

# Don't even study it: Geoengineering research hits societal roadblocks

Environmental science and  
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- *As climate change accelerates, some scientists are calling for more field research into solar geoengineering concepts. However, these ideas are running into opposition from other researchers, some governments and the public.*
- *A series of recent setbacks has put solar geoengineering research on the back foot, attempting to figure out a way to navigate the opposition.*
- *Proponents of field research say it would help humanity better understand the potential and problems with solar geoengineering, while opponents argue that there are too many risks and it could take our eye off the ball: cutting carbon emissions.*
- *The debate has spilled into the international arena, pitting nations that support greater research against those that would like to see a solar geoengineering non-use agreement.*

This is Part Two of a two-part story. Find [Part One](#) here.

In April, researchers from the University of Washington sprayed sea salt particles into the air off the California coast in the [nation's first field test](#) of this solar geoengineering concept.

The idea: When certain types of aerosol particles, whether natural or synthetic pollutants, enter clouds, they cause them to brighten. Brighter clouds reflect more sunlight away from Earth, leading to localized cooling. Put into practice on a large scale, solar engineering could potentially offset rapidly worsening climate change impacts.

The experiment was tiny: The team would spray sea salts for short periods each day for four months from the deck of the USS Hornet, a decommissioned aircraft carrier docked in Alameda, California, to understand how the particles moved in the air.

But public blowback was huge: Within two months of the experiment's start, [local officials](#) voted unanimously to halt it, citing the project's lack of transparency, despite city consultants determining that the research wouldn't impact wildlife or human health.

"This is the pitchfork brigades run amok," says Wake Smith, a climate researcher who lectures at Yale University. "This involved spraying seawater into the air over the sea, mimicking the action of waves. It's hard to conceive a

more harmless experiment. The [Luddites](#) are back.”



A beach along the Californian coastline. In April, researchers from the University of Washington sprayed sea salt particles into the air off the California coast in the nation's first field test of this solar geoengineering concept. Image by Laura LaRose via [Flickr \(CC BY 2.0\)](#).

### **To study, or not to study**

The public outcry in Alameda is indicative of several recent battles lost by scientists trying to research solar geoengineering through small-scale field experiments.

Meanwhile, a growing number of scientists are urgently calling for research and funding into geoengineering. They're not arguing for deployment, but point to escalating emissions and worsening climate change impacts, as a key reason to consider other tools, [however controversial](#), to combat the problem.

But not all scientists agree. Some criticize geoengineering as a dangerous distraction, arguing it takes the onus off the vital need for drastic emissions cuts, while putting humanity on a precarious path, risking dependence on a totally untried technology with potentially unforeseen results.

The debate has not only hit individual experiments and projects, but even international meetings, such as at the [February 2024 gathering](#) of the United Nations Environment Assembly, where Switzerland, backed by the U.S., Saudi Arabia, Canada and Japan, tussled with African nations in an attempt to move forward on an expert panel to assess the benefits and risks of solar geoengineering. Switzerland did not prevail.

“I think the best way forward is to just take this option off the table, to stop these debates, and to support a non-use agreement on solar geoengineering,” says Frank Biermann, a social science researcher at the Global Sustainability Governance at Utrecht University in the Netherlands.

Paul Goddard doesn't agree. A researcher studying how solar geoengineering could slow melting in Antarctica, Goddard says he doesn't understand the opposition, as it “is potentially removing a great tool in the toolbox against climate change.”

As a result of this heated dispute, those wanting more field research to better understand solar geoengineering options are running into roadblocks and issues of societal acceptance. But at the same time, a shift in the other direction is happening, with a rising number of researchers and policymakers starting to take solar geoengineering seriously.



Penguins on ice in Antarctica. Scientists are not arguing for geoengineering deployment, but point to escalating emissions and worsening climate change impacts, such as increasing Antarctic ice loss resulting in sea level rise, as a key reason to field test other tools to find ways to slow the rate of climate change. Image via Pexels (Public domain).

### **Is solar geoengineering becoming less taboo?**

Before he started researching geoengineering, Goddard says he thought there was “no way in heck” we should deploy such extreme

technology. But now that he's steeped himself in the science of its potential benefits, he's not only changed his tune, but seen changes of heart among other scientists.

"I think it's becoming less taboo [because] people are looking for methods that can help with the climate crisis," Goddard says.

Specifically, he's supportive of researching a solar geoengineering technique known as stratospheric aerosol injection (SAI), which would release small particulates, likely sulfates, from planes into the stratosphere at about 20,000 meters (66,000 feet) to block out a tiny percentage of sunlight and slow the heating of the planet to some degree.

Among researchers and policymakers, SAI is arguably the most popular of numerous geoengineering schemes due to the belief it would work — it mimics the globally cooling effect of large volcanic eruptions — and its relatively low cost.

David Keith, a professor in the Department of the Geophysical Sciences at the University of Chicago, who's worked in the field far longer than most, definitely sees a geoengineering sea change coming. "There was ... extremely little work on solar geoengineering in the '90s and the early part of the 2000s. I was one of the few people doing anything. Not the only one, but one of the few," he says, adding that in the

scientific community back then, researchers warned him that it would “hurt your career.”

