We are grateful to the referees for their time and energy in providing helpful comments and guidance that have improved the manuscript. In this document, we describe how we have addressed the reviewer's comments. Referee comments are shown in black italics and author responses are shown in blue regular text. A manuscript with tracking changes is attached at the end.

Reviewer #1

General comment:

The authors analyzed model simulation geoengineering results of G6solar, G6sulfur, and GLENS to examine effect of stratospheric aerosol injection (including sun-shading) on global drought and associated socioeconomic exposure. G6solar and G6sulfur results are from multi-model simulations of equatorial SO2 injection to bring down global mean temperature from SSP5-8.5 level to that of SSP2-4.5. GLENS results are from CESM simulations that inject SO2 at multiple locations to meet multiple temperature stabilization goals at current-day level under the background scenario of RCP8.5. The authors found that the frequency of global extreme drought is reduced by about 2% for both G6solar and G6sulfur, as well as GLENS. Also, the drought impact from geoengineering on economic and population exposure would be unevenly distributed for developing and developed countries.

This study provides some useful information on the potential effect of stratospheric aerosol injection geoengineering on global drought and economic consequences. However, the useful scientific insights provided is limited, and I think the overall focus of this manuscript is not suited for ACP.

As stated on the journal website: "Atmospheric Chemistry and Physics (ACP) is a not-for-profit international scientific journal dedicated to the publication and public discussion of studies investigating Earth's atmosphere and the underlying chemical and physical processes. ACP publishes studies with important implications for our understanding of the state and behavior of the atmosphere and climate, including the troposphere, stratosphere, and mesosphere."

As stated (also my opinion), the core research area published in ACP should be the underlying chemical and physical processes of the atmosphere. The impact study is *encouraged, but should not be the main theme of ACP. The analysis of socioeconomic exposure, which is more policy relevant and much less atmospheric physics relevant, should not be the focus of this study (for publication in ACP). More focus should be given on the drought response to stratospheric aerosol injection and the underlying mechanisms.*

The above point is clear by reading the abstract. The abstract has little scientific findings relevant to atmospheric physics except for the one-sentence description of drought response. In my opinion, the study framed here is more suited for publication in interdisciplinary journals such as Environmental Research Letters.

- We sincerely thank you for these insightful comments. While Atmospheric Chemistry and Physics (ACP) indeed places a strong emphasis on the physical and chemical processes of the atmosphere, it does not exclude policy-oriented studies related to atmospheric problems, such as climatic extremes and air pollution. For example, we found the following studies that focus on economic and/or health impacts:
  (1) Lee, J., Mast, J. C., and Dessler, A. E.: The effect of forced change and unforced variability in heat waves, temperature extremes, and associated population risk in a CO2-warmed world, *Atmos. Chem. Phys.*, 21, 11889-11904, 10.5194/acp-21-11889-2021, 2021.
  (2) Li, C., Hu, Y., Zhang, F., Chen, J., Ma, Z., Ye, X., Yang, X., Wang, L., Tang, X., Zhang, R., Mu, M., Wang, G., Kan, H., Wang, X., and Mellouki, A.: Multi-pollutant emissions from the burning of major agricultural residues in China and the related health-economic effects, *Atmos. Chem. Phys.*, 17, 4957-4988, 10.5194/acp-17-4957-2017, 2017.
  (3) Xu, J. W., Lin, J., Tong, D., and Chen, L.: The underappreciated role of transboundary pollution in future air quality and health improvements in China, *Atmos. Chem. Phys.*, 23, 10075-10089, 10.5194/acp-23-10075-2023, 2023.
  (4) Zhao, W., Zhao, Y., Zheng, Y., Chen, D., Xin, J., Li, K., Che, H., Li, Z., Ma, M., and Hang, Y.: Long-term variability in black carbon emissions constrained by gap-filled absorption aerosol optical depth and associated premature mortality in China, *Atmos. Chem. Phys.*, 24, 6593-6612, 10.5194/acp-24-6593-2024, 2024.

Furthermore, we revised the abstract to include more quantification and attribution of the SAI-induced drought responses as follows: "By 2100, the frequency of extreme droughts is projected to increase by 7.33% under the high-emission Shared Socioeconomic Pathways 5 (SSP5-8.5) scenario relative to present day. SAI reduces this increase by 1.99% in GeoMIP6, and by 1.80% in GLENS compared with Representative Concentration Pathways 8.5 (RCP8.5). Attribution analyses show that SAI-induced cooling alone reduces extreme drought frequency by 3.42% in GeoMIP6 and 4.28% in GLENS relative to their respective high-emission scenarios, outweighing the 2.12% increase driven by SAI-induced precipitation reductions under the same conditions." (Lines 24-32)

A more detailed comparison between the effect of G6sulfur and GLENs on extreme drought and possible underlying mechanisms should strengthen the physical science component of the manuscript.

