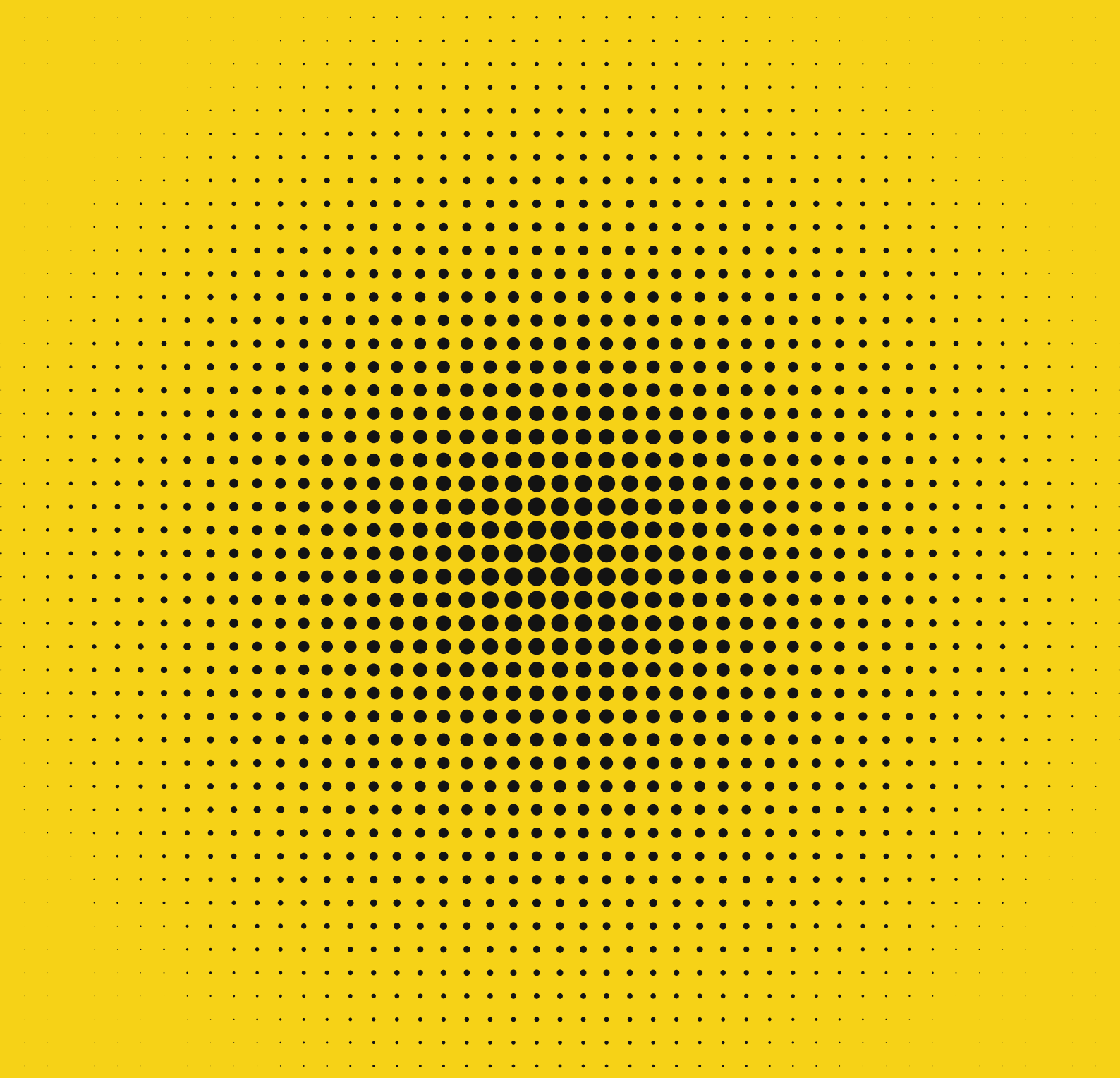




An Introductory Guide to SRM

Prepared by SRM360

SEPTEMBER 2026

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As the world continues to warm, the idea of using technologies known as sunlight reflection methods (SRM), or solar geoengineering, as a way to potentially cool the planet and limit some of the impacts of climate change is garnering increasing attention. This is a complicated and controversial subject, with a wide range of scientific and sociopolitical questions still to be answered. In this guide, SRM360 walks through the basics of SRM, including why these ideas are under consideration and how they would work, what the potential downsides might be, and the thorny questions of how such programs might be governed.

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About SRM360

SRM360 is a non-profit knowledge broker dedicated to informing people about sunlight reflection methods – or solar geoengineering – so they can contribute to critical decisions about its research, development, and governance.

Why Are People Considering SRM?

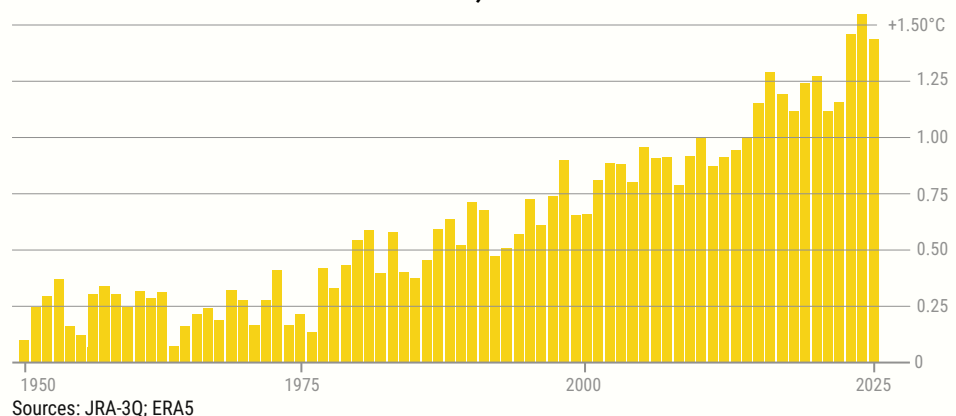
Scientists and policy experts around the world are exploring whether sunlight reflection methods (SRM) – also known as solar geoengineering – could be part of the toolkit for tackling climate change. But this work is controversial, and there are deep concerns about its potential consequences. Why are people turning to such a drastic idea? Could it help, and what are the challenges?

The climate crisis

The world is making progress on climate change but is not on track to meet its climate goals.

Around \$2.2 trillion – almost 2% of global GDP – went into clean energy investments in 2025, almost double what it was a decade ago. Enormous progress has been made, but global carbon dioxide emissions keep rising.

CHANGE IN GLOBAL ANNUAL AVERAGE TEMPERATURE RELATIVE TO PRE-INDUSTRIAL AVERAGE, 1850-1900



2024 was the first calendar year to see the global average temperature breach 1.5°C above pre-industrial levels. Keeping this rise below 2°C – the goal of global climate agreements – may soon be slipping out of reach.

