

Interactive comment on “A modelling case study of a large-scale cirrus in the tropical tropopause layer” by A. Podglajen et al.

Anonymous Referee #1

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Review of “A modelling case study of a large-scale cirrus in the tropical tropopause layer” A. Podglajen et al.

This paper describes simulations of a specific TTL cirrus event and provides useful insight into TTL cirrus physical processes and impacts on water vapor. The paper is interesting and well written. The paper should ultimately be suitable for publication in ACP, but I would like the authors to consider the following comments and suggestions. In particular, I would like to see more details about the WRF microphysics parameterizations used and the simulated cloud microphysical properties.

1. Page 31091, first partial sentence: Suggest citing Wang et al. (1996, JGR). This paper reported SAGE measurements of TTL cirrus which provided the first indication of their high occurrence frequency.

2. Page 31091, lines 2-4: I think the extents to which TTL cirrus radiative heating affects the temperature and upwelling are not well known. What is clear is that the clouds affect the TTL thermal budget.

3. Page 31095, lines 6-7: Somewhere prior to this point (perhaps in the model description section), the authors should describe the ice nucleation scheme in the Thompson parameterization. Does the nucleation parameterization require substantial ice supersaturation for ice production (which would be consistent with homogeneous freezing of aqueous aerosols)? Are treatments of heterogeneous nucleation included? Are mass-dimensional relationships used based on observations of cirrus at TTL temperatures or extrapolations from warmer temperatures?

4. Page 31095: What about the sensitivity of the ATB to ice crystal size distribution? I would hope that some comparison between the simulated effective radii and aircraft observations (Lawson et al., 2008; Krämer et al., 2009) is provided somewhere in the paper.

5. Page 31096, lines 12-14: Despite the lack of microphysical cloud property observations for this particular cirrus event, it would still be useful to present the simulated cloud microphysical properties (ice water content, ice concentration, ice crystal size) and compare with statistics from previous observations (Lawson et al. and Krämer et al.).

6. Page 31106, lines 4-5: The authors should also mention the Dinh et al. papers suggesting that radiative heating-induced internal cloud dynamics has a large impact on TTL cirrus evolution.

7. Page 31108, lines 10-20: In the discussion of cloud radiative heating rates for the simulated TTL cirrus system, it would be useful to know how typical the simulated cloud properties are for TTL cirrus. As suggest above, a comparison between the simulated microphysical properties and the typical values reported by Lawson et al. (2008) would be helpful in this respect.

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8. Page 31108, lines 24-25: It would be more accurate to say "...the magnitude of wind shear was found to be an important factor affecting the buildup of cloud-scale circulations..."

9. Pages 31109-31110: The authors make an important point here: that radiatively-induced cloud vertical motions have little impact on the cirrus evolution because (1) the lifetime of air parcels in the cloud system is too short, and (2) the induced vertical motions would be comparable to or smaller than the typical mesoscale motions present. Perhaps it would be worth mentioning this result in the abstract.

10. Figure 10: Most people working in the TTL clouds and water vapor field use ppmv. Figure 10 would be easier to quantitatively interpret if the authors used ppmv rather than ppm.

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