Scientists develop feedback technique to manage uncertainties in solar geoengineering

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(Phys.org) —In reality, there is no climate reset button. But climate models, unlike the real world, allow do-overs. Scientists at Pacific Northwest National Laboratory, Caltech and Lancaster University took advantage of this "what-if" proving ground by inserting a unique feedback loop into a climate model to react to theoretical climate engineering techniques. Like using a steering wheel to keep a car on course, their feedback technique reacts and adjusts to conditions resulting from designed climate engineering. And, it is much better at achieving climate objectives—whatever those might be—compared to predicting the amount of geoengineering required ahead of time. In this way, researchers can manage a large set of uncertainties inherent in understanding how these techniques may work in the real world.

"There are uncertainties in the climate system due to the amount of carbon dioxide, and geoengineering adds inherent uncertainties on top of that," said Dr. Ben Kravitz, climate scientist and modeler at PNNL. "Some of these uncertainties can't be reduced, so if society decides to use geoengineering to help meet climate objectives, it will be done in the presence of uncertainty. Our method allows us to manage some of those uncertainties."

Some postulate that if societies are unable to reduce the greenhouse gas warming effects through emissions reduction, and communities are unable to fully adapt to changing conditions, then using a technology to reduce climate warming would buy society some time. Geoengineering is a category of deliberate technologies proposed by some to reduce the climate warming effects of greenhouse gases. Scientists are using model-based analysis to understand how the climate might react to engineered solutions, the amount of carbon dioxide they offset, and how they could be adjusted to keep the climate at a desired state. Modeling investigations are important, because testing these techniques in the real world has a host of issues that need to be resolved first.

"After start-up, if the amount of geoengineering deployed to achieve a climate objective is wrong, we wouldn't get to start over and try again," said Kravitz.

The research team used two climate models in the study: one to design a geoengineering strategy, and one in which geoengineering was implemented (a real-world proxy). They implemented the design model as often as they wished, but conducted each simulation in the real-world proxy exactly once. This process parallels the situation that society might face if geoengineering is used to achieve climate goals. Through "what-if" scenarios, they turned up the sun's energy if the climate got too cold or dialed it down if the climate got too warm. Their research showed how using a deliberate feedback mechanism was effective in helping manage some of those uncertainties.

This study developed tools that can be more broadly used to understand real-world feedbacks in the climate system.

More information: Kravitz B, DG MacMartin, DT Leedal, PJ Rasch, and AJ Jarvis. 2014. "Explicit Feedback and the Management of Uncertainty in Meeting Climate Objectives with Solar Geoengineering." *Environmental Research Letters* 9:044006. DOI: 10.1088/1748-9326/9/4/044006

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