Response to Referee 2

We thank the reviewer for their insightful and thorough criticism. By addressing their comments, we have improved the study as described below. The reviewer's comments are shown in black, and our responses are shown in blue.

Review of C. E. Clapp et al. "Distribution of cross-tropopause convection within the Asian monsoon region from May through October 2017"

The manuscript by Corey Clapp and coauthors provides an analysis of geographic and intraseasonal distribution of cross-tropopause convection in the Asian Summer Monsoon region. The analysis relies on the overshooting tops database spanning a full monsoon season in 2017 and including nearly 41,000 events derived from Meteosat-8 geostationary imagery data. The distribution of overshooting tops is compared with OLR and precipitation data. The study points out significant intraseasonal and spatial variability of tropopause-overshooting convection in the Asian monsoon region.

The study represents a valuable contribution to a better understanding of the source regions and variability of the tropopause-overshooting convection in the Asian monsoon region. With that, the presentation of the results and their current context require careful revision before acceptance to ACP.

General remarks.

- The 2017 Asian monsoon season addressed by the study was the target of StratoClim campaign, which included extensive airborne and balloon-borne measurements across the Southern slopes and the North India regions. There is a large number of studies that followed this experiment, some of which are cited in the paper however this overview is far from being complete. I suggest that the authors make sure to mention all the relevant papers and carefully discuss the present results in relation with the previous work. More specific remarks on that matter are provided hereinafter.

To put our study more clearly in the context of the StratoClim campaign, a discussion of the results from StratoClim has been added to the introduction. A discussion of the results of our analysis in relation to the StratoClim studies has been added to the summary and discussion section.

- The graphical material is often hard to read, this is particularly the case for the OT maps. I suggest to use a different color map or otherwise make sure that the coastlines are clearly visible in each panel.

The presentation of the figures, including the size and colormap, has been improved to increase visibility. In general, the figures were reorganized to allow for significant enlargement.

- I wonder if is the authors could provide an estimate of the total OT area, which would help understanding the magnitude of the impact of tropopause-overshooting convection. Such information could be used to constrain the modeling studies.

In the analysis we chose to report the individual OTs as singular events rather than implement an area/pixel accounting of OTs because the temporal resolution (15 minutes) is insufficient to account for the full temporal/spatial evolution of an OT. With this temporal resolution, it is not possible to verify that the OT area observed at any given time is indicative of the areal coverage of that OT across its entire lifetime relative to the size of other OTs. For this reason, we focus on OTs as representing singular updraft areas that cross the tropopause, regardless of their spatial coverage. Further, at the 15-minute temporal resolution it is highly likely that OTs are missed, given their short time duration. Estimating a full account of the total OT area is a worthwhile endeavor but requires an observational dataset with a time resolution on the order of 30s-1min.

- Given the content of the last section, it should rather be named “summary and discussion”

The suggested section title has been implemented.

Specific remarks.

L29 – 37. Here the authors define the study objectives. I would suggest to move it towards the end of the Introduction.

We define the study objectives in the first paragraph as a thesis statement to frame the scientific background of, and motivate research into, convective transport in the Asian monsoon region. We have reworked the final paragraph of the introduction section, however, to restate these objectives and emphasize the advantages of our analysis more clearly.

L40 – 45. The referencing should be completed with StratoClim studies, such as Brunamonti et al., ACP 2018; Lee et al., 2021; Lamraoui et al., ACPD 2022). In particular, the source regions for the cross-tropopause convection are discussed in detail by Khaykin et al., ACP 2022.

Additional StratoClim studies have been cited with corresponding discussion, and a paragraph discussing the StratoClim in relationship to this study has been added to the Introduction section (Brunamonti et al., 2018; Bucci et al., 2020; Johansson et al., 2020; Khaykin et al., 2022; Lee et al., 2019; Lee et al., 2021; Legras & Bucci, 2020; Nützel et al., 2019; Vogel et al., 2019; von Hobe et al., 2021; Yan et al., 2019).

L55 – 57. For the effects of eddy shedding one might refer to Fujiwara et al., ACP 2021. For the transport of Asian pollution towards midlatitudes a pertinent reference would be Khaykin et al., ACP, 2014

The suggested references have been added to the paragraph (Fujiwara et al., 2021; Khaykin et al., 2017).

Fig. 1 caption. The description of the panels should be in order

Figure 1 has been significantly reorganized in response to commentary from Referee 1, including ensuring that the panel descriptions are in order.

L.123. Fig 1c -> Fig. 1d ?

The correction has been implemented.

L. 183-185. I am not sure to understand the line of logic here. What is meant by the particular efficiency of TB due to central location?

Here we briefly summarize the findings of Tissier and Legras (2016) and Legras and Bucci (2020). In disagreement with prior studies, they find that the Tibetan Plateau is not a numerically significant contributor to convective transport, but they find that vertical transport over the TP is particularly efficient. Specifically, a high proportion of convection reaching the UT over the Tibetan Plateau is subsequently transported into the LS via slow ascent. In Legras and Bucci (2020), this efficiency is attributed to the fact that parcels entering the AMA over Tibet enter the core region of the AMA, circulate for longer, and therefore experience greater uplift.

In this context, the lack of OT activity over the Tibetan Plateau confirms that convection in this region influences the LS through the slow uplifting process, not through cross-tropopause convection. The agreement with Legras and Bucci (2020) is particularly relevant as their study also covered the 2017 Asian summer monsoon. Additional clarifying text has been added to the relevant paragraph.

L.191-199. This paragraph is particularly difficult to follow. The term “convective activity” seems to be used for both the OT and OLR features, which renders unclear the discussion on their similarities.

We have reworded the instances of “convective activity” to refer explicitly either to OT or OLR features.

L.202 I do now see any significant agreement between OT and precipitation distributions. Overall, I find the discussion that follows largely unclear.

This discussion has been rewritten and expanded to discuss specific areas of agreement and disagreement between the OT and precipitation distributions.

Fig. 2. The panels are too small and barely readable. It is nearly impossible to distinguish between the different curves of similar color.

The presentation of the figures, including the size and colormap, has been improved to increase visibility. In general, the figures were reorganized to allow for significant enlargement.

Fig.2 caption. Wrong referencing to Fig. 1

The error in the caption has been corrected.

L.220-225 I believe a brief mention on the limited representativeness of OT evolution would be pertinent here.

This limitation, first discussed in the Data and Methods section, has been added.

Fig. 3 Where does an isolated feature at highest altitude come from?

The distributions of OT potential temperatures have long tails on the high-value end. In order to capture all OTs without reducing visibility by expanding the x-axis, all OTs that have values above the highest shown value have been placed in the bin with the highest shown value.

Additional explanatory text has been added. A supplemental figure showing the distribution of the long tail specifically has also been added.

L. 244. Altitude distribution -> vertical distribution

The correction has been implemented.

L.254 redundant with Fig. 3 caption.

The redundant sentence has been removed.

L.396 I do not fully agree with the statement regarding the match between OLR, precipitation and OT, or at least it is not obvious from the figures. Alternatively, if that is indeed the case, does the OT analysis provide an added value for a better characterization of ASM convection

This discussion has been rewritten and expanded to discuss specific areas of agreement and disagreement between the OT, precipitation, and OLR distributions.

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