- Thank you for your suggestions. In the revised paper, we provided more detailed comparative analyses of the effects of G6sulfur and GLENS on extreme drought and their underlying mechanisms as follows:

  "The SAI in GLENS exhibits stronger MP than G6sulfur in reducing the frequency of extreme droughts. Compared to the present day, the global drought probability increases by 1.92% during 2075-2094 under the RCP8.5 scenario (Fig. 5a). This increment is smaller than the 7.33% projected under SSP5-8.5 (Fig. 4a), because RCP8.5 produces a larger rise in global precipitation (Fig. 3c) than SSP5-8.5 (Fig. 2d). Relative to RCP8.5, SAI in GLENS reduces the global frequency of extreme droughts by 1.8% (Fig. 5b), offsetting nearly all of the drought increase caused by RCP8.5 warming (MP=93.8%). Compared to G6sulfur, GLENS shows enhanced MP over northern Eurasia, South America, and North America. This may be attributed to its multi-latitude injection strategy and the dynamic adjustment of injection amounts at different latitudes to fully offset future warming (Fig. 3). In contrast, significant drought amplification is projected with GLENS in India, northern Asia, and Alaska relative to RCP8.5 (Fig. 5b), a pattern not seen under G6sulfur (Fig. 4g)." (Lines 342-354)

  "Compared with RCP8.5, the SAI-induced cooling in GLENS reduces the frequency of extreme droughts by 4.28% by the end of the century (Fig. 7a). In contrast, the precipitation reduction in GLENS increases global extreme drought frequency by 2.12% (Fig. 7b), with regional hotspots in central Africa, India, North America, and northern Asia, consistent with the spatial pattern of the SAI-induced rainfall deficit (Fig. 3d). These patterns resemble those in G6sulfur (Figs 6c and 6f), except that the cooling-induced drought reduction is larger in GLENS, due to its stronger cooling effect (Fig. 3b vs. Fig. 2c). Overall, SAI-induced cooling plays the dominant role in mitigating the projected increase in extreme drought frequency under a warming climate, although the level of alleviation may vary across SAI strategies because of differences in injection locations and sulfate amounts." (Lines 387-397)

"The climatic effects of SAI vary depending on the intensity and deployment strategies. Under the same high-emission scenario, the SAI in GeoMIP6 (G6sulfur) experiment aims to limit global warming to a moderate level, whereas GLENS implements SAI intensively to maintain the temperature at the level of 2020 (Tilmes et al., 2015; Tilmes et al., 2018). Furthermore, these two experiments employ distinct injection methodologies, with the multi-latitude aerosol deployment in GLENS but fixed equatorial injection in G6sulfur. Despite these differences, both GLENS and G6sulfur exhibit similar spatial patterns in their impacts on extreme drought (Figs 4g and 5b). However, regional differences, particularly in India and northern China, lead to different levels of extreme drought risk for the global economy and population." (Lines 476-485)

Specific comment:

Abstract: The abstract is poorly written with a lot of unclear sentences. For example, "SAG implementation reduces this increase by 1.99% (1.80% in GLENS), primarily due to its cooling effects." by 1.99% relative to what? (current-day? SSP5-8.5?). "SAG-induced rainfall deficits" deficits compared to what condition? "Countries with less development experience smaller reductions, or even increases" Reductions or even increase of what? And, compared to what?

- Thank you for pointing out the problems. We have revised the abstract to enhance the clarity: "By 2100, the frequency of extreme droughts is projected to increase by 7.33% under the high-emission Shared Socioeconomic Pathways 5 (SSP5-8.5) scenario relative to present day. SAI reduces this increase by 1.99% in GeoMIP6, and by 1.80% in GLENS compared with Representative Concentration Pathways 8.5 (RCP8.5). Attribution analyses show that SAI-induced cooling alone reduces extreme drought frequency by 3.42% in GeoMIP6 and 4.28% in GLENS relative to their respective high-emission scenarios, outweighing the 2.12% increase driven by SAI-induced precipitation reductions under the same conditions." (Lines 24-32)

Throughout the text, the authors used SAG to represent stratospheric aerosol geoengineering. A more commonly used word would be SAI (stratospheric aerosol injection). Thus, I use SAI for the following comments.

- We used the abbreviation SAI (Stratospheric Aerosol Injection) throughout the revised manuscript, as recommended, to align with standard terminology in the field.

The writing is sloppy. For example, the first sentence, line 38. (Song et al), year is missing.

- We have thoroughly checked the revised paper to ensure that all citations are presented correctly.

Lines 65-67: This description is not accurate. For example, whether SAI would reduce rainfall depends on how SAI is employed and what reference scenario is compared (compare with historical baseline state or high-GHG world without SAI?). It is not right just to state SAG could reduce rainfall without context.

