Many thanks to the reviewer for the comments, and they have helped to improve the clarity of the manuscript. In the following, we address all the points raised in the review (denoted by italic letters). Text changes in the manuscript are highlighted in red or blue.

General comments

Overall this is an important and well written paper that will be a serious contribution to the literature about the role of the monsoon transport in the UTLS region. I really liked the idea that there are two pathways and that the model statistics support those pathways.

1. ***I think it would be helpful to summarize the efficiencies of the pathways and the differences in the models in a Table instead of text. Also Figure 11 should have the efficiency of the UT pathway to the base of the tropical pipe. The authors might also connect the efficiency of transport to the containment in the monsoons (see Pan et al, 2016, Transport of chemical tracers from the boundary layer to stratosphere associated with the dynamics of the Asian summer monsoon, J. Geophys. Res. Atmos., 121, 14,159−14,174, doi:10.1002/2016JD025616.) who showed that the ASM is not as leaky as the NASM.***

   A. We summarize the contribution and efficiency of transport and transit time from the source regions to the destination regions in the end of the manuscript. The numbers in red color in Fig.11 represent the sum of transport along monsoon and tropical pathways from 350−360 K over monsoon regions to the tropical pipe. The separation of the contribution of transport along different pathways to the tropical pipe is included in the discussion section with more than 50% of contributions from tropical pathway. Regarding the last point, we didn't find the work about NASM from Pan et al., 2016. We include two more subplots from MLS CO in the revised manuscript. Indeed, the ASM is not as leaky as the NASM. We also connected this point to the transport to the LS-NH in Section 4.

2. ***My major problem with this paper is I really don't understand the percentage argumentn used by the authors. Page 5 line 110 on the model set up confuses me. If I understand what the authors are doing is that they are starting up the model with some kind of uniform grid of parcels inside monsoon domain and the tropics. The model is running forward trajectories and then estimating the tracer ends up in each region. But as the system evolves, air from the SH will enter the tropics and air outside the monsoons will enter the monsoon region. The authors don't say how they account for this outside air in the estimates of the percentages after August 1. To be clear, I am not saying that the authors have done this wrong, but this paragraph gives me the impression that the CLaMS parcels are initiated over a limited domain. If this is true then it seems like the percentage estimates will be incorrect.***

   A. The text was not so clear about the setup of the model. The tracer set-up is the same as in Orbe et al. (2015), Ploeger et al. (2017). We set the artificial tracer mixing ratio as 1 inside the monsoon regions and the tropics during July and August. The model simulations are driven by horizontal winds and diabatic heating from reanalysis. We estimate the abundance of source tracer at any location in the atmosphere. The percentage in our study represents the monsoon/tropical tracer mixing ratio at any location, and it equals the fraction of air which left the corresponding source layer in the ASM, NASM or tropical domain during the previous monsoon season. The transport from different source regions is simulated independently in our study. Therefore, there is no interactive influence among the transport from the three source regions. Based on the comment, we rephrase the text in the manuscript to make it more clear.

3. ***A second issue is that the authors initialize on July 1 of each year assuming that the monsoon develops about that time and then they stop tagging parcels after August 1. This seems like a limitation since the monsoon circulation can persist through early September. It seems to me some additional runs of the model would put to rest the sensitivity of their results to the limited tagging period.***

   A. We run the simulation for the same period as Ploeger et al. (2017) to have the direct comparison from different definitions of the domain boundary (simplified box and PV-barrier). As suggested by the Reviewer, we now added a sensitivity simulation where we set the artificial tracer as 1 from 15 June to 15 September and run the simulation. Figure RL 1 shows the average air mass fraction from ASM and NASM regions