In fact, even if the countries of the world fully meet their emissions commitments, the world seems to be on track for around 2.4°C warming by the end of the century. That could be devastating.

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[What Does 2024's Breach of 1.5°C Mean for SRM?](#)

The impacts of global warming

The impacts of global warming are being felt in every country and every community around the world, but especially in the Global South. Devastating wildfires stoked by hotter, drier conditions are burning out of control; droughts and floods are made more intense by rising temperatures; glaciers and sea ice are retreating, changing landscapes and livelihoods. Almost everyone has a story about how the changing climate is affecting their local area, undermining prosperity, increasing insecurity, and changing ecosystems.

SOME KEY IMPACTS OF CLIMATE CHANGE

FOOD



Rising temperatures and intensified weather extremes will pressure food production systems, undermining food security.

EXTREME WEATHER



The intensity of many weather extremes rises with temperatures, e.g., the intensity of extreme rainfall rises by around 7% for every degree Celsius of warming.

WATER



Climate change is impacting water security, increasing both extreme high and extreme low water flows in some regions.

HEALTH



The health risks of extreme heat rise dramatically with warming – in Europe impacts at 3°C could be triple what they are at 1.5°C.

ECONOMY



The economic impacts of climate change are expected to rise dramatically with warming.

Climate change is changing how diseases like malaria spread, endangering new populations.

SECURITY



Climate change increases risks of violent conflict through climate extremes and impacts on water and food security.

ECOSYSTEMS



Tropical coral reefs will decline substantially by 1.5°C of warming and could be virtually lost by 2°C warming.

At 2°C of warming, up to 18% of species on land could face a very high risk of extinction, and up to 29% at 3°C.

Source: SRM360.org

Adding to those concerns, the world may be on the brink of multiple “tipping points” that, if crossed, could prove irreversible and cause massive harm to people and ecosystems. These include the destabilisation of the ice sheets and subsequent sea level rise, the potential collapse of critical ocean currents that have a huge influence on regional climate, and die-off of critical ecosystems like coral reefs and the Amazon rainforest.

There is no cliff edge at 1.5°C or 2°C of warming, but every tenth of a degree of warming will make things worse. Each additional tenth of a degree will impact people and ecosystems and is worth fighting to prevent.

LEARN MORE

[Will Climate Change Become Unbearable When the World Reaches 1.5°C or 2°C?](#)

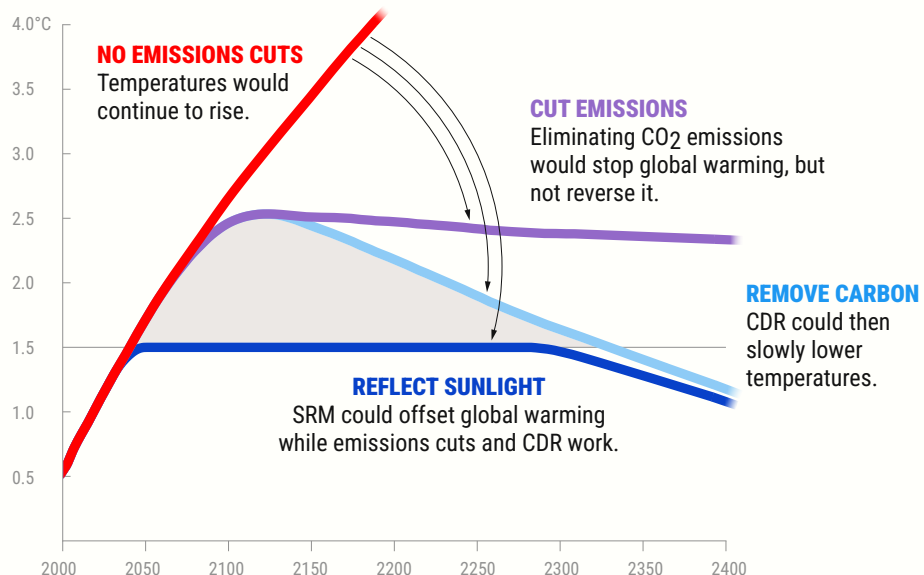
The current strategy and its limits

The primary strategy to prevent further warming is to stop burning fossil fuels and reduce other sources of greenhouse gas emissions.

EMISSIONS CUTS, CARBON REMOVAL, AND SRM

Emissions cuts and carbon dioxide removal (CDR) tackle the root cause of climate change, and sunlight reflection methods (SRM) could limit warming while they work.

GLOBAL TEMPERATURE INCREASE



Source: Based on Boselius et al. (2025), Oxford Open Climate Change

However, eliminating emissions would only stop global warming getting worse – it would not reverse it. To return temperatures to safer levels, the world must also remove hundreds of billions of tonnes of carbon dioxide already in the atmosphere.

Significant progress has been made and decarbonisation is underway. But the impacts of climate change are being felt today and will get worse over the coming decades. And in fact, efforts in recent years to reduce harmful air pollution are also contributing to global warming. Changes to the planet's reflectivity, from melting sea ice to changing cloud patterns, are also pushing temperatures higher.

That is why a growing number of scientists and policymakers are asking about additional approaches the world could use to reduce the impacts of climate change while emissions are driven down.

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[Every Tonne of CO2 Adds to Global Warming](#)

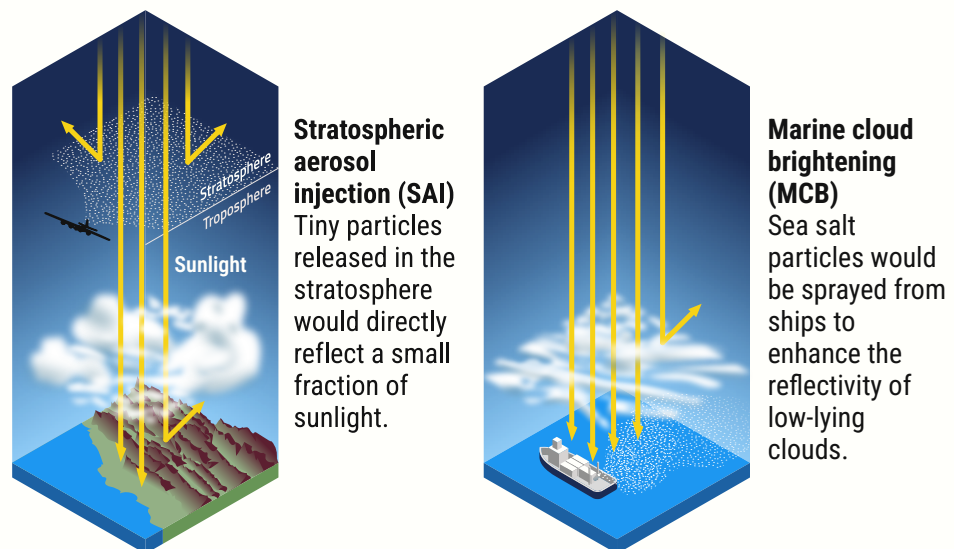
SRM cannot solve climate change, but could it help?