- We sincerely appreciate the reviewer's insightful comments of SAI effects on rainfall. The original statement oversimplified the complex relationship between SAI and hydrological responses, and failed to specify the reference scenarios for comparison. Throughout this study, SAI was always compared with SSP5-8.5 or RCP8.5. In the revised paper, we have rephrased this part as follows:

  "Ensemble of these simulations indicated that SAI could alter global hydrological cycle relative to high emission scenario (Jiang et al., 2024; Rezaei et al., 2025). Notably, the magnitude and spatial pattern of rainfall changes exhibit strong dependence on injection latitudes and altitude (Zhao et al., 2021; Krishnamohan and Bala, 2022)." (Lines 72-75)

Lines 68-71: The results mentioned here would all be scenario dependent. In particular, *regional climate responses to SAI would strongly depend on the specific SAI scenarios (e.g. amount of SAI-induced cooling, location of injections, background GHG scenarios). Therefore, it is just misleading to state something like SAI-induced cooling could offset about 90% of extreme drought risks in Cape Town, South Africa.*

- In the revised paper, we have rephrased this part to avoid possible misleading as follows: "Region-specific analyses suggest that specific SAI deployment strategies may mitigate extreme drought risks under the Shared Socioeconomic Pathways 5 (SSP5-8.5) scenario. For instance, in Cape Town, South Africa, model ensembles indicate a potential 90% reduction in extreme drought risk when applying the GLENS injection protocol (Botai et al., 2017; Odoulami et al., 2020). However, these benefits are highly contingent upon the specific implementation strategy: different SAI designs or distinct greenhouse gas background conditions (e.g., SSP2-4.5) could result in neutral or adverse outcomes (Du et al., 2025)." (Lines 75-83)

The latest literature the authors cited in the Introduction are from about four years ago. Many latest developments in the research field of climate effect of SAI are missing.

- In the revised paper, we have cited more recent researches on SAI:

  "Ensemble of these simulations indicated that SAI could alter global hydrological cycle relative to high emission scenario (Jiang et al., 2024; Rezaei et al., 2025)." (Lines 72-73)

  "However, these benefits are highly contingent upon the specific implementation strategy: different SAI designs or distinct greenhouse gas background conditions (e.g., SSP2-4.5) could result in neutral or adverse outcomes (Du et al., 2025)." (Lines 80-83)

Line 91: What does linear injection mean?

- In the revised paper, we clarified the injection method of GeoMIP6 as follows: "The G6sulfur experiment involves the injection of sulfur dioxide (SO_2) within the 10°S–10°N latitude band along the 0° longitude at altitudes of 18–20 km from the year 2020." (Lines 106-108)

Line 119: What are the latitudes of SO2 injection? Please specify. This is important.

- In the revised paper, we described the location of SO_2 injection as follows:

"This approach injects sulfate aerosols at four locations along 180° longitude (15°N, 15°S, 30°N, and 30°S) at latitudinally optimized altitudes. Based on predefined temperature targets, the sulfate aerosol injection rate is dynamically adjusted at each location." (Lines 135-138)

Line 176: How is scPDSI calculated from PET? This is not described.

- In the revised paper, we have provided a more detailed description of the scPDSI calculation as follows:

  "The calculation of PDSI requires the use of P, PET, and AWC to calculate eight variables related to soil moisture based on the water balance: evapotranspiration (ET), recharge (R), runoff (RO), loss (L), potential evapotranspiration (PE), potential recharge (PR), potential runoff (PRO), and potential loss (PL) (Webb et al., 2000). These variables are then used to calculate the Climatically Appropriate For Existing Conditions' (CAFEC) precipitation ($\hat{P}$):

$$\hat{P} = \alpha PE + \beta PR + \gamma PRO - \delta PL \tag{4}$$

  Here, α, β, γ and δ are the water-balance coefficients, which are derived from ET, R, RO, and L divided by their potential values, respectively. The difference between P and $\hat{P}$ is defined as moisture departure (d):

$$d = P - \hat{P} \tag{5}$$

  The d is scaled to a moisture anomaly index (Z index) using climatic characteristic (K):

$$Z = dK \tag{6}$$

  K can be calculated by potential evapotranspiration, recharge, runoff, precipitation, loss and moisture departure:

$$K_i' = 1.5 \log_{10}\left(\frac{\frac{\overline{PE_i} + \overline{R_i} + \overline{RO_i}}{\overline{P_i} + \overline{L_i}} + 2.8}{\overline{D_i}}\right) + 0.5 \tag{7}$$

$$K_i = \frac{17.67}{\sum_j^{12} \overline{D_j} K_j'} K_i' \tag{8}$$

  Where $\overline{D}$ is the average monthly moisture departure, 17.67 is an empirical constant. The PDSI for a given month is calculated using the Z index and empirical parameters:

