Reply to Referee's Comments

Dear reviewers,

Re: Manuscript ID: acp-2021-877 and Title: Impacts of three types of solar geoengineering on the North Atlantic Meridional Overturning Circulation.

Thank you for your comments concerning our manuscript. We have studied your comments carefully and have made corrections. Revised parts are marked in red in the manuscript. The main corrections in the paper and the responses to your comments are as following:

Suggestions for revision or reasons for rejection (will be published if the paper is accepted for final publication)

The revised version has improved over the previous submission. My only remaining comment is that eqn 3, eqn 4, and the associated text (on page 21 of the manuscript named "… -version2") can be made much easier to understand if you

1) First define a sensitivity parameter in terms of climate response signals divided/scaled by TOA radiation anomalies, written as P/R, where P is, for example, (G4-RCP4.5)_ AMOC, and R is (G4-RCP4.5)_TOA. This puts different mitigation experiments in equal footing.

2) Then use ratio of P/R between different mitigation experiments to compare efficacy. In math form, this would be (P1/R1)/(P2/R2). While this new form is equivalent to what you wrote in eqn 4 (P1/P2)/(R1/R2), it's easier to interpret and explain.

The text following Line 368 can be changed to something like:

"…. Because of the large differences in forcing magnitude between, for example Abrupt4xCO2 and RCP4.5, we first define climate response sensitivity parameters as :

(G4-RCP4.5)_ AMOC/ (G4-RCP4.5)_TOA,
(G1-4XCO2)_ AMOC/ (G1-4XCO2)_TOA (3)

which are AMOC changes per unit change of the corresponding TOA radiation flux changes. Then we compare the efficacy of different mitigation experiments by the ratio of their sensitivity parameters, e.g.:

$$\frac{\text{(G4-RCP4.5)\_ AMOC/ (G4-RCP4.5)\_TOA}}{\text{(G1-4XCO2)\_ AMOC/ (G1-4XCO2)\_TOA}} \quad (4)$$

…."

Then you can go on to describe Table 4 and interpret the results.

Thanks for your suggestions.

We think the use of sensitivity parameter is a good idea which make the equations easier to understand and interpret. But the symbols P, R may make the text more complicated and non-intuitive, because there are three type of experiments and three variables.

The revised parts are marked in red as follows:

We want to examine the differences in response to type of SRM as defined in the GeoMIP experiments we analyze. The ESM have different sensitivities to climate forcing so we normalize the model fields with top of atmosphere radiative forcing (TOA), for example:

$$(G4 - RCP4.5)_{AMOC}/(G4 - RCP4.5)_{TOA}, \quad (3)$$

which are AMOC changes per unit change of the corresponding TOA radiation flux changes.

Because of the large differences in forcing magnitude between, for example Abrupt4xCO_2 and RCP4.5 we cannot simply look at anomalies, but instead can compare the responses as a ratio, for example:

$$(G4 - RCP4.5)/(G1 - Abrupt4 \times CO2)\ , \quad (4)$$

compares the SAI and the solar dimming anomalies.

Then we compare the efficacy of different mitigation experiments by the ratio of their sensitivity parameters, for example the measure of efficacy in the example of comparing the SAI and the solar dimming anomalies above becomes:

$$\frac{(G4-RCP4.5)_{AMOC}/(G4-RCP4.5)_{TOA}}{(G1-Abrupt4\times CO2)_{AMOC}/(G1-Abrupt4\times CO2)_{TOA}}, \quad (5)$$

Which we can calculate for upward heat flux and September sea ice extent in addition to AMOC, and for ratios indicative of the relative responses of MCB to solar dimming and SAI to MCB. The ensemble means indicate the typical differences in efficacy between type of geoengineering (Table 4).