Global sunscreen won't save corals

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Emergency plans to counteract global warming by artificially shading the Earth from incoming sunlight might lower the planet's temperature a few degrees, but such "geoengineering" solutions would do little to stop the acidification of the world oceans that threatens coral reefs and other marine life, report the authors of a new study in the journal *Geophysical Research Letters*. The culprit is atmospheric carbon dioxide, which even in a cooler globe will continue to be absorbed by seawater, creating acidic conditions.

"There would be a slight reduction in this problem, because land plants would be expected to be able to grow more vigorously in a high CO_2, but cool world," says Ken Caldeira of the Carnegie Institution's Department of Global Ecology, a co-author of the study with lead author Damon Matthews of Concordia University, Canada, and Carnegie geochemist Long Cao. Land plants and soils would hold onto more carbon in this scenario, so less would find its way into the oceans. "However this expansion of the land biosphere, while it's a slight help to ocean acidification is not enough to make a big difference."

A widely-discussed proposal for countering warming with geoengineering involves injecting small, reflective particles into the upper atmosphere. This would partially block incoming sunlight before it reached the Earth's surface, lowering global temperatures just as volcanic ash from the Mount Pinatubo did following its eruption in 1991. But critics have warned that such a scheme might also alter rainfall patterns, damage the planet's ozone layer, or have other unexpected effects.

Until the current study, which used a computer model of the Earth's climate system and biosphere to simulate the effect of geoengineering on climate and the ocean's chemistry, the potential impact of such a scheme on ocean acidification had never been calculated. In the simulations, reduced sunlight cooled the planet as expected,,and it also slightly slowed the rise in atmospheric carbon dioxide, as more carbon was absorbed by natural sinks. But this slight change was not enough to significantly mitigate ocean acidification.

Ocean acidification rivals global warming as a threat to marine ecosystems, especially coral reefs, which need to be surrounded with mineral-saturated water in order to grow. Rising levels of carbon dioxide make seawater more acidic, leading to lower mineral saturation. Recent research has indicated that continued carbon dioxide emissions will cause coral reefs to begin dissolving within a few decades, putting the survival of these ecosystems at extreme risk.

Geoengineering's minimal effect on ocean acidification adds another factor to the debate over the advisability of intentionally tampering with the climate system. Some see geoengineering as a possibly necessary response to the prospect of devastating climate change caused by increased human emission of greenhouse gases. Others see it as reckless tinkering with the planet's complex and finely tuned climate system that could do more harm than good.

"Geoengineering approaches come with all sorts of risks," says Caldiera. "It is important we learn about the the full set of these risks and all of their implications." He considers deep cuts in human emissions of carbon dioxide to be the most effective safeguard against a global environmental crisis. "One of the good reasons to prefer CO_2 emissions reductions over geoengineering is that CO_2 emissions reductions will protect the oceans from the threat of ocean acidification, whereas these geoengineering options will not."

Citation: Matthews, H. D., L. Cao, and K. Caldeira (2009), Sensitivity of ocean acidification to geoengineered climate stabilization, *Geophys. Res. Lett.*, 36, 28 May 2009

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