Sunlight reflection methods (SRM) – also known as solar geoengineering or solar radiation modification – describe a set of ideas to reflect a small portion of incoming sunlight to reduce global temperatures. These differ from weather modification, which is a localised technology aimed at slightly altering how much rain or snow falls from clouds.

SRM covers a range of approaches, but two stand out. One would involve adding a layer of tiny, reflective particles into the upper atmosphere, and the other would make ocean clouds more reflective.

SUNLIGHT REFLECTION METHODS

Sunlight reflection methods (SRM) are hypothetical approaches to lower global temperatures by increasing the amount of sunlight reflected to space.



Source: SRM360.org

These approaches would not be a solution to climate change, but scientists are exploring whether they could limit some of the risks caused by global warming while the root causes are being addressed.

None of these ideas are currently being deployed, but they are being studied by scientists across the world, and a few small-scale outdoor experiments have been conducted. In recent years, as warming has continued and even accelerated while emissions have not come down as rapidly as required, there has been increasing attention on SRM. That includes countries, non-

governmental organisations, and other groups engaging with SRM, from calls for more research to proposals for restrictive measures.

By changing the global climate, SRM would affect everyone. This raises many difficult ethical questions that need to be discussed. To inform those discussions, people need to understand what these approaches are, how their risks compare to the risks of climate change, and what could go wrong.

With that understanding, the world can work towards more effective governance of SRM, whether that is to restrict these ideas or to develop them further.

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[What Is SRM?](#)

The Sunlight Reflection Methods

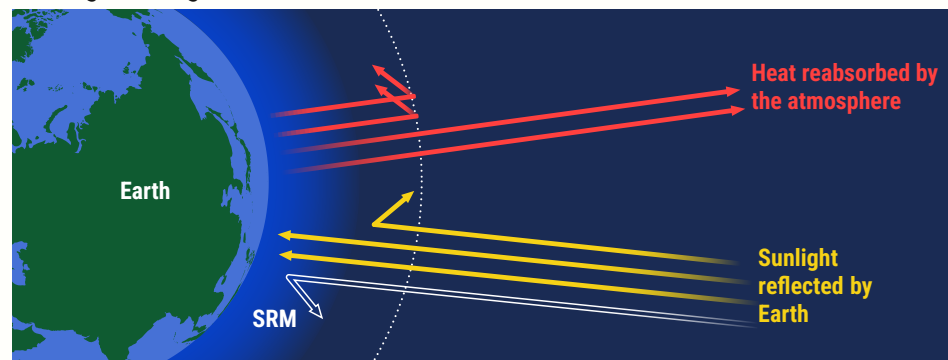
Sunlight reflection methods (SRM) – also known as solar geoengineering or solar radiation modification – are a set of ideas to reflect a small fraction of incoming sunlight to reduce global temperatures. There are several ideas, including stratospheric aerosol injection and marine cloud brightening.

Trapping heat and reflecting light

The Earth currently reflects around 30% of the sunlight that reaches it. If just 1% more sunlight were reflected, this would offset around 1°C of global warming, which would make a massive difference. This is roughly the gap between countries' climate goals of keeping below 2°C and what their current policies are on track for.

THE EARTH'S ENERGY BUDGET

When sunlight reaches the earth, it is either reflected to space or absorbed and re-emitted as heat. Emissions of greenhouse gases, like carbon dioxide, trap heat, causing warming.



Sunlight reflection methods (SRM) aim to reflect some sunlight to offset that warming.

Source: SRM360

Sunlight reflection methods (SRM) – or solar geoengineering – describe a set of ideas that aim to slightly alter that reflectivity equation.

This may sound like science fiction – and some of the ideas are far-fetched – but, by leveraging the incredible cooling potential of tiny particles known as aerosols, two ideas stand out as potentially feasible and effective.

LEARN MORE

What Is SRM?

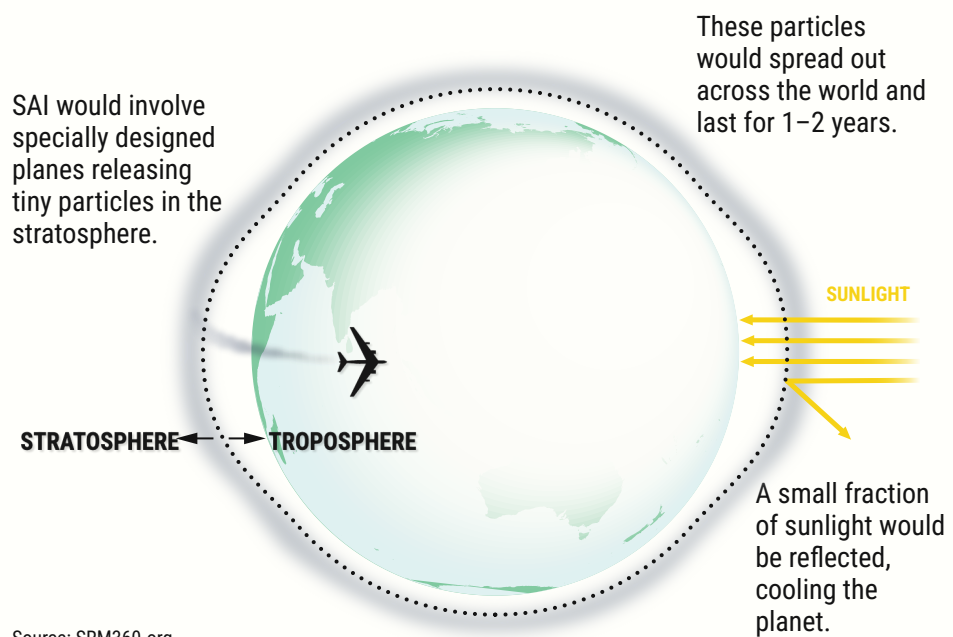
Stratospheric aerosol injection (SAI)

Major volcanic eruptions, like Pinatubo in 1991 and Tambora in 1815, added a layer of tiny reflective sulphate particles to the stratosphere, above the tops of most clouds. These particles spread out to create a thin global layer that reflected a small fraction of incoming sunlight and cooled the earth for a few years.

Stratospheric aerosol injection (SAI) would aim to mimic this proven cooling effect by releasing tiny aerosol particles into the stratosphere. There, they would have a much longer lasting, and so much larger, cooling effect than they would in the lower atmosphere.

