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Atmospheric Chemistry and Physics Discussions

Interactive comment on "New particle-dependent parameterizations of heterogeneous freezing processes: sensitivity studies of convective clouds with an air parcel model" *by* K. Diehl and S. K. Mitra

Anonymous Referee #2

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In this paper, authors modified the existing spectral-bin microphysical scheme that is implemented in an adiabatic air parcel model and performed number of simulations to test the sensitivity of different ice nucleation parameterizations that are constrained with different ice nucleating particles and respective sizes. These simulations produced important insights into the role of ice nucleating particles towards freezing via different ice nucleation mechanisms. The paper is well written, and will help to advance the status of ice nucleation. The paper is recommended for publication after the following comments are addressed.

Major comments:

Previously (e.g. Ervens and Feingold, ACP, 2012; also from the same group Ervens and Feingold, GRL, 2013; Kulkarni et al., ACP, 2012, Fan et al., JGR, 2010 and references therein in these papers) also explored the role of temperature, IN size, nucleation schemes on cloud properties. This previous work in the context of present work should be discussed in the section 1 and 4.

Sensitivity studies are very helpful, but these would be more meaningful if some results are compared against observations (remote sensing for example or laboratory measurements). Constraining against observations would help to understand the influence of microphysical processes, and also dynamics to certain extent. Previous lab data can be plotted in Figure 12a and discussed.

Minor comments:

Section 2.3.2: It is not clear how eqn. 16 is used in the model. Is it used after the ice is nucleated? Deposition ice nucleation parameterization gives number of ice particles that meet the r* criteria. No additional r* tests are required.

Section 4.1.3: Any references that define the strength of weak and strong convection. It is assumed that for weak convection the ΔT is 1.5K, but one can argue that it can be classified as a strong convection or mild convection based on the location.

Section 5: I suggest clearly mark a paragraph to aid the reader to read the conclusions. Currently, both summary and conclusion are somewhat difficult to separate.

Figure 1, 4: Can you compare to laboratory data.

Figure 11: Any particular reason why immersion + deposition is not considered. Also combination of feldspar and montmorillonite.

Figure 12: Is busy plot. If possible simplify it further or divide it.

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