Reviewer 2:

We thank the reviewer for their comments on our draft paper, which have helped to improve our study.

Main comments

1. *While the apparent 'benefit' of SRM on NPP over Amazon has been highlighted in this study, the possible 'damage' and associated modelling uncertainty over other ecologically sensitive regions such as central Africa and SE Asia must also be emphasized. I recommend this to be done both in the abstract and the conclusions section. This is to avoid any possible miscommunication that SRM is only purely beneficial for the Amazon region's productivity, without any side effects for other regions.*

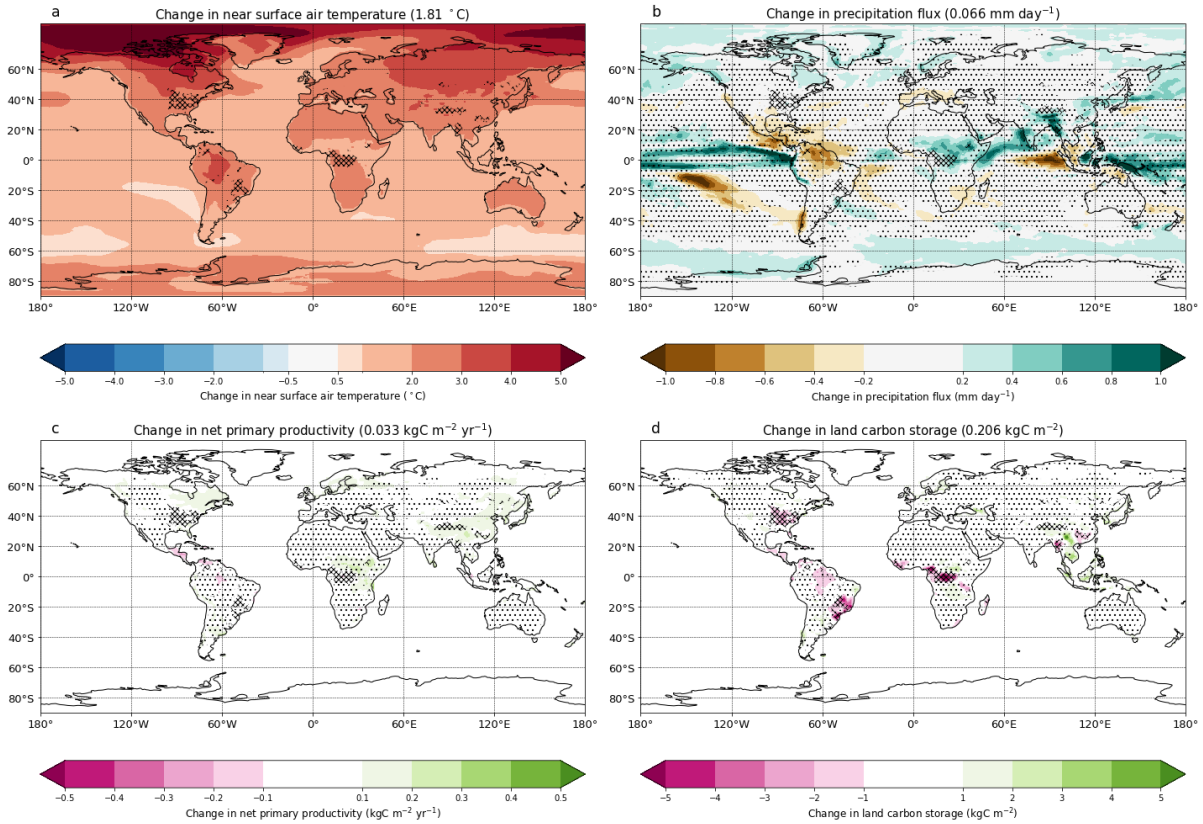
   We have included new text addressing the regions which experience decreases in NPP or land carbon storage in some model in the abstract:
   "Our results therefore suggest that SAI could provide some protection against the risk of climate change induced carbon losses from the Amazon rainforest, though this is not universally observed in all tropical forests. Additionally, we observe decreases in NPP and land carbon storage in some regions, such as eastern Africa, the northern high latitudes, and Indonesia."
   And the conclusion on line 300:
   "We note, however, that these observed increases in NPP and land carbon storage are not universal, with regions such as eastern Africa, the northern high latitudes, and Indonesia showing decreases for some models."

2. *Structure section 3 (results) into smaller subsections. For example, exclusive effects (G6sulfur – SSP585) can become subsection 3.1, and the cumulative effects (G6sulfur – SSP245) can become subsection 3.2. You could also further divide it into specific parts where focused discussion related to Amazon region is present. This is to improve the readability and ease of navigating the results section.*

   We have divided the results section into smaller subsections to improve readability as suggested.