STRATOSPHERIC AEROSOL INJECTION

Stratospheric aerosol injection (SAI) is an idea to lower the global temperature by dispersing tiny particles in the upper atmosphere to reflect a small fraction of sunlight. SAI is the most researched approach among the sunlight reflection methods (SRM), and researchers are confident that it would be technically feasible, but it would come with new risks and challenges.



With hundreds of specialised aircraft lifting millions of tonnes of sulphate or other particles to the stratosphere, geoengineering with SAI could lower global temperatures by one or even several degrees Celsius. While uncertainties remain, there is little doubt that this could have a substantial cooling effect.

By lowering global temperatures, SAI might reduce many climate risks, though not all. It would affect rainfall patterns, causing greater change in some places than expected under climate change alone. It would also have some undesirable side effects such as adding a little to acid rain, making the sky a little hazier, and delaying the slow recovery of the ozone hole by some decades.

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[Stratospheric Aerosol Injection](#)

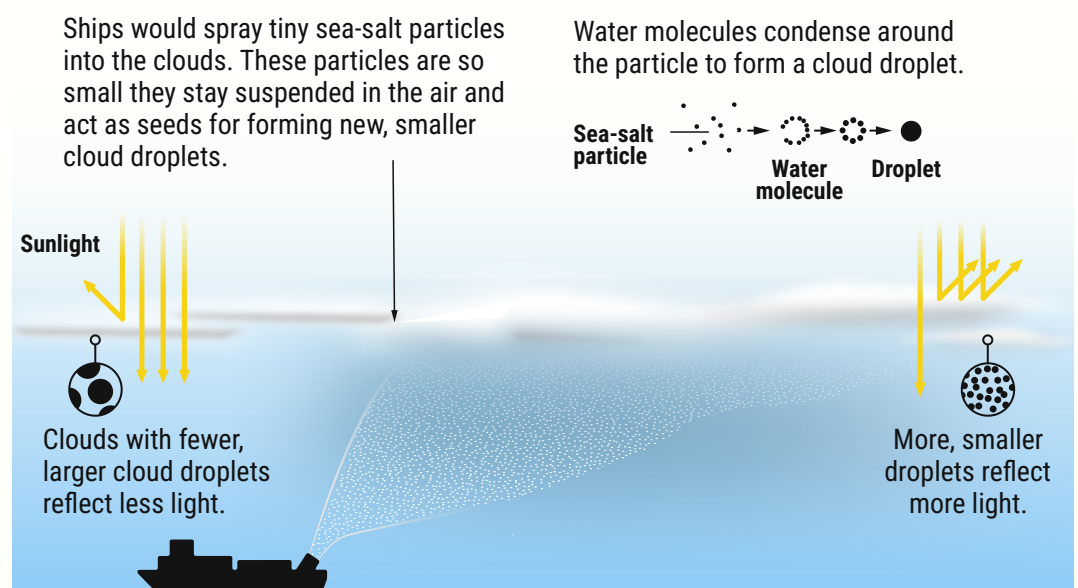
Marine cloud brightening (MCB)

“Ship tracks” form in certain areas of the ocean when polluting ships pass underneath low clouds. The tiny pollution particles emitted by these ships act as seeds for new cloud droplets, triggering cloud formation or brightening existing clouds.

Following changes to pollution standards for ships in 2020, ship tracks have become less common and ocean clouds near busy shipping routes have become less reflective. This clean-up effort could have contributed slightly to recent global warming.

MARINE CLOUD BRIGHTENING

Marine cloud brightening (MCB) is an idea to enhance the reflectivity of low-lying clouds over the oceans. MCB may be able to produce a large regional cooling effect, but the uneven cooling may lead to large shifts in global rainfall patterns.



Source: SRM360.org

Marine cloud brightening (MCB) is an idea to produce a similar cloud-brightening effect without the air pollution impacts by spraying sea-salt particles from ships.

While this idea could work in principle, engineers have yet to develop sea-salt sprayers that would be efficient enough to be used for deployment, and the effects of the particles on clouds remains very uncertain. In fact, these aerosol–cloud interactions are one of the biggest uncertainties in climate science.

This is why a team in Australia has been conducting outdoor experiments of this idea since 2020, and several other research teams are working on plans for outdoor experiments of their own.

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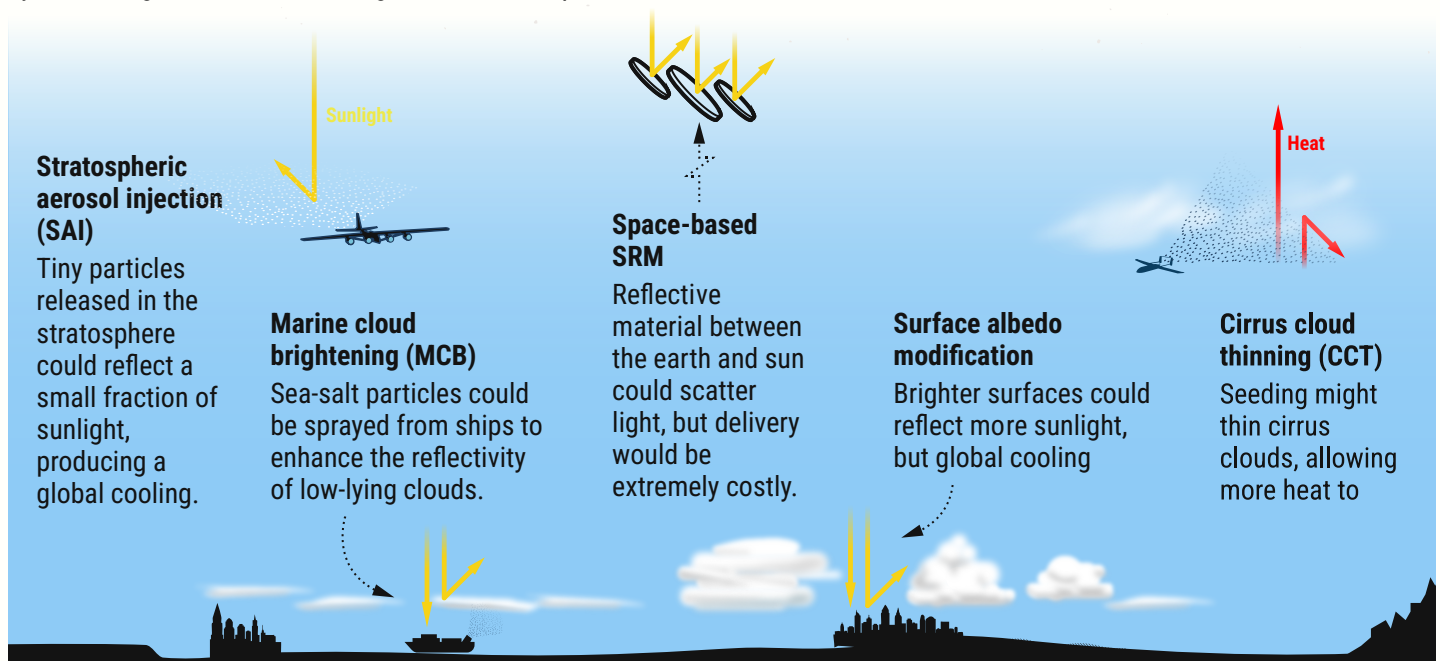
[Marine Cloud Brightening](#)

Other sunlight reflection methods

While SAI and MCB are receiving the most attention from researchers, there are several other SRM ideas.

