Against Geoengineering

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According to the most recent IPCC report, we have only twelve years to drastically reduce emissions if we're to keep the Earth's temperature rise from surpassing 1.5º Celsius. The dire conclusions of the report and the daunting task we have before us might make some think that geoengineering — actively intervening in planetary systems to keep temperatures down — is the only option to prevent catastrophic climate change. But the risks that come with geoengineering are also huge and could even worsen the climate imbalance. They aren't worth it.

Geoengineering is an umbrella term that refers to the deliberate large-scale technological manipulation of the Earth's systems to counteract the symptoms of climate change. Different kinds of technologies are used to intervene in the land, oceans, or atmosphere. Solar radiation management (SRM) techniques aim to block or reflect back part of the sunlight that reaches the Earth, attempting to lower the temperature: for example, by injecting sulphates in the stratosphere to mimic the effect of volcano clouds, or brightening marine clouds.

Other proposals aim to technologically remove carbon dioxide from the atmosphere. In a technique known as BECCS, large monoculture plantations are devoted to producing bioenergy, and the carbon is captured and stored. Ocean fertilization dumps iron into oceans to increase plankton blooms that would absorb more carbon. Enhanced weathering, which would dump tons of minerals into oceans, aims to change the chemistry of the oceans to make them absorb more carbon dioxide.

But despite these differences, all proposed geoengineering techniques, if deployed at the massive scale necessary to affect climate change, would have significant impacts on the environment, biodiversity, livelihoods, and food security. Some techniques, particularly those in the vein of solar radiation management, have military origins and could be weaponized as a way of controlling temperature and rain patterns.

Geoengineering techniques, particularly carbon capture and storage, are also actively promoted by the fossil fuel industry — the main culprits and the largest profiteers of climate change. If these techniques function, industry hope they would allow them to continue emitting greenhouse gases and keep profiting.

Proponents of geoengineering recognize that it will "create losers and winners" — some places may benefit from the intentional atmospheric changes, but others will suffer. But this is an overly glib euphemism. In some cases, there will be millions or billions of "losers."

Injecting sulfate aerosols in the stratosphere above the Arctic to mimic volcano clouds, for example, could disrupt the monsoons in Asia and increase droughts, particularly in Africa, endangering food and water sources for two billion people. And those are just the potential side effects of the most thoroughly researched solar radiation management proposal. Less well-understood proposals could be worse.

All of these issues raise serious questions not just about technology, but about power and justice. Who gets to

control the Earth's thermostat and adjust the climate and what interests will this serve?

When assessing the possibility of governing geoengineering in a democratic fashion, we should start with how we can confront the causes of climate change and whether geoengineering is necessary at all. The discussion must include those potentially most affected by geoengineering — specifically, those in the Global South, particularly local communities, peasants, and indigenous peoples.

Instead, the promoters of geoengineering are overwhelmingly based in the few countries that are also the largest historical and/or present greenhouse gas (GHG) emitters. The vast majority of geoengineering researchers are from industrialized countries, the majority from the United States, and work in climate sciences and engineering rather than ecology and social sciences. They are often not attuned to the social and ecological consequences of their research, or to the realities and alternative visions that drive communities and scientists from the Global South. Many of themare also patent owners of geoengineering techniques and shareholders in companies developing them. This spatial and demographic concentration of research on geoengineering reflects and repeats broad patterns and inequalities in the distribution of power.

It is not surprising that the solutions emanating from such quarters amount to a technofix, taming the symptoms of climate change — higher temperatures and excess GHG — instead of working towards alternatives that could remove its causes. But decisively addressing the root causes of our current predicament is the only environmentally sustainable and socially just pathway out of climate change.

Geoengineering prospects may also cause geopolitical competition among countries over possible future climate control. Manipulating the climate could have the same geopolitical function as nuclear weapons: even before geoengineering is deployed, it may be used as a threat that will likely incite countermeasures.

As with nuclear weapons research, the development of geoengineering in the US is likely to motivate China and Russia to scale up their own research programs. In fact, even geoengineering promoters take seriously the potential to scale up geopolitical conflicts: many are already speaking of "counter-geoengineering" — a means of stopping or countervailing unilaterally deployed geoengineering.

Because geoengineering attempts to modify the global climate, it also poses severe problems for governance. Democratic governance would require the establishment of a global multilateral democratic mechanism where all governments would participate on an equal basis. A truly democratic system would need to last for many decades, if not centuries, and decisions on deployment of geoengineering need to be taken by consensus.

This is no small feat. In fact, if this were possible, we wouldn't have a climate crisis in the first place, because governments would have been able to arrive at international agreements to reduce emissions. The consensus reached on the goals of Paris Agreement was a step in the right direction, but its guidance remains dominated by wealthy countries. It took only a change of government in the US, moreover, to withdraw from the agreement. If a similar mechanism were used in decisions related to geoengineering, the agreements would be worrisomely unstable.

