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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Formulation and test of an ice aggregation scheme for two-moment bulk microphysics schemes" *by* E. Kienast-Sjögren et al.

Anonymous Referee #1

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1 General Comments

The manuscript provides a potentially useful parameterization for the aggregation collection kernel in two-moment bulk schemes. The authors provide an elegant solution for the the number concentration of particles as a function of time using the parameterized kernel formulated from mass-size relationships of ice crystals. The aggregation parameterization is tested in three different modeling frameworks, each with increasing complexity to demonstrate the capabilities of the new parameterization. While the paper demonstrates the use of the model in these different frameworks, little evidence of model validation is given. If in fact the authors can provide numerical validation and/or

a comparison with other methods for prediction aggregation (along with a few other points of questioning) the manuscript ought to be published in ACP.

2 Major Points

1. The purpose of the manuscript is to present the formation of an ice aggregation scheme for use in two-moment bulk microphysics schemes. However, there is little to no discussion of aggregation parameterizations and two-moment bulk microphysics schemes (beyond that of the authors' own work) in the introduction (and, in fact, throughout the entire manuscript). Given the purpose of the paper, I feel that more emphasis needs to be made on aggregation parameterization and bulk schemes, especially in the introduction. In general, the introduction is lacking a thorough review of the relevant literature.

2. This point is in regard to that which was mentioned in the general comments above. The method used to formulate the aggregation scheme is quite elegant and the authors are thorough in describing it in the manuscript. However, there is little effort given to validating the numerical model against either relevant observations and/or explicit aggregation calculations. Without such details it is difficult to determine if the model is physically accurate. Moreover, the model ought to be compared to previous parameterizations used in bulk models for comparison purposes and to demonstrate that the new model does in fact improve on what has already been done. This is again inherently linked to the first point regarding a detailed review of the literature and methods contained therein.

3. Several of the figures, especially figures 8, 9, and 10 are very difficult to read. The text is too small. For clarity, the figures should contain the same units when possible. For example, Figure 8 uses km while figure 9 use m. Moreover, ice concentrations are given in m^{-3} in figures 2, 3, 4, 5, and 6 but are then given

in L^{-1} in figure 9. This makes it very difficult for the reader to compare figures. The units for each axis should also be given in a consistent manner throughout the manuscript. Please also use colors that are more readily distibguishable, especially, in figures 1, 2, and 3. Lastly, in figures 4, 5, and 6, the y-axis is a bit misleading since the units are actually in tens of thousands but this only appears that the very top of the figure. It would be much clear if this was noted in the axis title and/or in the figure caption.

3 Minor Points

1. The third sentence of the abstract is very confusing. It should be noted what is meant by “classical form”.
2. On page 23979, the description of the coagulation or collection kernel is not described accurately. Given what is stated in the manuscript, the unites ought to be ’per volume’ but in fact they are ’volume per time’. The latter corresponds to figure 1.
3. At the top of page 23985, the first two equations are repeated. The section would be clearer if these equations were simply referenced here.
4. The sentence encompassing line 24-26 on page 23987 is cumbersome and confusing. For clarity, please provide more details about the nucleation, depositional growth, and sedimentation algorithms applied in the model.
5. Section 4.4 should be changed to 4.3.1 and section 4.5 should be 4.3.2. Section 4.6 should be 4.4.

4 Grammar and Wording

1. Page 23977, Line 12 - Please add a comma after μm.
2. Page 23990, Line 18 - “mid latitudes” should be “mid-latitudes”.
3. Page 23994, Lines 7-8 - Move “for ψ(x)" after “...a gamma distribution)...".
4. Page 23994, Line 3 - Change “it has not a perfect exponential" to “it does not have a perfect exponential".
5. Page 23995, Line 7 - Remove “, and we have not tried yet to solve it" and instead state that this is beyond the scope of the current study.
6. Page 23995, Line 20 - Change “when it is important" to “when aggregation is important".
7. Page 23995, Line 21 - Please add a comma after “additionally".
8. Page 23996, Line 11 - Remove “, but there is much freedom for playing" and again state that this is left for future work.
9. Figure 1 - Change “asterisks" to “circles" in the caption.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 23975, 2012.