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Interactive Comment

Interactive comment on "Technical note: A new comprehensive SCAVenging submodel for global atmospheric chemistry modelling" *by* H. Tost et al.

Anonymous Referee #2

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The paper briefly describes a submodel component suitable for computing aqueous phase chemistry and gas/aerosol scavenging in single column or global atmospheric models. The chemistry computations are apparently described in separate publications, so are only referenced in the paper. The scavenging computations are described in some detail and are primarily constructed from textbook relations. The components of the submodel are collected from previously published material. Nevertheless, a complete documented scheme for these aqueous processes in one reference is a useful contribution. The paper also describes how the submodel fits within a larger modeling infrastructure for which other submodels are also being developed. Though the scheme is argued to be complete, the paper has a few gaps that make some sections a little difficult to follow. Below are some comments and some questions that I was left unsure of after reading the manuscript. Once the manuscript is revised to clarify these issues, it should be suitable for publication as a technical note.

The authors avoid the terms "in-cloud scavenging" and "below-cloud scavenging", which is to be commended. As the authors point out, these terms are common in the literature and have a poor correspondence to real physical processes. The authors choose "nucleation scavenging (NS)" and "impaction scavenging (IS)", which refer more precisely to physical processes. Nevertheless, I was somewhat confused in trying to piece together exactly which processes are included in the parameterization and which equations apply to each process:

1) Brownian motion refers to the motion of a particle, in this case and aerosol particle, resulting from collisions with gas molecules. In the paper, there are contributions to both NS and IS attributed to Brownian motion. If the Brownian motion of a small particle leads to a collision with a cloud drop, presumably that is a case of IS. What is the process by which Brownian motion leads to a case of NS?

2) The remaining cases of NS result from all other processes leading to the nucleation and growth of cloud/rain drops. My understanding is that all of these processes are encompassed in equation 9, which is said to be an empirical relation based on observations in clouds. There needs to be a reference for this equation and a more complete discussion of the all of the processes that are accounted for with this equation. For example, a significant portion of aerosol wet deposition likely results from aerosols which separately nucleate several cloud droplets which subsequently collide and coalesce into rain drops. Are these processes all included in equation 9? If so, why does the equation depend only on the aerosol size and not some properties of the cloud such as liquid water content or vertical velocity?

3) IS results from falling rain drops impacting gas molecules or aerosol particles. The authors correctly point out that this can occur within clouds, thus leading to their rejec-

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tion of the “in-cloud/below-cloud” nomenclature. IS for aerosols is described in equations 10-12. What happens when a rain drop falls to a lower model layer and collects a cloud drop containing an aerosol particle? Is that included in NS (eqn. 9) or in IS?

4) Is the terminal velocity of drops used in eqn. 3 (IS for gases) the same as that used in eqn. 11 (IS for aerosols)?

5) Figures 2 and 3 are referenced in the text before the equations are introduced which are presumably used to generate the figures. It would be easier for the reader to understand the links between the processes, equations, and the curves in the figures if the processes were referenced to the corresponding equation number, either in the text where the figures are introduced or in the figure captions.

6) Figure 1 indicates some of the inputs and outputs. Since the paper is describing a computational scheme, perhaps it would be helpful to indicate all of the input parameters and outputs. In particular, I was unsure of what is necessary for the aerosol species. How are the aerosol particle sizes determined? Must they be input, or is a size distribution assumed? Do the chemical processes included in the scheme modify the aerosol size distribution? Is a cloud drop size distribution assumed, or does it need to be specified in the input?

7) Second to last sentence in section 2.2: If F_rain pertains only to the precipitating portion of the grid cell, how is that raining fraction determined?

8) The aqueous chemistry and most of the scavenging parameterizations have been applied in models previously. Those references are included in the paper, but there is no mention of how well they perform. Have past implementations indicated any weaknesses in the schemes?

9) A comment: One more detail I appreciate regarding the authors’ style is there attention to units. When a researcher is studying or using a model or submodel created by another scientist, it is crucial to know the units for the model parameters. Coefficients

and dimensional conversions frequently appear in model code. It is virtually impossible for the user to understand the details of the computation unless the code and documentation are clear about where coefficients appear in the equations and what units are being used.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 11157, 2005.