When United Nations bodies have considered the dangers inherent to geoengineering proposals, they have taken precautionary measures. The Convention on Biological Diversity has declared a moratorium against all geoengineering deployment, while the London Protocol of the London Convention has taken a decision to ban marine geoengineering.

Geoengineering proponents argue instead that voluntary "governance," such as adhering to codes of conduct or guidelines for best practices of research and experiments, in private or public institutions, would be enough for now.

But this position is not commensurate with the inherent risks of geoengineering, which demand public independent oversight and obligatory rules. The moratoria currently in place must be maintained and reinforced: they provide at least a diplomatic warranty that debates can take place and decisions based on precaution can be reached, before unilateral geoengineering actions are taken by a powerful government alone or by "a coalition of the willing."

Geoengineering at the United Nations

The United Nations Framework Convention on Climate Change (UNFCCC), the major organ of international climate governance, has not yet addressed geoengineering as such. But the Intergovernmental Panel of Experts on Climate Change (IPCC) that informs the UNFCCC has uncritically incorporated one geoengineering technology (Bioenergy with Carbon Capture and Storage, BECCS) into the IPCC scenarios to keep the temperature below 2º Celsius until 2100. The most recent IPCC report (October 2018) on how to limit the increase of global warming to 1.5º Celsius considered other geoengineering technologies — only CO2 removal, not SRM — in three of its scenarios

But the IPCC has mostly focused on the supposed effects on climate change, leaving aside other issues like the potentially severe impacts of BECCS, which requires vast quantities of land and water, on biodiversity and food security.

Other UN bodies, however, have long acknowledged the potential risks of geoengineering. In 1978, the ENMOD Convention (1978) against the hostile uses of environmental modification emerged in response to US use of weather modification in the Vietnam War. From 1966 to 1973, the US conducted the now declassified "Project Popeye," a rainmaking campaign deploying 2,300 cloud-seeding missions over the Ho Chi Minh Trail during the Vietnam War, in an effort to swamp Vietnamese supply lines.

More recently, two UN Conventions have been central to the global discussion of geoengineering: the UN Convention on Biological Diversity (CBD) and the London Convention on the Prevention of Marine Pollution and its London Protocol (LC/LP).

In 2008, the CBD took a consensus decision calling for a moratorium on ocean fertilization: dumping iron or urea in the ocean to cause a sudden plankton bloom that would absorb CO2. It urged governments to ensure that no fertilization activities take place until a series of stringent requirements were met, including the creation of a "global, transparent and effective control and regulatory mechanism." The decision was based on a series of scientific documents showing that ocean fertilization would have serious negative impacts on the marine food web, could create ocean areas without oxygen, and might generate toxic algae.

In 2010, the CBD took another landmark decision on a *de facto*moratorium on geoengineering, a consensus call from 193 governments — not including the US, which is not a party to the Convention. The call stated that according to a precautionary approach, holding that no action should be taken if harm could result, climate-related geoengineering should not be deployed until its risks had been adequately studied, including potential impacts on environment and biodiversity and its associated social, economic, and cultural impacts.

The CBD has since produced two peer-reviewed technical reports on geoengineering and reaffirmed the moratorium twice, in 2012 and 2016. Both moratoria leave space for "small scale" experiments, but only for scientific purposes. Scientific experiments must fulfill strict requirements, such as an environmental impact assessment, experimentation in a "controlled setting," and precautions taken to ensure that no boundary-crossing impacts would occur. The CBD also stated that ocean fertilization may not be used for commercial purposes, like generating carbon offsets.

Since then, three geoengineering experiments have been halted by reference to these CBD decisions. Those are: an ocean fertilization experiment called LOHAFEX, by India and Germany; a private ocean-fertilization experiment undertaken near Haida Gwaii, Canada, by a company called Haida Salmon Restoration Company; and a UK-government-funded project, called Stratospheric Particle Injection for Climate Engineering (SPICE), an experiment devised to try SRM equipment.

The London Convention (LC) on marine pollution, meanwhile, has addressed ocean fertilization specifically since 2007 and has issued several calls on "utmost precaution." In 2013, it took a decision prohibiting ocean-fertilization activities except for those that constitute "legitimate scientific research" — a term that has been closely defined in a specific framework document.

Notwithstanding, several geoengineering promoters continue to argue that these moratoria are just recommendations, trying to downplay their relevance. In place of more stringent regulation, these parties suggest the use of nonbinding "ethical guidelines," "codes of conduct," and similar voluntary measures. But comparing the consensus decision of 193 governments in a universal treaty like the CBD to guidelines developed by academics

endorsed by pro-geoengineering institutions makes a mockery of the concept of democratic governance.

