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

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The manuscript discusses the timely topic of cirrus properties in the TTL with a suitable numerical approach, given the current state of knowledge of the processes affecting the ice phase in this region. Jensen et al. do an excellent job in sorting out possible mechanisms, keeping the balance between aerosol effects and dynamical effects. This includes the pertinent issue of how shattering affects measured number concentrations of small particles.

I do think that no final answer is provided (and was not intended), but the study represents an important and thoughtful step towards a better understanding of ice cloud microphysical properties (and hence radiative impact) of TTL cirrus. It is therefore highly recommended for publication in ACP.

The authors might wish to comment on the following points.

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.

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.

Durran, D.R. et al., The mesoscale dynamics of thin tropical tropopause cirrus, J. Atmos. Sci., 66, 2859–2873, 2009.

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