

The Ethics of Geoengineering [Working Draft]

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What is Geoengineering?

According to David Keith ‘Geoengineering is the intentional large-scale manipulation of the environment, particularly manipulation that is intended to reduce undesired anthropogenic climate change’ (2000, p. 245). Shepherd et al. define geoengineering as ‘... deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change (2009, p. 1), but this seems an overly narrow definition as one might attempt large scale manipulation of the environment with some goal other than to counteract anthropogenic climate change and it seems that such manipulations would be likely to be referred to as ‘geoengineering’.

Arguably we are currently manipulating the environment, by emitting carbon dioxide and other greenhouse gasses into the environment and we can foresee that these emissions will result in a significant change in the environment. But although we can foresee the occurrence of such significant changes, these are not intended by us so these do not count as geoengineering. The distinction between intended effects and foreseen but unintended effects is commonsensical, which is why it has implicitly found its way into definitions of geoengineering, but it is philosophically controversial. Some philosophers will deny that there is a meaningful and significant distinction between the intended and the merely foreseen. On the views of Henry Sidgwick and H. L. A Hart the fact that we can foresee that the emission of significant amounts of greenhouse gas will lead to an increase in global temperature shows that we intend that the mean global temperature is to be increased (Aulisio, 1995, p. 341).

The above definitions of geoengineering do not involve restrictions on the means by which we might seek to manipulate the environment and this lack of restriction seems appropriate given the broad range of approaches to manipulating the environment that have been suggested. These include direct interventions that involve blocking some sunlight from reaching the Earth, including the use of mirrors and the emission of sulphur dioxide into the upper atmosphere. They also include the use of various techniques to capture carbon in the atmosphere and store it in

such a way that it will be prevented from returning back to the atmosphere. Interventions that can be involved in geoengineering proposals those involving living organisms such as mass reforestation programs and fertilizing large areas of the oceans to promote algal growth. It can also involve the use of genetically modified organisms and synthetic organisms.

Dual-Use Issues

The risks most commonly associated with geoengineering are risks of unintentionally disrupting complex ecological systems, which will be discussed in more detail below. Another risk is that geoengineering technologies might be intentionally misused, for example, in terrorist or military attacks. Existing discussions of geoengineering have focused on technologies that might have global effects on climate. However, technologies with more localised effects might be developed, and we can imagine that a malevolent agent might use such technologies to, for example, induce drought or flooding in an enemy territory. Even technologies with global effects might be intentionally misused. For example, a country that would benefit from a global temperature rise might seek to induce such a rise through geoengineering methods even if this would harm most other countries.

It may be possible to reduce the risk of intentional misuse through governance arrangements such as those that have been used to control nuclear, biological and chemical weapons. Similarly, it may be possible to prevent risks from unintentional misuse through sound regulation. However, in some cases the only effective measures for reducing risk may also forestall beneficial uses of geoengineering, for example by having a general chilling effect on scientific progress in this area. There is thus the potential for dilemmas to arise in which it is unclear how to trade-off benefits of promoting good applications of geoengineering against the risks of enabling harmful ones. Such ‘dual-use dilemmas’ have been recognised in other areas of science and technology including nuclear physics and synthetic biology (Miller and Selgelid, 2009; Parliamentary Office of Science and Technology, 2009).

Symptoms & Causes, Moral Hazard

Geoengineering techniques for combating climate change can be regarded as treating symptoms (such as temperature rise or elevated carbon dioxide levels) rather than causes (i.e, carbon emissions from human activities). This has given rise to a concern about *moral hazard* (The Royal Society, 2009) In economics, the term ‘moral hazard’ is used to refer to the reduced incentive to take care caused by insurance; a car driver with insurance is less likely to drive carefully than one without. In relation to geonengineering, the fear is that polluters, policymakers or society at large will have weaker incentives to reduce carbon emissions if they know that geoengineering methods can and likely will be used to offset these omissions. This will lead to greater carbon emissions.

