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Geoscientific Model Development Discussions

Interactive comment on "Supersaturation calculation in large eddy simulation models for prediction of the droplet number concentration" *by* O. Thouron et al.

Anonymous Referee #1

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Review of Thouron et al., Superaturation calculation in large eddy simulation models, GMDD, 2011.

General comments

The paper compares the performances of three aerosol activation schemes implemented in a LES model. The first one, A, is typical for aerosol activation in GCMs. It uses the vertical velocity and aerosol is activated only when this is positive. The paper nicely illustrates that additional requirements of the parameterization are needed when spatial and temporal scales become smaller, and because mixing between cloudy and clear air masses can lead to positive supersaturation also at negative vertical veloci-

ties. Parameterization B does not consider the velocity but uses the supersaturation. It considers the liquid water from a previous time step in a grid box; any excess supersaturation due to mixing is first used to calculate aerosol activation. This approach however results in spurious activation at the cloud top. Parameterization C mimics the simultaneous calculation of aerosol activation and condensation of water vapor on existing drops. The latter appears the most consistent treatment and yields the most representative results.

The paper is well written and clear. It is interesting for anyone interested in the simulation of aerosol activation microphysics in Eulerian models, and merits publication.

Specific comments/questions:

- The model explicitly calculates cloud drop number concentration, but I missed specific information on the aerosol properties (size distribution, concentration, solubility) used as input for the calculation. Also, do you expect that for different CCN spectra (e.g., polluted atmosphere) the performance is qualitatively similar?

- Parameterization B produces spurious activation at the cloud top. The authors mention that this is due to too high supersaturation when cloudy and clear air masses mix. It is therefore a dynamical phenomenon that does not depend on the activation parameterization. This spurious activation around 950 m altitude is not visible for parameterization A in Figs 2 and 3 (upper right) as compared to B, I assume this is because vertical velocities are not positive there. On the other hand, average droplet number concentrations near the cloud top are the same (Fig 1, second row, dashed lines). Can you explain?

- Is it possible to include cloud drop concentration measurements to illustrate the accuracy of the individual parameterizations?

- page 3326, line 14-17 "..., while in real cloud ..... as inhomogeneous mixing." This is not very clear, can you rephrase?