AN OVERVIEW OF SUNLIGHT REFLECTION METHODS

Sunlight reflection methods (SRM) are hypothetical approaches to lower global temperatures by increasing the amount of sunlight reflected to space.



Source: SRM360.org

Space-based SRM would involve placing material between the Earth and the Sun to deflect light before it reaches the Earth, though it would be prohibitively costly, at least for the next several decades.

Cirrus cloud thinning would aim to reduce the heat-trapping effect of high wispy cirrus clouds. Adding the right kind of particles might thin these clouds, but there are deep uncertainties about its potential and effectiveness.

Mixed-phase cloud thinning is a similar idea, though focused on a different type of cloud that forms lower in the atmosphere and contains both ice crystals and supercooled liquid. Thinning those clouds, especially in winter months at the poles, may allow some extra heat to escape and help regrow melting sea ice.

There are also several ideas for brightening surfaces, for example, developing slightly more reflective crops, building with brighter materials, or brightening and thickening sea ice. These ideas might have some potential to alleviate local impacts, but none could be scaled up to have a substantial global cooling effect.

LEARN MORE

[Space-Based SRM](#)

Could SRM help in the fight against climate change?

Cutting greenhouse gas emissions is and will remain the primary strategy to combat climate change. Removing carbon already in the atmosphere and adaptation are also critical.

SRM is being explored as an additional tool to use alongside these other strategies, offering a way to reduce temperatures and limit many of the harms of climate change. However, these approaches would bring new risks and uncertainties of their own, as well as raising profound ethical and political questions.

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[Are Emissions Cuts on Track to Avoid Catastrophic Impacts?](#)

Could SRM Help Reduce Climate Risks?

Sunlight reflection methods (SRM) – also known as solar geoengineering – would not be a solution to climate change but might offer a powerful new tool to reduce climate risks while emissions cuts are ramped up. However, these ideas would also come with additional side effects and risks. How do the risks of SRM compare to the risks of climate change?

SRM is risky, but is it less risky than the alternative?

The goal of sunlight reflection methods (SRM) – also known as solar geoengineering – would be to cool the planet and reduce the risks of climate change.

Stratospheric aerosol injection (SAI) – an idea to add tiny reflective particles in the upper atmosphere – seems to offer a practical means of lowering global temperatures. By reflecting around 1% of incoming sunlight, it could lower global temperatures by about 1°C. Many of the risks would depend on the details of an SAI deployment, such as the latitude at which the particles are injected and the targeted amount of cooling.

Many climate risks are closely tied to temperature, so geoengineering with SAI could help reduce many climate impacts if deployed carefully alongside emissions cuts. However, it could not offset all the effects of climate change and would also introduce new risks or shift how risks are distributed.

How would the risks of deploying SAI compare to the risks of climate change?

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[Risk-Risk Analysis: Understanding the Risks of SRM in Context](#)

Lowering temperatures could reduce climate impacts

By strategically distributing particles in the upper atmosphere, SAI could produce a more-or-less even pattern of cooling that would offset the warming from greenhouse gases across the planet. This could greatly reduce many of the risks of climate change.

Rising temperatures make heat extremes more intense and more frequent, with significant impacts on ecosystems, crops, and human health.

Warmer air can also hold more moisture, making droughts more intense by driving stronger evaporation and making rainfall more extreme by releasing more water in short periods of time. This impacts crops, harms economies, and endangers people.

Higher temperatures also cause snow and ice to melt, replacing bright white surfaces with darker ones that absorb more sunlight, adding to global warming. They also lead to glacier melt and retreat, undermining the year-round water supplies that many communities rely on.

For these and other reasons, lowering temperatures with SAI or other SRM approaches could reduce many of the risks of climate change.

LEARN MORE

[Could SAI Replace the Lost Cooling Effect From Cleaning Up Air Pollution?](#)

Side effects and shortcomings

While SAI and other SRM approaches could cool the planet, no SRM approach could cancel out all the effects of climate change. Notably, wind and rainfall patterns would be changed, with rainfall increasing in some areas and decreasing in others. This would lead to some regions seeing greater impacts on their water resources than they would have under global warming alone.

Marine cloud brightening – an approach that would brighten clouds over some ocean regions – could produce a global cooling effect, but it may be uneven. This patchiness could lead to greater changes in wind and rainfall patterns than would be seen with SAI.

No SRM approach would address the root cause of climate change – the build-up of carbon dioxide and other greenhouse gases. This means that SRM cannot address ocean acidification, which is caused by the ocean absorbing carbon dioxide, harming marine ecosystems.

SAI would also have several side effects, adding a little to acid rain and air pollution, as well as delaying the slow recovery of the ozone hole.

SRM POTENTIAL BENEFITS AND RISKS

Sunlight reflection methods (SRM) could lower global temperatures, reducing many risks, but introducing

	 FOOD	 WATER	 HEALTH	 ECOSYSTEMS	 EXTREME WEATHER	 ECONOMY	 SECURITY
POTENTIAL SRM BENEFITS	By reducing warming, SRM might boost crop yields overall.	SRM would change rainfall patterns, improving water security in some regions.	SRM would reduce extreme heat and its health impacts and, reduce shifts in the spread of diseases overall.	Lower temperatures would reduce coral bleaching. Reduced climate change would mean fewer extinctions overall.	Many weather extremes would be less intense, including reduced extreme rainfall overall.	Reduced climate change could mean reduced economic impacts with SRM.	Less intense climate extremes could reduce the risk of violent conflict.
POTENTIAL SRM RISKS	Changes in rainfall due to SRM could reduce crop yields in some regions.	Those changed rainfall patterns might cause worsening water security in other regions.	SRM could delay the recovery of the ozone hole and add to air pollution, posing health risks.	SRM would not address ocean acidification, which would still threaten coral reefs. Reduced climate change could potentially mean more extinctions in some regions.	Droughts may be more intense in some regions with SRM.	Reduced water availability in some regions could have economic consequences.	There could be conflict over the use of SRM.

Source: SRM360.org

LEARN MORE

[SRM Cannot Address Ocean Acidification](#)

How do scientists know about SRM?