3. *Briefly summarize the exclusive climate change signal (SSP585 – SSP245): how does the temperature, precipitation, NPP and LCS change due to lack of mitigation measures. The discussion could then focus on how well or to what extent does G6sulfur restore/counteract this climate change signal.*

   We now include a figure in the supplementary material (Supplementary Figure 6) which shows the exclusive climate change signal (SSP585 – SSP245).



We also include some text at the start of the results & discussion section, starting on line 112, abut this exclusive climate change signal:

"Compared to SSP245, the SSP585 scenario sees an average increase in global temperatures across the models of 1.81°C, though the warming is very concentrated in the northern polar regions with increases of more than 5°C in some regions (Supplementary Figure 6). The warmer temperatures in SSP585 are accompanied by an increase in rainfall globally, especially in higher latitudes, and an apparent shift in the ITCZ. NPP appears to increase on average in SSP585 compared to SSP245, with areas of increase across central Africa, north America and east Asia. The only area of notable decrease in NPP is observed in central America. Land carbon storage also increases on average, though there are few areas of significant change (without stippling). The two areas with notable change are a decrease over northern Amazonia and an increase in southeast Asia."

4. *4) Conclusions section: It would be good to have a brief quantitative summary of the main results of this study, in this section.*

Done as suggested – quantitative results now included in the conclusion.
"However, based on results from five Earth System Models, this study suggests that Stratospheric Aerosol Injection (SAI) geoengineering would likely increase global NPP and land carbon storage relative to both unmitigated climate change (under the SSP585 scenario) and conventional mitigation (as represented by SSP245 relative to SSP585), with NPP and land carbon storage increasing by 15.6% and 5.9%

respectively compared to SSP245. The modelled positive impacts of SAI are most marked in Amazonia, where SAI is projected to lead to significant increases in both NPP and land carbon storage. We observe increases in land carbon storage on the order of 8.6% and 10.8% in G6sulfur compared to SSP245 and SSP585, respectively."

5. *L18: "little more than a decade more". Remove the repeated 'more'*

   Done as suggested.

6. L51: Aims to reduce forcing from SSP585 to SSP245? or global mean temperature? or both? Please clarify it here and make it consistent across the manuscript.

   G6sulfur aims to reduce global mean temperatures using SAI to reduce the radiative forcing from the SSP585 levels to SSP245 levels. We have clarified this on line 51:
   "We examine the projected climate under SAI (G6sulfur), which aims to reduce global temperatures by reducing the radiative forcing levels from the high emissions scenario (SSP585) to the medium forcing scenario (SSP245) using equatorial SO2 injections into the stratosphere."

7. *L134-135: "hatching in these plots removes changes in land carbon storage that are not due to SAI from our analysis.". This is inconsistent with the caption in Figure 4: hatching indicates where the forest fraction difference between SSP585 and SSP245 is more than 0.1.*

   We assume that where the forest fraction difference between SSP585 and SSP245 is more than 0.1 these changes are due to prescribed land use change, thus we exclude these areas from our analysis of SAI impacts.
   We have changed the text to clarify the point: "…hatching in these plots removes changes in land carbon storage that are not due to SAI from our analysis."

8. *L143: "warming of up to 2 K in some regions". Since this comparison is the exclusive effect of SRM, I wonder why it could induce additional warming to an already warm climate. Could be worth elaborating on.*

   As well as sometimes under-cooling polar regions, SAI can result in greater arctic amplification compared to a greenhouse gas only forcing scenario. This may be caused by heating in the lower stratosphere around the tropics which can then cause surface warming in some northern high latitude regions (Duffey et al., 2023).
   We have elaborated on this point on line 143:

"This warming may be caused heating in the lower stratosphere around the tropics which results in surface warming in some northern high latitude regions, which can result in under-cooled polar winters and a reduced seasonal cycle in these regions (Duffey et al., 2023)."

9. *Figure 4 caption: "land-use scenarios, differs by more than 0.1" has been written twice. Remove the repetition.*
   Done as suggested.

10. *L182: "(a decrease of more than 1 mm/day". Close the parenthesis.*

    Done as suggested.

11. *L182: Any explanation for why models simulate a decrease over north-western and increase over north-eastern South America? (both precipitation and NPP).*

    We have added some text to clarify as to why this is the case from line 184:

    "This increase in precipitation over the northeast is likely driven by a move towards La Niña like conditions which shifts the ITCZ northward. This shift increases precipitation over the northeastern Amazon while reducing precipitation in the northwest. Because the reduction in precipitation in the northeastern Amazon is particularly severe, vegetation in this region likely becomes water-limited, thereby reducing NPP."

