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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol forcing based on CAM5 and AM3 meteorological fields" *by* C. Zhou et al.

Anonymous Referee #1

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The authors present a study of the impact of using different meteorological fields, here from the CAM5 and AM5 models, on the output of a global aerosol model (IMPACT). This is a highly relevant topic, as a good fraction of the remaining uncertainty in modelling of aerosol radiative forcing may well be linked to descriptions of water content, clouds, precipitation, vertical fluxes etc. The study is thorougly performed and documented, and the paper is well written. I recommend that it proceed to be published in ACP, however I do have a small number of comments and requests for clarification.

General comments

As a general comment, while I enjoy the details presented in the study I find I miss a closer connection to the ongoing process of understanding the difference between aerosol models. As stated in the introduction, comparison of coupled aerosol/climate

models typically combine differences because of diverse treatments of atmospheric aerosol processes and because of varying meteorological fields. Given the difference seen here between two different meteorologies, how much of the differences seen e.g. in the list of references given (Penner et al., 2002, 2006; Kinne et al., 2006; Schulz et al., 2006; Textor et al., 2006, 2007; Shindell et al., 2008, ...) can be explained? This can of course not be thorougly quantified from two fields alone, but a closer link would strengthen the impact of the paper. Currently, the authors state in the conclusion (p10701) that

"Today, there is a large emphasize on determining aerosol affects and their interactions with clouds and precipitation. However, our study highlights that as long as the hydrological cycles simulated by different GCMs do not converge, the aerosol fields, direct effects, and aerosol indirect effects will differ due to this factor alone. Thus, at least as much effort should be put into examining this aspect of GCMs as on examining aerosol indirect effects."

I agree, and believe the present analysis could be further exploited to quantify the difference.

Regarding the simulation setup: The authors have used 2-year consequtive meteorological fields (p10684,l21) from both input models. The emphasis of the analysis is on comparisons of the models, but not so much on the internal variability of each model. Have the authors looked at the effects of using different input years from a single model? Are the differences seen, e.g. in cloud mass flux and subsequent aerosol loading, robust? I would assume so, but cannot tell to what degree this is from the present analysis.

I find I also miss comparisons of the radiative forcing of individual species, especially BC, OA and SO4, but I realize that this requires additional simulations and may be beyond the scope of the present analysis.

Technical notes and questions

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p10682,l7: "3-mode version of IMPACT" used twice in two sentences

p10685,l3: Regarding Figure 1, would propose showing (in addition) the vector difference fields between CAM5 and AM3 results - at least for one or two combinations. It's a bit hard to spot the difference between two vector fields visually.

p10688,l6: The connection between condensed water content and precipitation amount is crucial for the later discussion, but I do not find the explanation of why increasing it decreases precipitation quite clear. Clarify?

p10696,l25: "...two major factors..." Could the difference in BC vertical profiles in the Arctic, as shown in figure 9, also have an impact here? The A1 field is more markedly peaked at high altitudes than C1 and C1 concentration is generally higher. E.g. Shindell and Faluvegi, 2009, show a difference in forcing sign from BC in the Arctic when the forcing is applied low (local emissions) or high (transported), and in a region where the sensitivity of BC forcing to altitude is very strong (e.g. Samset and Myhre, 2011).

p10701,l12: emphasize -> emphasis

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 10679, 2012.