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The Many Problems with Geoengineering Using Stratospheric Aerosols¹

ALAN ROBOCK, Rutgers University

In response to the global warming problem, there has been a recent renewed call for geoengineering “solutions” involving injecting particles into the stratosphere or blocking sunlight with satellites between the Sun and Earth. While volcanic eruptions have been suggested as innocuous examples of stratospheric aerosols cooling the planet, the volcano analog actually argues against geoengineering because of ozone depletion and regional hydrologic and temperature responses. In this talk, I consider the suggestion to create an artificial stratospheric aerosol layer. No systems to conduct geoengineering now exist, but a comparison of different proposed stratospheric injection schemes, airplanes, balloons, artillery, and a space elevator, shows that using airplanes would not be that expensive. We simulated the climate response to both tropical and Arctic stratospheric injection of sulfate aerosol precursors using a comprehensive atmosphere-ocean general circulation model, the National Aeronautics and Space Administration Goddard Institute for Space Studies ModelE. We simulated the injection of SO₂ and the model converts it to sulfate aerosols, transports them and removes them through dry and wet deposition, and calculates the climate response to the radiative forcing from the aerosols. We conducted simulations of future climate with the Intergovernmental Panel on Climate Change A1B business-as-usual scenario both with and without geoengineering, and compare the results. We found that if there were a way to continuously inject SO₂ into the lower stratosphere, it would produce global cooling. Acid deposition from the sulfate would not be enough to disturb most ecosystems. Tropical SO₂ injection would produce sustained cooling over most of the world, with more cooling over continents. Arctic SO₂ injection would not just cool the Arctic. But both tropical and Arctic SO₂ injection would disrupt the Asian and African summer monsoons, reducing precipitation to the food supply for billions of people. These regional climate anomalies are but one of many reasons why geoengineering may be a bad idea. I also discuss 19 other reasons. Global efforts to mitigate anthropogenic emissions and to adapt to climate change are a much better way to channel our resources to address anthropogenic global warming.

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