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# What is wrong with Solar Radiation Management?

Solar Radiation Management (SRM) describes a set of geoengineering techniques that aim to counter human-made climate change by artificially increasing the reflection of heat from sunlight (solar radiation) back into space. Some advocates have started using the term "solar geoengineering" – but these techniques are not related to solar power production.

SRM encompasses a variety of techniques: using reflective "pollution" to modify the atmosphere, covering deserts with reflective plastic, increasing the whiteness of clouds or blocking incoming sunlight with "space shades." The most-promoted proposal is to create dust clouds that artificially mimic "volcano clouds" by injecting layers of reflective particles, such as sulfates, into a higher layer of the atmosphere called the stratosphere.

Common to all these technologies is that they do not aim to influence the concentration of greenhouse gases, which is the physical cause of climate change. They are only intended to counter some of its effects, particularly temperature increase. At this point all proposed SRM techniques are only theoretical – they have not been developed or tested.

**Unequal negative impacts.** Climate scientists have begun to run theoretical computer models of how SRM deployment may impact the climate. Most of these models show that the negative impacts will be unfairly distributed, with many scenarios negatively affecting countries on the Global South who have contributed the least to causing climate change.[1]

**Environmental risks.** If deployed, SRM has the potential to cause significant environmental damage. It is not possible to know with any certainty how altering the amount of incoming heat to the planet could affect ecosystems, since it will create an entirely new ecological balance (or disturbance) that could diminish biodiversity and disrupt ecosystems. The energy from incoming sunlight is an essential resource for life on the planet and many species at the base of the food chain that also produce oxygen and key nutrients – such as algae and plants – depend on solar energy. Basic ecological common sense tells us that changing this one key variable could have ripple effects throughout global ecosystems. There are other potential effects of SRM depending on the technique, including increased depletion of the ozone layer, changed weather patterns around the tropics and subtropics, and severe droughts in Africa and Asia. These could negatively affect the source of food and water for billions of people. [2]

[1] Several studies carried out under the Geoengineering Model Intercomparison Project (GeoMIP 2013, 2014) point in this direction, as well as showing that once SRM projects have been initiated, the effects of ending them could be worse than not doing them at all. GeoMIP is an international research collaboration to determine climate system model responses to solar geoengineering.

[2] Robock, Alan, A test for geoengineering, Science, January 2010
http://climate.envsci.rutgers.edu/pdf/TestForGeoengineeringScience2010.pdf

**No turning back.** SRM may be a one-way street. Because SRM masks the actual warming in the atmosphere, if it was terminated, a sudden jump in warming would occur, which would be much more difficult for ecosystems to adapt to and for society to tackle than gradual warming.

**Not addressing root causes.** SRM will not address the problem of atmospheric GHGs, which will continue increasing. Nor does SRM address ocean acidification (also caused by atmospheric buildup of carbon dioxide). Indeed, ocean acidification could be worsened by some SRM techniques.

**Exacerbating global power imbalances.** Even more critically, the prospect of controlling global temperatures raises serious questions of power and justice: Who gets to control the Earth's thermostat and adjust the climate for their own interests? Who will make the decision to deploy if such drastic measures are considered technically feasible, and whose interests will be left out?

**Weaponization:** The military origin and implications of geoengineering for warfare are often forgotten or intentionally not mentioned. But the whole idea of controlling the weather comes from military strategies and led even to the signing of the international Environmental Modification Convention (ENMOD). Military leaders in the United States and other countries have pondered the possibilities of weaponized weather manipulation for decades. If the aim of a technology is to "combat climate change," it doesn't guarantee its use will be limited only to that application. If anybody can control the Earth's thermostat, this can and will be used for military purposes, as Prof James Fleming describes.[3] Even before hostile use any state or actor claiming to be able to alter global weather patterns will hold a powerful geopolitical bargaining chip with which to threaten and bully.

**SRM is the perfect excuse for inaction.** SRM, and geoengineering more broadly, is a "perfect excuse" for climate deniers and governments seeking to avoid the political costs of carbon reductions. For those looking to stall meaningful climate action the active development of tools and experiments will be presented as preferred pathway to address climate change and as an argument to ease restrictions on high carbon emitting industries. This line of argument was already put forward by conservative think tanks in the United states such as the American Enterprise Institute.[4]

**SRM is already under a moratorium.** These serious risks and unresolved issues justify banning SRM. As a precautionary measure, the 193 countries at the UN Convention on Biological Diversity (CBD) established a *de facto* moratorium against most forms of geoengineering including all forms of SRM.[5] The landmark decision was reaffirmed in 2012 and 2016. However, promoters of geoengineering – the most vocal of whom are based in Northern high GHG-emitting countries – have been attempting to ignore the CBD decision and to move toward initiating experimental trials of SRM technologies.