It is not always clear why a weaker incentive to reduce emissions would be a bad thing, provided that any increase in emissions is indeed offset through geoengineering. In the case of insurance, moral hazard is often regarded as socially suboptimal because offsetting the costs of accidents through insurance is typically more costly than taking care to avoid such accidents. But it is not clear that this reasoning applies to moral hazard in climate change: proponents of geoengineering believe it will be *less* costly to offset emissions than to tackle their causes. If this is right, then the moral hazard objection may have force only if contributing to climate change is intrinsically wrong, and therefore wrong *even if* ones contribution will be offset by geoengineering techniques.

The Precautionary Principle, the Balance of Nature, and Anthropogenic Harm

Policy-makers are in need of a decision-making schematic that is designed to manage risk in the context of scientific and regulatory uncertainty. Due to a general dissatisfaction with traditional cost-benefit analysis, many ethicists and lawmakers have moved toward a ‘precautionary’ approach to emerging technologies that would intervene in complex living systems. The precautionary principle is increasingly being incorporated into domestic and international legal regimes as part of a general overhaul of health and environmental regulation. Although there are many formulations of the precautionary principle, generally speaking it holds that scientific uncertainty shall not be a bar to preventive regulatory action, and that we should err on the side of caution when harms either to health or the environment are implicated.

Despite its general popularity and commonsensical connotations, the precautionary principle has been met with far less enthusiasm in the philosophical literature. The strength of the precautionary principle is determined by (1) the threshold trigger for precautionary action, including the probability and magnitude of the contemplated harm, and (2) the nature of the prescribed regulation. Weaker versions of the precautionary principle are criticized for being vacuous, impotent, and failing to provide any meaningful guidance in decision-making. Stronger versions, on the other hand, are rejected for issuing irrationally restrictive prescriptions due to their blinkered focus on risk-avoidance and environmental harm, which causes them to overlook the potential benefits of non-regulation and the importance of non-environmental factors. Analytical attempts to stake out a workable middle ground have proved largely unavailing. For these reasons, we believe that the precautionary approach does not offer useful ethical guidance for the design and implementation of geoengineering technologies.

One of the chief concerns regarding geoengineering technologies relates to the unanticipated and potentially cascading consequences such interventions might have for organisms, ecosystems, and the abiotic environment. These concerns are not unique to geoengineering, and similar worries have been voiced in connection with genetically modified organisms, the intentional introduction of non-native species, high-energy particle physics, and nanotechnology. It is therefore important to resist an exceptionalist ethical attitude toward geoengineering technology,

which as far as we can tell involves a risk structure (and by and large a moral structure) that is analogous to that associated with the aforementioned technologies.

Much of the skepticism surrounding technologies designed to intervene in living systems stems from a misguided view of the causal structure of the natural living world, especially with regard to the interrelations between species that comprise communities and ecosystems. A *prima facie* preference against activity that would intervene in living functional systems could be justified if the living world was composed of optimally, delicately, and benevolently configured equilibria—a set of beliefs that is captured by what we will refer to as the ‘benevolent balance of nature’ metaphor. Indeed, the benevolent balance of nature idea is more than just a metaphor, since it often motivates legal instruments and academic papers adopting or arguing for the precautionary approach. Nevertheless, this view of nature is neither consistent with the structure of evolutionary theory, nor supported by contemporary ecological science.

First, whereas it was long-assumed that strategic interaction (e.g. between predator and prey) would lead to evolutionarily stable solutions, there is now a great deal of evidence that biotic interactions will tend to undermine, rather than reinforce, the stability of faunal associations. Second, the view that ecosystems represent delicate webs of interdependent species hinges on the plausibility of a certain model of niche organization which is hotly contested, and the competitive exclusion theory of ecological evolution for which there is little evidence. Third, it appears that trophic webs are typically maintained despite significant fluctuations in extinction, invasion, migration, diversity, and energy pathways. Research on both living and paleontological communities suggests that invasions in general and anthropogenic additions in particular, tend to be fairly weak in terms of their ecological impact, especially in the context of non-island invasions. Studies of the fossil record suggest that the origination and extinction of paleoecosystems is not coordinated in any way that indicates their long-term evolutionary cohesion. Finally, and crucially, there is a growing body of evidence that the more weakly linked the components of a given community are, the more diverse and stable that community will be. Weaker ecological connections reduce the potential for destabilizing biotic interactions. So ironically, to the extent that an ecological balance exists at all, it will depend on the *absence* of sensitive interactions between species.

