Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-729-RC2, 2017

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Multi-model comparison of the volcanic sulfate deposition from the 1815 eruption of Mt. Tambora" *by* Lauren Marshall et al.

Anonymous Referee #2

Received and published: 21 September 2017

Review of Marshall et al. "Multi-model comparison of the volcanic sulfate deposition from the eruption of Mt. Tambora"

This study does a careful comparison of the sulfate aerosol deposition from the Mt. Tambora eruption to test the models ability to simulate deposition observed in the ice core record as well as the assumption made to back out SO2 injections from ice core sulfate signals. This work is done using a variety of models that include microphysical aerosol modules and highlights some of the successes as well as the continued work that needs to be done. I do find that it is a clearly written paper with results that would be of interest to the ACP community and would recommend publication with only a few mostly minor comments for authors to address.

The main comment I have would be related to needing some additional discussion of hydroxyl radical (OH). I would like the authors to include more details on OH in the main paper and possibly consider a figure in the main text or supplement showing something like profiles of its tropical concentrations in the various models (both background and perturbed if applicable). The table S1 would be best to include in the actual paper rather then the supplement. 3 Models have interactive OH and 1 prescribed. Given OH's critical role in the conversion of SO2 into sulfate aerosol and given the differences in sulfate aerosol evolution in the different models it would be really helpful to look at whether any differences in the amount of OH or its distribution can explain the differences in sulfate conversion noted on page 8 lines 17-20.

For the models with interactive OH does the sulfate aerosol impact photolysis rates, which would decrease OH formation and slow conversion. Does stratospheric water vapor increase in these runs, increasing OH production? Do any of the models deplete OH when reacting with SO2?

If so it would be important to note in the text, if not mention as a source of uncertainty in the sulfate conversion.

page 5 line 2 you should add "as emitting" after simulated or something similar.

page 6 line 20-22 Is there a notable difference between UKCA and other models in this regard that would be worth discussing it seems like a potentially important point concerning the focus of this paper w.r.t. deposition schemes.

In general given the focus of this paper a brief mention of the deposition scheme used in each model and reference would be very helpful.

page 13 lines 13-14 More discussion about OH here and earlier would be helpful

page 13 lines 15-17 I don't think it is beyond the scope of this paper to show or discuss the OH since it is critical in the formation of the sulfate aerosols and could help address difference in the the sulfate burdens

page 14 lines 19-20 sentence starting with "Even if the models were perfect. . ." I would recommend removing this sentence, it is not necessary and confusing

Table S1 SOCOL is listed as 8S location of injection the rest are equator is the a typo or real difference in injection latitude.

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