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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sensitivity of aerosol optical thickness and aerosol direct radiative effect to relative humidity" *by* H. Bian et al.

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The paper is a fine listing of the effects of what happens when a nonlinear function (humidity growth of the aerosol) used for the AOD computation is combined with a linear change in resolution. Knowing the function the result might sound trivial. However, the actual shape of the relative humidity (RH) pdf and its dependence on time and space make the result not totally foreseeable. The results add thus a clear though may be not totally new hypothesis to why models provide different estimates of AOD. Minor revisions should do it, the paper should be published in ACP.

The real reasons why models diverge are not found in this article. Humidity differences among models with different resolution might indeed be a reason. However, it would be slightly more convincing to real dig them out from the AeroCom models. Resolution

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differences might not be as easy to translate into AOD differences as suggested by the authors in the conclusion. Nudged GCMs for instance compute RH fields every 30 minutes even if the resolution is in some of the models coarser than that of GMI. RH variability might be higher in a free running GCM than in reanalysed RH fields as used here. The spatial and temporal variability of RH might be very different even if the resolution would be the same. Finally, one day it has to rain even in the coarsest GCM model. I wonder how much the RH pdf distribution in a balanced GCM depends on its resolution. May be not too much? What if large domains are near the 100% RH level in a given model? A discussion of these items and a proposal on how to better diagnose such differences in any future intercomparison might do the paper good. I could think of a RH histogram. Please add one for the three GMI experiments. It would be easier for other modellers to compare their results with yours.

Other remarks which might be included in a slightly enhanced discussion: In the Kinne et al AeroCom paper mass extinction coefficients are listed. Funny enough the model with the coarsest grid shows the highest MEE for sulphate, followed almost immediately by the one with the finest grid. The differences in the vertical distribution of the RH was mentioned in the Schulz et al 06 paper to be one possible reason for the anticorrelation of MEE and residence time of sulphate. Such vertical distribution differences of water vapour might co-vary with resolution changes.

Small more technical comments: Figure 1: How is the humidity region close to 100% handled? Is there a kind of constant MEE for high humidities? Would be nice to document this region. The figure is white above 98 (?) % RH, does it mean there is a maximum humidity growth? Please clarify.

Figure 3: Why is the comparison shown only for one month? I would prefer a one year comparison. Is the relative bias the bias between the means of model and observations? Why not computing RMS including all data points in addition?

Title 3.4: Factors controlling xx the variation of ?

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Interactive Comment

Page 13242, last line: Inflow OF hydrated aerosols…

Page 13243: Many factors involved in A weather system…

Page 13245: “Considering anthropogenic aerosols”… It is not totally clear how the anthropogenic aerosols is singled out in the model and experimental setup. May be I missed it.

4 Conclusions “Note that the magnitude of spatial resolution is twice…” I wonder if that can be inferred like that. Where is the RH variance located – in space or time? It depends on the change in the RH pdf in combination with the total AOD magrnitude. However, it would be nice to quantify the change of the RH pdf in between the different experiments. Maybe you find a good way how to characterize that.

Conclusions Reword phrase: “On a regional scale, the influence…”

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