$$PDSI_i = 0.897 PDSI_{i-1} + \left(\frac{1}{3}\right) Z_i \tag{9}$$

  The duration factors (0.897 and 1/3) are empirical parameters obtained by Palmer from previous studies (Alley, 1984). The original drought index, PDSI, is calculated using fixed climatic thresholds that are not comparable across different climatic regions. To address such limitation, the scPDSI employs dynamic climatic characteristic and duration factors based on the regional environment, offering the advantage of both spatial and temporal comparability (Wells et al., 2004; Dai, 2011; Van Der Schrier et al., 2013). In the calibration of PDSI, monthly K was adjusted using local climate statistics to ensure that extreme drought events (PDSI ⩽ -4.0) and wet periods (PDSI ⩾ 4.0) occur at frequencies of approximately 2%. The duration factors were derived from linear regression analyses of accumulated Z-index values during extreme drought and wet conditions, thereby enhancing sensitivity to regional climate variability." (Lines 190-220)

2.6 The heading (and corresponding texts) is misleading. These are just offline calculations, not numerical experiments.

- In the revised paper, we changed the original heading "Numerical Experiments" to "Calculations and attributions of scPDSI". In this section, we emphasized the use of "offline experiments" to distinguish scPDSI calculation from numerical simulations.

Lines 256-258: Why use 46.5% for G6solar and -1.84 Celsius for G6sulfur?

- In the revised paper, we have unified the descriptions. In addition, we focused only on LAND surface temperature:

  "Reduction of the solar constant in G6solar causes an intense cooling worldwide (Fig. 2b), resulting in a decrease in global average land surface air temperature of approximately -2.61°C and counteracting 45.6% of the warming in SSP5-8.5. For G6sulfur, the injection of sulfur aerosols (or SO_2) contributes to a reduction in global average surface temperature of about -2.45°C, offsetting 42.8% of the SSP5-8.5 warming (Fig. 2c)." (Lines 303-308)

Lines 246-270: The description of temperature and precipitation response to G6solar and G6sulfur is too lengthy. These have been shown in previous studies and should only be briefly discussed. Also, for comparison, climate response in GLEN simulation is only described in one sentence (268-270). Why?

➢ Thank you for your suggestions. In this revision, we simplified the discussion on the global temperature and precipitation responses of GeoMIP6, and expanded the description of the GLENS results as follows:

"This reduction in temperature and precipitation is more pronounced in the GLENS simulations (Fig. 3). By the end of this century, the GLENS strategy successfully maintained the temperature at 2020 level, reducing the global average by 5.48°C compared to the RCP8.5 scenario. Due to the different injection magnitude and locations from GeoMIP6, the GLENS injection results in more pronounced precipitation reduction in central Africa, India, and high-latitude regions of the NH (Fig 3d)." (Lines 312-318)

Line 274: Increase by 7.33%. What period compared with what period? This should be clear.

➢ In the revised paper, we clarified as follows: "Following the intense warming, frequency of extreme drought events increases by 7.33% globally at 2081-2100 under the SSP5-8.5 scenario relative to the present period." (Lines 321-323)

Lines 281-283: frequency of extreme drought events is reduced by 2.12% globally, mitigating 28.9% of the increased drought stress under the SSP5-8.5 scenario.
This sentence is not clear. 'reduce by 2.12%', this reduction is relative to what? (SSP5-8.5 or historical baseline?). Also, what does 28.9% mitigation mean? Actually, the description of SAI effect as a whole is not clear. I am not clear whether the SAI effect is compared with historical baseline or SSP5-8.5.

➢ In this study, the SAI-induced climatic changes were in general compared with SSP5-8.5 (or RCP8.5) scenarios. "Reduced by 2.12%" refers to the reduction in drought frequency under G6solar relative to SSP5-8.5 (not compared to historical). "Mitigating 28.9%" indicates the offsetting fraction of SSP5-8.5-induced drought stress increment by G6solar (following Equation 10). In the revised paper, we clarified as follows: "Compared to SSP5-8.5, G6solar reduces the global frequency of extreme drought events by 2.12% globally at 2081-2100 (Fig. 4d), mitigating 28.9% of the SSP5-8.5-induced drought stress increment." (Lines 330-332)

Lines 285-286: With G6sulfur, a similar reduction of -1.99% is predicted for global drought extremes

In the above, it stated that in response to G6solar, drought is reduced by 2.12%, but it stated here that in response to G6sulfur, drought is reduced by -1.99%. The sign is opposite (I believe the negative sign is not needed). This is just one example of the sloppy writing.

- We have made the correction as suggested.

Lines 292-293：What does mitigation efficacy mean?

