

Response to Anonymous Referee #1

We appreciate the Referee's constructive comments on the manuscript, and respond to each point below.

p18640 line 18 - Is the inter hemispheric forcing ratio the NH:SH ratio of the TOA ERF shown in Fig 5? Please clarify

Yes; text added to clarify.

Fig 7a - why is there a sudden drop in HIST precipitation around 1960? It can't simply be anthropogenic aerosols, that should be more gradual. Is it a combination of volcanism and AA?

Yes, it is a combination of volcanic and AA forcing. As also seen in Fig 7a, the NoAA experiment (which includes volcanic forcing) has a sudden, but smaller drop in precipitation around 1960. Actually, this was already alluded to: "In the model, substantial fluctuations during the historical period are associated with volcanic eruptions (seen in NoAA as well as HIST) and strengthening aerosol effects between about 1960 and 1990." We revised the text to be more explicit about the timing of the volcanic effects.

p18640 lines 19-27: is there a way to quantify the relative contributions of ERF vs dynamics in determining the relative responses of NH and SH rainfall in figure 7b? That would be interesting. Presumably one could use the response of global mean precipitation change in fig 7a to get an approximate relationship between ERF and precipitation; and then apply it to each hemisphere.

This is an interesting suggestion. However, I couldn't see how to use Fig. 7a to get an approximate relationship between ERF and precipitation, given that there is really only one data point, so I wondered if you meant to write Fig. 11a (the scatter plot of global-mean aerosol ERF versus projected precipitation changes). I thought this had merit, but it seemed debatable whether the regression relation in Fig. 11a (based on 13 models) applied well enough to CSIRO-Mk3.6 to make quantitative statements about Mk3.6, especially given that Mk3.6 doesn't sit especially close to the regression line in Fig. 11a.

After further thought, I decided that it makes more sense to apply this idea to the hemispheric precipitation responses of the 13 models, rather than Mk3.6 specifically. With this in mind, I added the aerosol ERF-precipitation regression line from Fig. 11a to the hemispheric scatter plots for aerosol ERF versus precipitation (Figs. 13a and 13c in the revised version). This enables one to see that in RCP4.5, most of the models have larger (smaller) precipitation increases in the NH (SH), compared to the expectation based solely on the relationship between aerosol ERF and precipitation change.

At the same time, I noticed that in RCP4.5 the aerosol ERF-temperature regression slopes are very similar for the global mean and both hemispheres, but they differ strongly for aerosol ERF versus precipitation. These points add weight to the argument that most of the models show a degree of dynamical response in their NH and SH rainfall projections. New text has been added at the end of Section 5.3.

p18644 lines 9 onwards (until the end of the section): given that the correlation between aerosol atmospheric ERF and hydrologic sensitivity has almost no correlation (Fig 12), I wonder if this is really saying that hydrologic sensitivity simply isn't the right way to

took at this? Fig 11 (between aerosol TOA ERF and precipitation) is a more compelling relationship - perhaps best left at that?

I had a similar thought in the back of my mind. Since you made this point, I'm happy to remove Fig. 12 and the associated discussion. I originally put it in based on a smaller set of models (when the correlations looked better). With only 10 models or so, one or two outliers can make a big difference. A more detailed analysis would be needed to understand the responses of the different models, and to determine if this approach really adds value.