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[3] Fleming, James, Fixing the Sky, Columbia Studies in International and Global History, 2012

[4] See more examples at Geopiracy, The case against geoengineering, 2010, page 15
http://www.etcgroup.org/sites/www.etcgroup.org/files/publication/pdf_file/ETC_geopiracy_4web.pdf

[5] Decision X/33 (w) https://www.cbd.int/decision/cop/?id=12299

**Lack of a democratic, transparent, multilateral mechanism for governance**. The CBD moratorium on geoengineering clearly articulates the need for a global transparent regulatory mechanism for governance before experimentation be considered. 193 countries agreed to require a global mechanism because of the recognition that potential impacts and side effects of geoengineering will be unfairly distributed. Since SRM could be a tool to control the Earth's thermostat for those who have the legal, economic and technological resources, any step towards realising those capabilities must be agreed by consensus of all members of UN.

If all governments could effectively agree on such a complex issue with so many social, economic, environmental and intergenerational aspects at play, including how and who will carry the cost and burden of the negative impacts, and if countries had the capacity to implement agreed climate measures that demand persistence and coherence over several decades, we wouldn´t have climate change in the first place. Even the Paris Agreement, which seems a miracle convergence of political will, barely lasted one week after entering into force before the largest historical GHG emitter declared it won´t respect it. The failure to manage fair and effective international climate governance is a clear argument against moving ahead with geoengineering, which is more deeply unfair and complex, and carries poor prospects for establishing the fully democratic, multilateral, legally binding and century long agreement needed for fair governance. In the absence of such a mechanism, once the tools are developed, who will stop a powerful government from using it?

**SRM could wreck the climate agreements.** As noted already, achieving global consensus on measures to control one major variable of climate change (greenhouse gas emissions) has been highly challenging and fraught with conflict. Adding geoengineering can only further complexify international diplomacy. The most likely outcome of which is to see the breakdown of collaborative multilateral efforts. If adding geoengineering to the mix leads to the breakdown of global climate negotiations, there are commercial and political forces who would welcome that outcome.

**Who decides what is an emergency?** Who has the moral authority to decide when there is an emergency and therefore the use of SRM "justified"? Like other political aspects, the definition of "emergency" and how it should be confronted, greatly varies among countries, regions and institutions, and often determined by political agendas.[6] In 2009, outspoken geoengineering advocate David Schnare of the conservative Jefferson institute argued that the way to build public support for geoengineering is to declare an emergency and then push for funds for experimentation of SRM. David Schnare is now one of the principal administrators of the Environmental Protection Agency installed by the Trump administration.

**Politics and precaution first**

Because of the geopolitical high-stakes, risk of weaponization, and intergenerational implications of geoengineering and SRM, the debate should be first and most on these aspects, before developing any tool that a climate-denying government or "a coalition of the willing" could use,

[6] Sillman J et al "Commentary: Climate Emergencies do not justify engineering the climate" Nature Climate Change, Vol 5, April 2015 pp. 290-292). Sillmann further argues why the ability of SRM to respond to the climate tipping-point emergencies is "very restricted."

even if all other governments would conclude it is too risky and unfair to use. Geoengineering can never be confined to a technical discussion, a matter of "developing tools, just in case." Geoengineering "research" should be focused on social science, ethics, and debate whether democratic governance is possible, and how.

**Trump administration**

SRM experiments developed in the US will particularly and directly feed the artillery of the new administration to deny climate change, ignore Paris Agreement and justify the ongoing increase of fossil fuels exploitation, including pipelines with devastating impact on indigenous lands, fracking, etc. A number of pro-geoengineering politicians sit in Trump's administration including Secretary of State Rex Tillerson, former house speaker Newt Gingrich, and David Schnare, who led Trump's transition team in the EPA.

**Geoengineering promoters argue:**

1. That we will need SRM to address climate change because even if GHG emissions would be stopped now, the inertial lock-in emissions will continue warming the planet.
2. While most promoters of geoengineering options recognize that impacts of SRM will likely be bad and unevenly distributed, they claim the impacts of unchecked climate change will also be bad and SRM may be the lesser of two evils.
3. Other interests, often oil-industry financed think tanks, argue that SRM offers an efficient way to address climate change without having to transform the fossil-fuel driven economy

All these arguments, in one form or another, distract from the real strategies to confront climate chaos: the need to make drastic and real GHG reductions at the source; decarbonize the global economy; and the need to research and support solutions that are sound, fair, decentralized and affordable, including, among others, agroecology, good mass transport and renewable energy systems.

