

Interactive comment on “Impact of parametric uncertainties on the present-day climate and on the anthropogenic aerosol effect” by U. Lohmann and S. Ferrachat

Anonymous Referee #1

Received and published: 20 August 2010

The paper presents an exploration of the impact of perturbations to 5 parameters within the cloud scheme in ECHAM5 on cloud amount, precipitation and top of atmosphere radiative balance. The analysis is extended to consider the impact of these parameter changes on radiative forcings attributable to anthropogenic aerosol effects. The language and the structure in the paper is excellently written, and the paper flows and is easy to read. The results presented in the paper represent an extensive body of work. The weakness of the current draft however is that the implication of the results is not clearly identified and hence the scientific relevance is not clear to the reader. This needs to be addressed before publication.

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Specific points:

The main issue with this paper is that, while the paper is well written and the work done significant, points which the paper aims to make are not clear. Who is the target audience who will make use of the results? What are the wider implications beyond ECHAM5 model tuning? What new questions does this work provoke? I can make guesses but I am not sure they are what the authors intended nor convinced that most people will guess the same.

(1) The abstract only lists a series of statements about the results (what is the significance?). The introduction is very thorough, well researched, but does not provide a motivation for the work (what are the authors seeking to test/show and why?). The conclusions are perhaps the better of the three, but still fall short of identifying what the implications of the work are. This needs to be addressed before possible publication.

The other specific points are as follows. These just need to be clarified.

(2) “Is a TOA flux in a fixed SST run expected to be in balance?” The authors make an assumption that the TOA in the prescribed SST ECHAM5 simulations should be in balance (plus or minus 1 Wm^{-2}). I would question whether this should be the case – given contemporary atmospheric composition and SSTs isn't the TOA expected to be out of balance? Comparisons of fixed SST and fully coupled configurations of other climate models suggest that the prescribed SST configurations often have a positive bias of 1 to maybe as much as 2 Wm^{-2} whilst the net TOA for the equivalent coupled model control simulations are near balance.

(3) “Are these the only parameters which are under constrained by observations or unobservable and which play a role in top of atmosphere balance?” For example within the UK Met Office modelling framework there are a large number of parameters which are either unobservable (such as rain auto-conversion, used in this study, and many others such as the critical relative humidity) and parameters which are in principle observable but which in practice are poorly constrained by what obs. we have (e.g.

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ice fall speed). Taking parameters from these two groups together there are a very large number of parameters which are likely to impact top of the atmosphere radiation, cloud and precipitation diagnostics – something which is likely to be true for all current models including ECHAM5. Given that this paper explores only 5 and that there is likely to be sensitivity to other unexplored parameters, how do the authors interpret the significance of their results?

(4) Do the authors want to comment on the apparent differences in radiative impacts of anthropogenic forcing arising from this study and Haerter et al, 2009? Both use the same underlying atmospheric model – and study some but not all of the same parameters, but the Haerter study produces a wider range of historical aerosol forcing. The Haerter et al, study suggest a much larger parameteric uncertainty for aerosol forcing – is the smaller range in this paper a result or just an artefact of different experimental methodologies? In either case it would be useful if this could be discussed.

General comments:

(1) Page 3 line 7, “If the GCMs are also free to choose their emission data base, then all publications of the total indirect aerosol effect can be compared.” – do the authors mean “can not be compared”?

(2) Page 7, line 13: “However, based on our experience one year is sufficient in order to evaluate the global annual mean radiation balance at the top-of-the atmosphere (TOA), which is the goal of this study.” How much year to year variability is there likely to be in TOA? Is this likely to have an impact on the tolerance of allowable TOA?

(3) Page 7 Set-up of the Simulations, 2nd paragraph: It is not clear what these simulations are, how they differ from the previous fixed SST experiments and why nudging was introduced. Can the authors expand this discussion?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 19195, 2010.