

Interactive comment on “Application of a new scheme of cloud base droplet nucleation in a Spectral (bin) Microphysics cloud model: sensitivity to aerosol concentrations” by E. Ilotoviz and A. Khain

Anonymous Referee #1

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Review on “Application of a new scheme of cloud base droplet nucleation in a Spectral (bin) Microphysics cloud model: sensitivity to aerosol concentrations” by Ilotoviz and Khain.

The results of numerical runs with new nucleation scheme are presented and compared to the standard scheme for which the supersaturation is calculated as a function of the mean thermodynamic variables of the grid box.

In the new scheme they estimate $S_{\max}$ using the method proposed by Pinsky et al. [2012], in which $S_{\max}$ is proportional to $W^{3/4}$ and to $N_d^{-1/2}$. They use this scheme

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to correct for the underestimation that usually occurs in numerical models for which the grid size is too large to resolve $S_{\max}$. They compare runs with and without the new scheme and show that it significantly improves the droplet concentration profiles, as compared with a parcel model, for polluted clouds.

This paper deals with an important problem of cloud resolving models. The resolution effect on the maximum supersaturation near cloud base is an important problem that potentially creates underestimation in the activation of the first mode of the droplets and offering an alternative approach to correct for this underestimation is an important task. The paper should be published but few clarifications will make it much clearer:

1) The paper relay heavily on the theoretical work presented in Pinsky 2012 and previous works. It would be nice to have this paper on a more “standalone mode”. A summary of the main assumptions and derivations would make it much useful. 2) On the same note, throughout the paper the validation of the new scheme (NA) should be better explained. When the results are compared to a one D model – is it a parcel model? When the authors states that the results of the NA are “much better” they should explain more on how they reached this conclusion. 3) Does the model with the new scheme assigns $S_{\max}$ as the supersaturation for all of the gridbox near cloud base? If yes wouldn't it results in an overestimation of the activation? If not please explain why? 4) Is this parametrization done only for the gridbox near (above) cloud base? If yes how does the LCL is found? How sensitive is it to the location of the theoretical LCL within the gridbox? Say that in one case the theoretical LCL is toward the upper part of the gridbox, wouldn't it make more sense to assign the $S_{\max}$ parameter to the gridbox above? How sensitive it is to such details? 5) $S_{\max}$ and N (number of activated droplets) are coupled. $S_{\max}$ depends on N and N (or r (critical for activation)) on $S_{\max}$. Could the authors explain how they solve them both and it the analytical parametrization? I guess one equation is eq. 3 but another equation is needed.

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