

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-877

Anonymous Referee #1

Referee comment on "Impacts of three types of solar geoengineering on the Atlantic Meridional Overturning Circulation" by Mengdie Xie et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-877-RC1>, 2021

Review on "Impacts of three types of solar geoengineering on the North Atlantic Meridional Overturning Circulation" by Xie et al.

The authors study the efficacy of different geoengineering on ameliorating the AMOC reduction under GHGs forcing using ESM simulations. While I suspect the author's analyses were constrained by what's available in the GeoMIP output, could you explain why G1 and G1oa were used to counter 4xCO₂ forcing whereas G4 and G4cdnc were to counter RCP4.5 scenario? The authors are fully aware that GHG forcing in 4xCO₂ and RCP4.5 is very different, and the geoengineering forcing strength is also different between G1, G1oa, G4, G4cdnc. These differences render the comparison across G1/G1oa and G4/G4cdnc somewhat arbitrary, and this is true whether you are talking about an absolute anomaly (e.g., table 2), or a ratio (as in equation 3), or ratio's ratio (as in equation 4). But, if it has to be done this way, you should provide more justification and/or motivation. Alternatively, you can compare G1 with G1oa, and G4 with G4cdnc without the cross-group comparisons. The presentation is otherwise generally clear, except for a few places (see specific comments below).

Specific Comments

Line 187-188, "Generally, mitigation of AMOC weakening under G4cdnc is more than with G4, but weaker than G1 solar dimming":

But mitigation of G1 solar dimming was applied to 4xCO₂ not RCP4.5, so this comparison is not apples-to-apples.

Fig. 4, difference plot:

Is there a reason why you didn't perform the statistical significance test here?

Line 233, Fig. 5 caption, "in the whole North Atlantic (North of 30°S)":

Within this large domain, wind in the subpolar NA (e.g., north of 45n) in particular may matter more than wind in the other regions. Have you done a similar calculation but use wind in the NA?

Line 245, "...is dependent on":

Change it to something like "is correlated with", so no causality is implied.

Line 246, "and a direct causal relation between wind and AMOC is not evident":

Change it to something like "but this analysis does not address causal relation between wind and AMOC."

Line 339-340, "This also shows that the fresh water changes caused by Arctic September sea ice is the main factor of AMOC 340 changes under the four Geoengineering.":

Please clarify. What about the heat flux you just described? Is it not a main factor?

Line 354-356, "the specific MCB measures simulated to counteract RCP4.5 are relatively more effective than those under G4. This might mean that specific measures under G4cdnc appear more effective than those simulated under G4 stratospheric aerosol injection,":

If I read it correctly, the second sentence largely repeats the first sentence, right? Please clarify.

Line 356-357, "but the forcing applied under G4cdnc was not specifically designed to match the net radiative forcing of the G4 SAI.":

Precisely. So what does the comparison tell you?

Line 360-361, "we cannot simply look at anomalies, but instead can compare the responses as a ratio,":

Ratio is not less arbitrary than anomalies. Is there a reason why G1 was not done to counter RCP4.5 as well like G4 was?

Technical Corrections

Line 12, cross out "North" before "Atlantic Meridional..."

Line 60, cross out "side" before "effects that SRM..."

Line 174 -175, "differences which are significant at the 95% level.":

Table 2 shows 1.4 sv is significant, 0.7 sv is not.

Line 183 -184, "The difference between G4cdnc with G4 over the 40-year analysis period is also significant":

Table 2 shows that this difference is 0.6 Sv which is not statistically significant. Could you clarify?