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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Significant climate impacts of aerosol changes driven by growth in energy use and advances in emissions control technology" *by* Alcide Zhao et al.

Anonymous Referee #1

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Summary

The authors conduct coupled ocean atmosphere and fixed SST aerosol simulations with the CESM, focused on 1970-2010 emission perturbations due to changes in energy growth and advances in emission controls. The latter is associated with a negative ERF, global cooling and reduced precipitation. The former is associated with the opposite responses. Regional impacts are also discussed, as is the non-linearity of the responses, and the limitations of using the ERF to diagnose aerosol temperature/precipitation responses.

Overall, the paper is well written, and the experiments and results are clearly pre-

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Discussion paper

sented. From my perspective, the result emphasized in the title of the manuscript is not that surprising (at least qualitatively). What appears to be most interesting is the significant amount of non-linearity in the responses. As discussed, this has important implications for experimental design to quantify aerosol climate responses, and also reinforces the difficulty in quantifying future aerosol-climate impacts.

Specific Comments

Figure 1. A bit confusing for BC. Is the BC ERF also increased by a factor of 10? I assume no (which is confirmed by the text), but the panel label shows “BCx10”.

Section 2.2. Please include information on CESM’s aerosol forcing, relative to other models. For example, CESM has a relatively large aerosol indirect effect. Which will subsequently impact these results. Allen and Ajoku calculated the aerosol effective radiative forcing (ERF; (W/mˆ2)) for 2000 relative to 1850, from CMIP5 models using the sstClim and the sstClimAerosol experiments. CESM yields -1.52 W/mˆ2, which is one of the largest aerosol ERFs. See Table 1 in “Future aerosol reductions and widening of the northern tropical belt” JGR, 2016.

Also, it is not acknowledged that these results are likely highly model dependent until the conclusions (L21 P11). I suggest making this point earlier in the manuscript (as well as in the conclusions).

P8 L15. See also “A 21st century northward tropical precipitation shift caused by future anthropogenic aerosol reductions” JGR 2015.

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