So far, what scientists know about SRM is mainly based on climate models – sophisticated computer simulations of the Earth system.

Using the same models that they use to predict the extent and impacts of global warming, climate scientists are asking how the risks of lowering temperatures with SRM would compare to the risks of climate change.

There are many uncertainties – predicting the response of the complex climate system is challenging – but these models are built on decades of theory, observations, and lab experiments.

It is not possible to “test” how the climate would respond to SRM with small-scale outdoor experiments. However, such experiments can shed light on key processes so that scientists can improve their climate model projections; some [small-scale experiments](#) have taken place, and others are planned.

Observations of volcanic eruptions and other natural analogues can also help test how well their models capture responses seen in the real world.

LEARN MORE

[What Can We Learn About SRM From Climate Modelling?](#)

Nasty surprises

When something new is introduced into the environment, there can often be nasty surprises – think of CFCs (chlorofluorocarbons) damaging the ozone layer. Should the world expect nasty surprises if SRM is deployed?

Unlike CFCs, the main SRM approaches would not be entirely new. SAI with sulphate particles would mimic the cooling effect of major volcanic eruptions, and marine cloud brightening would increase the amount of sea salt in the lower atmosphere. There are many uncertainties around these ideas, but because nothing wholly new is being introduced into the environment, there is little chance of truly surprising physical interactions occurring.

But how would the climate respond? Some of the biggest uncertainties in climate science are around how key systems will respond to a changing climate. How warm can it get before the tropical corals or the Amazon rainforest can no longer take the heat and die off? When would the Greenland and West Antarctic ice sheets destabilise and how quickly could they collapse? How high do temperatures need to rise before key ocean currents, like the Atlantic Meridional Overturning Circulation, shut down?

SRM would certainly add new uncertainties, but it would also reduce others. By helping to prevent the planet from warming so much, SRM could keep the climate from moving further into uncharted territory, reducing the risk of triggering “tipping points” like the loss of the tropical corals or ice sheets.

LEARN MORE
[SRM & Corals](#)

Towards a risk-risk analysis of SRM

SRM is not a solution to climate change. It would not address its root causes but might help if used alongside emissions cuts and other policies.

SRM poses many risks, but it might also greatly reduce the risks of climate change. Understanding whether SRM could play a useful role alongside emissions cuts will require a careful risk-risk analysis, where the risks of SRM are compared to the risks of climate change.

But the risks of SRM are not fixed and would be different for different people and places; they would depend on how it is deployed and how the world would respond to it. For example, SRM might stoke international tensions or threaten progress on emissions cuts. Even if responsible SRM deployment could reduce risks, it might ultimately prove harmful if it is not used or governed responsibly.

RISK-RISK ANALYSIS

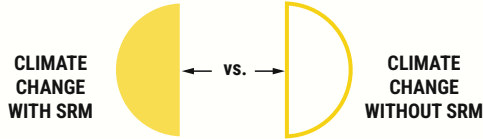
The deployment of sunlight reflection methods (SRM) would come with risks. More comprehensive forms of risk-risk analysis can provide a broader perspective on the policy options available. A look at three levels of analysing SRM risks:

“SRM is risky.”



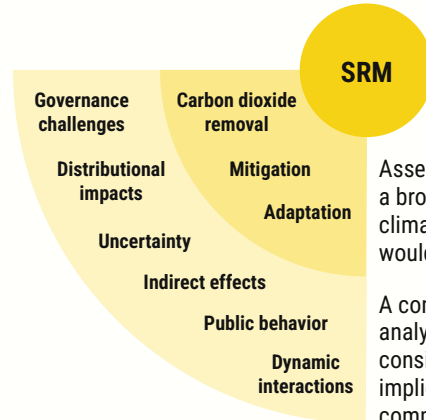
Considering only the risks of SRM would provide only a narrow assessment.

“How do SRM risks compare to climate change?”



A simple risk-risk analysis would compare the risks of SRM against the risks of climate change without SRM, all else equal.

“What about other options and impacts?”



Assessing SRM as part of a broader portfolio of climate policy options would be more thorough.

A comprehensive risk-risk analysis would go further, considering broader implications and complexities.

Source: SRM360, Mark Borsuk, Tyler Felgenhauer, Jonathan Wiener

LEARN MORE

[Risk-Risk Analysis and SRM: Moving Beyond Misunderstanding](#)



How Could SRM Go Wrong?

Sunlight reflection methods (SRM) – also known as solar geoengineering – might help if used as a complement to other climate policies. However, they might undermine emissions cuts, fail at some point, or disrupt international relations. Reducing these risks will be a key challenge of SRM governance.

SRM might help if used wisely, but that is a big if

Many of the risks of climate change are driven by rising temperatures, and sunlight reflection methods (SRM) – or solar geoengineering – might greatly reduce those risks if used wisely to complement other climate policies. But that is a big if.

The world's response to climate change has been far from perfect. Many countries are making very slow progress on emissions cuts, and some are downplaying or even denying the realities of climate change.

On top of this, geopolitical tensions are high, and international institutions are struggling to get countries to cooperate.

There are several ways in which SRM might go wrong if it is not governed well.

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[The Geopolitics of SRM](#)

Could SRM undermine emissions cuts?

Many experts fear SRM could undermine the crucial work of cutting emissions. They worry that it could be used as an excuse to delay climate action and continue burning fossil fuels. This is an important concern.

If the world abandoned emissions cuts and instead relied instead on SRM to cool the planet, the climate problem would not be solved. Ever larger amounts

of SRM would be needed, with ever greater risks and side effects. Ocean acidification would go unaddressed and would continue to worsen. This would leave future generations with an ever-growing carbon debt that would be very difficult to clear.

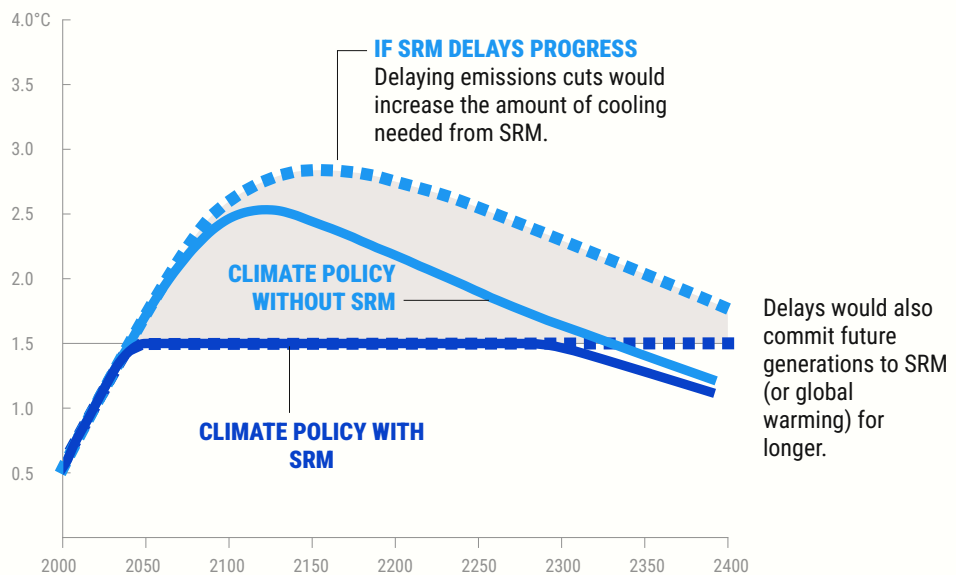
While SRM might help reduce some risks, it does not address the underlying cause – the build-up of carbon dioxide and greenhouse gases. The only sustainable way to stop climate change getting worse is to eliminate carbon dioxide emissions, and the only sustainable way to drive global temperatures down is to remove carbon dioxide from the atmosphere.