Voluntary Guidelines and the Fragmentation of the Discussion

Geoengineering governance is repeating the same pattern as other emerging technologies whose promoters would rather not have any independent oversight. But geoengineering entails so many obvious dangers and is so ripe with controversy that its proponents try to erect the appearance of oversight while preempting any real public control measures. A first attempt in this direction was the Asilomar International Conference on Climate Intervention Technologies, held in 2010. The organizers wanted to model the conference on the 1975 Asilomar conference on recombinant DNA, which agreed to voluntary guidelines on genetic engineering that helped preemptlegislative restrictions.

The Asilomar "international" conference on geoengineering had 172 participants, of whom only 4 were from institutions outside the industrialized north. It produced a set of very general recommendations — for example, that research should aim to "promote the collective benefit of humankind," and that governments could "when necessary, create mechanisms for the governance and oversight of large-scale climate engineering research activities."

Since then, several other initiatives have been launched offering guidelines and codes of conduct to govern geoengineering research, all in the same "voluntary" mode.

In more recent years, those who promote geoengineering have tried to fragment the discussion into separate kinds of geoengineering. Advocates often suggest that geoengineering could be governed separately depending on which technique is applied. For example, some argue that the governance of Carbon Dioxide Removal (CDR) techniques could be regulated nationally or regionally, while Solar Radiation Management (SRM) is inevitably global.

But the goal of both categories is to modify the global climate, intervening in vast shared ecosystems, such as oceans, forests, and the atmosphere. If regulation is fragmented, the larger impacts on those shared ecosystems will not be recognized. A fragmented approach is also likely to miss the interaction of different techniques that might be deployed simultaneously. Likewise, a national or regional approach to regulating land-based carbon-dioxide removal technologies would miss the impact of the result of all the different projects that would be carried at the same time. Such impacts are likely to be much more than the sum of their parts.

Geoengineers also try to separate the governance of research, field experiments, and deployment, suggesting that only deployment would require governmental regulation, while research and field experiments could be governed by voluntary guidelines or existing national laws.

But this ignores the history of other powerful technologies: investing in research and experiments creates entrenchments and "lock-ins" that then are used to justify and advance larger experiments and final deployment. The fact that many researchers have patents on their technologies, giving them commercial interests in the results, intensifies this problem: as Paul Oldham concludes in his mapping of the landscape of geoengineering research, "The practices of scientific research and intellectual property acquisition can de facto shape the development of the whole field." Too many researchers have a financial stake in showing that the techniques they have invested in are necessary.

The Danger of Open-Air Experiments

Questioning experiments may seem extreme: shouldn't we at least research the technologies? Indoor laboratory research and mathematical modeling could indeed serve to provide more information on geoengineering technologies and estimate some of the impacts they may have on the climate and the regional differences. But research is not cleanly disconnected from broader goals and interests shaping the discussion.

Currently there are several SRM open-air experiments planned in the US — that is to say, experiments done outside the lab, in the "real world." Often, this means experimenting not only in the environment but in indigenous territories. There are three currently proposed experiments in the US: 1) SCoPEx, in Arizona, is a Stratospheric Aerosol Injection experiment by the Harvard Solar Geoengineering Program; 2) a Marine Cloud Brightening Projectplanned in Monterey Bay, California; and 3) a project called Ice911, which aims to disseminate glass microbeads over ice and sea in Alaska. All of them are in indigenous territories.

The CBD and the London Convention decisions do allow for small-scale experiments under certain conditions. But these experiments would violate those provisions: they would take place in uncontrolled settings and are aimed at testing equipment rather than advancing climate science. The institutions planning the experiments seem to be taking advantage of the fact that the US is not a party to the CBD.

There are also ocean-fertilization projects planned out of the coast of Chile and Peru, by Oceaneos, a company built by some of the researchers that were part of the closed down experiment in Haida Gwaii, Canada. These experiments would violate the London Convention, and they have been challenged by marine scientists in Chile.

It is also important to remember that small-scale experiments will not reveal anything about the effect of geoengineering on climate change. For that, an experiment would need to be carried out over a long time and on such a large scale that it couldn't be called an experiment; rather, it would be large-scale deployment of geoengineering, with all its potential impacts and irreversibility. Geoengineering can't really have an experimental phase.

What trials of geoengineering techniques *can* establish is a "proof of principle," which will be useful to those involved in fundraising for further and larger experiments. This is likely to end with geoengineering technologies being available to powerful actors who could use them unilaterally to advance own their interests — which history suggests they will.

Harvard's ScoPEx announced experiment, for example, is privately funded, and subject to no governance save what Harvard chooses to impose upon itself. Although it will be subject to national laws, such as the National Environmental Policy Act, such laws are weak and designed to protect against physical hazard only. Proceeding to field experimentation crosses a thin red line beyond which lies the slippery slope down to ever-larger field trials and ultimately deployment, eventually making the techniques available to whoever have the economic and political power to appropriate them.

As climate scientist Raymond Pierrehumbert observes, "It's bad enough that Trump has his hands on the nuclear weapons launch codes. Do we really want to give someone like him the tools to monkey with the world's climate as well?"