How could SRM affect Small Island Developing States?

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Prepared by SRM360 and the University of the West Indies

Above: the coastline of the Bay of Pigs, near Playa Larga, Cuba (ZUMA Press Wire)

SRM360 THE UNIVERSITY OF THE WEST INDIES

Contents

With risks from climate change mounting, there is growing interest in emerging approaches to cool the planet, known as sunlight reflection methods (SRM) or solar geoengineering. What are these approaches, and what could they mean for Small Island Developing States (SIDS)?

About us

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.

About the University of the West Indies

The University of the West Indies (The UWI) Mona Campus is Jamaica's premier institution of higher education, advancing teaching, research, innovation, and regional development. Through climate science, sustainability, and strategic partnerships, Mona contributes to climate action, resilience, and sustainable development across Jamaica and the Caribbean.

Key messages

The frontlines of climate change

SIDS are on the frontlines of climate change, facing a range of severe and interconnected threats including extreme heat, rising sea levels, tropical cyclones, and changes to rainfall, with impacts on health, agriculture, water security, and more.

Risks to be weighed

SRM has the potential to reduce many climate risks, but it would also introduce new risks and challenges. These should be carefully weighed against the impacts of climate change without SRM.

Increasing engagement

SIDS may experience some of the greatest consequences from decisions on SRM, so increasing engagement with SRM across these regions will be key for discussions to better represent the views of those with most at stake.

The climate context

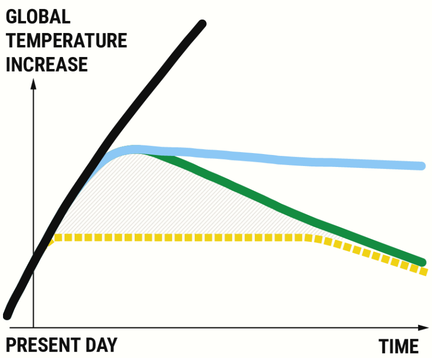
The world is fast approaching 1.5°C of warming and is on track for about 2.8°C under current policies.[1] Threats from climate change are increasing globally, with weather becoming more extreme, sea levels rising, and tipping points approaching.

Many SIDS are low-lying islands with large coastal populations, leaving them particularly exposed to sea-level rise and related flooding or land loss.[2] SIDS are also home to 40 percent of the world's coral reefs, which play key roles in their fisheries, tourism, and coastal protection while facing existential threats from climate change.[3,4]

Many SIDS have relatively small economies focused on sectors that are sensitive to environmental changes, such as agriculture, fisheries, and tourism.[2] The climate risks faced by SIDS are interconnected and can compound, leaving these regions particularly vulnerable to climate change, with their capacity for adaptation and recovery already limited.

Strategies to tackle climate change

This illustrative diagram explores the potential contributions of different climate strategies over the long term:



NO EMISSIONS CUTS
Temperatures would continue to rise.

REACH NET ZERO EMISSIONS
This would stop further global warming, but not reverse it.

REMOVE CARBON
Carbon dioxide removal could then slowly lower temperatures.

REFLECT SUNLIGHT?
Could SRM offset global warming while emissions fall and carbon is removed?

The main strategy to address climate change is cutting carbon dioxide emissions; there cannot be a sustainable solution to climate change without emissions cuts. Reaching net zero emissions would stop further global warming, but would not reduce temperatures to safer levels.[5]

Reducing global temperatures once emissions are eliminated would require also removing hundreds of billions of tonnes of carbon dioxide from the atmosphere, which would be extremely costly and could take more than a century.[6]

SRM may offer a way to cool the planet relatively quickly, but it comes with trade-offs and challenges. Could it help as an additional measure to tackle climate change?

