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Comment on acp-2021-905

Anonymous Referee #2

Referee comment on "Characterization of transport from the Asian summer monsoon anticyclone into the UTLS via shedding of low potential vorticity cutoffs" by Jan Clemens et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-905-RC2>, 2021

The paper „Characterization of transport from the Asian summer monsoon anticyclone into the UTLS via shedding of low-potential vorticity cutoffs“ studies the dynamical evolution of cutoff vortices shed eastward from the Asian monsoon anticyclone and their associated transport of chemical tracers. The topic of this study is surely interesting and, as the fundamentals of monsoon eddy shedding are not fully understood yet, it forms a valuable contribution to the existing literature, in particular, it advances our understanding in terms of troposphere-stratosphere transport. The manuscript is well-written, has a clear structure and uses very clear language, figures are generally well-composed and easy to understand and the underlying science is mostly robust. I, therefore, recommend the paper to be published after the authors address a few points and questions.

General comments

Introduction: the introduction only discusses eddy shedding in general without a distinction between east- or westward shedding and the dynamical studies cited mostly discuss solely westward shedding (Hsu+Plumb, Popovic+Plumb, Amemiya+Sato, Rupp+Haynes, ...). However, the analysis focuses strongly on eastward shedding events. I suggest you introduce the distinction between east-/westward shedding in more detail and cite a few dynamical studies that deal with eastward shedding.

Fig 1: the plot and corresponding discussion suggest there to be two (qualitatively) different types of eastward eddy shedding (associated with direct and indirect transport into the stratosphere). However, this theory seems to be mostly based on the analysis of specific events like shown in Figs. 2 and 3, the rest of the results section does not really

discuss this distinction. For example, I am not sure if Fig. 5 shows any indication for two distinctly different transport pathways. Do the authors think that these two pathways indeed result from two different types of underlying dynamics? As this is a main conclusion of the paper, I suggest some additional discussion/clarification.

Specific comments

L94: what time format is used? GMT?

L112: TST is not explained anywhere.

L155: how do you know that it is the "same cutoff"? I suppose your methodology actually works the other way round, so if a large fraction of trajectories initialised in cutoff X at time t_0 end up in cutoff Y at t_1 you identify cutoff Y as actually being cutoff X, right? Or is this based on something like PV overlaps?

Figs 2 and 3: I would suggest you include a colour bar beside the contour level description in the caption.

L200: Maybe make clear at the beginning that this subsection focuses on all cutoffs, not just the monsoon ones, since the previous subsection just discussed how you identify monsoon cutoffs.

L224-228: you need to be careful here with your phrasing because Fig 5 does only show the frequency of cutoff occurrence, not actually the transport. Also, do you have an idea why you only find a weak signature of westward shedding (because other studies (eg Popovic+plumb) rather suggest a dominance of westward over eastward shedding? Could this relate to the details of your identification algorithm? Or does it have something to do with the zonal extent of the climatological monsoon PV low already including a signature of westward shedding (eg the region $<60N$) and hence such signatures are hard to identify?

L228: Hsu+Plumb only study westward shedding, so they do not say anything about the eastward shedding signatures.

L239: should say "... larger extent of the former cutoffs."

Fig 5: you should either extend your colour bar to include a shading for >5% or indicate that these values are coloured white. Also, the cutoff tracks are quite hard to see with the coastlines also being thin black lines.

Fig 6: the grid in the lower row plots should probably be moved to the background, otherwise it looks like the lines are discontinuous. Also, is there a reason why panels c and f use a different line width?

Fig 8: The legends should be checked again. And maybe combine the two separate entries for "entire atmosphere", otherwise this might be confusing.

Fig 9: is it reasonable to include some sort of reference lines here, eg values typical for the bulk monsoon anticyclone and for the troposphere/stratosphere, so the reader can see a gradual convergence from one to the other?