

***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 #2

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Comments on Croft et al.

The article by Croft et al. presents simulations of different aerosol scavenging by cloud particles parameterizations in the global climate model ECHAM5-HAM. These scavenging routines range from very gross assumptions of what fraction of aerosol is scavenged to diagnostic methods that are described in detail in the paper to a prognostic approach. It is interesting to see the performance of these three types of scavenging parameterization in comparison to each other and to observations. One thing that was not clear to me was why these comparisons were being made. Is the goal to recommend a particular parameterization? Or is the goal to demonstrate the weaknesses of

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a specific type of parameterization (and strengths of another)?

The paper is well written and introduces a new diagnostic approach to parameterizing the in-cloud scavenging of aerosols. There are some major points that need to be addressed before consideration for publication.

Major Points

1. For the entire paper and for specific sections, including explanations of why the investigation is being conducted needs to be included.
2. In addition, explanations of what the results mean would significantly improve the paper.

Specific Points

1. The abstract and conclusions are key places where the reasons why the study is being conducted and what the results mean should be placed. The introduction, of course, needs to include the reasons for conducting the study.
2. One paper that was not cited or discussed is the one by Jacobson (2003) JGR who presented a 1-d parameterization of chemical and aerosol cloud processes. How does his work compare with the current study?
3. In the results section, there is a lot of detail about how one simulation compared to another. I think it would be better to reduce the detail and point out what is important to learn from the figure or table.
4. One thing that I am not sure that I learned is whether it is worthwhile calculating separate aerosol number and mass scavenging coefficients or not. On p. 22059 lines 14-17, differences described lead me to think that it is not important to have separate scavenging coefficients. However, in the conclusions (p. 22069, lines16-17), it

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says that further investigations of this comparison should be done. Could the authors provide a more definite recommendation?

5. I found the results of the different scavenging parameterizations on sulfate and black carbon burdens (p. 22069, lines 23-24) to be significant with 22% and 30% changes between parameterizations. It should be stressed as a major conclusion, but it would be useful to know its relevance – that is, the model predictions of BC vertical profiles were significantly different than observations.

6. Figure 4 shows aerosol mass concentration (zonal and annual mean) while Figure 7 shows aerosol mass mixing ratio (zonal and annual mean). Why is it important to show both of these very similar quantities? An explanation could be included near the top of section 3.3.

7. In discussing results for the aerosol number distributions, the authors point out that models that use a simple scavenging parameterization tend to overestimate the production of new particles. From this finding, are there important parameters from the previous studies that could be impacted (radiation, chemistry, aerosol burden)?

8. Why is BC poorly predicted (p. 22066)?

9. I recommend strengthening the conclusions with recommendations, instead of saying “some consideration should be given . . .” or “future work could be directed. . .”.

Technical Details

1. p. 22043, line 1, It would be more clear to say “cloud nucleation scavenging scheme” so as not to confuse with particle or aerosol nucleation.

2. P. 22043, line 23-25, The last sentence of the abstract is missing a verb.

3. P. 22049, line 6 → must be apportioned

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4. P. 22052, line 14, what size is assumed for the monodispersed ice crystals?
5. P. 22054, line 21, reference to the table should be at the beginning of the paragraph.
6. P. 22060, line 19, → interstitial
7. P. 22061, line 7, → associated
8. P. 22064, lines 4-5, I do not see that DIAG-FULL and PROG-AP are different than how the CTL simulation behaves in Figures 10 and 11. Could this sentence be clarified?
9. p. 22068, line 1, It would be more clear to say “cloud nucleation scavenging scheme” so as not to confuse with particle or aerosol nucleation.
10. P. 22069, lines 17-18, I suggest combining sentences to more easily explain why separate mass and number scavenging coefficients should be used.
11. Multi-panel plots with colorbar for each panel are hard to read. Try enlarging panels and using only one colorbar for each column or figure.
12. Figures 10 and 11, please state what the acronyms mean (NDAP, EMEP, etc.).

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

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