Atmos. Chem. Phys. Discuss., 13, C1849–C1853, 2013
www.atmos-chem-phys-discuss.net/13/C1849/2013/

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 #2

Received and published: 2 May 2013

Review of "The magnitude and causes of uncertainty in global model simulations of cloud condensation nuclei" by L. A. Lee, K. J. Pringle, C. L. Reddington, G. W. Mann, P. Stier, D. V. Spracklen, J. R. Pierce, and K. S. Carslaw

The authors present an uncertainty study of aerosol processes leading to changes in the model simulated global distribution of cloud condensation nuclei (CCN). The authors select 28 uncertain parameters which they find to be important in impacting on the distribution of CCN. They select possible ranges of these uncertain parameters by "expert elicitation", a process by which experts of the modeling community are requested to give plausible ranges of the parameters of interest. Within these ranges of parameters, the authors then perform 168 model runs, where combinations of the uncertain 28 parameters are used to sample the complete space of parameter vectors.

Using the results of these model runs, the authors construct a statistical model – an emulator – to represent the mapping of a given parameter sample onto a distribution of CCN. In this way, as they claim, the actual process of simulating the outcome of a given parameter combination can be replaced by evaluating the statistical model for that particular parameter combination. They motivate that the emulator does represent such a statistical analog to the actual model simulation by performing an additional set of model simulations. These are then compared to the outcome of the emulator-predicted computation. They find the deviation to be small compared to that introduced by the overall span of parameters. They then present a detailed analysis of the effect of the 28 different parameters of the model.

Please find my comments below and in the attached annotated pdf.

1. Does the paper address relevant scientific questions within the scope of ACP? The paper addresses the question of parametric uncertain (PU) within climate models. The question of parametric uncertainty is not new in the community. Notably, as the authors dutifully point out, several other studies have addressed this topic, e.g. the distributed computing activities within the climateprediction.net initiative. Within the field of aerosol effects, the authors also cite previous work on parametric uncertainty. This said, PU it is an ongoing – and important topic in climate research. The authors present a new aspect of this uncertainty, namely the reaction of the distribution of the CCN to 28 crucial model parameters. The detail at which the study is presented is convincing and insightful. In a broader perspective, the question of whether PU can appropriately be assessed, is unclear. This is due to the difficulty of even defining a proper range of prior parameter ranges or the type of distribution of the prior. “Expert elicitation”, an approach often taken in these types of studies, is perhaps the only available path by which to assess these ranges, but whether it is sufficient, is questionable. Even experts have biases and their opinions are impacted upon by the very expert knowledge they have on the realism of simulation outcome resulting from a given choice of parameters. The model used is only one out of many possible models. How general are the results

ACPD
13, C1849–C1853, 2013

obtained for the present 28 parameters to a more general class of models? What can be learned more generally? The authors are encouraged to expand on this question.

2. Does the paper present novel concepts, ideas, tools, or data? The concepts and tools, as pointed out in (1) are not new, as they are based on “expert elicitation”, “latin hypercube sampling” and construction of an emulator, a statistical model. The idea of assessing the uncertainty in a wide range of aerosol parameters and the data used are new. The authors present a thorough piece of work, likely to be very useful to the community.

3. Are substantial conclusions reached? Yes, a ranking of important and less important parameters and their associated “uncertainty” are presented. This will likely be very useful for model developers and observational scientists who could work on constraining the parameters in a prioritized manner.

4. Are the scientific methods and assumptions valid and clearly outlined? “Expert elicitation” is a rather subjective process. There is no proof of its scientific benefit for the type of study presented. The authors are encouraged to make somewhat clearer what the shortcomings of this type of query are (I mention some points in the attached annotated review). The construction of the emulator and its validation are clearly explained. However, it could be interesting to see how robust the emulator is to changes in the number of model runs that go into its construction. Would half the data yield similar results and how much is the emulator actually influenced by only a few crucial parameters? I.e. are the results obtained (within the error bars presented) essentially a result of only a handful (not 28) parameters? Also, the authors do not address the question of interaction of parameters and their independence. It is important to note that when many parameters are sampled independently, a cancellation of effects is a likely outcome. This effect could moderate the overall finding (or make them more extreme), depending on the exact correlations of parameters. I make some statements in my annotated review. The authors are encouraged to investigate these issues further.

ACPD

13, C1849–C1853, 2013

5. Are the results sufficient to support the interpretations and conclusions? The study is overall thorough and the conclusions carefully supported.

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Fairly clear.

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? It could be made somewhat clearer which parts of the present study (conceptually and technically) have been also performed in the previous literature the authors cite. The authors should describe the key feature of previous studies on parametric uncertainty (Collins et al., 2011; Pan et al. (1997); Ackerley et al. (2009); Frame et al., 2009; Haerter et al. (2009); Lohmann and Ferrachat (2010)) in greater detail. In what ways is the current study building on this previous work and where does it differ? Given the overall length of the MS, embedding it clearly in previous literature would be useful.

8. Does the title clearly reflect the contents of the paper? "The magnitude and causes of uncertainty in global model simulations of cloud condensation nuclei" could be seen as somewhat overstating the results. In my view, the study mainly examines parametric uncertainty using samples of 28 parameters. The title may lead the reader to believe that more general causes, such as the physical modeling (structural aspects) could be discussed in the paper. The title should reflect the objective of sampling parameters and assessing their influence on the CCN distribution. A recommend re-consideration of the title.

9. Does the abstract provide a concise and complete summary? This abstract is somewhat lengthy and I suggest removing some of the technical details there.

10. Is the overall presentation well structured and clear? Yes, the overall presentation is good.

11. Is the language fluent and precise? Yes, good.

ACPD
13, C1849–C1853, 2013

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Fine.

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? It is a long paper, but a clear characterization of all 28 parameters requires a long MS.

14. Are the number and quality of references appropriate? Yes.

15. Is the amount and quality of supplementary material appropriate? N/A.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/13/C1849/2013/acpd-13-C1849-2013-supplement.pdf

---

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

ACPD

13, C1849–C1853, 2013

Interactive Comment