

This paper examines the impact of changes in different measures of precipitation over China under a high emissions scenario and with a small ensemble of climate intervention simulations at the end of the century. One climate model (UKESM1) is used for comparison with two different realisations of stratospheric aerosol injection - G6solar, using a constant solar dimming, and G6sulfur, with gradually increasing injections of sulfur into the stratosphere. The paper is well organised and generally clearly and well written. My main criticism is that the discussion does not evaluate the results with respect to other research that was carried out from other experiments such as GLENS. Suggestions for other relevant literature is at the end together with references made in the comments below.

Major comments:

Consider reducing the content of Section 2.2. A lot of this is repetition from the literature that is cited and doesn't necessarily need to be included in this article.

To avoid confusion, consider changing any reference to "present-day" to the control period and sticking with this consistently, rather than switching between 'historical', 'baseline' and 'present-day'. The WMO has adopted 1990-2020 as the "current climate period", which suggests that the period used in this article is historical.

Is there a benefit in the data validation against APHRODITE? The article does not include an assessment of extreme precipitation metrics with respect to observations, nor do the results or conclusions refer back to the observations. I think you could drop this, and instead refer to other assessments of the validity of extreme precipitation in climate models such as (Sillmann et al., 2013; Donat et al., 2020; Tebaldi et al., 2021).

Given that this research uses one climate model, and three ensemble members for each scenario it isn't really appropriate to state that G6sulfur/G6solar abates or ameliorates climate change as depicted by SSP5-8.5. There aren't sufficient model members to remove model uncertainty, and without observations we do not know which model realisation (if any) adequately simulates the effects of SAI. All you can state with confidence is that using this methodology and data, the SAI experiments produce results consistent with a lower emissions target. I would prefer to see all of the statements on improvements with respect to climate change removed, or at least reduce the emphasis of the statements.

Minor comments:

L28 change impacts to efficacy

L30 rephrase this sentence as noted above.

L31 remove trends

L42 is the higher risk of flooding associated with increased extreme precipitation? Remove the time periods studied, this is implicit.

L44-60 is this level of detail on historic events warranted? You do not examine the changes in jets or other sources of extremes.

L44 Why was summer of 2020 anomalous - it seems in keeping with the other extreme events you reported.

L61 change appears to have, and cite relevant literature such as (Donat et al., 2016; Pendergrass and Knutti, 2018), which also discuss changes in the hydrological cycle.

L64 Should causes go before faster?

L66 Update this to the more nuanced and recent research that shows extreme precipitation generally goes up everywhere (Pendergrass and Knutti, 2018)

L79 SAI does not mitigate anthropogenic climate warming, it may mitigate some of the impacts.

L79-89 This paragraph needs rephrasing to explain that SAI is premised on reproducing the effects associated with volcanic eruptions. However, you do not need to list the different volcanic eruptions themselves - just point to a large body of literature that supports these effects.

L99 include other recent research that explored changes in temperature and precipitation in other SAI experiments not just the GeoMIP archive (e.g. Tye et al., 2022; Simpson et al., 2019).

L100 What about (Tew et al., 2023)?

L105 remove maximise the signal-to-noise in the simulations as

L114 remove according

L126 See comment above, but at the very least remove The GeoMIP G6sulfur simulations that reduce global mean temperatures from the SSP5-8.5 scenario to the SSP2-4.5 are described in detail elsewhere.

L143-145 remove this last sentence.

L154 I believe that the extreme indices were defined by the WCRP not IPCC.

Table 1: the authors should be Frich and Klein Tank. Also refer to (Sillmann et al., 2013; Zhang et al., 2011) for the correct definitions

How did you calculate the 95th percentile? Did you bootstrap the individual years to avoid data inhomogeneities (Zhang et al., 2005)

L161 This may not be relevant if you remove the Aphrodite data as suggested above. However, I am concerned about regridding the larger data to the smaller grid. No additional information is gained in this respect (just several grid boxes with the same values) and may show errors and biases that are not true. Instead it would be more robust to regrid the observations to match that of UKESM. See <https://climatedataguide.ucar.edu/climate-tools/regridding-overview> for more information.

