



The Gulf of Mexico and US Gulf Coast at sunset, as seen from the International Space Station. Terry Virts/NASA

This controversial climate solution could be exactly what the planet needs. Or it could be a colossal disaster

By Laura Paddison, CNN

6 minute read

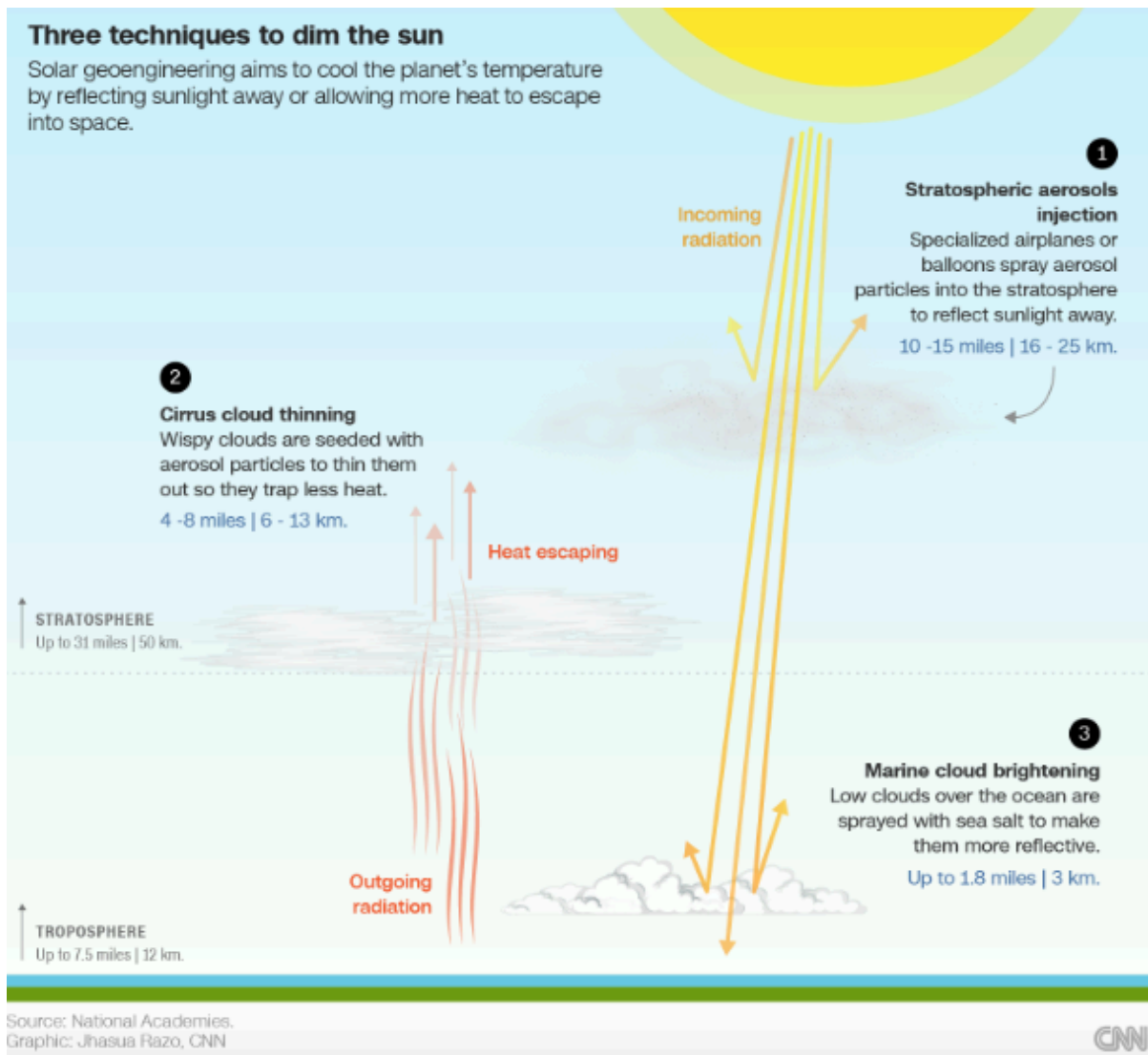
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### **CNN —**

When US startup Make Sunsets released two weather balloons into the skies above Mexico's Baja California peninsula last year, it kicked up a fierce debate about one of the world's most controversial climate solutions.

