Could spraying particles into marine clouds help cool the planet?

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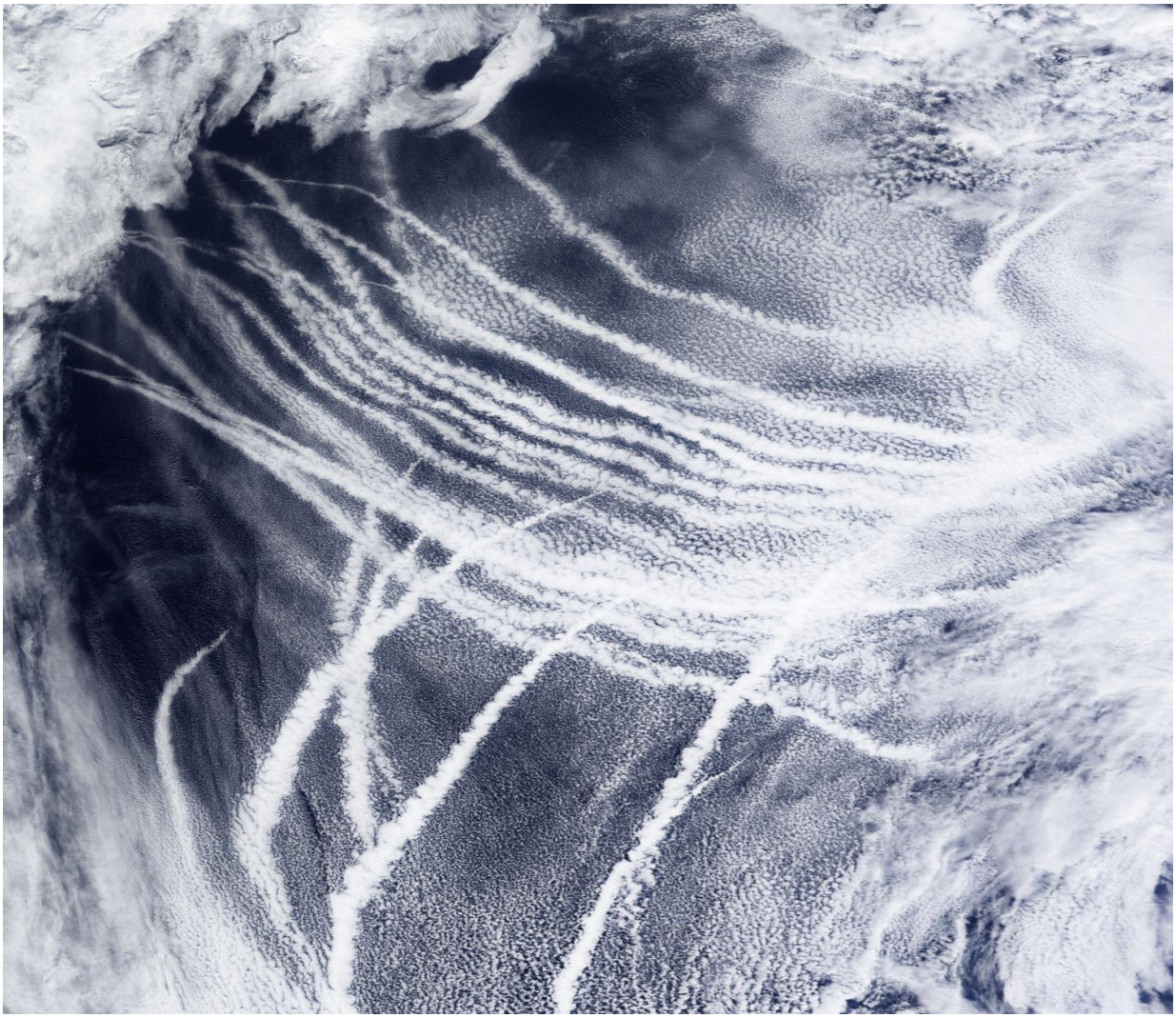

Ships crossing the Pacific Ocean emit particles into the clean air that create a seed for marine clouds. Credit: NASA

The idea of geoengineering, also known as climate engineering, is very controversial. But as greenhouse gases continue to accumulate in our atmosphere, scientists are beginning to look at possible emergency measures.

