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Livermore researchers determine biosphere unaffected by geoengineering schemes

LIVERMORE, Calif. -- Using models that simulate the interaction between global climate and land ecosystems, atmospheric scientists from the Lawrence Livermore National Laboratory have shown that compensating for the carbon dioxide "greenhouse effect" by decreasing the amount of sunlight reaching the planet (geoengineering) could create a more vigorous ecosystem while helping to curb global warming.

The study suggests that planetary-scale engineering projects to lessen the amount of solar radiation reaching the Earth's surface will likely do little to prevent the effects of increased greenhouse gases on the terrestrial biosphere. In fact, plants could experience growth spurts.

In a paper entitled: "Impact of Geoengineering Schemes on the Terrestrial Biosphere," Livermore researchers Bala Govindasamy, Starley Thompson, Philip Duffy, Ken Caldeira and University of Wisconsin collaborator Christine Delire, modeled the impact on Earth's land biosphere due to various schemes that would reduce the amount of sunlight reaching the planet's surface. The research appears in the Nov. 26 online edition of Geophysical Research Letters.

"Our models show plant life getting a big boost from the carbon dioxide fertilization when atmospheric CO2 levels are doubled due to anthropogenic fossil fuel emissions," Govindasamy said. "We noticed that in a CO2-enriched world, the terrestrial biosphere was largely unaffected by decreases in surface solar radiation by a couple of percentage points through various geoengineering schemes."

In earlier research, scientists have maintained that greenhouse gases emitted from the burning of fossil fuels are one of the largest sources of global warming because they cause an increase in the amount of carbon dioxide in the atmosphere. Methods to reduce atmospheric carbon dioxide vary from storing it in the deep ocean to reducing the amount of sunlight reaching the planet (geoengineering) that could largely counteract the warming influence of more greenhouse gases.

"Critics suggested that 'turning down the sun' could harm terrestrial ecosystems that depend on light for photosynthesis, but this new work shows that a change in solar flux to stabilize climate would have little effect on the terrestrial biosphere," Caldeira said. "In fact, turning down the sun a bit reduces evaporation and therefore gives the plants more water for photosynthesis so that they may actually grow better in a geoengineered world than they do today."

The researchers, however, strongly caution against adopting any geoengineering scheme because "there are many reasons why geoengineering is not a preferred option for climate stabilization." Among these are the risks of system failure and unpredictable responses of Earth's climate system to large-scale human intervention ecosystems.

"First, geoengineering schemes impose a variety of technical, political and economic challenges. International consensus to develop and maintain the schemes would be difficult. Failure of a scheme could be catastrophic," said Govindasamy said. "CO2 fertilization could impact ecosystem goods and services not represented by our land biosphere model, such as plant species abundance and competition, habitat loss, biodiversity and other disturbances."

The LLNL-led group used a general circulation model coupled to a model of land vegetation to conclude that the change in solar flux needed to stabilize climate would have little effect on net primary productivity in land.

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