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Ecosystem carbon turnover time response to solar geoengineering and high-emission scenarios

Sung-Bin Park and Chang-Eui Park

Center for Climate Carbon Cycle Research
Korea Institute of Science and Technology (KIST)

Solar geoengineering technology is being considered as potential climate mitigation solutions to artificially lower global temperatures. Prior studies showed that geoengineering was effective to reduce halting the global temperature increases with more effective in northern high latitudes. However, an assessment of ecosystem carbon turnover time, which indicates the average time of carbon remains in terrestrial ecosystem, is still lacking. Here, we investigated the effects of solar geoengineering on terrestrial ecosystem carbon turnover time, averaged from 2081-2100, using two solar geoengineering and future climate scenarios using three Earth system models. Results showed that implementing geoengineering could lead to increased residence time of carbon toward the high northern latitude compared to high-emission scenario, indicating that more carbon is absorbed by ecosystem under geoengineering scenarios. However, significant regional differences in ecosystem carbon turnover time were observed in South America, South Africa, Southeast Asia, and Australia. This suggests that the benefits of geoengineering technology could be uneven, potentially exacerbating existing inequalities. Our research emphasizes the importance of emission reduction policies are a more promising, effective and lower-risk climate mitigation strategy. Additional research is necessary to quantify the regional effects of geoengineering and various emission scenarios on ecosystem carbon dynamics.

Key words: ecosystem carbon turnover time, solar geoengineering, land carbon cycle, carbon storage, carbon flux

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