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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evidence of horizontal and vertical transport of water in the Southern Hemisphere Tropical Tropopause Layer (TTL) from high-resolution balloon observations" *by* Sergey M. Khaykin et al.

Anonymous Referee #2

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The paper presents observational evidence from balloon measurements of two water vapor transport mechanisms in the TTL. The two mechanisms, horizontal in-mixing from the extra-tropics and vertical overshooting convection, lead to hydration of the tropical lower stratosphere. The results are supported by trajectory model simulations and remote sensing observations. The paper is well written and easy to follow, and the results shed light on the TTL transport processes from an observational perspective. I recommend publication in ACP after the following minor suggestions and comments are addressed.

General comments

* From the introduction and the abstract is unclear which are the mechanisms that control water vapor concentrations in the tropical lower stratosphere. The authors either refer to in-mixing and overshooting (L23-24, L87-88) or to slow ascent and overshooting (L57-59). I suggest that the authors rephrase these sentences to make clear that there are 3 main mechanisms (slow ascent by the Brewer-Dobson circulation, in-mixing from the extratropics and overshooting convection). Dehydration along the slow ascent determines the mean concentrations and seasonality of tropical lower stratospheric water vapor, on top of which interesting hydration features can be observed as a signature of overshooting convection and in-mixing. The latter are the subject of the present study.

* L180: Why are two different Lagrangian transport models used/needed?

* L 182: The HYSPLIT model is a CTM that uses GDAS winds to compute the trajectories (as CLaMS uses ERA-Interim), rather than being just "initialized" by GDAS.

* P3 L189-190: How is "the (diabatic) vertical velocity deduced from the forecast total diabatic heating rate"? I would think these two are the same thing.

* L239: It would be good to mention the origin of the overall methane distribution, as it is done for water vapor and aerosols.

* L247-250: Does the filament result from a Rossby wave breaking event?

* L330: "... at 4 levels corresponding to the hydrated layers vertical extent and spaced vertically by 50 m". Do you mean 4 levels within each of the 2 hydrated layers identified (404 K and 386 K)?

* L345-348: Reanalysis winds are given on a 1 or 0.5 degree grid (so there are only 1 to 4 wind values within the box in Fig. 7). Is there a chance that faster subgrid-scale winds exist around the convection, and thus the in situ measurements could be affected by other overshooting towers?

Figures

* Fig. 3 It's hard to see where the arrows are pointing.

* Fig. 4: indicate whether the sampling time is local time or UTC time?

* Fig. 5 caption: "Black arrows indicate [...]" and the UTC of the radar measurement. Also, indicate what are the dark and light blue lines.

Technical corrections

* L201: Was reaching → reached

* L250: hundreds kilometers → hundred kilometers

* L305: Fig. 6 → Fig. 5

* L336: has reached → reached

* L442: totally → completely

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