RESOURCES
for the FUTURE

Impact of Solar Geoengineering on Temperature-Attributable Mortality: Supplementary Materials

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About the Authors

Anthony Harding is a postdoctoral fellow researching the intersection of innovative technologies and climate policy. He received his PhD in economics from Georgia Institute of Technology, where his research focused on climate and energy economics, and earned a BS from Rensselaer Polytechnic Institute in math and physics. Harding's research applies both econometrics and economic modelling to evaluate climate policy and climate impacts. His most recent work estimates the distribution of economic impacts of solar geoengineering across countries and compares it to the impacts of climate change. His current interests include the design of effective international climate governance structures and the measurement of the value of scientific learning.

David Keith has worked near the interface between climate science, energy technology, and public policy for twenty-five years. He took first prize in Canada's national physics prize exam, won MIT's prize for excellence in experimental physics, and was one of TIME magazine's **Heroes of the Environment**. Keith is Professor of Applied Physics at the Harvard School of Engineering and Applied Sciences and Professor of Public Policy at the Harvard Kennedy School, and founder of **Carbon Engineering**, a company developing technology to capture CO_2 from ambient air to make carbon-neutral hydrocarbon fuels. Best known for his work on the science, technology, and public policy of solar geoengineering, Keith led the development of **Harvard's Solar Geoengineering Research Program**, a Harvard-wide interfaculty research initiative.

Wenchang Yang is an associate research scholar in the Department of Geosciences at Princeton University, working in the group of Prof. Gabriel Vecchi. His research is focused on better understanding climate variability and change on broad timescales from sub-seasons to millennia, as well as why the mean climate of the planet is the way it is.

Gabriel Vecchi is a professor of geosciences at **The High Meadows Environmental Institute**, and director of **Cooperative Institute for Modeling the Earth System** at Princeton University. His research interests are climate science; extreme weather events; hurricanes; mechanisms of precipitation variability and change; ocean-atmosphere interaction; detection and attribution.

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About RFF

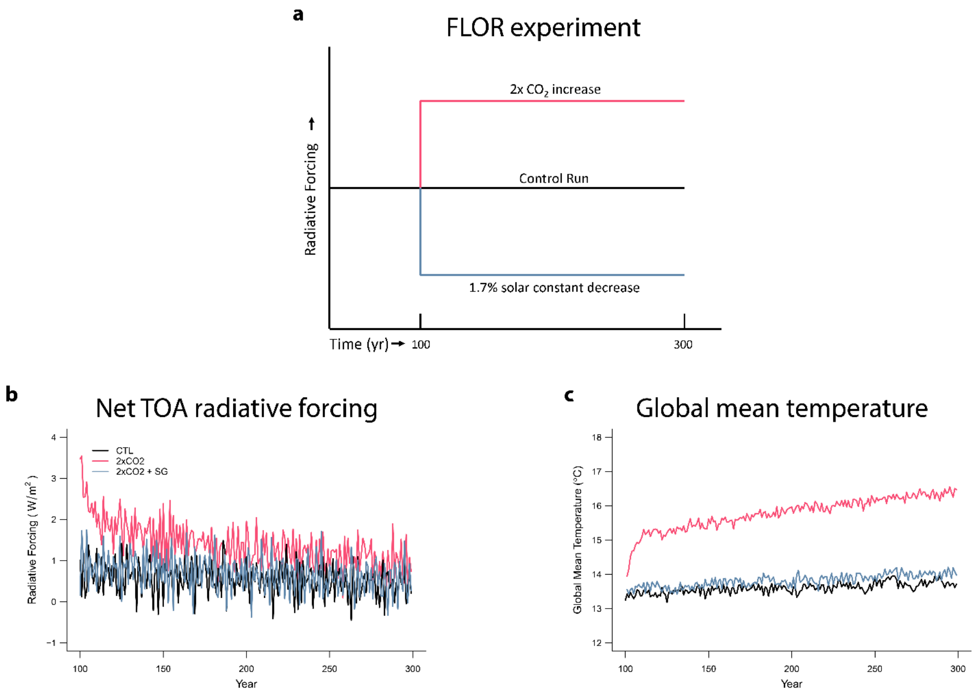
Resources for the Future (RFF) is an independent, nonprofit research institution in Washington, DC. Its mission is to improve environmental, energy, and natural resource decisions through impartial economic research and policy engagement. RFF is committed to being the most widely trusted source of research insights and policy solutions leading to a healthy environment and a thriving economy.