12. *Figure 8: Please write "land carbon storage" instead of only "land carbon"*

    Done as suggested.

13. *L197-199: The sentence is too long and confusing. Do you mean to run SRM simulations to simulate dieback in the absence of SRM?*

    We have edited the sentence to improve clarity, it now reads:
    "The results presented here indicate that SAI would protect against carbon losses in the Amazon forest. However, future studies would benefit from longer-duration experiments that produce clearer instances of forest dieback in the absence of SRM, allowing us to better evaluate the impact of SAI when applied."

14. *L201: It is interesting and useful to note that all the models considered here have consistently/robustly simulated NPP and LCS increase over eastern Amazon. What can*

we say about the consistency in the simulated signal among the models over other regions?

We now include text which elaborates on regions other than the Amazon which show consistent signals across the models.

Continuing from line 201:
"We note that, aside from Amazonia, we observe few regions with the same consistent signal across models. Only eastern Australia shows a consistent increase in NPP and land carbon storage. The decreases within the models are generally inconsistent across models in their magnitude and location."

Continuing from line 259:
"Other than the increases we observe over the Amazon, we observe an increase in NPP and land carbon storage in eastern Australia, in comparison to SSP585. This signal is consistent across all the models. Similarly, we observe increases in NPP and land carbon storage across regions of central Africa, though only in three of the five models. Aside from these instances there are few regions which display a consistent signal across all the models in either the comparison with SSP245 and SSP585, highlighting the significance of these examples."

15. *Figures 4, 10, 11, 16: Please mention in first sentence of their captions that the model ensemble mean is plotted in these figures. You could also consider mentioning the figure numbers in which the quantities simulated by the individual models are plotted*.

    Done as suggested.

16. *L224-L226: Long and confusing sentence. Large decreases and large increases both similarly found in the band around equator?*

    We have edited the sentence to improve clarity, it now reads:
    "In most models, there is a pattern of both large increases and decreases in precipitation concentrated in a band around the equator."

17. *L231-L232: Cite Figs. 11d and 4d for readers' convenience.*

    Done as suggested.

18. *L242: Fig. 14 shows NPP and not LCS. Why did you cite it here when NPP has not been discussed in this sentence?*

    This was done in reference to NPP being discussed in the previous sentence. We have moved the citation of Fig 14 to line 240 for better clarity.

19. *L259: IPSL model shows decreases rather than smaller increases over most Amazon region. See Figure 17c.*

    We have changed the text to highlight that IPSL also shows sizable areas of decreases in land carbon storage:
    "Interestingly, CNRM-ESM2-1, which experiences the largest increase in land carbon storage globally, shows relatively little increase in land carbon storage in Amazonia compared to other models, only IPSL-CM6A-LR has smaller increases alongside notable areas of decrease."

20. *L266: sensitivity to temperature is shown in 18a not 18b.*

    Fixed as suggested.

21. *L268: could be better when a map is cited to illustrate the "warming in the tropics and positive effects in the high latitudes."*

    We now cite two studies which show regionally varying NPP sensitivity to warming (Cramer et al., 2001; Tjiputra et al., 2010) on line 268.

    We also now reference Figure 5 on line 268 which shows global NPP changes in G6sulfur relative to SSP585.

22. *L271: These reasons are not clear from reading the next paragraph. In what way, to what extent and for what reasons is the LCS and NPP response different in G6S compared to SSP? Please explain concisely, preferably in the form of a table.*

    The reasons referred to on line 271 are in relation to the fact that there are different mechanisms which result in the increase in land carbon storage in G6sulfur relative to SSP585 and SSP245. Relative to SSP245, G6sulfur shows a greater increase in land carbon storage due to extra CO_2 fertilisation. Relative to SSP585, G6sulfur shoes a greater increase in land carbon storage due to reduced soil respiration, which results from the reduced temperatures in G6sulfur.

    We have edited the text on line 271 to make this clearer:
    "However, projected global land carbon storage increases are larger in G6sulfur relative to either SSP245 or SSP585 (Figure 18c&d), but for different reasons."

    And on line 274:
    "Meanwhile, global land carbon storage is increased in G6sulfur compared to SSP585 as the reduced warming in G6sulfur results in reduced soil respiration (Figure 18d)."

23. L291: Kalidindi et al., 2015 would be a good article to cite when discussing how different the primary productivity responses are to solar constant reduction and sulfate aerosol geoengineering.

    Cited as suggested.