Delaying the essential work on emissions cuts and carbon dioxide removal would diminish the effectiveness of SRM and raise other risks, while committing future generations to managing the world's carbon legacy for longer.

COULD SRM UNDERMINE EMISSIONS CUTS?

Sunlight reflection methods (SRM) could cool the planet, but there are fears it could delay progress on emissions cuts and carbon removal.

GLOBAL TEMPERATURE INCREASE



Source: Based on Boselius et al. (2025), Oxford Open Climate Change

LEARN MORE

[Mitigation Displacement: Could SRM Undermine Emissions Cuts?](#)

Termination shock: what if the cooling stopped?

All SRM approaches only provide temporary cooling. If they were stopped, the warming they offset would rapidly return.

If the cooling effect was large enough, this “termination shock” could be devastating. The climate would warm at a faster rate than it would have without SRM, giving societies and ecosystems less time to adapt.

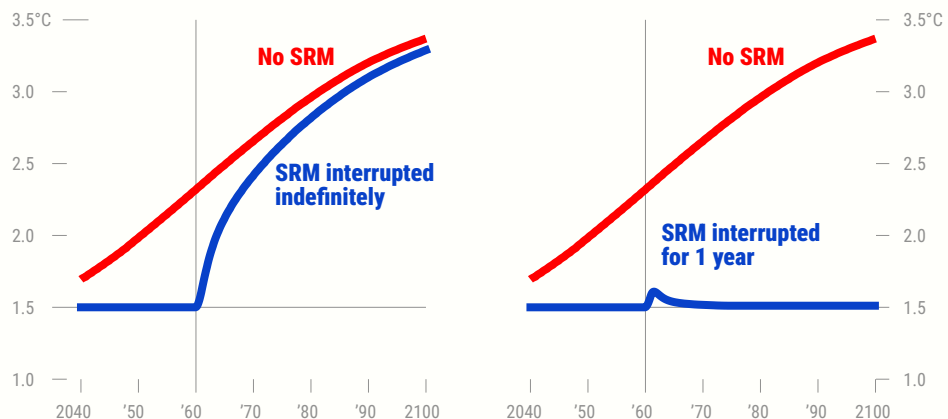
TERMINATION SHOCK

Sunlight reflection methods (SRM) only provide a temporary cooling effect, which would need to be maintained for decades to offset global warming.

GLOBAL TEMPERATURE INCREASE

If SRM deployment suddenly and permanently stopped, temperatures would rapidly rise in what's called a "termination shock".

But, if the deployment were restarted within a few months, this rapid warming could be avoided.



Source: Based on results from Farley et al. (2024), Environmental Research Climate

If SRM were deployed at large scale, the world would need to take great care to maintain it, and to restore it if it were ever disrupted. Like the internet or electricity grids that societies now depend on, SRM would become one of the most critical pieces of infrastructure in the world.

LEARN MORE

[What Is Termination Shock?](#)

Whose hand would be on the thermostat?

One of the troubling things about SRM is that the power to alter the climate could be held by a single powerful country. While it appears SRM could not be used as a climate weapon, it might be deployed for selfish reasons rather than to advance the global public good.

Any decision to deploy SRM would entail difficult choices. How much should the planet be cooled – should global warming be slowed, completely stopped, or driven into reverse? And where should be cooled most – should the poles be cooled more than the tropics, or vice versa?

There are no right answers to these questions. Any deployment of SRM would lead to different risks across the world, meaning countries could have very different views about how, or even if, SRM should be deployed.

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[Unilateral Deployment: Could a Single Country Change the Global Climate?](#)

The blame game and the risk of conflict

Attributing the effects of SRM deployment would be challenging – especially in the initial years – and could lead to accusations of harm and even conflict. What if a country experienced a record-breaking drought shortly after a deployment started? Regardless of whether this was a side effect of deployment or would have been worse without SRM, the affected country may blame SRM for this drought.

The uneven impacts that SRM would likely produce – an overall decline in average global temperature, but regionally varied changes in rainfall – could lead to that sort of accusation. Countries that believe they have been harmed by SRM – rightly or wrongly – might feel compelled to respond with sanctions or other actions that could spark conflict.

Without a robust scientific understanding of the effects of SRM and a trusted mechanism for resolving disputes, the potential for misunderstandings and conflict would be high.

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[Will Scientists Know if SRM Caused Extreme Weather?](#)

The need for assessment and governance

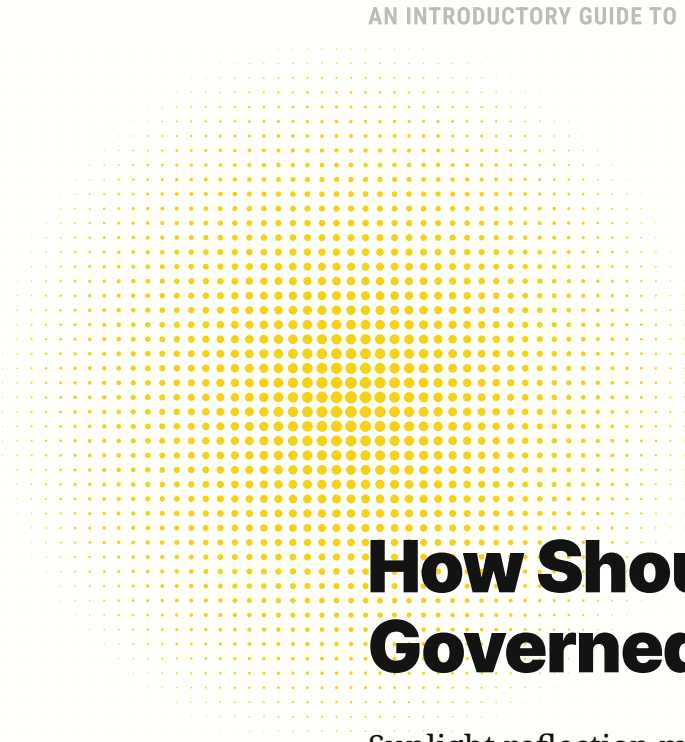
Used wisely, SRM might offer an effective means of reducing the risks of climate change while other climate policies are implemented. However, if it undermines those other efforts or heightens international tensions, it could lead to disaster.