Working papers are research materials circulated by their authors for purposes of information and discussion. They have not necessarily undergone formal peer review. The views expressed here are those of the individual authors and may differ from those of other RFF experts, its officers, or its directors.

About the Project

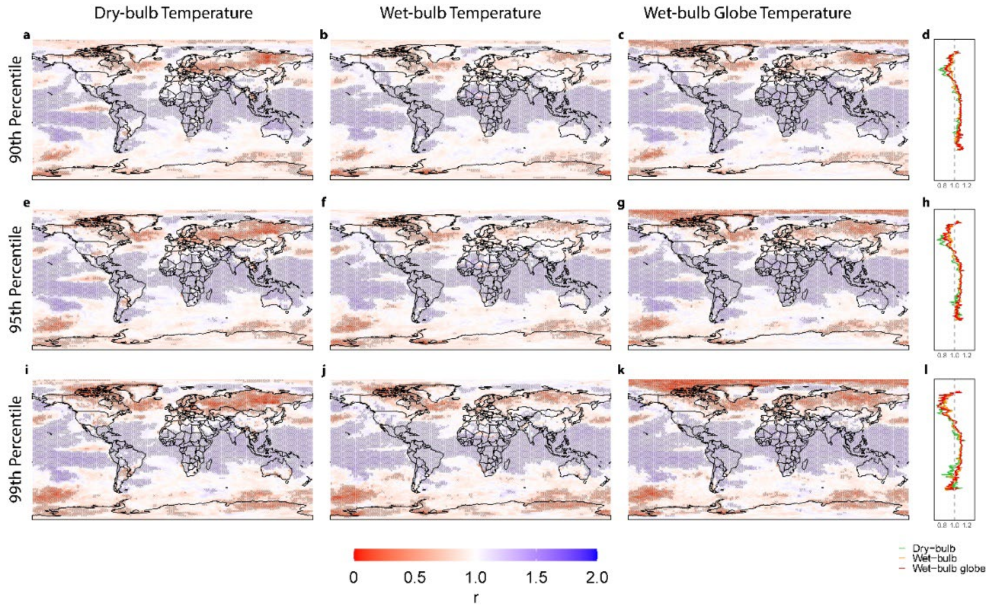
The Resources for the Future Solar Geoengineering research project applies tools from multiple social science research disciplines to better understand the risks, potential benefits, and societal implications of solar geoengineering as a possible approach to help reduce climate risk alongside aggressive and necessary mitigation and adaptation efforts. The project began in 2020 with a series of expert workshops convened under the SRM Trans-Atlantic Dialogue. These meetings resulted in a 2021 article in *Science* that lays out a set of key social science research questions associated with solar geoengineering research and potential deployment. The Project followed this with additional sponsored research, including a competitive solicitation designed to address research areas highlighted in the *Science* article. This paper is one of eight research papers resulting from that competition and supported by two author workshops. A key goal of the solicitation and the overall project is to engage with a broader set of researchers from around the globe, a growing number of interested stakeholders, and the public.