- The mitigation efficacy here should be the "mitigation potential" (MP) as we defined in Equation (10): "We define the MP value to quantify the extent to which SRM could mitigate the increased drought risks induced by climate warming:

$$MP = \frac{P_{SRM} - P_{SSP585}}{P_{SSP585} - P_{hist}} \quad (10)$$

  Here, P_{hist} represents the drought probability or the exposure (either GDP or population) to drought extremes (scPDSI < -4) at present day averaged for the period of 1995-2014. P_{SSP585} and P_{SRM} represent the mean drought probability/exposure at 2081-2100 under the SSP5-8.5 and SRM (G6solar or G6sulfur) scenarios, respectively." (Lines 231-237)

Lines 293-295: The comparison between G6sulfur(G6solar) and GLENEs should be discussed more extensively, especially at the regional scale. G6sulfur and GLENs have distinctly different strategies of SO2 injection, but in the manuscript, the response to GLENs is only very briefly discussed.

- In the revise paper, we provided a more detailed comparison of drought responses between GLENS and G6sulfur as follows:

  "The SAI in GLENS exhibits stronger MP than G6sulfur in reducing the frequency of extreme droughts. Compared to the present day, the global drought probability increases by 1.92% during 2075-2094 under the RCP8.5 scenario (Fig. 5a). This increment is smaller than the 7.33% projected under SSP5-8.5 (Fig. 4a), because RCP8.5 produces a larger rise in global precipitation (Fig. 3c) than SSP5-8.5 (Fig. 2d). Relative to RCP8.5, SAI in GLENS reduces the global frequency of extreme droughts by 1.8% (Fig. 5b), offsetting nearly all of the drought increase caused by RCP8.5 warming (MP=93.8%). Compared to G6sulfur, GLENS shows enhanced MP over northern Eurasia, South America, and North America. This may be attributed to its multi-latitude injection strategy and the dynamic adjustment of injection amounts at different latitudes to fully offset future warming (Fig. 3). In contrast, significant drought amplification is projected with GLENS in India, northern Asia, and Alaska relative to RCP8.5 (Fig. 5b), a pattern not seen under G6sulfur (Fig. 4g)." (Lines 342-354)

Lines 312-313: "Relative to SSP5-8.5, SRM-induced cooling reduces extreme drought frequency by 3.44% in G6solar (Fig 2e) and 3.42% in G6sulfur (Fig 2h)." So the numbers in line 281 (2.12%) and line 286(1.99%) refers to the change relative to the historical baseline?

- All these percentages are the changes of drought frequency induced by SRM relative to SSP5-8.5. The 3.44% reduction in G6solar and 3.42% reduction in G6sulfur are the reduction in extreme drought frequency caused by the temperature reduction **alone** in G6solar and G6sulfur. The numbers of 2.12% (now line 331) and 1.99% (now line 335) refers to the **net** changes of extreme drought frequency induced by G6solar and G6sulfur relative to the SSP5-8.5, as a result of the **combined** effects of changes in temperature, precipitation, and radiation.

  In the revised paper, we clarified as follows: "We performed sensitivity experiments to quantify the contributions of changes in temperature, precipitation, and radiation to the variations of extreme droughts." (Lines 357-358) "Relative to SSP5-8.5, SRM-induced cooling alone reduces extreme drought frequency by 3.44% in G6solar (Fig. 4e) and 3.42% in G6sulfur (Fig. 4h)." (Lines 371-372)

Line 297: Why not include the similar analysis for GLENS? Is it because the lack of required data?

- In the revised paper, we showed the similar analysis for GLENS in a new Figure 7, and included following descriptions: "Compared with RCP8.5, the SAI-induced cooling in GLENS reduces the frequency of extreme droughts by 4.28% by the end of the century (Fig. 7a). In contrast, the precipitation reduction in GLENS increases global extreme drought frequency by 2.12% (Fig. 7b), with regional hotspots in central Africa, India, North America, and northern Asia, consistent with the spatial pattern of the SAI-induced rainfall deficit (Fig 3d). These patterns resemble those in G6sulfur (Figs 6c and 6f), except that the cooling-induced drought reduction is larger in GLENS, due to its stronger cooling effect (Fig. 3b vs. Fig. 2c). Overall, SAI-induced cooling plays the dominant role in mitigating the projected increase in extreme drought frequency under a warming climate, although the level of alleviation may vary across SAI strategies because of differences in injection locations and sulfate amounts.” (Lines 387-397)

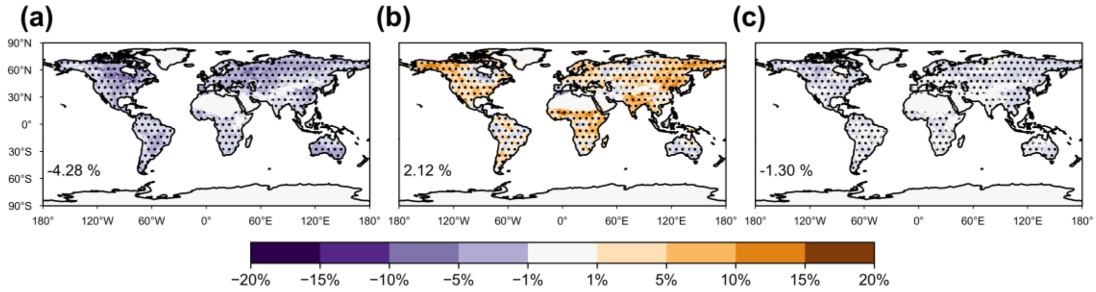

Figure 7. The same as Figure 6. but GLENS is applied. Results shown are the changes in frequency of drought extremes (scPDSI < -4) under SAI scenarios relative to RCP8.5 at 2075-2094 attributable to (a) temperature, (b) precipitation, and (c) radiation changes.

