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Interactive comment on "High-resolution Beijing MST radar detection of tropopause structure and variability over Xianghe (39.75° N, 116.96° E), China" *by* Feilong Chen et al.

Anonymous Referee #2

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In this study, the authors demonstrated the potential of MST radar in detecting the tropopause height (RT) from the radar backscattered echo power profiles by carrying out extensive comparison with the lapse rate tropopause (LRT) derived from radiosonde data and with dynamical tropopause (2 PVU) derived from ERA-Interim reanalysis dataset during the period Nov. 2011 to May 2017 covering all seasons. Comparison results showed good agreement between Radar and radiosonde and that between radar and ERA data in most of the seasons. The RT determination and comparison with other observations has been already carried out by many other investigators. However, a systematic comparison has been carried out in this paper and the difference in tropopause height is attributed to the sharpness of the tropopause inversion

layer (weak / strong). The potential of radar in examining the short-term variability of tropopause useful for wave studies etc and its limitation in detecting tropopause in few occasions are also discussed. In general, the paper is well written and the results are interesting. However, a few concerns need to be addressed, before the manuscript is published. 1) RT is determined using the vertical beam echo power data collected in "low mode" operation (which receives strong signal up to 14-15 km). In "middle mode", strong signals can be obtained in the altitude region 7-25 km (as seen in Fig. 8). Also, the "first tropopause" and "second tropopause" (based on WMO definition of LRT) are clearly evident in the mean effective data acquisition data obtained from middle mode operation (Fig.8). I strongly believe, that if "middle mode" vertical beam data is used, the strong gradients in radar echo power could be discernible corresponding to the altitudes of first and second tropopause. The authors can examine this aspect for available dataset in middle mode observations and compare with the first and second tropopause derived from radiosonde data. 2) Radar provides a vertical resolution of 150 m in "low mode" and 600 m in "middle mode" and "1200 m" in "high mode" and the temporal resolution is about 30 minutes. In the present study, RT derived from the vertical beam data in low mode is compared with the dynamical tropopause (2 PVU) derived from potential vorticity obtained from ERA-interim reanalysis The comparison results shows large deviation between the two. Fine resolution radar data is compared with the coarse resolution ERA dataset. What is sanctity in comparing these two datasets.

Specific/Minor comments

Line 28 : replace "good capability of Beijing MST radar" with "potential of Beijing MST radar "

Lines 108, 246, Fig. 8: Is this the "data acquisition rate" of backscattered echo power received ?. Effective data acquisition rate for different modes of radar operation are shown? How is this parameter estimated . Give details.

Lines 165-168: The method of identifying dynamical tropopause from potential vorticity is to be added. ERA-interim reanalysis data does not have fine vertical resolution. But the dynamical tropopause determined from the above is compared with RT derived from higher vertical resolution radar backscattered echo power. Hence, the larger difference in tropopause height is expected between the two methods.

Line 181: delete "fine-scale" Line 190-191: ".....the RT is well defined as the first layer with enhanced echo power..." Line 209: replace "good capability" with "potential"

Line 217: "sharpness of tropopause" is affected by cyclonic /anticyclonic systems. Explain. Are radar measurements carried out during such systems. please clarify.

Line 237, 246: what is "effective data acquisition rate?: Middle mode observation in Figure 8 shows two distinct peaks corresponding to the mean of first and second tropopauses based on LRT definition by WMO. Then why the data obtained from this mode (middle mode) is not used for the extensive comparison of first and second tropopause derived from radiosonde dataset, which is not so far studied extensively.

Lines 247-249: Correct this sentence (message not clear).

Line 272: "....radar-derived winds are combined...." what does it mean? Line 289-290: correct the sentence

Line 293-294: what are the system problems that makes RT identification difficult?

Lines: 297-298: correct the sentence Line 300: In this case, the temperature inversion is observed at 16 km...

Line 307-308: Correct this sentence....

Line 311: ..difficult in identifying the thermal tropopause from radiosonde profiles ..

Line 313: ...altitude extent of inversion layer is too thin to meet the WMO criterion...

Line 316: delete "Need to highlight again that"

Line 324: inconsistency between the RT and PVT

Line 326-327: Confirm whether radar measurements are carried out during cyclones /anticyclones in the upper troposphere (which period/season). Is the asymmetric differences in tropopause heights mainly due to the above conditions or due to difference in vertical resolution of radar and ERA dataset.

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