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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global streamflow and flood response to stratospheric aerosol geoengineering" *by* Liren Wei et al.

Anonymous Referee #1

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The authors analyze the results of GeoMIP G4 simulations on future streamflow and flood risk. Terrestrial hydrology has been looked at in detail in only a few solar geoengineering papers; this study is novel in that it utilizes a river routing model to connect climate model output with streamflow and flood risk. The study could use some additional analysis to back up claims made in the discussion section, and there are some issues with wording and language. I recommend publication after these and other comments are addressed.

General comments:

Initially I was surprised to see this manuscript show up in ACPD, as it seems almost outside the scope of this journal. Given that "hydrosphere interactions" is a stated subject area, I suppose this paper fits in there. The premise of sulfate geoengineering

is very much related to the scope of ACPD, but the paper focuses on downstream impacts of SRM on streamflow and flood risk. I would encourage the authors to add connections to atmospheric chemistry and physics implied by their results, perhaps through precipitation and evaporation feedbacks.

I also think the authors need to show more results to back up some of the mechanistic claims in the discussion section (large scale circulation changes, monsoonal flows in different regions, flooding vs. terrestrial water availability). Right now, this section reads more like conjecture because the figures show only runoff-derived streamflow and flood return period.

I would like to see more discussion on model uncertainties (both in the climate models, and the river routing model) in the discussion section. This is hinted at starting around Line 420 with respect to model internal variability but should go further. How do the various biases and uncertainties impact the results?

Lack of anthropogenic effects in the river routing model (e.g. dams) seems like a big uncertainty in the results. What sort of effect might this have? Furthermore, how useful is analysis of a "hypothetical natural condition" (line 427) when the premise of the study implies large-scale human intervention in the climate system?

There are minor issues with wording and grammar throughout; I address some in the specific comments but not all.

Specific comments:

Line 22: Lower/higher relative to which simulation?

Line 27: How does the return period show increased drying?

Line 42: Connect the text descriptions to flow abbreviations (I assume percentiles are used to define high/low flow but that is not clear from the text.) I see these are defined later in the methods (lines 158-159) but should be defined at first mention. Alternatively, don't use the abbreviations in the introduction.

Line 45: How do the effects on streamflow scale with the emissions scenario (or the amount of CO2)?

Line 70: Change model to model's

Line 78: Define SO2; how many models?

Line 80: Is aerosol injected or SO2?

Line 103: Is scenario the right word here?

Line 115: Why is it important to use the same 40 years?

Line 124: How are the different model realizations generated? What is the impact of using a single historical run (MIROC-ESM-CHEM) as reference for multiple experiment simulations?

Table 1: For the models with multiple experiments for each type of simulation, are these ensemble members? Specify this in table caption or text. Also, better to define horizontal resolution as degrees lat/lon.

Line 136: Is "FLOW" an acronym? If so, please define.

Line 141: Need a sentence break here.

Line 145: How good are the daily runoff outputs from the climate models? Is this discussed anywhere (e.g., in the discussion section)?

Line 174: Does "generated data" refer to runoff output from the climate model or streamflow output from the river routing model?

Line 184: Should that be 1:N instead of 1/N?

Line 240: This is an important point, distinguishing changes in flow level with changes in flood frequency.

Figure 1: Can you explain more about the metric plotted here? Why are you using the

mean of G4 and RCP4.5? It would also be useful to see this figure for the difference between G4 and historical/present day climate.

Line 280: I see streamflow increases (blue colors) on the western side of large continents in Fig 1 (Mexico, southern California, Spain, western Europe); please elaborate.

Figure 3: The color bar labels are confusing and should at least be in larger font.

Line 374: Can you show some results that back up these mechanistic claims?

Line 390: Not sure anyone would "benefit from increased flooding", perhaps increased water availability? Do you have the results to show that?

Line 406: Change "G4" to "solar geoengineering"

Lines 411-418: This sentence is too long and convoluted. It needs to be cleaned up or broken into multiple sentences to clarify the important points.

Line 420: Why only this region?

Line 437: I like the reference to the DECIMALS project. I wonder if you could include a bit more detail here about potential connections to socioeconomic research, based on the results of this study. I can see this discussion being very useful to researchers in climate change adaptation, urban design, and hydrologists (among others).

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