Line 330: This part builds on the effect of SAI on global drought. It is just an impact assessment of the drought analysis. Not sure to what extent the reported specific numbers here are useful. These numbers in terms of GDP and population exposure are likely to change substantially for different SAI scenarios, in particular at the regional scale.

➢ We agree that absolute GDP and population exposure values may be sensitive to SAI implementation and socioeconomic assumptions. However, the absolute numbers are not our focus. Instead, we define the Mitigation Potential (MP) to quantify the extent to which SRM could offset the increased drought exposure caused by climate warming. For the uncertainty tests in Figures 12 and 13, we replaced future GDP and population with present-day values. Comparisons (Fig. 8 vs. Fig. 12 and Fig. 10 vs. Fig. 13) show that the spatial distribution of MP remains highly consistent, regardless of whether future or present-day GDP and population values are utilized in the analysis.

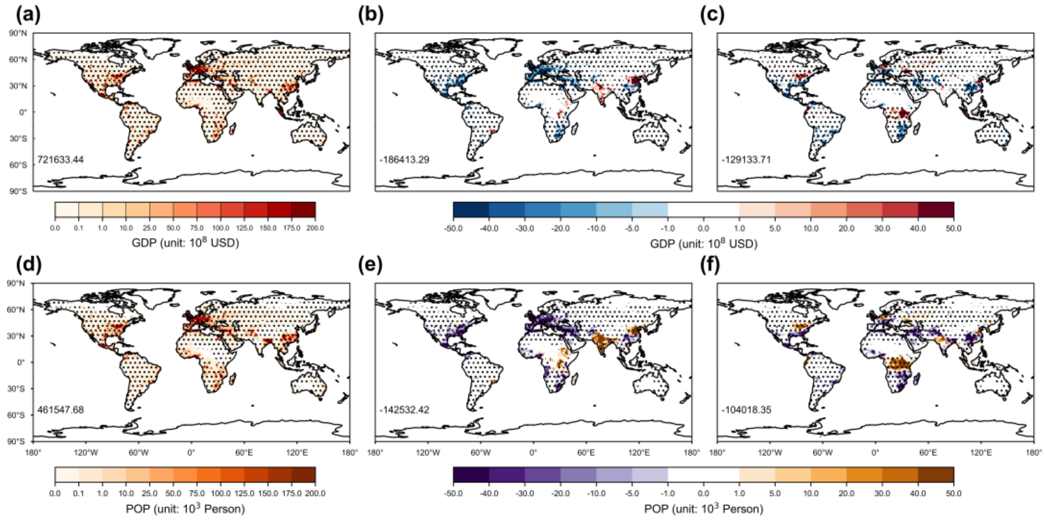

Figure. 8. Changes in GDP and population exposure to drought extremes. Results shown are the changes of (a, b, c) GDP and (c, d, f) population (POP) exposure to drought extremes at 2081-2100 (a, d) under SSP5-8.5 scenario relative to the historical period of 1995-2014, as well as that (b, e) under G6solar and (c, f) G6sulfur scenarios relative to SSP5-8.5 both at 2081-2100. The dotted areas indicate regions where at least four out of five models show changes with the same signs. The global sum value of the difference is shown at the lower-left of each panel.

