Atmos. Chem. Phys. Discuss., 9, C7663–C7665, 2009
www.atmos-chem-phys-discuss.net/9/C7663/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influences of in-cloud aerosol scavenging parameterizations on aerosol concentrations and wet deposition in ECHAM5-HAM" *by* B. Croft et al.

Anonymous Referee #1

Received and published: 30 November 2009

General Comments:

There is no new development of parameterizations involved in this study, but the results might be useful in the uncertainty assessments of model performance related to aerosol scavenging (both nucleation and impaction). With a diagnostic nucleation scavenging scheme introduced into ECHAM5-HAM, this study is able to carry out sensitivity investigations of the scavenging on the global burden of aerosols and concentrations of several aerosol species. Generally, a better agreement is found with the new diagnostic scavenging scheme. As there are many uncertainties in predicting the global aerosol distributions, this paper presents a method to improve the accuracy of model

results from the improvements in in-cloud removal schemes. The finding is very useful in helping other global models in improving the wet removal processes.

Specific Comments:

(1) A grammar distribution for cloud droplets is chose in this study, it should be noted that using different droplet spectra can cause scavenging coefficients different by a factor of 3-5. Using different collection kernel can cause scavenging coefficient differ by an order of magnitude. A brief discussion regarding the potential uncertainties related to these different choices of inputs is needed.

(2) Figure 1 shows size-dependent scavenging coefficient, but this is not really for a specific size, but rather for a whole aerosol spectrum that has this geometric mean. There is nothing wrong with the figure, but the related discussion in the text implies that the scavenging coefficient is for a specific aerosol size. Some clarification is needed in the text.

(3) The comparisons between DIAG-FULL and CTL runs with observations show some degree improvements by DIAG-FULL. Is this improvement statistically significant?

(4) Aerosol size distribution is a key parameter in the in-cloud scavenging scheme. It impacts not only the cloud activation but also the cloud nucleation and impact scavenging. Is the size distribution simulated from the model comparable with observations? How does the impact of size distribution on in-cloud removal compare with the impact between DIAG-FULL and CTL?

(5) Figure 2 shows the collection kernel of in-cloud ice droplet-aerosol collisions. There is a sharp decrease in the collection efficiency around 1-2 um range. Is this physical and what kind of impact would this on the aerosol size distribution after in-cloud scavenging?

(6) The sensitivity of various in-cloud scavenging schemes on the global aerosol budgets is informative. It seems that the DIAG gave a better agreement for black carbon

profiles. For other aerosols, the budgets are changed by the DIAG scheme but no information was given if the scheme made a better agreement.

(7) As there are many variation of the DIAG scheme tested in the model, it would be nice to see a summary on the applicability of these tests to offer some guidelines for other global models in implementing in-cloud schemes.

Technical Corrections:

(1) Page 22043 ln 24: change “are” to “is”

(2) Figure 4: the labels in the plots should be enlarged to be seen properly.

(3) Page 22068 ln 6: insert an “were” before “increased”

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 22041, 2009.