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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ice nucleation and cloud microphysical properties in tropical tropopause layer cirrus" *by* E. J. Jensen et al.

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We appreciate the supportive review. Specific responses to comments are provided below.

1. **In view of the ongoing debate about the accuracy of water vapor data in the very cold TTL conditions, what are the implications of the proposed microphysical pathway involving ammonium sulfates for PDFs of relative humidity? Are relative humidities well surpassing the homogeneous freezing limit of aqueous aerosols (as observed with some in situ instruments) any longer compatible with the presence of only a small number of ice crystals? It would be great if the authors could include an explicit statement connecting their results to this topic.**

In writing this paper, we have specifically avoided discussion of the relative humidity measurements because of the ongoing issue of accuracy. It would require a considerable amount of verbiage to review the supersaturation measurements, instrument discrepancies, and associated issues. Although it is tempting to try to use the measured cloud properties to infer the plausibility of the measured relative humidities, this pathway is potentially perilous. Of course, what we really need is definitively accurate water vapor measurements.

Aside from the above comments, it is not clear that the low ice concentrations and/or ammonium sulfate IN hypothesis would necessarily preclude high supersaturations. The issue of relative humidities exceeding $\simeq$160% still involves somehow preventing homogeneous freezing.

2. **Even optically thin cirrus can generate gravity waves themselves through radiative heating (Durran et al., 2009) and thus may trigger nucleation somewhat away from the cloud. I wonder whether we need more detailed LES studies to capture more physical details of TTL cirrus in the future. What do the authors think about the role of turbulence and stochastic condensation in TTL cirrus- these are potential mechanisms that can lead to broadening of the ice crystal size distributions not considered in the present simulations. The processes may be slow and may not dominate the larger- scale appearance (life time) of TTL cirrus, but the clouds can be very long-lived so there is a chance even for slow processes to become relevant. I am raising that point for further consideration because much emphasis is put onto the future study of the aerosol impact.**

These are excellent points. We have added a discussion of the need for LES simulations to investigate the influence of radiation-dynamics interactions on ice nucleation and size distributions (with a citation of the Durran et al.. paper). We have also added a sentence about stochastic condensation.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 20631, 2009.