Atmos. Chem. Phys. Discuss., 9, C8349–C8352, 2009
www.atmos-chem-phys-discuss.net/9/C8349/2009/

Atmospheric Chemistry and Physics Discussions

ACPD

9, C8349–C8352, 2009

Interactive Comment

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

D. Koch (Referee)

dkoch@giss.nasa.gov

Received and published: 14 December 2009

This paper describes the implementation of a detailed diagnostic precipitation scavenging scheme that scavenges aerosol number and mass individually, including separate treatment for liquid, mixed and frozen clouds and including in-cloud impaction scavenging. The results of this scheme are compared with the original scheme, a prognostic scheme in which aerosols are retained in-drop or in-crystal between model timesteps, and some sensitivity tests to help discern the impacts of individual components of the diagnostic scheme.

The new scheme is sophisticated, and although it does affect the model results, most

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

of the comparisons with observations show little difference among the various cases. The biggest impact occurs in the mid to upper troposphere and so the comparison with aircraft BC data showed the largest difference among model simulations. By contrast the comparison with surface measurements and column AOD did not make much difference.

Major comment: Therefore the major suggestion I have for revision is to encourage the investigators to pursue comparison with more aircraft data, widely available for sulfate, 210Pb and 7Be. I expect that the schemes may eventually have a large effect on indirect effects for high-level clouds. So proper simulation of aerosols in that region will be important. Therefore further testing of the schemes against aircraft data would be important. Note that, in Koch et al., 2006, there is discussion of the challenge of simulating 7Be and 210Pb changes with altitude. In particular 210Pb is overestimated in the free troposphere. Liu et al. (2001) had a similar problem and corrected it by adding a cirrus-cloud settling parameterization. It would be quite interesting to see which of your schemes are most successful in comparison with sulfate, 7Be and 210Pb.

Minor comments:

The Introduction is confusing, with what feels like random discussion of various scavenging mechanisms making it difficult for the reader to know what this study will address. Some introductory sentences clarifying and summarizing the various aspects of scavenging addressed would be helpful. For example, there is discussion of how this study focuses on diagnostic model development but then moves on discuss a prognostic approach. An introductory explanation of that both of these will be considered should follow the paragraph on p 22044 line 23. Similarly on p 22045, the 2nd paragraph should begin with a statement that this study will address not only aerosol uptake but also in-cloud impaction.

P22047 What are the sources for 7Be and 210Pb/radon? How are they distributed onto the aerosol size distribution?

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

P22051 line 2-3 "The used version of the ECHAM5-HAM" change to "The version of the ECHAM5-HAM used here". There was an earlier sentence like this as well.

P22051 line 2, define "homogeneous freezing" and explain why this means the treatment must be different. Is homogenous freezing the only IN scheme used here?

P22052 equation 15, define E.

P22054 I do not understand DIAG2, it uses prescribed impaction kernels in Table 2, but how do these differ for number and mass?

There are simulations listed in Table 3 that are not described in section 2.1.5.

P22056 top paragraph. The explanation for why the DIAG-FULL has more aerosol in-cloud and in-crystal compared to CTL is not clear.

P22056 This should appear earlier, in the model description: "Our study also implemented the below-cloud scavenging parameterization of Croft et al. (2009),. . ." along with a summary of what this is. And what was used for below-cloud in Hoose et al. 2008a that makes the new scheme more efficient? And further in this sentence, the word "interstitial" should not apply to below-cloud scavenging.

Although Figure 5 is similar to a figure in Hoose et al., it would be worth discussing it further here.

P 22059 Lines 18-25 why does noimp have a bigger effect on PROG-AP?

Figs 10 and 11, I suggest plotting these up to 18 instead of 20-something in order to see the points better, especially for Fig. 11 where the data/model values are so small.

P22065 line 13 the underprediction of PROG-AP over Asia is present in all cases so should not be attributed to the scavenging scheme.

Fig 14 provide more information on the locations of the profiles.

P22066 I think this: "For the simulation PROG-AP as compared to PROGAP-noimp,

ACPD

9, C8349–C8352, 2009

Interactive Comment

black carbon concentrations are lower by up to a factor of five, and two in the middle and upper troposphere, respectively." Should be reworded: "For the simulation PROGAP-noimp as compared to PROG-AP, black carbon concentrations are lower by up to a factor of five, and two in the middle and upper troposphere, respectively."

P22066 Since PROGAP-noimp agrees better with observations does this suggest a problem with the impaction scheme?

P22067 Line 18. The age of the radionuclide measurements does not matter. However for 7Be is it important to have the correct point in the solar cycle or to average over an entire cycle. This should be pointed out as a source of model bias (if the source does not match the observation strength in solar source.)

Conclusions:

1. Would it be worthwhile to make the FULL scheme prognostic?

2. Since there was minimal difference among the sensitivity studies when comparing with most observations, it would really be interesting to see how the direct and indirect effects change for the schemes. Maybe add a paragraph anticipating where the big changes might occur. For example, maybe cirrus cloud

---

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