To understand their options, policymakers will need to weigh the full risks of SRM against the full risks of climate change without it, and understand how this balance would play out in different regions. Such risk-risk assessments will be an essential component of good governance, but they will not be sufficient on their own.

Good governance could help ensure this technology is studied and developed responsibly and reduce the risks of it being misused, undermining emissions cuts, or heightening international tensions.

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[SRM Governance With Cynthia Scharf](#)



How Should SRM Be Governed?

Sunlight reflection methods (SRM) – also known as solar geoengineering – would affect the whole world. Answering the social, political, and economic questions SRM raises could be even more challenging than navigating its physical impacts. As climate risks continue to grow and increasing attention is paid to SRM, discussions about the rules and policy frameworks that may be needed are also growing.

The expanding SRM landscape

As the world continues to warm, increasing attention is being paid to sunlight reflection methods (SRM), or solar geoengineering. This attention has taken the form of more research and discussion, as well as increased funding and a growing number of outdoor experiments.

Scientific assessment and research funding will play a crucial supporting role in the governance of SRM. The leading scientific academies of several countries, including the Royal Society in the UK, as well as international bodies such as the United Nations Environment Programme, have conducted assessments of SRM, drawing on the research conducted in the field.

SRM research has been mostly funded by governments, mainly in the Global North, and philanthropies, mainly in the US. The latter have been the largest source of funding for research in the Global South, much of which is distributed through the Degrees Initiative. There is still relatively limited participation in the Global South, raising questions of justice given those countries' high degree of vulnerability to climate change and, potentially, climate interventions.

In addition, Stardust Solutions, a for-profit company, recently entered the field. It has raised tens of millions of dollars in funding and has generated significant criticism among experts.

Given the growing interest and activity, questions of how to govern SRM are looming larger. From the current focus on computer modelling research through outdoor experiments and eventually potential deployment, what is being done to guide and govern SRM, and what form might that take in the future?

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[How Should Solar Geoengineering Research Be Governed?](#)

International law and SRM

There is currently no comprehensive international governance framework for SRM, though there is a patchwork of agreements and organisations that address related issues.

SRM is not banned outright under international law. However, the 1977 ENMOD treaty prohibits the hostile use of environmental modification without restricting peaceful uses. The Convention on Biological Diversity has also passed decisions urging countries to avoid potentially harmful deployments of SRM, but these are not legally binding.

There are also relevant legal obligations from what is known as customary international law, such as the “no-harm rule”, which requires countries to take steps to reduce significant environmental harms to other countries. While customary international law could present legal obstacles to SRM, it does not amount to an outright prohibition.

While no comprehensive rules on SRM have been set at the international level, there is increasing engagement with the issue in intergovernmental organisations as well as regional bodies.

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How should outdoor experiments be governed?

In the absence of top-down, international governance, researchers and their funders have developed their own approaches to SRM research governance. Most SRM research, like computer modelling or public perception studies, is conducted without intervening in the environment; outdoor experiments have proved more controversial, with some cancelled after vocal opposition.

Academic efforts to identify a responsible governance approach for outdoor experiments have arrived at a broadly similar set of principles, with key points

including:

- Managing risk and uncertainty – through risk assessments, efforts to minimise risks, monitoring, and measures to respond to any potential damages.
- Promoting research integrity – through transparency, peer review of research, open publication of findings, and limiting the impact of commercial interests.
- Ensuring public engagement – through outreach and engagement with the public, including vulnerable and Indigenous groups.

Putting these governance principles into practice would raise several challenges. For example, what would be considered sufficient public engagement? There are also definitional issues: what counts as an outdoor SRM experiment, and how are they distinguished from other outdoor atmospheric experiments?

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[Outdoor SRM Experiments](#)

Near-term governance options

Near-term governance options could take many forms at a variety of levels, from regional and national frameworks to initiatives set up through civil society organisations, philanthropies, or the private sector.

A parliamentary research briefing from the UK noted possible options for improving SRM governance, including more international dialogue on SRM, improved oversight of some SRM activities, greater clarity on what counts as “SRM research” at different scales, and expanded public engagement.

Governance can help guide the field, setting priorities and moving research forward, though some prefer a more restrictive approach.

Hundreds of academics and many civil society groups have signed up to the “solar geoengineering non-use agreement” campaign, which goes further than just calling for SRM not to be deployed. It also calls for no outdoor experiments, no public funding, no patents, and no normalisation of SRM in international institutions.

Some [African ministers](#) have indicated support for a non-use agreement but not for the broader restrictions called for by the non-use campaign. [Several US states](#) have passed laws banning solar geoengineering, cloud seeding, and other atmospheric modifications in recent years. [European leaders](#) have also called for a moratorium, or temporary prohibition, on SRM deployment, while still allowing small-scale outdoor experiments under certain conditions.

Long-term governance challenges

As the impacts of climate change worsen over the coming years and decades, the incentives for a country or coalition of countries to develop and potentially deploy SRM will grow. Given the technical feasibility of stratospheric aerosol injection (SAI), it could in theory be deployed as early as the 2030s.

This raises important governance questions now, before any such deployment begins:

- How would the risks of an SRM deployment be weighed against the risks of not deploying as climate change continues to worsen?
- How specifically would decisions about a deployment be made? Which institutions, governing bodies, and multilateral processes would be involved?
- How might equity and justice be factored into decisions around SRM, given the wide variation in vulnerability to climate change as well as the potential negative impacts of a deployment?

Were a decision to deploy made, the deployment itself would pose significant political and governance challenges, and there are many open questions:

- Could this lead to conflict between countries? What steps could be taken to build trust and develop cooperative approaches to decision-making on SRM?
- What would this mean for other efforts to address climate change? Could this undermine efforts to cut emissions or support adaptation to climate risks?
- How could SRM affect weather extremes? How might claims of harm from SRM be adjudicated and resolved?
- What if it failed? What could be done to maintain the long-term stability of SRM deployment and reduce the risk of termination shock?

Steps are already being taken today by a range of actors in many countries, shaping how this field develops. Good governance of SRM will depend on understanding the issues, tracking developments in the field, and considering a diverse range of perspectives on this challenging emerging issue.

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[How Could the First Decade of Solar Geoengineering Unfold?](#)

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The History of SRM

How did this field get started? Explore a timeline of SRM research and how it evolved.