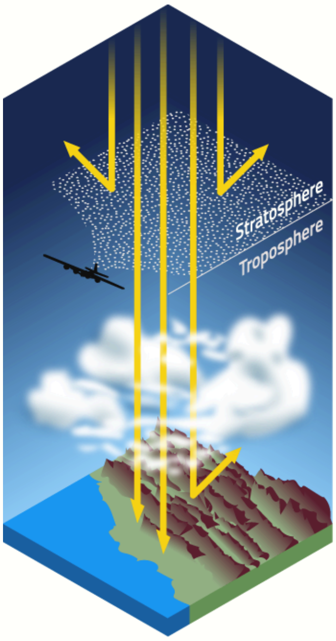
What is SRM?

SRM is a set of potential approaches to cool the planet by increasing the amount of sunlight the Earth reflects back to space. If deployed wisely, it could reduce many impacts of climate change, but it comes with new risks and challenges.

Two approaches have received particular attention.

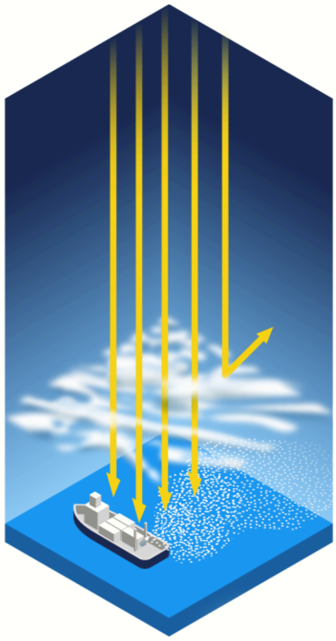
Stratospheric aerosol injection (SAI)

A global intervention



Marine cloud brightening (MCB)

A regional intervention



What's the idea?	A global layer of tiny particles in the upper atmosphere to directly reflect a small fraction of sunlight before it heats the Earth.	More reflective ocean clouds to provide regional cooling, which could potentially be scaled up to a global level.
How could it be done?	By a fleet of specially designed high-flying planes releasing tiny reflective particles that would stay in the stratosphere for 1–2 years.[7]	By a fleet of ships with specially designed sprayers delivering precisely sized sea-salt particles into low-lying ocean clouds.[8]
Would it work?	Researchers are confident that this would be technically feasible and capable of lowering global temperatures,[9] estimating a cost of tens of billions of dollars per year.[7]	Researchers are not currently confident that this would be technically feasible, as current sea-salt sprayers are far too inefficient.[9]
What are the drawbacks?	It would have several side effects, and some regions could see greater changes to rainfall compared to climate change alone.[10]	Its patchy, regional cooling effect could substantially shift rainfall patterns, and it may be less effective or counter-productive in some cases.[11]

How might SAI affect Small Island Developing States?

This table outlines how some key risks for SIDS could be affected by SAI compared to future climate change.

	What impacts would climate change have?	What impacts would SAI have?
Extreme heat	Heatwaves are expected to become more intense, more frequent, and longer lasting across the world due to climate change.[12]	SAI could significantly reduce extreme heat and its associated risks.[13]
Tropical cyclones	While the total number of tropical cyclones may decrease with future climate change, they are expected to get more intense, with higher proportions of Category 4 and 5 storms.[2] However, changes in frequency, intensity, and storm tracks vary substantially between ocean basins and therefore between SIDS regions.	The effects of SAI on tropical cyclones are unclear. Substantial regional differences are expected, potentially reducing risks in some areas while increasing them in others.[14]
Sea-level rise	Many SIDS will suffer severe losses from sea-level rise due to climate change, with coastal flood risks expected to increase dramatically even under ambitious emissions cuts.[15]	SAI could reduce the rate of sea-level rise by reducing the thermal expansion of the oceans and by reducing the melting of ice sheets; however, even halting warming would not stop sea-level rise.[16,17]
Fisheries and coral reefs	Climate change will significantly impact fisheries through ocean warming, acidification, and other effects, with tropical regions at particular risk.[18] More intense marine heatwaves are the main threat facing coral reefs,[19] which could be almost entirely eliminated at 2–2.5°C of global warming.[20]	SAI would not address ocean acidification,[21] but could reduce risks from marine heatwaves in most regions, limiting some threats to fisheries and providing potentially significant benefits for coral reefs.[22,23]

