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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Hydration and dehydration at the tropical tropopause" *by* C. Schiller et al.

Anonymous Referee #2

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This manuscript is an important contribution to the study of water vapour entry into the stratosphere at the tropical tropopause. In agreement with other recent studies, the manuscript concludes that water vapour distribution is influenced by the distribution of convective detrainment below the tropopause but is mainly controled by large-scale transport and the application of the last saturation principle above the tropopause. The novelty is in the fact that the comparison with data is based on airborne profiles instead of large-scale satellite observations and it is remarkable that the Lagrangian reconstructions performed with CLAMS fit very well the data in all the cases above the tropopause. The profiles exhibit a number of high-level peaks in the distribution of water vapour that are unambiguously attributed to recent overshooting convective events. However, it is also clear that the main profile can be recovered without assuming a convective source in the lower stratosphere and hence that the impact of overshooting

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convective events is hardly visible in the lower tropical stratosphere.

I do not have any significant objection and the following are a number of minor remarks to take into consideration in order to improve locally the clarity of the manuscript.

- p. 17501, last line: The authors mean probably heating instead of cooling.
- p. 17502, l.9: AMMA/SCOUT-O3 mixing ratios
- In section 4.1, the sampling of the flight path by trajectories is not indicated. It is also unclear whether the trajectories are purely deterministic (given the velovcity field) or contain some amount of randomness.
- In section 4.1.1, p.17504. The way of calculating a fraction of trajectories satisfying a given criteria at each level is not indicated. Is it performed by bining the altitude range or launching a number of parcels in the vicinity of the flight track?
- Section 4.1.1. The hybrid coordinate used in the CLAMS model as described in Konopka et al. (2007) induces a spurious vertical barrier in the TTL where vertical velocities exhibit wide spread descent betwwen 340K and 360K (see their figure 4) that does not agree with other studies. As a result mixing is diagnosed to play an important role in overcoming this barrier. If similar vertical velocities are used in the present study, the transport of water vapour within the TTL and its vertical profile below the cold point might be affected. It is, however, unlikely that the vertical profile above the cold point and the main resuls of this study could be affected. Some comments would be appreciated.
- Contrary to the opinion of another reviewer, I find that section 4.1.3 is important in this study since it allows to match the reconstructions with observations in all cases above the cold point. This is an important element of the discussion and the caveats are not strong enough to invalidate it. It is also providing a bridge with previous global reconstructions which all rely on similar approximations.

ACPD

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- Section 4.1.3, p.17508, l.10: Do the authors mean below or above 410K?
- Section 4.1.3, p.17508, l.19-22. The beginning of this sentence is badly written. It is meant probably the difference between previous and HALOE initialized profile.
- Section 4.1.3, p.17510. The estimate of zonal assymetry during summer would be higher if the latitude band is extended to the North in order to include the Asian monsoon anticyclone. It is unclear what really means figure 7 drawn for a fairly artificial boundary at 15N.
- Conclusions, p.7514, l.16-17: The sentence suggests a relation between the existence at 420K of a boundary between local and global circulation regime and the fact that 420K is also the upper height of observed overshoots. This contradicts the rest of the discussion which rather shows that overshoots do not control the distribution of the water vapour above the tropopause, and therefore the double boundary at 420K, which is not so well defined actually, might be purely coincidental.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 17495, 2009.