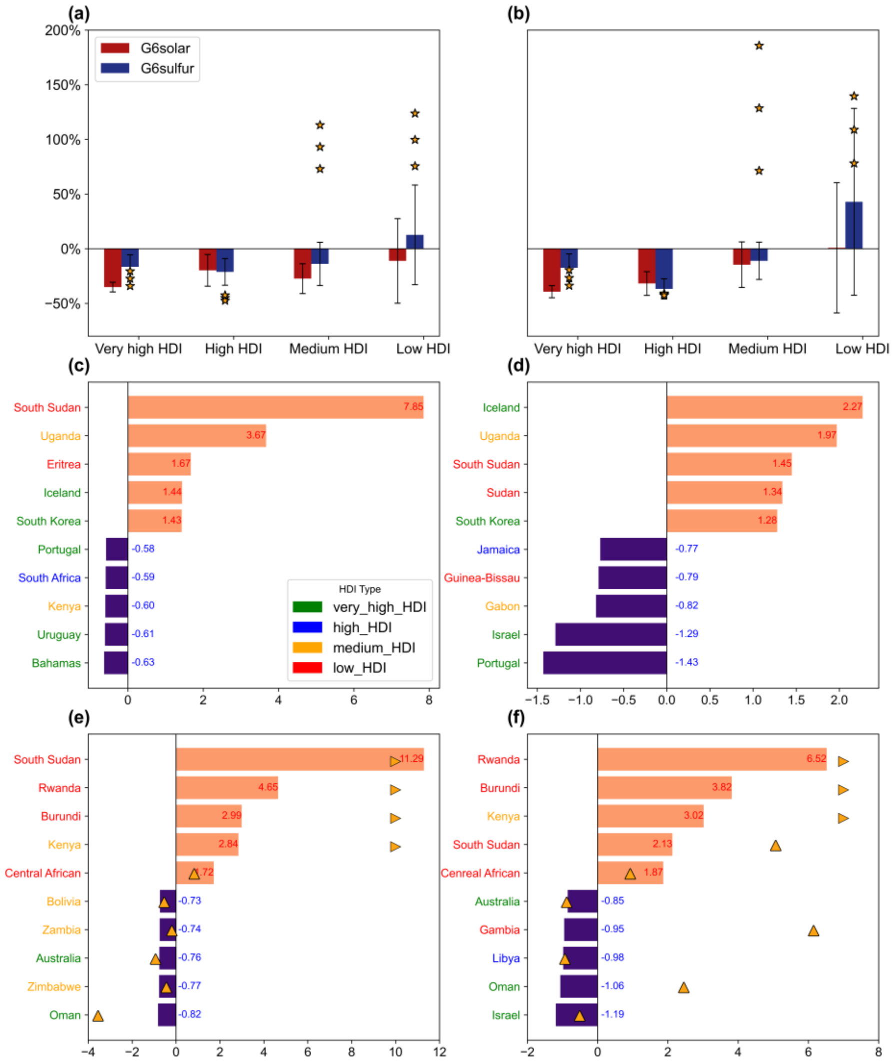

Figure. 10. Changes in GDP and population exposure to drought extremes by HDI. For each of four HDI groups, changes in (a) GDP or (b) population exposure to drought extremes for 2081-2100 in G6solar (blue) and G6sulfur (red) relative to SSP5-8.5 are normalized by the differences under SSP5-8.5 relative to 1995-2014. The bars represent the mean changes from five models with errorbars indicating one standard deviation for inter-model spread. Yellow stars represent results from three members of GLENS. The mitigation potential (MP, see Methods) is also calculated for individual countries, and the top 5 countries with the greatest mitigation (violet) or aggravation (orange) of (c, e) GDP and (d, f) population exposures to drought extremes are shown for (c, d) G6solar and (e, f) G6sulfur, respectively. The MP values (ratios of changes) are denoted for those top countries. Yellow triangles denote GLENS outcomes (right-aligned for values exceeding axis limits).

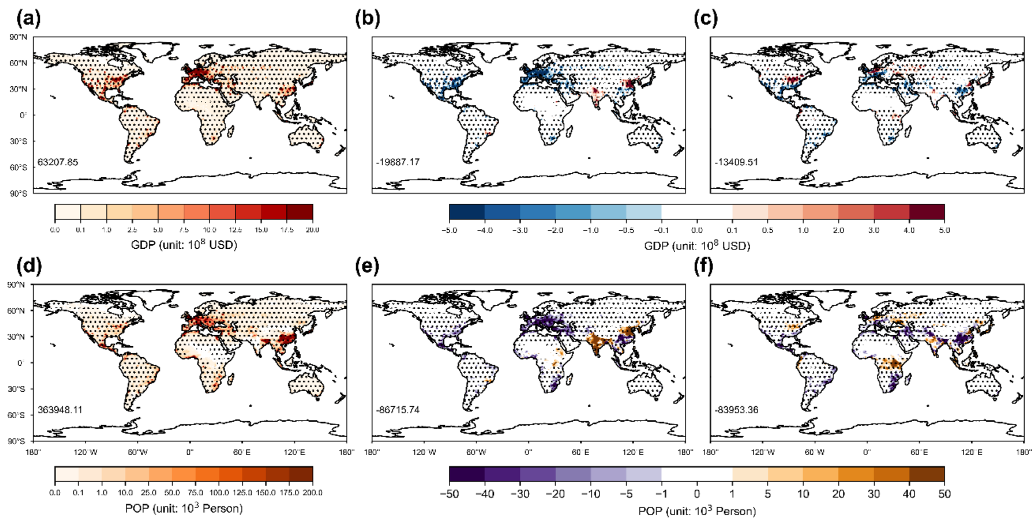

Figure 12. The same as Figure 8 but present-day GDP and population is applied.