“That’s definitely changed,” Keith says. “The last few years, there’s been much more attention. There’s been high-level policy attention.”

U.S. government interest is arguably where the biggest shift is occurring. In 2022, the Biden administration called for a five-year [research plan](#) into SAI.

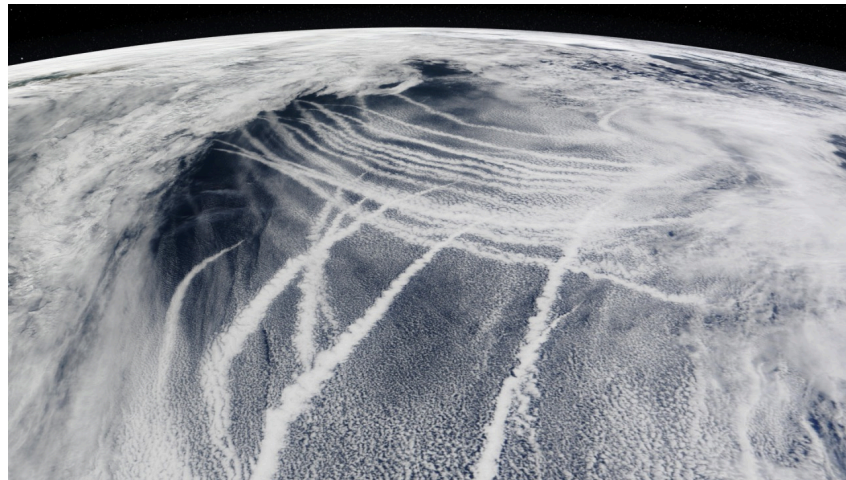
It’s also recently [come to light](#) that the Environmental Defense Fund, a U.S.-based NGO, is planning to study SAI. The group, one of the biggest environmental NGOs in the nation, brought in [\\$255 million in 2023](#). Likewise, the [Union of Concerned Scientists](#) and the [Natural Resources Defense Council](#) have come out in favor of field research.

Research backers now include wealthy proponents like [Bill Gates](#) and [Mike Schroepfer](#), formerly of Meta. As with the scientists, these funders are talking only about research at this point, not deployment.

There’s a downside to these proponents, Biermann says. The extensive support coming mostly from the U.S. government, and U.S. entrepreneurs, financiers and NGOs, has caused those in other parts of the world to be wary of equity issues surrounding

geoengineering. It “makes many people quite suspicious.”

As geoengineering becomes less taboo in some circles, opposition rises elsewhere. Biermann, for example, is one of the initiators of an [open letter](#) signed by 500 experts and endorsed by 2,000 civil society groups calling for a global geoengineering non-use agreement.



When sulfate-spewing ships pass under clouds, the aerosols they emit cause the clouds to brighten in a process known as the Twomey effect, creating “ship tracks,” and masking some climate change-induced heat impacts. Recent studies show that new pollution reductions implemented by ocean shipping may have triggered increased warming Image courtesy of [NASA](#).

### Field research permissions

In March, Harvard University [shut down](#) a solar geoengineering experiment known as the Stratospheric Controlled Perturbation Experiment, or SCoPEX. A brainchild of David



Keith (now with the University of Chicago) and Frank Keutsch, the experiment never got off the ground. It would have used high-altitude balloons to deliver small particles into the stratosphere, then measure how well they reflected sunlight.

SCoPEX ran into trouble in 2021 when the Saami Indigenous group discovered that the project was planning to use balloons above their traditional lands in Sweden. After a protest, the Saami were able to get the planned experiment canceled.

“Harvard proposed an utterly exquisite governance structure sitting atop a teeny-weency science experiment,” Smith says. “In the end, the governance superstructure crushed the pitiful little experiment.”

Keith notes that Harvard only canceled this particular experiment; the university hasn't said it would stop geoengineering research altogether. However, what happened there is emblematic of how difficult conducting a geoengineering field experiment has become.

The non-use agreement, supported by Biermann and others, doesn't propose a total ban on solar geoengineering research. But if implemented, it would “ban outdoor experiments” and disallow the use of public funds for geoengineering research. The signers are also against any geoengineering technology

development, patenting, or the qualification of any geoengineering project for carbon offsetting.

“We believe that outdoor experimentation doesn't add much to general knowledge, but leads to [geoengineering] technology development,” Biermann says, adding this is what the signers oppose.

“It's really a ‘non-research agreement,’” Smith counters. “I don't see how one can reasonably say, ‘We don't know much about it, but we know it would be bad.’ We can only know that after doing the research.”

Biermann, though, says supporters of the non-use agreement are not “Luddites ... We are scientists.” However, he adds, “Our societies [get to] decide that certain activities and technologies should be banned ... So far, chemical weapons, biological weapons, human cloning, Antarctic mining, deep seabed mining, antipersonnel landmines, and a couple of other activities are not allowed. That's for a good reason. You can't sit in the United States of America and have a chemical weapons factory in your backyard.”