	What impacts would climate change have?	What impacts would SAI have?
Agriculture and water security	Climate change is expected to increase drought risks and reduce soil fertility, causing crop failures and long-term declines in crop yields for SIDS.[24] As many SIDS are particularly reliant on rainfall for their water supplies, climate change could also significantly impact the regions' water security.[25]	SAI's impact on rainfall would be uncertain and vary regionally, with some areas likely getting drier and others wetter.[26] This could have negative impacts on water security and agriculture, though reduced heat stress would benefit many crops. The overall impact on agriculture would be uncertain, regionally variable, and dependent on crop type.[26]
Health	Climate change is expected to have a range of damaging effects on health in SIDS, particularly for older adults, children, and outdoor workers.[27] These include the direct impacts of rising heat and indirect effects, such as increasing the transmissibility of dengue and Vibrio.	SAI would bring some health benefits by reducing extreme heat,[28] but it could have some negative effects, including shifting the distribution of infectious diseases.[29] The overall impact on health would be unclear, particularly at a regional scale.

Issues and challenges

While SRM might reduce many climate impacts, it raises several concerns, including side effects and governance challenges.

Physical effects

- SAI could reduce the rainfall changes expected under climate change overall, but it could worsen them in some places.[10,30] Deployed unevenly, SRM could produce substantial shifts in rainfall patterns.
- SAI could delay the recovery of the ozone hole and add a little to air pollution, though these risks may be small compared to the benefits of reduced heat.[28]
- SAI would impact renewable energy generation through regional changes to weather patterns, likely increasing generation in some regions and decreasing it in others.[31,32]

Sociopolitical concerns

- There is a concern that advancing SRM would undermine efforts to cut emissions. This is known as mitigation displacement or moral hazard.[33]
- SRM deployment would have impacts across the world and countries might not cooperate to make decisions fairly or effectively.[34]
- The benefits and risks of SRM would be uneven, which could increase tensions between countries.[35] The attribution of SRM's impacts may also be contested, which could pose further geopolitical risks.[34]
- Large-scale SRM would need to be reliably maintained, as an abrupt and long-lasting stop would cause a "termination shock" – a rapid increase in temperature with devastating effects for the planet.[36]

These issues raise important questions for SIDS, which may experience some of the greatest consequences from decisions on SRM. Could SIDS be meaningfully involved in decision-making on SRM? How could control over a potential SRM programme be fairly distributed? How could deployment be reliably maintained or safely stopped?

SIDS have shown historic leadership on climate change, playing key roles in the Paris Agreement's 1.5°C temperature goal, the establishment of a fund for responding to loss and damage, and the ruling from the International Court of Justice on legal responsibility for climate harms.[37] Given the high stakes involved with SRM and the regions' vulnerability to climate change, SIDS also have an important role to play in discussions on SRM. Continued efforts to strengthen expertise and engagement with SRM across these regions will be key for more informed and inclusive decision-making.

Appendix

Additional reading

Learn more about SRM in SRM360's introductory guide at SRM360.org/guide/why-consider-srm

For the online version of this primer, scan the QR code or visit SRM360.org/primer/small-island-developing-states

The United Nations list of Small Island Developing States (SIDS)

Antigua and Barbuda, Bahamas, Barbados, Belize, Cabo Verde, Comoros, Cook Islands, Cuba, Dominica, Dominican Republic, Fiji, Grenada, Guinea-Bissau, Guyana, Haiti, Jamaica, Kiribati, Maldives, Marshall Islands, Mauritius, Micronesia (Federated States of), Nauru, Niue, Palau, Papua New Guinea, Samoa, São Tomé and Príncipe, Seychelles, Singapore, Solomon Islands, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Timor-Leste, Tonga, Trinidad and Tobago, Tuvalu, Vanuatu

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