One might nonetheless argue that anthropogenic intervention is intrinsically bad, even if it does not increase the chances of harmful consequences beyond that which would exist in the absence of human intervention. It is often claimed that anthropogenic extinction or alteration of the biosphere is “unnatural,” and that somehow the element of human causation makes it morally distinct. Of course, grounding moral judgments in the conceptual distinction between the “natural” and the “unnatural” is notoriously problematic. Moreover, it is difficult to justify treating anthropogenic harms differently from “natural” harms, even when they are equivalent in terms of their likelihood and expected consequences for human populations and the environment.

On almost any plausible moral theory, we should (for example) expend comparable resources guarding against a rogue asteroid impact as we would in dealing with a rogue nuclear regime, assuming the probabilities and magnitudes of nuclear fallout were identical.

For sure, there is a tendency for people to be more concerned about anthropogenic harms (e.g. terrorism) than “natural” harms (e.g. hurricanes)—compare, for instance, the motivation to guard against terrorism after 9-11 with the inclination to shore-up domestic infrastructure after hurricane Katrina. The moral basis for this distinction is dubious, however. It likely reflects not moral principle, but affect-driven response—an evolutionary heuristic designed for life in complex social groups where homicide is the most likely cause of traumatic injury and death.

Some argue that it is a greater wrong to cause harm than to allow the same harm to occur “naturally,” but this idea is premised on there being a defensible distinction between positive and negative duties, which many philosophers, including the present authors, deny. We do not believe that the degree of “badness” that is added to some state of affairs because of its “wrongness,” i.e., because it implicates a culpable moral agent, has any significant bearing on the duty of society to take steps to prevent harm. Our duty to contain a preventable outbreak of infectious disease is equally weighty whether it is caused by bioterrorism or “natural” microbiological evolution. To conclude otherwise would be to confuse the culpability of the actor with the badness of the consequences that he or she brings about. At any rate, global ecosystems have been substantially perturbed by human activity, particularly in the 20th century, and hence it is difficult to view interventions aimed at restoring some previous state of affairs, or nudging them toward some alternative state, as unnatural. Furthermore, even if we could formulate a defensible distinction between the natural and unnatural, and even if this distinction was of moral significance, there is no reason to believe that it would trump all other possible human goods, many or perhaps most of which do not track the natural-unnatural distinction.

Justice

Concerns about justice in this context, involve the way in which the costs and benefits are distributed between those involved. Any account of what to count as a just distribution will be heavily dependent on the estimation of the costs and benefits involved.

The question of justice is one of the central ethical issues in discussions of how to deal with climate change. A recurring theme is to focus initially on apportioning blame and responsibility for both the current and on-going condition of the environment. The underlying principle here is that the major cost burden should be absorbed by those who are responsible for the current situation. One extension of this idea, suggested as a means for controlling future distribution is a “polluter pays” system, which again relies on the idea that the costs are borne by those who are responsible. Against this principle, might be the claims that (i) those in the past are the ones who

are mostly responsible for the current situation and (ii) ‘this is a global problem and needs a global solution’. The latter claim can be understood as distributing the costs across those who stand to benefit from a solution to the problem. Classically this debate is couched in terms of a broad distinction the developed and the developing world but questions about future generations are also very relevant in this context.

In the narrower context of geoengineering the issues are very similar: who should pay for the research and its implementation? Who should absorb the risks associated with research on geoengineering interventions and their implementation? And how should the benefits be distributed (assuming that they are not going to be enjoyed by all)?