A new University of Washington study looks at the idea of marine cloud brightening, which a UW group is investigating as a promising strategy to offset global warming. The strategy would spray saltwater into the air to make marine clouds reflect more incoming solar rays.Small-scale tests of marine cloud brightening would also help answer scientific questions about clouds and aerosols, two UW atmospheric scientists say in a paper published in July in the journal *Earth's Future*. This dual goal for early-stage geoengineering tests would follow the U.S. National Academies of Sciences' 2015 recommendation that any tests of geoengineering also yield a scientific benefit.

"A major, unsolved question in climate science is: How much do aerosol particles cool the planet?," said lead author Rob Wood, a UW professor of atmospheric sciences. "A controlled test would measure the extent to which we are able to alter clouds, and test an important component of climate models."

Other co-authors are Thomas Ackerman, a UW professor of atmospheric sciences, Philip Rasch at the Department of Energy's Pacific Northwest National Laboratory and Kelly Wanser at the Ocean Conservancy.

The authors are part of a group that is proposing to spray saltwater over oceans to cause a small increase in the brightness of marine clouds and boost their capacity to reflect sunlight. Doing so could be a short-term measure to offset global warming in a possible future emergency situation. In the meantime, it could also further understanding of the climate system.

One of the biggest uncertainties in climate models is the clouds, which reflect sunlight in unpredictable ways. Water droplets can only condense on airborne particles, such as smoke, salt or human pollution. When the air contains more particles the same amount of moisture can form smaller droplets, which creates whiter, brighter, more reflective clouds. Climate scientists believe pollution since the Industrial Revolution has created brighter clouds that reflect more sunlight, offsetting the warming from greenhouse gases, which trap long-wave radiation. But they can't pin down the size of the effect or predict how much it might change in the future.

"Testing out marine cloud brightening would actually have some major benefits for addressing both questions," Wood said. "Can we perturb the clouds in this way, and are the climate models correctly representing the relationship between clouds and aerosols?"

A conceptualized image of an unmanned, wind-powered, remotely controlled ship that could be used to implement cloud brightening. Credit: John MacNeill

The proposal is now waiting on funding from government or private donors. For several years, UW researchers have been working with a group of engineers in California's Bay Area to develop a nozzle that turns saltwater into tiny particles that could be sprayed high into the marine cloud layer. It's the first in a series of steps needed to implement the roughly three-year plan. The researchers propose to:

- Produce a sprayer that is able to eject trillions of aerosol particles per second
- Conduct initial lab tests of the sprayer (UW research scientist Dave Covert helped conduct wind-tunnel testing of a prototype nozzle in 2015 in the Bay Area)
- Do preliminary outdoor tests in a coastal area that is fairly flat, relatively free of air pollution and prone to marine clouds (the group is currently seeking funding for proposed coastal tests in Monterey Bay)
- Move to small-scale offshore tests If tests were successful, people might someday decide whether to use a scaled-up version to create a small increase in the reflection of sunlight over large swaths of the world's oceans.

"We're talking about some kind of new world in terms of the ethical issues," Ackerman said. "But for climate, we're no longer in an era of 'do no harm.' We are altering the climate already. It's now a case of 'the lesser of two evils.'"

Ackerman will speak July 27 in Newry, Maine, at the first Gordon

Research Conference on Climate Engineering about the proposed testing plan. Another speaker is the leader of a Harvard University test of an alternate proposal to spray reflective particles high in the atmosphere.

In addition to the paper on the scientific benefits of testing marine cloud brightening, a group of UW graduate students and professors published a recent paper on what specific measures might be feasible, ethical and scientifically useful for evaluating a cloud-brightening test. Authors include UW graduate students and faculty in philosophy, atmospheric science and civil engineering who were part of an interdisciplinary UW graduate course on geoengineering—among the first of its kind.

The class was taught last winter by Ackerman and Stephen Gardiner, a UW philosophy professor who wrote a book on the ethics of deliberately tinkering with the planet's atmosphere. Ackerman has since written an essay about the teaching experience. He believes the interdisciplinary approach is the right way to proceed with geoengineering.

"There's a science question about can we do it, but there's also an ethical question about should we do it, and a policy question about how would we do it," Ackerman said. "I'm an agnostic on this. I want to test geoengineering and see if it works. But the whole time we're working on this, I think we need to still be asking ourselves: 'Should we do it?'"

More information: Robert Wood et al, Could geoengineering research help answer one of the biggest questions in climate science?, *Earth's Future* (2017). DOI: 10.1002/2017EF000601

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