Those arguing in support of expanded field research say it will help the world better understand both the potential and drawbacks of geoengineering. They also point out that a research ban won't prevent a nation from

deploying the technology. Keith notes that when it comes to SAI, a nation could deploy a major project without doing further research, dubbing this “One of the good or bad, terrifying things about [SAI].”

There are no global policies in place to legally prevent such a deployment. A country, or even a large corporation, without further study, could start sending planes with aerosol payloads into the stratosphere tomorrow and hope for the best. But, of course, researchers argue, it would be far better to have an extensive understanding of the technology before launching it at scale.



There are no global policies in place to legally prevent geoengineering deployment. A nation, or even a large corporation, without further study, could start sending planes with aerosol payloads into the stratosphere tomorrow and just hope for the best. Image via [Pexels](#) (Public domain).

## Debate erupts in the international arena

A heated geoengineering discussion has arisen internationally over going forward with geoengineering research, largely between nations of the Global North (mostly supporting it) and the Global South (largely opposing it).

Last year, at the African Ministerial Conference on the Environment, African nations signed on to a [text](#) calling for “the need for a global governance mechanism for non-use of solar radiation management.” The call was seen as a victory for those wanting to slow or stop field research and curb consideration of SAI.

Then, in February, at the most recent United Nations Environment Assembly, Switzerland proposed the creation of an expert group to look into SAI. The motion was fiercely fought by African countries that instead called for an SAI “non-use agreement,” preventing future utilization of the technology, according to [Climate Home News](#). A letter by the African delegation complained of “efforts to use Africa to justify use of this dangerous technology.”

In the end, neither group triumphed. Switzerland tabled its proposal, and a non-use agreement made no headway. The meeting ended in a stalemate, enforcing the status quo, which allows SAI research, but not large-scale deployment.

“What has happened so far is mixed comments from climate negotiators,” Keith says. “My hope is that these calls trigger more robust debates rooted in the Global South.”

But Biermann says the writing is on the wall: “Researchers make the argument that they do [geoengineering work] for the Global South and for the ‘global poor’ — but those who make these arguments should think very carefully about the fact that African governments don’t want solar geoengineering.”

Of course, the Global South isn’t a monolith. For example, a [poll](#) of students in Japan, Australia, the Philippines and India on their geoengineering views found that a higher percentage of those from the Philippines and India were open to geoengineering. Notably, students in those two countries also said they believe outcomes from climate change will be worse and more likely to affect them personally.

“We feel like it’s a moral responsibility and an ethical responsibility to at least look at every possible option, not necessarily to do anything yet, but if we don’t even look at them, then we are tying our hands behind our back,” says Brad Ack, the CEO of Ocean Visions, a nonprofit organization currently investigating and evaluating geoengineering ideas.

Graph showing baseline radiative forcing under three different Representative Concentration Pathway scenarios, and how it would be affected by the deployment of SAI, starting from 2034, to either halve the speed of warming by 2100, to halt the warming, or to reverse it entirely. Image by Wake Smith via [Wikimedia Commons \(CC BY 4.0\)](#).

### **A future without a choice?**

Geoengineering research, whether or not to do it, has become a political fight, one that likely portends far larger political battles down the road over deployment.

“It’s a political struggle of course, and there are people who have a lot of money; there’s a well-funded pro-SRM [solar radiation management] lobbying community in the United States and they’re doing their thing. They’re lobbying, they have money, we don’t have money,” Biermann says. “It’s a bit like David and Goliath.”

But true to the David and Goliath story, it often seems like David is winning. In case after case, the side against geoengineering has halted

field experiments. Biermann says one of the problems with geoengineering research is that it often excludes social and governance issues from the equation. Those supporting geoengineering field research “are presumably natural scientists, so they have not been much involved in thinking about the political economy, the political ecology, and the governance challenges that come with [this new technology],” he says.

For his part, Biermann says he doesn't believe any of the world's current institutions would be up to deploying geoengineering in a just way.

“It will be hard for SAI to move forward until there are some full-throated advocates calling for it to countervail the full-throated opponents,” Smith says. “There is only so far that research can go without substantial public support.”

But Smith and others who want more field research say eventually the terrors of climate change will make this question moot. It's hard to imagine a non-use agreement stopping a nation from moving forward if millions of its citizens are uprooted or dying from extreme heat.

“Those disputing [solar geoengineering] do overplay risks, but more importantly, they underplay [the] risks of runaway climate change in the absence of solar [geoengineering],”

Smith says. “They are implicitly comparing today’s climate to engineered climate, and saying, ‘I want today’s climate, not Franken-climate!’ Well, so do I, but that won’t be the choice we will confront.”

***Banner image:*** *Put into practice on a large scale, solar engineering could potentially offset rapidly worsening climate change impacts – but there are a variety of potential risks. Image via [Pexels](#) (Public domain).*

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### **Citation:**

Biermann, F., & Gupta, A. (2024). A paradigm shift? African countries call for the non-use of solar geoengineering at UN Environment Assembly. *PLOS Climate*, 3(5), e0000413. doi:[10.1371/journal.pclm.0000413](https://doi.org/10.1371/journal.pclm.0000413)