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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying uncertainty from aerosol and atmospheric parameters and their impact on climate sensitivity" *by* Christopher G. Fletcher et al.

Anonymous Referee #3

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Review of manuscript entitled: ''Quantifying uncertainty from aerosol and atmospheric parameters and their impact on climate sensitivity" by Fletcher et al.

This work attempts analyzing the relative influence of aerosol and atmospheric parameters uncertainty on climate sensitivity. The methodology used here is to sample combinations of 9 parameters (4 representing the aerosols and 5 representing clouds) in the CAM4 general circulation model. The number of emulations to be performed is of the order of 10^5. The design of the emulations and the methodology are well described but I believe that the conclusions of the paper are too far reaching. Here is why: Although the setup and the methodology appear to be well chosen, I would argue

that the authors sample only a small part of the aerosol space and not the most relevant parameters for ascertaining which part of the variation in climate sensitivity can be explained by atmospheric parameters and which one is due to aerosol parameters. Therefore part of the sentence included in the abstract and the conclusions: '' The atmospheric parameters explain more than 85% of the variance in climate sensitivity for the ranges of parameters explored here, with two parameters being the most important: one controlling low cloud amount, and one controlling the timescale for deep convection." can mislead readers. I recommend to edit this conclusion for the following reasons: 1) Page 4, line 18-19 the authors state: '' CAM4 does not include aerosol-cloud interactions, yet sulfate aerosols are known to be effective cloud condensation nuclei." This is right, sulfate aerosols are effective CCN (cloud condensation nuclei) as can be organic aerosols, seasalt and large dust particles. But since CAM4 does not include the effects of aerosol on cloud microphysics, trying to mimic it by varying the hygroscopicity (aptitude to uptake water) by sulphate is a shortcut that can hyde a large part of the effect aerosols have on cloud and precipitation. 2) The authors restrict the influence of aerosol parameters to studying the hygroscopicity of sulphate and the abundance of black carbon. To be complete, they should also integrate possible uncertainties of the distribution of organics, seasalt, dust and nitrate, their aging as well as their ability to be CCNs.

If these were taken into account, I doubt that the results of Figure 4 would remain the same as the aerosol influence on cloud microphysics would change the relative importance of aerosol versus atmospheric parameters on climate sensitivity. This is why I propose that the authors take out from their conclusion that: ''atmospheric parameters explain more than 85% of the variance in climate sensitivity". I anticipate that future publications will contradict this result. It is very likely that the authors are correct when they state that: ''low level clouds and the time scale for deep convection are the two most important parameters" since this will probably hold true even when the aerosol parameter space is better sampled.

With this caveat I believe that this study is of interest to ACP and that this paper could be published after the authors restrict one of their conclusions.

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