The plan was for the balloons, filled with helium and a small amount of sulfur dioxide, to float high into the stratosphere. There they would burst, dispersing their load of sun-reflecting sulfur dioxide particles and cool the Earth, just a tiny bit. Some dismissed it as a stunt. It is not clear if any particles were actually released or even if the balloons made it to the stratosphere. But Make Sunsets' experiment is significant for crossing a threshold when it comes to a hotly-debated climate solution: solar geoengineering.

To its supporters, solar geoengineering is a fix we cannot ignore as the world hurtles toward climate disaster. For critics, it is a technology so dangerous we shouldn't even research it.



The Next Big Idea: Reengineering the planet (2021)

04:58 - Source: [CNN](#)

What is solar geoengineering?

At its simplest, solar geoengineering, also known as solar radiation management, is an attempt to bring down the planet's temperature by reflecting sunlight away or allowing more heat to escape into space.

There are three main techniques:

Marine cloud brightening involves trying to make the low clouds over the ocean more reflective by spraying them with sea salt.

Cirrus cloud thinning targets wispy clouds higher up in the atmosphere, seeding them with aerosol particles in an attempt to thin them, so they trap less heat.

The most-researched method, however, is stratospheric aerosol injection. It involves spraying aerosols – such as sulfur dioxide particles – into the stratosphere, more than 12 miles above the Earth's surface, to reflect sunlight back into space. It could be done with balloons or specialized airplanes able to fly at high altitude.

The idea takes its cue from volcanoes. When Mount Pinatubo erupted in the Philippines in 1991, the sulfur dioxide it expelled high into the atmosphere had the

effect of temporarily cooling the planet by 0.5 degrees Celsius (nearly 1 degree Fahrenheit).

Why is solar geoengineering such a hot topic?

The idea has been around since the 1960s, but it's getting more attention because progress to tackle climate change is so far off-pace.

The world is on track to pass critical warming thresholds, beyond which the chances of extreme flooding, drought, wildfires and food shortages increase dramatically.

Scientists have even gone as far as to propose blowing moon dust toward the Earth to act as a sun shield, reducing the amount of sunlight reaching the planet.

"I wish there was no geoengineering!" Luke Iseman, the founder of Make Sunsets told CNN in an email. But "there are no other realistic options to stay below 2 [degrees Celsius]," he said.

While pretty much no one is claiming solar geoengineering could replace planet-warming pollution cuts and solve climate change, supporters argue it could have a big planetary cooling effect for a relatively small price tag. A 2018 Harvard study estimated it would cost around \$2.25 billion a year over a 15-year period.



Mount Pinatubo volcano erupted in 1991, sending a cloud of ash into the atmosphere which cooled global temperatures. Arlan Naeg/AFP/Getty Images

Research Article

# THE IMPACT OF MOUNT PINATUBO ON WORLD-WIDE TEMPERATURES

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Global mean air temperatures were reduced, by up to 0.5°C at the surface and 0.6°C in the troposphere, for some months in mid-1992, in approximate accord with model predictions. Differences from these predictions occurred in the Northern Hemisphere winters of 1991–1992 and 1992–1993, as a result of atmospheric circulation changes that yielded continental surface warmings not fully reproduced by the model.

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The world needs to cut emissions, “no question,” David Keith, professor of applied physics and public policy, at Harvard University told CNN. But it doesn’t mean we can afford to ignore other climate solutions, he added.

“I’m not saying we have to do solar geoengineering, but I think it’s worth considering all the tools,” he said.