Figure S1. FLOR Experiment



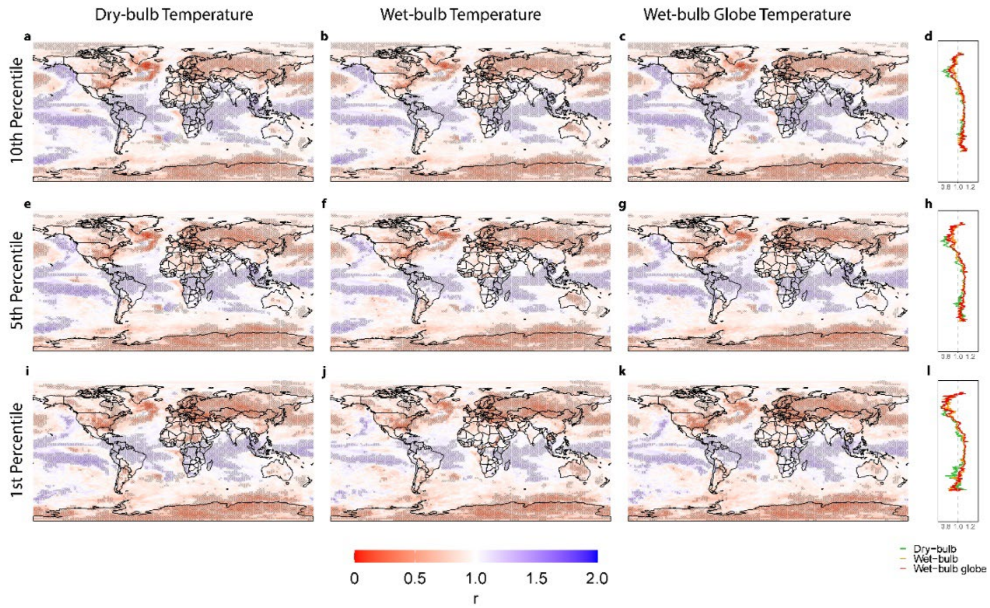
Note: (a) simulation experiment setup. (b) net top-of-the-atmosphere radiative forcing and (c) global mean temperature for each climate simulation.

Figure S2. Heatwave Response to Solar Geoengineering Relative to Emissions Cuts



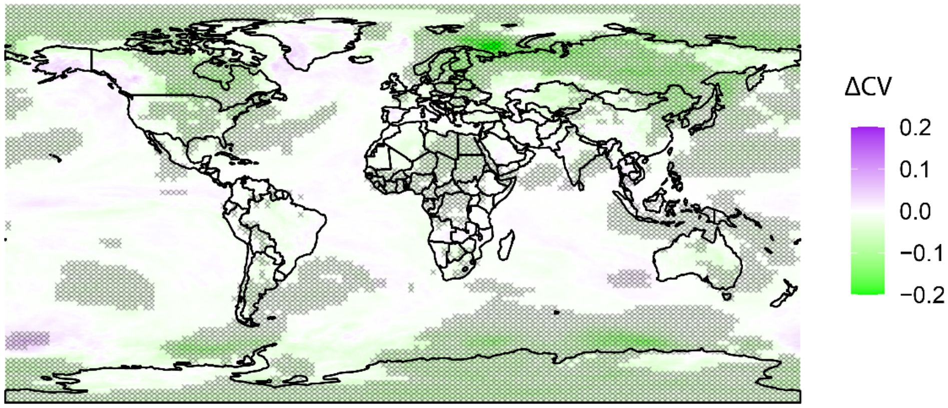
Note: The normalized difference in dry bulb, wet bulb, and wet bulb globe temperature between solar dimming and $2xCO_2$ experiments relative to the normalized difference between control and $2xCO_2$. Blue indicates solar geoengineering leads to colder temperatures and red indicates solar geoengineering leads to warmer temperatures. Values shown are median values across 100 simulation years. Crosshatches indicate statistical significance at 95 percent confidence level using a Wilcoxon signed rank test corrected following the false discovery rate. Zonal average response is calculated as the population-weighted average by latitude band.

Figure S3. Coldwave Response to Solar Geoengineering Relative to Emissions Cuts



The normalized difference in dry bulb, wet bulb, and wet bulb globe temperature between solar dimming and $2xCO_2$ experiments relative to the normalized difference between control and $2xCO_2$. Blue indicates solar geoengineering leads to colder temperatures and red indicates solar geoengineering leads to warmer temperatures. Values shown are median values across 100 simulation years. Crosshatches indicate statistical significance at 95 percent confidence level using a Wilcoxon signed rank test corrected following the false discovery rate. Zonal average response is calculated as the population-weighted average by latitude band.

Figure S4. Effect on Intra-annual Variability



Note: The normalized effect of emissions reduction on intra-annual coefficient of variability differenced by the normalized effect of solar geoengineering. Procedure. Green areas indicate lower variability with solar geoengineering. Values shown are median values across 100 simulation years. Crosshatches indicate statistical significance at 95 percent confidence level using a Wilcoxon signed rank test corrected following the false discovery rate.