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# Implication of future large-scale stratospheric aerosol injection on the land and ocean biogeochemistry

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In this study, we address several outstanding and emerging issues of future climate geoengineering, particularly its impact on the global biogeochemical. Applying a state-of-the-art fully interactive Earth system model, we simulate two cases of artificial stratospheric aerosol injection (SAI) on top of future RCP8.5 scenario. In the first case, the SAI brings the projection of global mean surface temperature down to the RCP4.5 level by the end of this century. For the same climate target, the non-mitigated, climate engineered scenario leads to approximately 100% and 50% more carbon sinks by the ocean and terrestrial biosphere, respectively. Consequently, the reduction in ocean surface pH is approximately three times stronger than the mitigated RCP4.5 scenario. In the second SAI case, stronger climate engineering (CE) could bring the projected temperature at 2100 down to the 2000 level. In this case, warming still occurs in the Arctic regions. Compared to the reference RCP8.5 without CE, the net global cumulative carbon uptake by land and ocean only increase slightly. Regionally, the biggest difference in carbon inventory were simulated in the mid-latitude northern hemisphere over land and the North Atlantic and Southern Oceans. Over land, reduced soil respiration overcomes reduction in the net primary production associated primarily with the cooler climate. In the North Atlantic, stabilized meridional overturning allows for more carbon sequestered into the ocean interior, while the absence of poleward amplification of Southern Annual Mode leads to less outgassing of natural carbon in the Southern Ocean. CE-induced cooling also alleviates the reduction of net primary production in the equatorial Pacific related to stratification change. Following SAI termination in 2100, rapid warming in the next few years was simulated, bringing the global temperature up to the reference RCP8.5 simulation level. By 2200, the net cumulative carbon sinks by land and ocean is insignificantly different than the scenario without climate engineering, implying that future CE impact on the climate-carbon cycle feedback is likely to be relatively weak and short lived.