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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global cloud and precipitation chemistry and wet deposition: tropospheric model simulations with ECHAM5/MESSy1" *by* H. Tost et al.

Anonymous Referee #2

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Through a novel global chemical transport model (CTM), Tost et al. successfully demonstrate that adequate treatment of cloud and precipitation process is important for the simulation of global tropospheric chemistry. The authors extend the area of global CTM to the complicated aqueous-phase chemistry that has been neglected in global models. Furthermore, the model results are extensively evaluated with surface wet deposition monitoring data and aircrafts observations from several field campaigns. Effects of scavenging and simple to complicated aqueous-phase chemistry on the wet deposition and the vertical distributions of trace gases are clearly identified through several sensitivity studies. I highly recommend the acceptance of the paper for the publication although in the manuscript more explanations and clarification are needed

in some places.

(Specific)

Since accurate model prediction of precipitation is crucial in estimation of wet deposition, I suggest that authors show a plot or a table comparing observed and simulated precipitation rather than mentioning the references, for example, a plot such as Fig. 2 using precipitation data or addition of the plot of observed precipitation to Fig. 1. Taylor diagram with precipitation observations similar to Fig. 2 may help interpretation of wet deposition fluxes observed at different location and time.

P791, Line 17-19: What specific process causes the differences in the dynamics of the various simulations if there are no radiation feedbacks between chemistry and dynamics?

P 795, Line 13: If emission is the cause, why does D06 show much better agreement between model and measurement of nitrate wet deposition for IDAF dataset (Table 2 and Table 3)? Does D06 use different emissions?

Table3: Why are the observed sulfates so different from this study and D06 study for IDAF dataset?

P 812, Line 6-8 & P 813, Line 7-8: Provide the reference indicating the minor role of wet deposition in the distribution of HCHO. To my knowledge, scavenging of HCHO can be large depending on how microphysical conversion of HCHO is treated. For example, wet deposition of HCHO can be large if HCHO in the cloud water is retained after freezing of cloud water into ice, snow, and hail and precipitated to the ground (see Barth et al., 2001, JGR). Poor representation of microphysical transfer process may cause overestimation of upward transport of soluble species.

P 812, Line 19: No aqueous phase chemistry involving HCHO? What is reaction A4105?

P 813-P 814 (section about ozone): The discussions here lack details. The authors

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7, S141–S143, 2007

can provide more plots (in supplementary material) supporting conclusions here. It is not clear how the authors reach these conclusions. Did the authors calculate the ozone production and destruction budget to explain the spatial distribution of ozone difference between SCM and COM? How does the nitrogen oxides difference between SCM and COM look like? What is the indirect effect to increase ozone for EASY2 compared to COM?

P 814, Line 20-24: Does it mean coarse vertical resolution enhance mixing in the upper troposphere? Resolved scale motions with coarser resolution should lead less mixing. Does subgrid-scale diffusivity (diffusivity at free atmosphere) cause too strong mixing? Or can boundary-condition lead to this problem? I have the same question for P 811, Line 24-27.

P817, Line 11-12: The authors may need to rewrite the sentence.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 785, 2007.