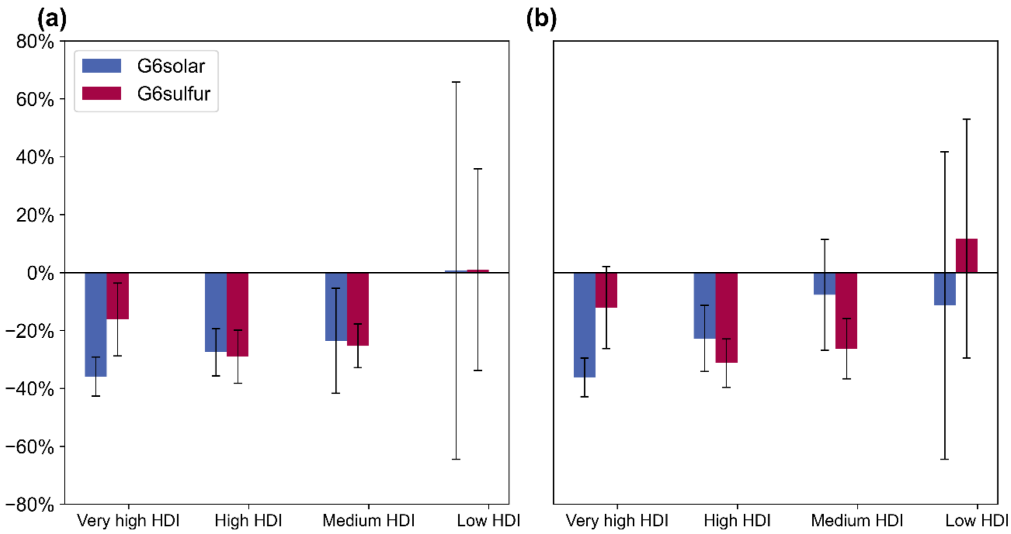

Figure 13. The same as Figure 10 but present-day GDP and population is applied.

Lines 370-371: What does asymmetric responses in temperature and precipitation mean?

➢ In the revised paper, we provided an example to illustrate the asymmetric response of temperature and precipitation:

"Our analyses show asymmetric responses in temperature and precipitation to SRM. For example, the SAI in G6sulfur mitigates only 42.8% of the SSP5-8.5

warming (Fig. 2c) but offsets 88.9% of the rainfall increase under SSP5-8.5 (Fig. 2f), indicating a disproportionate suppression of the water cycle. While cooling directly reduces evaporation, aerosol-induced increase in atmospheric stability indirectly weakens monsoon circulation (Tilmes et al., 2013; Krishnamohan and Bala, 2022), such as India and China (Fig 2e). Consequently, SRM may inadvertently degrade hydroclimate security in vulnerable regions under a high-emission scenario." (Lines 442-450)

Lines 368-385: This paragraph mostly discussed previous findings. What is the point here? Also, all result regarding climate response to SAI would depend on the specific SAI scenarios used in that study, but the authors failed to acknowledge this important point. For example, statement like "SAG overcompensates for the greenhouse gas-forced expansion of the Hadley circulation and offsets the poleward shift of storm tracks in mid-latitude of NH" would strongly depend on how SAI is implemented.

➢ Thank you for your valuable comments. The purpose of this paragraph is not simply to review the literature, but to summarize the underlying physical mechanisms driving varied responses of different SRM interventions (GeoMIP6 vs. GLENS). We first compared the climatic differences between G6solar and G6sulfur, and then examined the responses of G6sulfur versus GLENS:

"Relative to G6solar, precipitation is even more inhibited in G6sulfur especially over central Africa (Fig. 2f), because the absorbing sulfate aerosols induces an anomalous stratospheric heating that further enhances air stability (Simpson et al., 2019; Tilmes et al., 2022). In addition, under the GLENS scenario, SAI overcompensates for the greenhouse gas-forced expansion of the Hadley Circulation (Cheng et al., 2022) and offsets the poleward shift of storm tracks in the mid-latitude of NH (Karami et al., 2020). These changes, along with a more positive phase of the North Atlantic Oscillation induced by SAI (Jones et al., 2022), resulting in increased exposures to drought in Europe and the northeastern U.S. (Figs 4d and 4g)." (Lines 451-459)

Line 405: In GLENS, SAI is not designed to offset all the GHG-warming, but just to keep temperature at current-day level.

➢ Corrected as suggested: "GLENS implements SAI intensively to maintain the temperature at the level of 2020(Tilmes et al., 2015; Tilmes et al., 2018)." (Lines

478-479)

Lines 409-410: The SAI strategies investigated here are just two specific SAI scenarios, and thus the statement "that the choice of injection strategy does not substantially alter the major conclusions" is just not right. One can certainly design many SAI scenarios that 'substantially' alter major conclusions here.

- We agree with your comment and have removed this statement in the revised paper.

Fig. 1. TAS and PR in figure are not defined.

- Defined as suggested (now Figure 2).

Reference

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