Since no SRM proposals are ready for deployment at this time, the emphasis now for geoengineering advocates is on the need to secure endorsement and public and private funds to move into a phase of research, hardware development and open-air experiments.

# Five Reasons Why SRM Experiments Are a Bad Idea

Proponents of geoengineering are now actively making the case that it is necessary to move to series of SRM experiments carried out in the open air. They argue that they intend to make "only experiments," differentiating field tests from deployment. From their perspective, field tests serve a dual purpose – they are seen as a necessary step to establish both the safety and feasibility of SRM technologies. They argue that society needs to have practical experience with these techniques to be able to either reject them or to be ready in case they need to use the techniques in the future or "in case of climate emergency."

This argument that scientific and technical field trials are different from deployment and are a necessary evaluation step could appear sensible on the surface. However, there are a number of countervailing considerations.

1. **Experiments are political acts**

First, geoengineering must be considered a political rather than technical issue. Geoengineering advocates are keen to move to open-air experimentation not for the purpose of disinterested science, but for political reasons. Once a technical field moves into 'proof of principle' experiments it crosses a significant line towards realization and can be more credibly advanced as policy option. This is one of the reasons that 'field tests' have often become so controversial (e.g. field testing of nuclear technologies, GMO crops, space weapons, "scientific whaling"). In the case of SRM, in the first instance the existence of proof-of-principle experiments and visible activity will act more like public performances, intended to catalyse greater political and public interest in the geoengineering option more than gather essential data. It is an essential step towards normalizing geoengineering as an acceptable policy path.

2. **Experiments create technical and political 'lock-in'**

There is ample evidence from the history of science and technology studies that commencing hardware and testing of a new technology increases the incentives towards development and deployment by creating a constituency with a vested interest in the technology. Not only do companies and individuals develop clear financial interests in a particular technological outcome (through investment in careers, patents and know-how), but the accompanying work to develop regulatory systems and enable oversight of the experiments also creates an institutional interest in maintaining the technology as well as prefiguring an enabling political pathway.

3. **Meaningful SRM safety and efficacy "experiments" are not possible**

On a more technical level, to be able to create a noticeable difference in climate, and to understand the impacts of SRM after excluding normal climate variation and weather "noise," scientists would need to deploy SRM over several decades and at such a large scale that it would be the same as deployment, and would be irreversible. SRM "experiments" are therefore an oxymoron.

So-called "small-scale experiments" are therefore a slippery slope – they will not provide the needed information on its impact on climate. Promoters will thereafter argue that larger and larger experiments are needed to establish safety and efficacy, raising important political questions about who defines what scale is enough.

The real purpose of so-called "small outdoor experiments" is to test equipment hardware, which is more about proving technological capabilities (e.g., can a hose be lifted to the stratosphere or can we whiten marine clouds), and to build political will towards larger experiments. They will not provide crucial information on the impacts of large-scale SRM deployment, but they could encourage some governments to invest in the technology without the necessary prior societal debate on many aspects that are not technical, and without establishing the essential internationally agreed framework for governance.

4. **Experiments violate the UN CBD moratorium**

CBD Decision X/33(w) on geoengineering moratorium, make an exception for

> "small scale scientific research studies that would be conducted in a controlled setting in accordance with Article 3 of the Convention, and only if they are justified by the need to gather specific scientific data and are subject to a thorough prior assessment of the potential impacts on the environment."

Open-air SRM experiments will not be in a controlled setting. They will most likely violate Article 3 of the CBD – on avoiding transboundary impacts – because it is not possible to ensure if, how and when an open-air experiment (e.g. stratospheric particles released close to Mexico) may cross borders. Much of what is proposed for SRM experimentation falls into the category of "hardware development" rather than investigating scientific data to address safety. There are also, so far, no agreed terms for what constitutes a "thorough prior assessment of the potential impacts on the environment."[7]

5. **Deviating resources from true solutions**

Ratcheting investment in geoengineering also acts to undermine research and experiments for cutting emissions, developing real solutions and researching solutions that are not unfair or risky. Moreover, if deployed, SRM could actually undermine true solutions to climate change. For instance, SRM will reduce the effectiveness of solar cells by reducing incoming sunlight. It does not make sense to field test technologies that undermine the good, existing solutions that need to be developed and supported.

[7] In a parallel process (the work by the London Convention on regulating Ocean fertilization) guidelines were developed for that treaty's scientific groups to evaluate what constituted justifiable scientific research. That work hasn't been done under the CBD or any other body for SRM.