Chris Field, director of the Stanford Woods Institute for the Environment, told CNN there are good reasons to be skeptical of solar geoengineering. But, he said, if it “could provide a path for decreasing the impacts of climate change on millions of the world’s most vulnerable people (and on ecosystems), we have a responsibility to explore the opportunities, as well as the risks.”

For some of the most at-risk countries, including low-lying island nations, climate change already threatens their existence. A 2019 survey of more than 700 climate experts found those who expected severe climate damage in their own countries were more supportive of solar geoengineering.

Why is it so controversial?

In the eyes of its opponents, the technology could open the door to an almost infinite number of potential negative consequences.

“Just because we’re desperate doesn’t suddenly make solar geoengineering a good idea, because the risks are so immense,” Lili Fuhr, from the Center for International Environmental Law, told CNN.

There are fears fiddling with the planet’s thermostat could alter rainfall patterns and shift monsoons, with potentially devastating consequences for crops.

Effects could vary across regions, with some areas reaping benefits while others are harmed, increasing the chance of conflict.



“When things go wrong, it is usually the poor people that suffer the most,” said Chukwumerije Okereke, professor of global climate and environmental governance at Alex Ekwueme Federal University in Nigeria.

People are already suggesting African countries as a testing ground for the technologies, Okereke said. “It is a distraction from the sort of policies and help that should be coming to Africa.”



Devastating floods in Nigeria in 2022 were found to have been made 80% more likely by climate change. Temilade Adelaja/Reuters

Solar geoengineering could also damage the ozone layer, which shields Earth from harmful ultraviolet rays, and is currently on track to repair itself after the success of a ban on ozone-depleting chemicals.

Then there are the difficulties of implementation.

As the aerosol particles do not tend to remain in the atmosphere for more than about a year, solar geoengineering would have to be continuously maintained. If halted, there is a risk of “termination shock,” unleashing all the pent-up warming “waiting in the wings, ready to slap the Earth in the face,” Raymond Pierrehumbert, professor of physics at Oxford University, told CNN.

It would also require unprecedented international cooperation, Frank Biermann, professor of global sustainability governance at Utrecht University in the Netherlands, told CNN. “It would mean that countries have to collaborate forever,” he said, including those currently at war.

One of the biggest criticisms of solar geoengineering is it could be grasped by polluters as a way to continue polluting, and by governments as a distraction from policies to reduce planet-heating pollution.

In 2021, a group of nearly 400 scientists called for an “international non-use agreement,” a commitment to restrict the development of solar geoengineering “before it is too late.”

Governments should consider solar geoengineering in the same way they do chemical weapons, biological weapons, nuclear testing and Arctic mining, Biermann said.

What’s the progress so far?

There has been a flurry of interest in the technology, especially in the US.

In 2019, Congress allocated \$4 million to the National Oceanic and Atmospheric Administration for stratospheric research, some of which was for solar geoengineering. And last year, the Biden administration announced a five-year research plan to explore the concept.

A 2021 report from the National Academy of Sciences called for the US to allocate up to \$200 million to a research program to better understand solar geoengineering, including its feasibility, impacts on society and the environment, and public perceptions.

Research organizations are also providing funding. In February, the UK-based Degrees Initiative announced \$900,000 for research in countries across Africa, Asia and South America to look at how the technology could affect the Global South.

So far, outdoor experiments have been difficult to get off the ground and have faced heavy resistance.

An attempt by Harvard University researchers to test a high-altitude balloon in Arctic Sweden in 2021 was abandoned after an outcry from local Indigenous Sami people.

A letter on behalf of the Sami Council said solar geoengineering “entails risks of catastrophic consequences.”

And following Make Sunset’s balloon release, the Mexican government announced in January it would ban solar geoengineering experiments.

As the world heats up and solar geoengineering shifts from sci-fi to mainstream, tussles between those who say there is an obligation to research it as a potential last-chance solution and those convinced it is the path to catastrophe are only likely to increase.

Critics like Biermann, however, remain unwavering in their opposition.

“It’s very risky. It cannot be governed. It’s unethical,” he said. “And it is one of the biggest dangers in the current climate policies.”