The issues that geoengineering aims to solve do not threaten every region in the same way. Global warming, for example, would be substantially beneficial in Canada and Russia, where the amount of arable and habitable land could be greatly increased by significant warming. (Easterbrook, 2007) Most of the existential risks, including rising sea levels, hurricane activity and depletion of marine life, affect mainly equatorial regions. By the same token, many of the proposed types of geoengineering involve changes which would be beneficial to equatorial regions and harmful to polar regions.

These opposing needs will require us to identify equitable and ethically justifiable climate targets. Since it is not clear that anthropogenic intervention is intrinsically bad, there is no prima facie justification for attempting to preserve the current climate, if some other climate might be better for humans and animals. Thus, the most egalitarian decision could involve a deliberate move to a warmer climate, or conversely to a climate which is even colder than historical levels.

Different theories of distributive justice will yield different solutions. A utilitarian/consequentialist/cost-effectiveness model, standard in rational choice, will advocate deployment of strategies to maximise overall utility, impartially conceived. “Get the most (global) bang for your buck.” Egalitarian theories will aim at equality of some variable, such as welfare. Prioritarian accounts will give priority to improving those countries which are currently worst off. Other theories (sufficientarian) will aim to improve the lot of as many people affected by climate change to raise them above some satisfactory threshold of welfare or opportunity.

Crucially, how benefits, burdens and risks are distributed globally will depend on which theory of distributive justice guides policy.

Governance

One important practical issue that brings together the considerations discussed above is the governance of geoengineering research and its future implementation. Governance arrangements

including oversight, regulation and control are an ethical issue largely because it is these mechanisms that manage the other ethical concerns at the practical level. People differ about the contentious issues but are in various circumstances prepared to respect the need for decisions to be made in the appropriate way and by the appropriate people. Governance arrangements are ethically important because of this mediating, practical role.

Geoengineering research should be conducted with the public good in mind. Similarly, the implementation of geoengineering technologies will be done for the sake of the good of all. In order to achieve the best results from research a coherent strategy should be developed that enables researchers to build on the progress of one another towards a practical goal, while permitting the appropriate amount of national and individual freedoms and interests. A system of governance and regulation should be constructed so as to enable this balance to be struck and should be in a position to manage individual, institutional and national interests through forms of recognition, compensation or a patenting process.

The governance structures for geoengineering should allow for nation states to consent to the research and implementation of the relevant technologies. In the 1960s and 70s, the United States was involved in a programme of research into hurricane abatement, entitled 'Project Stormfury'. Even then, the risk that a diverted hurricane would land on a neighbouring country was considered problematic.(Bodansky, 1996) But even apparently benign geoengineering strategies such as reforestation may have similar unwanted climatic effects on citizens of neighbouring states. Under current international law, even if a state makes a unilateral decision to employ geoengineering technologies, they are not liable for harms to other states unless it can be proved that the geoengineering caused the harms — often an impossible task.(Weiss, 1978) Here, the consent of the nation state is a fundamental ethical issue concerning both international and domestic accountability. The issue of state consent is not simply legal and political--it is a fundamental moral issue about the right to rule, about where the moral legitimacy of law comes from (e.g. from consent, the protection of human rights, etc.), about whether domestic legal regimes should for moral reasons subordinate national legal authority to international institutions that may have problems of legitimacy and accountability to the domestic electorate.

The public and society more broadly understood, also have an important part to play in the system of governance for geoengineering. Society has a stake in this research and how it proceeds. Public support is crucial for both the research and any significant actual implementation to go ahead. The lessons of GMOs and the MMR vaccine in the UK are fitting examples of the importance of public education, engagement and involvement. Proper and inclusive governance should enable stakeholders to be a part of the development of the technologies that can be used if, when and to the extent that they are needed.

Consequently, a governance structure that can manage the issues above should be sufficiently inclusive — stakeholders, the public, international representation and the scientific community all need to be involved in this process. It should have a clearly agreed remit and set of goals and it should have an appropriate enforcement mechanism. The details and forms of governance, including regulation and enforcement, will depend among other things on the specific scientific and current regulatory framework but their guiding principles and justification will involve significant ethical consideration.

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