Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2020-1317

Anonymous Referee #1

Referee comment on "On the contribution of fast and slow responses to precipitation changes caused by aerosol perturbations" by Shipeng Zhang et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1317-RC1, 2021

The manuscript submitted by Zhang et al. uses the global Earth system model ECHAM6-HAM to investigate how idealized perturbations of BC and SO4 influence precipitation. They divide precipitation responses into the rapid and the slow surface-temperature-mediated response, and find – as earlier work – that BC-induced precipitation changes are dominated by the rapid response while SO4-induced changes are driven mostly by the slow response. Authors analyze both rapid and slow responses in terms of the energy budget, and further decompose every term into contributions from clouds, aerosols, and clean-clear-sky. This approach allows for a thorough understanding of which processes underly the different changes. The paper is very well written and based on sound scientific analyses. While the results are unsurprising, I believe that the clear scope, the thorough method, and the systematic and accurate account of results makes the paper a good contribution to the field, and I recommend the paper to be published after relatively minor revisions.

General comment:

As the manuscript is so well worked through and so well written my comments are few.

Specific comments:

- L 79: “lacks agreement in both model simulations and observations”. Please clarify – is there little agreement between typical model results and what observations show, or is there both deviations between models and observations as well as large inter-model disagreement?
- L 88: “Fast and slow responses are essential in determining changes in precipitation” This one is a bit unclear as to what the authors mean. Do you perhaps mean that identifying fast and slow responses is essential to determining the causes or processes behind the precipitation change? Consider rewording this sentence.
- L 128: “on different scales” – Please clarify, is it different timescales (fast vs slow) you mean here?
- L 198: I’m not familiar with ECHAM6-HAM – does this model include any microphysical effects of BC, allowing BC to function either as a condensation or as an ice nuclei?
- L 285: Please fix the subscript in “Rresp”
- L 311: Just for easier reading: please add “fast” before “precipitation” in the beginning of this line
- L 326: What causes the slow BC-induced change in atmospheric cooling?
- L 343: Again, just for easier reading it would be good to remind the reader that this sentence is regarding SO4, not BC (which is mentioned on the previous line).
- L 490: “largely balance and less balanced” – does this refer to global and extratropical respectively? Please consider rewording the sentence to make this more clear.
- FIG 2: Consider adding a short sentence in the caption explaining what values of e.g. -1, 1 and 0 would mean, to make the figure easier to understand without reading the manuscript text.
- FIG 3 and 4: Please increase the font size of the legend in panels e)
- FIG 5: In the legend, you use e.g. ARCaero and ARCcc, while in the manuscript text and also in the figure caption it differs whether you use ARCaerosol /ARCaero or ARCcc/ARCclean,clear. Please make this consistent throughout the text and figures. Also, please increase the font size of this legend.
- FIG 6 and 7: Could you, to help the reader, consider adding a short sentence in the caption, explaining that red/blue is descent/ascent in d-f?