L165 remove instead of the more commonly used Student's t-test. Wilcoxon Rank Sum Testse work as

L167 change “with p-value <0.05 suggesting” to “with a 5% confidence level of”

L169-182 How did you establish the CDFs? Did you fit distributions, or are these empirical CDFs from the data? Did you examine the uncertainty in the CDFs, and were they fitted for each model member (correct) or the model mean (as the figures suggest)? I am also wary about CDFs for very small sample sizes - i.e. 30 values of the annual maximum rainfall.

L185-194 put this into the previous section

L193 Include this statement in the figure caption instead of the text - and check which way you have represented significance, this is opposite from the figure.

L211 Comment on the increase in drought in west and Taiwan under G6sulfur.

L215 Change this statement to something like projected changes are similar to those of SSP2-45, meaning that the SAI simulations are approximately successful.

L246 There are no absolute values >100mm or no increases from the control period >100mm?

L250 remove (p-value <0/05) and every other instance - this has already been stated.

L251 remove which is generally. Is there really only one research paper on increases in extreme precipitation in this region?

L257 Remove this sentence.

L265 should this be depicting?

L266 remove sentence “The comparisons confirm....”

L278 remove “This suggests that G6sulfur....” This is the results section, so discussions aren’t appropriate.

L280 Stick to reporting the differences between the simulations in this section, then interpret (with appropriate caveats) in the discussion sections and remove the sentences on the implications or efficacy of SSPs vs G6.

L291 Remove ameliorating

Table 2: I am not sure that this adds to the interpretation of the results and could be removed. If retained, re-phrase as difference between G6 and SSP or something similar.

L311 Why is this interesting? Elaborate please.

L325 It might be more meaningful to look at the relative changes (e.g. in percentage terms) rather than absolute values. With regard to the “arbitrary” regions, why are they somewhat arbitrary? Surely they relate to some geographical or political definition, the point to make is that they may not correspond with climatological regions. Note that smaller regions would just emphasise noise in the results.

L329/30 remove this sentence.

Figure 6 as noted above the uncertainty across model members should be included in these curves. Please also check the colour scheme for colour blind appropriateness, and use the same x-axis for each variable for all regions (i.e. one x-axis for Rx1day, another for R95p). This also applies to Figure 9 and 12.

L350 Decreases in CWD do not necessarily equate to reductions in precipitation intensity. You can only make this interpretation if there is a reduction in the total number of wet days AND an increase or no change in the annual total.

L356 R50mm is not one of the formal ETCCDI indices, it is user defined.

L371 remove effectively ameliorates the

L373-375 This is discursive and needs more references to support it (and moving to the discussion section). There is likely a combination at play including changes in the location of the jet streams and ITCZ, as well as interactions with topography and changes in maritime temperature gradients.

L380/1 Remove this sentence

L387 CWD=200 days is right at the far end of the tail, I don't think it's appropriate to make this statement without any error estimates or uncertainty information. Further, the duration estimates of CWD and CDD add up to longer than a year - this is particularly obvious in comparison with Figure 12. Please check.

L402 Should this refer to Figure 9? This statement would be more meaningful with uncertainty envelopes to clearly demonstrate whether there are or are not differences between each model.

L413 Remove , and would have the ....

L458 It is not noteworthy that these yield similar results - that's the objective of the cooling. Remove this sentence.

L468 Remove last sentence of paragraph.

L475-481 There are other aspects related to drought risk - not least evaporation - that don't show up in the dry day count, such a strong statement about changes in drought risk aren't appropriate. See (Cheng et al., 2019; Dagon and Schrag, 2019, 2016) for more results related to climate intervention.

G6solar and G6 Sulfur are different ways of simulating a possible climate, we have no way of knowing whether one or the other is more valid without observations, and so can't be described as outperforming each other. See (Bednarz et al., 2022; Vioni et al., 2021) for more discussion on this.

Section 4

I suggest condensing the bullet points to short concluding statements, which can then be followed by the explanations. Given that the focus of this article is on the climate intervention, it would also make more sense to emphasise those results rather than the future projections that have been published elsewhere. This is also the point to discuss how valid the results are with respect to other research - including experiments outside the GeoMIP project.

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