several reasons including:

- There is a lack of knowledge about climate sensitivity or how much warming or cooling will be caused by different concentrations of substances in the atmosphere. There are also uncertainties about the cooling effects of aerosols--given open questions about their impacts on clouds and other feedback mechanisms. (MacCracken 2006, and Bengtsson 2006)
- There is uncertainty about how these technologies will result in specific atmospheric concentrations of aerosols.
- Because there are different timescales of the effects of aerosols and carbon dioxide in the atmosphere, if aerosols injections were to suddenly cease, the heating that would have occurred in the absence of the increased albedo caused by the aerosols would resume as if there had been no intentional injection of aerosols. This creates uncertainty about how long aerosol injections would be needed in the future (Bengtsson 2006).
- Injecting aerosols does not prevent CO2 levels from increasing. There is lack of understanding about the adverse non-warming impacts of increased CO2 including effects on plants and weeds, acidification of oceans, and whether increasing CO2 concentrations will lead to saturation of carbon sinks to absorb additional CO2. (Bengtsson 2006)

In cases where it is uncertain that human actions will cause adverse effects on others, several ethical issues arise including who should have the burden of proof about proving whether harm will be experienced, what quantity of proof should satisfy that burden, and whether potential victims of possible harm have a right to free-informed consent to be put at risk, etc. (Brown et al. 2006).

For these reasons, to conclude that any geo-engineering project is ethically defensible, its consequences need to be predicted reliably and risks need to be consented to by those who may be affected (Jamieson 1996). Given the huge uncertainties about the effects of these geo-engineering projects on human health and the environment, there are serious ethical questions with their deployment until the uncertainties are resolved and until the international community agrees to allow their deployment. These uncertainties also create significant procedural justice issues discussed below.

Article 3 of the United Nations Framework Convention on Climate Change includes the precautionary principle that provides in relevant part that the absence of scientific certainty about harms should not prevent the Parties from taking precautionary measures to anticipate, prevent or minimize the causes 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 measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost (UNFCCC, 1992, Art 3). It follows that as long as there is uncertainty about whether the injection of aerosols will cause serious harm, one could interpret the "precautionary principle" as requiring that the aerosols not be injected in the atmosphere.

C. What ethical issues are raised by the need of someone to determine the heating goal is for the entire planet?

Because these projects will require the actors who inject aerosols into the atmosphere to make a decision about the quantity of the aerosols to be injected--a decision intended to determine global

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temperature--decisions about the use of these technologies will result in a choice about where to set the global thermostat. For this reason, the projects under consideration raise ethical questions about the right of one group of actors to determine future climate for others. Changing the climate for some will change the climate for all, although people around the world may be differentially affected by introduction of aerosols into the atmosphere. Given that different parts of the world will be harmed or benefited differently by different temperatures, setting the global thermostat will have differential impacts on various parts of the world. That is, the setting of a global temperatures goal will influence wind, storm, drought and flood frequencies, intensities and the effects of climate on human health, and sea-level rise, among other things, for some people. For this reason, in the absence of an international democratically empowered institution to make a decision about global temperature goals, there are serious ethical questions about the right of any actor or nation to make such decisions unilaterally. Because persons who can be harmed by the actions of others have rights to free-informed consent to be put at risk by others, the absence of international agreement on where to set the temperature goal creates serious procedural justice problems (Brown et al, 2006)

D. The ethics of continuing research on these technologies.

A decision to do further research on these technologies could be ethically problematic if:

- It leads to reductions in efforts to rapidly reduce GHG emissions;
- The research takes money away from other needed climate change research issues;
- The research affects the climate system of others who have not consented to the research;
or
- The decision leads to the deployment of these technologies before there was international consent on implementing them.

Yet because it is conceivable that some small-scale research on these technologies could proceed without violating these ethical concerns and given that the world might reach a state of affairs where it is too late to prevent catastrophic warming, additional research on these technologies might be justified provided the above ethical constraints are acknowledged and complied with. However, because this research could always lead to the deployment of these technologies without the consent of all of those who might be affected, international law should be strengthened to prohibit the deployment of these technologies in absence of a global agreement to do so.

	Feasibility (1 to 10)	Cost (\$ to \$\$\$\$)	Risk (1 to 10)	General description and Comments
Store CO2 Underground:	10	\$\$	4	CO2 can be stored in oil reservoirs, coal mines and saline aquifers. It is estimated that underground reservoirs and saline aquifers could store as much as 200,000 gigatons.
Filter CO2 from the air	4	\$\$\$	4	To extract carbon dioxide from ambient air.
Fertilize the ocean	10	\$	9	Adding iron to the ocean would cool the planet by CO2-consuming plankton.
Turn CO2 to Stone	7	\$	3	Known as "mineral carbonation"
Enhance Clouds to Reflect Sunlight	6	\$\$	7	It doesn't involve capturing carbon dioxide. But the focus is on turning down the heat by deflecting or filtering incoming sunlight. It would be said it is like a mirror for incoming solar radiation.
Deflect Sunlight With A Mirror	1	\$\$\$\$	5	Giant space "mirror" positioned between the Earth and sun to intercept sunlight.

Table 1: Geoengineering projects are a range of different strategies--from capturing and storing carbon to reflecting incoming sunlight. These projects all possess different sets of costs, risks, and uncertainties. This table provides a brief overview of the various strategies and the degree of risks and costs.

By:

Maria Silvia Muylaert de Araujo

Collaborator Teacher at the Energy Planning Program of the Coordination of Post Graduation Programs in Engineering at the Federal University of Rio de Janeiro. PPE/COPPE/UFRJ
email: muylaert@ppe.ufrj.br

Luiz Pinguelli Rosa

Executive Secretary of the Brazilian Forum on Climate Change
Director of COPPE/UFRJ

Donald Brown

Associate Professor of Environmental Ethics, Science and Law
Project Coordinator, the Collaborative Program on the Ethical Dimensions of Climate Change,
Rock Ethics Institute
The Pennsylvania State University

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