

Assessing terrestrial biogeochemical feedbacks in a strategically geoengineered climate

*Forrest M. Hoffman^{1,2}, Cheng-En Yang^{2,1}, Joshua S. Fu^{2,1}, Simone Tilmes³, Lili Xia⁴, Douglas G. MacMartin⁵, Jadwiga H. Richter³, Michael Mills³, Ben Kravitz⁶

1. Oak Ridge National Laboratory, 2. University of Tennessee, 3. National Center for Atmospheric Research, 4. Rutgers University, 5. Cornell University, 6. Pacific Northwest National Laboratory

Stratospheric geoengineering by injecting sulfur dioxide into the lower stratosphere has been suggested as a possible means of reducing anthropogenic warming. While the impacts of stratospheric aerosol geoengineering on climate change have been investigated in the past few decades, only a few studies have considered the terrestrial biogeochemical feedbacks resulting from such treatment. These feedbacks can alter the atmospheric carbon dioxide concentration by storing or releasing additional carbon in terrestrial and marine ecosystems, thus, changing the climate trajectory and aerosol injection strategy for geoengineering. In this study, we analyzed model output from the recent Stratospheric Aerosol Geoengineering Large Ensemble project to assess the changes in terrestrial biogeochemical feedbacks on climate, particularly the carbon sink strength (CSS), in response to stratospheric aerosol geoengineering. Our results showed that the terrestrial CSS increased globally by 5.2 Pg C during 2070–2089 compared to that during the first twenty years of geoengineering starting from 2020, *i.e.*, an additional 11 ppm CO₂-equivalent amount of carbon in the atmosphere would be stored on land. Among seven latitude bands, the midlatitudes in the Northern Hemisphere (35°N–60°N) had the largest CSS increase (+8.0 Pg C) whereas the Tropics (23.5°S–23.5°N) released carbon back to the atmosphere (–2.9 Pg C). Hypotheses regarding the causes of the variations in the differences in regional responses will be presented.

Keywords: geoengineering, biogeochemistry-Earth system interactions, carbon sink strength