

Finding the right 'dose' for solar geoengineering

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One of the key misconceptions about solar geoengineering—putting aerosols into the atmosphere to reflect sunlight and reduce global warming—is that it could be used as a fix-all to reverse global warming

trends and bring temperature back to pre-industrial levels.

It can't. Applying huge doses of [solar geoengineering](#) to offset all warming from rising atmospheric CO₂ levels could worsen the [climate](#) problem—particularly rainfall patterns—in certain regions. But could smaller doses work in tandem with emission cuts to lower the risks of a changing climate?

New research from the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS), in collaboration with MIT and Princeton University, finds that if solar geoengineering is used to cut global temperature increases in half, there could be worldwide benefits without exacerbating change in any large geographic area.

"Some of the problems identified in earlier studies where solar geoengineering offset all warming are examples of the old adage that the dose makes the poison," said David Keith, the Gordon McKay Professor of Applied Physics at SEAS and senior author of the study. "This study takes a big step towards using climate variables most relevant for human impacts and finds that no IPCC-defined region is made worse off in any of the major climate impact indicators. Big uncertainties remain, but [climate models](#) suggest that geoengineering could enable surprisingly uniform benefits."

The research is published in *Nature Climate Change*.

To better understand what regions could experience worse climatic conditions if solar geoengineering were combined with emissions cuts, the researchers used a state-of-the-art high-resolution model to simulate extreme rainfall and tropical cyclones (a.k.a. hurricanes). It's the first time such a model has been used to study the potential impact of solar geoengineering.

Researchers looked at temperature and precipitation extremes, water availability, and a measure of the intensity of tropical storms. They found that halving warming with solar geoengineering not only cools the planet everywhere but also moderates changes in water availability and extreme precipitation in many places and offsets more than 85 percent of the increase in the intensity of hurricanes.

Less than 0.5 percent of the land would see the effects of climate change exacerbated, according to the model.

"The places where solar geoengineering exacerbates climate change were those that saw the least climate change to begin with," said Peter Irvine, Postdoctoral Research Fellow at SEAS and lead author of the study.

"Previous work had assumed that solar geoengineering would inevitably lead to winners and losers with some regions suffering greater harms; our work challenges this assumption. We find a large reduction in climate risk overall without significantly greater risks to any region."

The researchers are quick to point out that this is a simplified experiment, which assumed doubled CO₂ concentrations and represented solar geo-engineering by turning down the sun. However, it is a first step towards understanding how solar geoengineering could be used in tandem with other tools to mitigate some of the worse impacts of climate change.

"For years, geoengineering has focused on compensating for greenhouse gas induced [warming](#) without worrying too much about other quantities like rainfall and storms," said Kerry Emanuel, the Cecil & Ida Green Professor of Atmospheric Science at MIT and co-author of the study.

"This study shows that a more modest engineered reduction in [global warming](#) can lead to better outcomes for the climate as a whole."

"The analogy is not perfect but solar [geoengineering](#) is a little like a drug

which treats [high blood pressure](#)," said Irvine. "An overdose would be harmful, but a well-chosen dose could reduce your risks. Of course, it's better to not have high blood pressure in the first place but once you have it, along with making healthier lifestyle choices, it's worth considering treatments that could lower your risks."

More information: Halving warming with idealized solar geoengineering moderates key climate hazards, *Nature Climate Change* (2019). [DOI: 10.1038/s41558-019-0398-8](https://doi.org/10.1038/s41558-019-0398-8) , www.nature.com/articles/s41558-019-0398-8

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