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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The tropical tropopause layer in reanalysis data sets" *by* Susann Tegtmeier et al.

Anonymous Referee #4

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This paper evaluates data quality of multiple atmospheric reanalyses focusing on thermal characteristics of the tropical tropopause layer (TTL). The comparisons are made against long-term archives of radiosonde and GNSS RO data, which provide the most accurate temperature measurements in the TTL. Purpose of the paper is very clear, methods are reasonable, and results are well organized. It provides valuable information on reanalysis data sets and is recommended for a publication in ACP after considering several minor issues listed below.

Minor issues

1. The title is too broad. The analyses focus mainly on long-term mean features and inter-annual variability of the TTL, while the title gives an expectation that it will cover overall aspects of the TTL. Annual cycle and intra-seasonal variation are also important

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features of the TTL, particularly for dehydration processes. A more detailed title is required if authors decide not to include these features. One suggestion is making this paper as "part 1" covering long-term structures and inter-annual variability and left annual cycle and intra-seasonal variability for a future study (as this paper already has enough material, I think. . .).

2. This is also related to comment #1. The temperature bias peaking near the equator and its potential connection to Kelvin waves (Figs. 6-8) are interesting results. This part is worth to be further investigated (even in a different paper) as it provides noble information for researchers studying the dehydration process based on reanalyses. Particularly, this feature could be "seasonally" different because temperature and circulation structures in the TTL undergo strong seasonality. The same is true for the Kelvin source over central Africa.

3. Please provide some details describing how the CPT/LRT and their properties are calculated in this study. Several methods have been used to estimate properties of the CPT, and the results could be sensitive to the selected method, particularly for data set with coarse vertical resolution. This information will be helpful for readers to better understand the results provided in this paper.

4. Given the accuracy and vertical resolution of ERA5 described in section 3, CPT temperature trend from ERA5 would be most reliable. It will be very useful if this information could be added in Fig. 12. (just suggestion)

5. Dynamical aspect (e.g., upwelling) in the TTL is not covered in this paper. Some discussion may be beneficial (but not necessary).

Technical comments

P3L20: Pan and Munchak (2011), Pan et al. (2018) could be good references for this paragraph P3L37: 0.5 km is roughly 5 hPa at this level, 5 hPa maybe more consistent P10L29: "near 100 hPa (ERA-Interim; -0.82 K)". This is correct in Fig. 4 at $\sim$96 hPa, but

could look inconsistent with Fig. 3 (right panel) as it shows ∼ -0.4 K at 100 hPa. Better to mention that it is on a model level, not 100 hPa. Fig. 4: Average on pressure level could be a bit misleading as it shows a smooth CPT. Additional figure on tropopause relative coordinate (e.g., Birner et al. 2002) could be useful. P12L1: "comes at the expense . . . tropopause". This expression could be a bit misleading because there is no clear causality. P13L5: "with respect to the zonal mean" => in meridional direction? Fig. 7: ERA5 could provide an important clue on this issue as it has a good vertical resolution, but it is missing in the figure. Fig. 8: Is the left figure different from that in Fig. 7? P17L24: datasets => data sets Fig. 10: RAOB is used for the first figure, but IGRA is used for the second figure. It will be helpful if an explanation is provided why authors made this choice. Periods ('.') are missing in several section titles and figure captions.

References

Birner, T., A. Dornbrack, and U. Schumann, 2002: How sharp is the tropopause at midlatitudes? Geophys. Res. Lett., 29, 1700. Pan, L. L., and L. a. Munchak. (2011). Relationship of cloud top to the tropopause and jet structure from CALIPSO data. J. Geophys. Res., 116, D12201. Pan, L. L., Honomichl, S. B., Bui, T. V., Thornberry, T., Rollins, A., Hintsa, E., & Jensen, E. J. (2018). Lapse Rate or Cold Point: The Tropical Tropopause Identified by In Situ Trace Gas Measurements. Geophysical Research Letters, 45(19), 10-756.

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