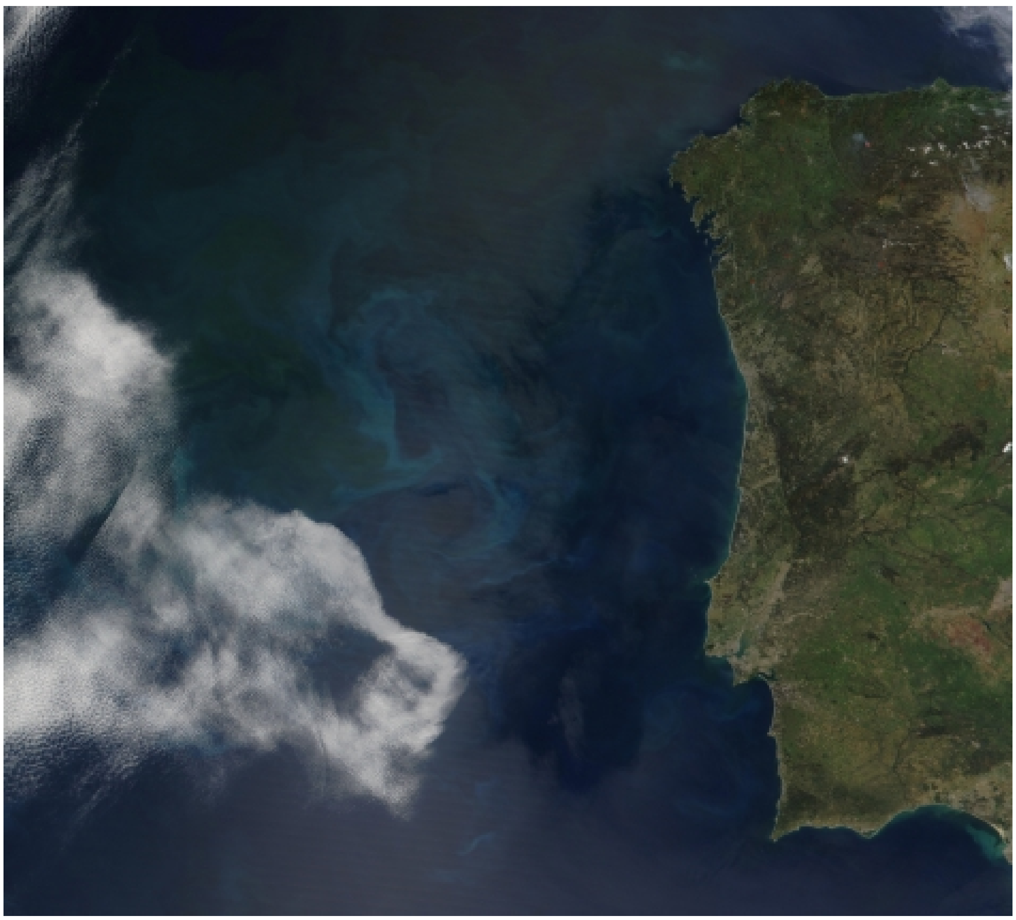
Researchers find unintended consequences of geoengineering to slow climate change

September 9 2015, by Mark Dwortzan



A large phytoplankton bloom off the coast of Portugal. Credit: Jacques Descloitres/NASA Goddard Space Flight Center

Like the leaves of New England maples, phytoplankton, the microalgae at the base of most oceanic food webs, photosynthesize when exposed to sunlight. In the process, they absorb carbon dioxide from the atmosphere, converting it to carbohydrates and oxygen. Many phytoplankton species also release dimethyl sulfide (DMS) into the atmosphere, where it forms sulfate aerosols, which can directly reflect sunlight or increase cloud cover and reflectivity, resulting in a cooling effect. The ability of phytoplankton to draw planet-warming carbon dioxide (CO_2) from the atmosphere and produce aerosols that promote further cooling has made ocean fertilization—through massive dispersal of iron sulfite and other nutrients that stimulate phytoplankton growth—an attractive geoengineering method to reduce global warming.

But undesirable climate impacts could result from such a large-scale operation, which would significantly increase emissions of DMS, the primary source of sulfate aerosol over much of the Earth's surface, and a key player in the global climate system. Now, in a study published in Nature's *Scientific Reports*, MIT researchers found that enhanced DMS emissions, while offsetting greenhouse gas-induced warming across most of the world, would induce changes in rainfall patterns that could adversely impact water resources and livelihoods in some regions.

"Discussions of geoengineering are gaining ground recently, so it's important to understand any unintended consequences," says Chien Wang, a co-author of the study and a senior research scientist at MIT's Center for Global Change Science and the Department of Earth, Atmospheric, and Planetary Sciences. "Our work is the first in-depth analysis of ocean fertilization that has highlighted the potential danger of impacting rainfall adversely."

To investigate the impact of enhanced DMS emissions on global surface temperature and precipitation, the researchers used one of the global climate models used by the Intergovernmental Panel on Climate Change (IPCC), which simulates the evolution of and interactions among the ocean, atmosphere, and land masses. Running simulations that compared two scenarios, they found mixed results. In one simulation they implemented a scenario known as RCP4.5 that is used by the IPCC to project greenhouse gas concentrations, aerosol emissions, and land-use change based on policies that lead to moderate mitigation of greenhouse gas emissions over the course of the 21st century. They also used RCP4.5 in a second simulation, with one exception: DMS emissions from the ocean were increased to the maximum feasible levels, or about 2.5 times higher.

The simulations showed that enhanced DMS emissions would reduce the increase in average global surface temperature to half that of the RCP4.5 scenario, resulting in a net increase of 1.2 degrees Celsius by 2100. But the cost would be a substantial reduction in precipitation for some regions.

"Generally, our results suggest that the cooling effect associated with enhanced DMS emissions would offset warming across the globe, especially in the Arctic," says the study's first author, Benjamin Grandey, a senior postdoc in Wang's group who configured the model simulations and analyzed the data. "Precipitation would also decline worldwide, and some parts of the world would be worse off. Europe, the Horn of Africa, and Pakistan may receive less rainfall than they have historically."

Grandey and Wang warn that the lower rainfall could reduce water resources considerably, threatening the hydrological cycle, the environment, and livelihoods in the affected regions.

The researchers hope their investigation will inspire further studies of more realistic ocean fertilization scenarios, and of the potential impacts on marine ecosystems as well as human livelihoods. Further research will be needed, they say, to fully evaluate the viability of ocean fertilization as a geoengineering method to offset greenhouse gas-induced warming.

More information: "Enhanced marine sulphur emissions offset global warming and impact rainfall." *Scientific Reports* 5, DOI: 10.1038/srep13055

This story is republished courtesy of MIT News (web.mit.edu/newsoffice/), a popular site that covers news about MIT research, innovation and teaching.

Provided by Massachusetts Institute of Technology

Citation: Researchers find unintended consequences of geoengineering to slow climate change (2015, September 9) retrieved 20 June 2024 from https://phys.org/news/2015-09-unintended-consequences-geoengineering-climate.html