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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The magnitude and causes of uncertainty in global model simulations of cloud condensation nuclei" *by* L. A. Lee et al.

Anonymous Referee #1

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The manuscript describes the uncertainty of cloud condensation nuclei (CCN) concentration on different aerosol processes. The manuscript is well written, has some very interesting results, and presents a unique method for evaluating model processes in global scale models. The study shows how emulators can be efficient tools in evaluating model uncertainties. It remains to be seen if the processes causing uncertainties in GLOMAP would rank similarly in other models. I would like to see the following issues addressed before the manuscript is accepted:

Comments and questions

- As GLOMAP is run within a chemical transport model, does the prescribed model

meteorology make it less sensitive to certain processes that would cause larger uncertainty in models that calculate their own meteorology (e.g. global climate models)? This should be discussed in the manuscript since it is too early to make recommendations on what processes modelers should focus on, if the recommendations are based on only one model.

- On a related note, on Page 6310 (Line 5) it is said that the dynamical responses would have complicating effects. Is it relevant if the dynamical responses are complex or not, when studying how the variance in an aerosol process translates to variance in CCN?
- According to Mann et al. (2010), primary aerosol and trace gases (except for biomass burning and volcanoes) are emitted to the lowest model layer in GLOMAP. Does this cause dry deposition to be the process causing highest uncertainty in GLOMAP? I would expect that, for example, the models that use vertical profiles for emissions would be less sensitive to changes in dry deposition rate.
- Page 6302, Line 18: GLOMAP is mentioned here for the first time. It would be good to first introduce, what kind of a model it is.
- Page 6319, Line 23, The notation '$\times$0.5/2.0' is difficult to understand.
- Page 6320: It is unclear to me what "Biogenic SOA production" and "Anthropogenic SOA production" actually are. Are they the amount of condensing SOA? If so, why the emission of anthropogenic VOC is varied (or is it?). Overall, the description of "Anthropogenic SOA production" is difficult to understand.
- Page 6320: Goldstein and Galbally (2007) estimate the upper limit of global SOA production to be 910 Tg C a^{-1}, while in this study, the upper limit is 520 Tg a^{-1}.
- Page 6343, Line 7-9: Which AEROCOM intercomparisons are you referring to?

- Text in Figures 3, 8, 9, and 11 is very difficult to read.
- Figure 11: What is the added value of Figure 11? Figure 8 includes basically the same information.

References

Goldstein, A.H., and I.E. Galbally, "Known and Unexplored Organic Constituents in the Earth's Atmosphere", Environmental Science and Technology, 41, 5, 1514 - 1521, 2007

Mann, G. W., Carslaw, K. S., Spracklen, D. V., Ridley, D. A., Manktelow, P. T., Chipperfield, M. P., Pickering, S. J., and Johnson, C. E.: Description and evaluation of GLOMAP-mode: a modal global aerosol microphysics model for the UKCA composition-climate model, Geosci. Model Dev., 3, 519-551, doi:10.5194/gmd-3-519-2010, 2010.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 6295, 2013.