

Interactive comment on “Reanalysis comparisons of upper tropospheric/lower stratospheric jets and multiple tropopauses” by Gloria L. Manney et al.

Anonymous Referee #1

This paper provides a comprehensive study of the dynamics of the UTLS regions as encapsulated in the jets and multiple tropopauses occurring in this region. The paper provides useful information to the atmospheric sciences community. The discussion of the performance of the reanalyses further provides information on their ability to represent the dynamics of the UTLS region. I recommend acceptance for ACP once the authors address the specific comments below.

We thank the referee for their helpful comments. The referee’s comments are shown in blue italics; our responses are shown in black. (Note that in addition to addressing the referees’ comments, the figures have been re-done to use the recently updated “standard” S-RIP colors for each reanalysis.)

Specific comments

P. 5 L. 23 and elsewhere: Is the standard convention ms⁻¹ or m/s? Same for similar ratios C1 (and see caption for Fig. 13).

We have changed all occurrences to ms⁻¹, and, similarly, K/km to Kkm⁻¹.

P. 6 L. 9-11: Perhaps rephrase, as the meaning of this sentence is not fully clear to this reviewer.

This text has been rephrased to describe the definition and methods used here more explicitly, and text added to address the comments of Dr. Añel. The revised text reads:

“If dT/dz drops below -2 Kkm^{-1} above the primary thermal tropopause, then the next level above that where the WMO criterion is fulfilled is identified as a multiple tropopause (Randel et al. 2007, Manney et al. 2011, Manney et al. 2014); this definition follows that of Randel et al. (2007), who showed that requiring dT/dz to drop only below -2 Kkm^{-1} above the primary tropopause for the relatively coarse resolution reanalyses (rather than -3 Kkm^{-1} as is typically used for high-resolution temperature profiles) resulted in multiple tropopause distributions more comparable to those from high resolution measurements. Linear interpolation is used to locate the tropopause between two adjacent vertical gridpoints. Note that “multiple tropopause” is used here to denote any profile with more than one tropopause. As quantified by Schwartz et al. (2015), a very small fraction of the profiles have more than two tropopauses, and using only double tropopause versus all multiple tropopause profiles makes no significant difference in our results.”

L. 18: As a percent of what?

We have added a parenthetical remark explaining this, thus: "...expressed as a percent (representing the fraction of the time there is a jet core, multiple tropopause, or subvortex jet in the bin, as discussed below in relation to normalization)". The immediately following wording has also been revised / clarified in response to a comment from referee #2.

P. 8 L. 29: Why is this unsurprising?

The much coarser vertical grid spacing (about 2 km for pressure coordinate versus less than 1 km for model level fields) leads to effective vertical smoothing of the fields, so that the magnitude of gradients and extrema can be underestimated. This is particularly likely to affect the representation of threshold phenomena using criteria based on vertical structure. We have changed the sentence in question to read "Because the much coarser vertical grid spacing can lead to underestimation of gradients and extrema, it is also unsurprising that a vertical spacing near 2 km in the UTLS..."

P. 10 L. 18: Omit superfluous "the".

This has been corrected.

P. 14 Sect. 4, Summary and conclusions: This is an editorial decision, but I would suggest the authors consider splitting this section into two, a summary and a conclusion sections with the latter being succinct.

We feel that the Summary and Conclusions section is already concise and focused, and do not see a natural way to divide into two sections that would provide further information or further clarify the results. We have therefore chosen to keep it as one section.

P. 23 Fig. 1: Not clear to this reviewer which contour line corresponds to each percentage. I suggest the authors make this clearer in the figure, maybe by attaching the percentage to the contour (same for other figures, e.g., Fig. 2). I also suggest the authors consider providing information in the caption what the colours indicate, e.g., red/blue indicate positive/negative differences. Same for other figures.

It would be difficult to add legible numbers to the contours on the figures, and would make the figures more "cluttered". However, we have modified the Fig. 1 caption to read: "...Overlaid contours show frequency values from each reanalysis of 10, 20, and 30% for upper tropospheric and subvortex jets, and 30, 45, and 60% for multiple tropopauses; the smallest value is always the largest or "outermost" contour. In the difference plots, blues/oranges indicate negative/positive differences." We have added similar text to each caption where overlaid contours are described and difference plots are shown.

P. 28 Fig. 6: The authors should clarify in the caption the differences between Figs. 5 and 6.

To clarify this, we have changed the start of the Fig. 5 caption to:

“Seasonal maps of frequency distributions during JJA in 1980 through 2012 of JRA-55 (left) fields and the difference between JRA-55 and JRA-55C fields (right).”

And that of the Fig. 6 caption to:

“Seasonal latitude/altitude cross-sections of frequency distributions for JJA in 1980 through 2012 of JRA-55 fields (left) and the difference between JRA-55 and JRA-55C fields (right).”