Review report on “On the relationship between static stability and anvil clouds” by Zhenquan Wang.

In this manuscript, the author tried to explore the relationship between high-level anvil clouds and static stability through a novel approach known as estimated anvil-top stability (EAS), which is based on the minimum value of $d\theta/dz$. The author claims that the upper-tropospheric stability (UTS) method, which relies on the lapse rate tropopause, underestimates the effect of stability on the anvil, while EAS provides a more accurate relationship. The findings further indicate that EAS has a stronger correlation with anvil clouds than UTS. This proposed method may be useful in understanding the factors that control cloud structure and composition. The topic of the research is interesting and the analysis results would be worth a concise publication. Though the manuscript is scientifically sound enough, the presentation style needs to be improved. Overall, the manuscript requires major revisions. I had the chance to read the comments of Anonymous Reviewer #2 and I do share all his/her general comments.

Comments:

1. What I can see as one of the major problems of the manuscript is that it lacks clarity in many places in its current form. Several sentences are not clear, please revise.
2. Is it 3 km moving smoothing? What is the basis for selecting 3-km smoothing? What is the final vertical resolution of radiosonde data?
3. Is the LRT derived from this 3 km smoothed temperature profile as well? What is the reliability of the relationship established by the results obtained?
4. The author may clearly describe how the Anvil cloud is categorized in this manuscript. What are the limitations of the MMCR for detecting the anvil clouds?
5. What is the time frame for the ERA-5 data and other satellite measurements? Does it align with the radiosonde data from 2001 to 2011? The author should provide clarification on this matter.
6. Similarly, the author needs to provide the spatial gridding of each data set in the study. What is the spatial resolution for ERA-5, CERES, and DARDAR? While using multiple data sets of observation, reanalysis, and satellite data, it is suggested that it should be gridded to a uniform resolution for better comparison.
7. What was the horizontal drift of the balloon while comparing the cloud fraction of MMCR?
8. How are the lower-level thin cirrus ice crystals accounted for if the ice clouds are identified based on cloud top temperature?
9. The methodology to estimate the moist adiabatic from observation and model datasets used in this study may be explained.
10. The height of the minimum potential temperature gradient (**Fig. 4b**), commonly known as the convective outflow level or convective tropopause, has been extensively studied and documented by numerous researchers and needs to be included and discussed in the present study (see the reference).

Technical corrections:

The English language used in the manuscript needs to be checked by professionals who are native English speakers.

Line 28: "Cloud responses to the environmental changes have not been correctly simulated in models" may be rewritten avoiding concluding statements.

Line 197: ‘Nevertheless, the high-resolution radiosondes are limited at islands and coastal sites or during short-term field campaigns.’ What about using the available high-resolution GNSS RO data? see the attached references.

Line 225: How is the ERA-5 data on pressure levels used to identify the height of LRT?

Figure 1 The tick labels are missing on the y-axis.

References:

Biondi, R., W. J. Randel, S.-P. Ho, T. Neubert, and S. Syndergaard, 2012: Thermal structure of intense convective clouds derived from GPS radio occultations. Atmos. Chem. Phys., 12, 5309–5318, https://doi.org/10.5194/acp-12-5309-2012.

Sunilkumar, S.V., Babu, A., Parameswaran, K., 2013. Mean structure of the tropical tropopause and its variability over the Indian longitude sector. Clim. Dyn. 40, 1125–1140. https://doi.org/10.1007/s00382-012-1496-8.

Ravindra Babu, S. “Convective Tropopause Over the Tropics: Climatology, Seasonality, and Inter-Annual Variability Inferred from Long-Term FORMOSAT-3/COSMIC-1 RO Data,” Atmospheric Research, vol. 298, https://doi.org/10.1016/j.atmosres.2023.107159, 2024.

Ho, S.-P., and Coauthors, 2020: The COSMIC/FORMOSAT-3 radio occultation mission after 12 years: Accomplishments, remaining challenges, and potential impacts of COSMIC-2. Bull. Amer. Meteor. Soc., 101, E1107–E1136, https://doi.org/10.1175/BAMS-D-18-0290.1.

Xian, T., and Y. Fu, 2015: Characteristics of tropopause-penetrating convection determined by TRMM and COSMIC GPS radio occultation measurements. J. Geophys. Res. Atmos., 120, 7006–7024, https://doi.org/10.1002/2014JD022633.