**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "The two faces of cirrus clouds" *by* D. Barahona and A. Nenes

Anonymous Referee #3

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General comments:

The authors address the interesting question of observed low ice number concentration (Ni) (10^1-10^2 /L) at the tropical tropopause layer (TTL) at low temperatures. They suggest a "dynamical equilibrium" state with ice production and sedimentation loss balance. The author suggestion that this state of low Ni and high supersaturation (S) only occurs when temperature fluctuation is less than some threshold value (1K). Since the ice freezing is driven by vertical velocity, however, it is not clear to me from the manuscript why the low Ni can not be explained by "conventional" picture of homogeneous freezing. If the vertical velocity is sufficiently low, will you also get the observed Ni from the homogeneous nucleation?

Aerosols at TTL behavior very differently for ice nucleation at low temperatures (one example, glassy aerosol). Will the glassy aerosols reproduce the observed Ni under

your low temperature fluctuation framework?

Specific comments:

1. Abstract
   Please explain why the "dynamical equilibrium" is insensitive to IN? Please describe another regime "pulse-decay" as well.

2. Page 30858, Line 22. "Fridlind et al"
   You may not cite this paper since it is now recognized that this paper's conclusion (role of free troposphere aerosol) is based on the measured high Ni with the problem of shattering of ice crystals.

3. Page 30859. Line 29. Please explain what do you mean "specific conditions"?

4. Page 30860. Line 1. Why low Ni and high S cannot coexist? Low Ni will have slow deposition of water vapor, thus allow high S.

5. Page 30861. Line 29. Should "heterogeneous" be "homogeneous" here?

6. Page 30862. Line 3. Supersaturation between 30% and 70%. Is this the in-cloud and clear-sky? If the heterogeneous IN is frozen to form ice at S=20%, further uprising of parcel will continue to increase S. why should the maximum S be below 20%?

7. Somehow the uncertainties with water vapor and ice measurements at low temperatures and how they affect your conclusions need to be discussed in the manuscript.

8. The connection between section 3 and 4 is rather weak. How are the equations in section 3 used to calculate the results shown in section 4.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 30857, 2010.