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Solar Radiation Modification Slows Down Permafrost Carbon Loss

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Circumpolar permafrost is degrading under anthropogenic global warming, thus the large amount of soil organic carbon in it would be vulnerable to microbial decomposition and further aggravating future warming. However, solar radiation modification (SRM), as a theoretical approach to reducing some of the impacts of anthropogenic climate change, hopefully could mitigate the permafrost degradation and slow down permafrost carbon loss. Here we use two solar geoengineering experiments came up in CMIP6/GeoMIP6 -- G6solar and G6sulfur, to explore changes in circumpolar permafrost carbon under solar radiation modification scenarios. Earth system models' simulations show that under G6 scenarios, annual mean surface air temperature in circumpolar permafrost region is about 5 K lower relative to the high forcing scenario SSP5-8.5 by year 2100, with a growing trend but remains below 0 K from 2015 to 2100, which is close to that in the medium forcing scenario SSP2-4.5. The lower temperature causes lower degradation rate of permafrost area. In SSP5-8.5 scenario, almost all the permafrost thaws by year 2100, but up to half of it remains frozen in SSP2-4.5 and G6 scenarios compared to year 2015. The lower temperature also results in less carbon assimilation in this area, thus the lower vegetation carbon accumulation. By 2100, a maximum soil carbon loss of 18.09 PgC under SSP5-8.5 scenario regarding to different model constructions, while in G6 the soil carbon loss could be reduce to 3.70 PgC, even less than that of 5.29 PgC in SSP2-4.5 scenario.