Reviewer of the paper:

"Dynamics of the Asian Summer Monsoon Anticyclone: Insights from Potential Vorticity Tendency Diagnostics"

Written by Li et al.,

General:

This paper investigates the dynamics of the Asian Summer Monsoon Anticyclone (ASMA) using three modern reanalysis datasets (ERA5, MERRA-2, and JRA-3Q) and introduces a potential vorticity (PV) tendency diagnostic to disentangle dynamical and thermodynamical contributions to ASMA evolution. The study identifies a trimodal structure of the ASMA (Iranian Plateau, Tibetan Plateau, and Western Pacific/Bonin High) and examines the roles of horizontal advection and diabatic heating in modulating its propagation, intensification, and eddy-shedding behavior.

The topic is relevant and within the scope of the journal, and the use of multiple reanalyses combined with PV diagnostics is potentially valuable. While the topic is relevant and the use of multiple reanalyses is commendable, the manuscript in its current form has several critical issues that must be addressed before publication.

Major Comments:

1. The estimation of latent heating in ERA5 using radiation fluxes and "precipitation-related top latent heat flux (mtpm)" raises concerns. These variables do not directly represent the vertical structure of latent heating, which is crucial for PV generation. This approximation may introduce uncertainty into the diabatic contribution to PV tendency. The assumptive latent heating in ERA5 shows large difference from that in Merra2 and JRA-3Q in Fig.8. The authors should provide justification and supporting references for this approach, perhaps by showing the comparison with datasets that include explicit latent heating or the spatial patterns of "mtpm" correlate well with upper-tropospheric diabatic heating from other reanalyses. Limitations in both the methodology and conclusions should be discussed to justify its use.

2. The vortex tracking method has already been well-documented in prior work (Siu and Bowman, 2020) and could be significantly condensed. The core novelty—the PV tendency diagnostic and its application to understanding the three modes—should

be the central focus. The derivation and presentation of the PV tendency equations (Eq. 7 -- 10) are difficult to follow. Please provide a clear and consistent derivation. Some terms are introduced without sufficient explanation.

Minor comments:

L100: “including zonal wind, u, MSF, ψ , and relative vorticity, ζ .” --Consider changing to “including zonal wind (u), MSF (ψ), and relative vorticity (ζ).”

L142: Please move Eq.2 ahead to Sec 3.1, as MSF is already mentioned there.

L161: The second term on the right-hand side of Eq.6 appears unnecessary based on Eq.3 and Eq.5.

L179: Eq.8 is difficult to follow.

L199-201 and caption of Fig.2: Please specify which reanalysis was used for the results.

L226: “eddy shedding events” -- Are all eddy shedding events marked by the gray and dashed circles in Fig. 4, or only some examples? Is there a clear definition of an eddy shedding event?

L233-234: The zonal advection and vertical advection of PV are positive (negative) in the west (east) of anticyclone in Fig.5. They are not always positive or negative above 300hPa. Please rephrase this sentence for clarity.

P15: Please include the values of PV anomaly in the black dashed contours in Fig. 5, as is done in other figures.

P16, Caption of table 3: “while the northward direction is taken as negative in the tripole patterns ...” -- Please confirm whether the northward direction is taken as negative or positive.

L308-310: The description of the results in Fig.8 is unclear. Consider revising to: In contrast, the effect of mean meridional advection opposes that of mean zonal

advection; specifically, mean meridional advection intensifies anticyclones for all three modes in the west, and also intensifies the TP and BH anticyclone in the east, while diminishing IP anticyclone in the east.

L314: The latent heating for ERA5 looks quite different from that in Merra2 and JRA-3Q in Fig.8. Is the assumptation for ERA5 latent heating reasonable? Please carefully revise this whole paragraph discussing Fig.8.

L317: “ASMA is stronger than in eastward in TP and BH modes...” -- change to “ASMA is stronger than in westward...”. Also note that “both the intensification and propagation are negative PV tendency”, but the intensification appears as positive in Fig.9. Please clarify.

P18: The caption about Fig.8 is unclear. I had to read it several times to understand the different terms in the plot. Please revise. The “meridional mean advection” in Fig.8(a-f) -- consider change to “mean meridional advection”.

P19: Check the caption of Fig.9. Please confirm whether the value next to each bar shows the relative contribution to PV tendency.

P21: Please clarify what the “PV tendency anomalies” refer to in Fig.10 and Fig.11?

General: Improve figure captions to clearly state main findings.