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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Parameterizing the competition between homogeneous and heterogeneous freezing in cirrus cloud formation – monodisperse ice nuclei" *by* D. Barahona and A. Nenes

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Relating to p.15669, l.9-15 of the discussion paper:

I support the statements made by reviewer 1. The K06 parameterization does resolve the competition between homogeneous freezing and an arbitrary number of heterogeneous modes. It has been the first of its kind without hard-wiring important IN information.

It is argued that K06 resolve this competition through numerical integration. This step

permits an accurate treatment of how IN affect the homogeneous freezing process by slowing the increase in supersaturation. The numerical treatment, when used in a GCM, is not prohibitive in terms of CPU time demand.

Reduction of the rate of supersaturation and subsequent freezing of fewer liquid particles is the first order effect IN exert. The authors claim that their parameterization "explicitly" (I presume "analytically" is meant) resolves this competition. I argue that their approach adds a second order accuracy in describing the competition, because the homogeneous freezing process is not sensitive to concomitant changes in the liquid aerosol size distribution.

I further argue that their explicit approach may be beneficial to refine predictions of total ice crystal concentrations only if the IN size distribution and chemical composition (and the resulting ice nucleation spectrum) are known. However, the authors opt to study monodisperse and chemically uniform IN in this work, so an advantage over K06 is not readily apparent. The required information about atmospheric IN in cirrus levels is not easily available from measurements, so theoretical assumptions may not realistically describe the overall process and improve over K06.

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Interactive Comment