

### III. Response to comments and suggestions of Reviewer #3

#### Peer Review, Liu, et. al., 2022: PInc-PanTher estimates of Arctic permafrost soil carbon under the GeoMIP G6solar and G6sulfur experiments

This is a really interesting study. The authors have done a careful job and obtained some interesting results. I think that most of this is well done, but I am recommending some revisions.

We would like to thank the Anonymous Referee #3 for the appreciation of the main advances of our work. For each question and comment, we gave point-by-point response and made additions and revisions to the manuscript. Please see the attached response.

My main issue is the econometrics section where you're computing socioeconomic benefits. I'm fine with what you've done, but I think you need to be more careful in your descriptions. There may be socioeconomic harms (or other unforeseen benefits) that you're not discussing because those are not captured in your model. Statements in your abstract like "averting about \$20 trillion in economic losses" does not communicate this uncertainty and conveys way too much confidence. There are other examples in the paper that need similar attention.

Thanks for pointing it out. We have added the uncertainty range to statements. For example, in abstract "G6 experiments mitigate ~1/3 of permafrost area loss and halve carbon loss for SSP5-8.5, averting \$0–70 (mean 20) trillion in economic losses through reduced permafrost emissions."

Other similar expressions in the manuscript have likewise been modified.

Relatedly, your 90% confidence intervals for economic benefits are approximately \$0-70 trillion. Does that mean there is no possibility of harm (negative values)? That requires justification.

The economic impact of SG in reducing GHG emissions from permafrost is negative or greater than 70 trillion in 10% of the 100,000 Monte Carlo simulations. Thus, the harm is present in about 5% of the simulations.

We have added additional notes "In about 5% of the simulations, small negative benefits – that is harm – are predicted, the 2.5 percentiles being \$-9 and \$-11 trillion for G6solar and G6sulfur, respectively and, for comparison, the corresponding 97.5 percentiles are \$90 and \$77 trillion."

Figures 1-3: It's hard to see differences between the top and bottom rows. Can you add a third row showing the differences?

Thanks for the suggestion. We have modified the colors in Figures 1-3 to make the scenario differences easier to identify and added Table 2 to show the offsets.

We decided not to add a third row because the trends before and after the bias correction are consistent by design, and the offsets are small.

Table 2. Bias correction mean offsets of TSL, NPP and RPE. Mean offsets of soil temperature (TSL, in °C), net primary productivity (NPP, in g m<sup>-2</sup> yr<sup>-1</sup>), and rhizosphere priming effect (RPE, unitless) for all scenarios over the period 2015–2020. Negative values represent that reference data are smaller than the original ESM simulations.

Variables	CESM2-WACCM	CNRM-ESM2-1	IPSL-CM6A-LR	MPI-ESM1-2-LR	MPI-ESM1-2-LR	UKESM1-0-LL
TSL	1.3	1.6	-1.7	3.4	4.0	-0.9
NPP	10.3	-88.0	69.9	-37.7	-51.2	-31.9
RPE	-0.04	0.00	-0.06	0.00	-0.04	-0.06

Lines 360-361: Stating that Indigenous people should consider geoengineering “with urgency” when they're not the ones capable of deploying geoengineering smacks of colonialism.

Agreed. We certainly did not intend it that way, quite the opposite, in fact. At the suggestion of Reviewer #1, we have decided to remove the statement relating to indigenous peoples from the abstract and discussion.