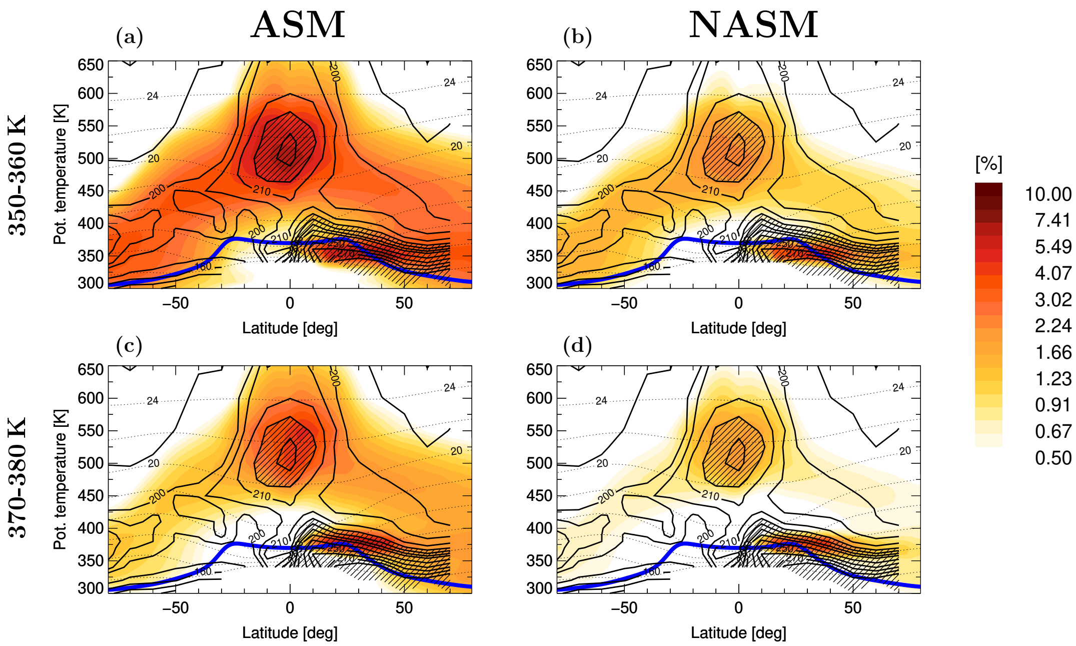

Figure RL 1: Climatological (2010−2013) zonal mean air mass fraction from the ASM (a and c) and the NASM (b and d) initialized at 350−360 K (upper) and 370−380 K (lower) in CLaMS-EI (color shading) during the following April−June. HCN from ACE-FTS observations (black contours) is also shown for context. Regions with HCN volume mixing ratios greater than 215 pptv are hatched. Blue lines mark the lapse rate tropopause. (Note the logarithmic color scale.)

initialized in the 350−360 K and 370−380 K layers during 15 June−15 September of 2010−2013 in the CLaMS-EI simulations during the following April−June. We can see a lot of similarities between Figure RL 1 and Fig.3 in the manuscript. In particular the transport patterns are not depending on the exact length of the initialization period. More monsoon tracer is transported into the stratosphere from the 350−360 K layer than from the 370−380 K layer for both the ASM and NASM regions. The abundance of monsoon air initialized at 350−360 K is higher in the SH stratosphere than in the NH, while monsoon air initialized at 370−380 K is more likely to remain in the NH. The exact value of monsoon air mass fraction in the stratosphere is higher for the the longer initialization period.

As Fig.8 in the manuscript, we also quantify the transport from source regions to the destination regions

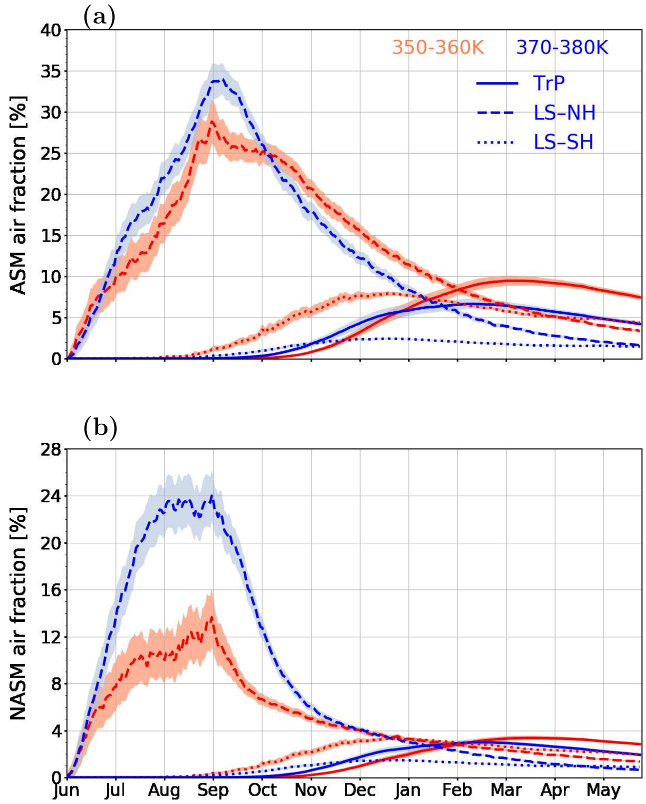

Figure RL 2: Climatological time series based on the CLaMS-EI simulations of source regions: (a) ASM and (b) NASM air mass fractions (in %) and diagnosed in three destination regions (see Fig.2 in the manuscript): tropical pipe (TrP, solid line), extratropical lower stratosphere in the NH (LS-NH, dashed line) and in the SH (LS-SH, dotted line). Shading shows the mean standard deviation in the zonal average (multiplied by 0.2 for better visibility). Red and blue lines respectively represent the tracers released in the 350−360 K and 370−380 K layer.

(Figure RL 2). The abundances of monsoon air in the three destination regions are larger than those from Fig.8 in the manuscript because of the longer simulation period. However, the transport patterns are quite similar. July and August is at the mature phase of the monsoon circulations. Using this period can transport less in-mixing of air from the adjacent regions of the monsoon regions. The simulation results from July and August include most of the features from longer period. The same range of simplified box domain of monsoon regions used in June and September may overestimate the contribution of transport from monsoon regions. The contributions of transport from ASM region to the TrP and LS-NH quantified in our work based on July-August period show similar values with the previous study covering the time period of May−October Vogel et al., 2019. Hence, we simulate the monsoon transport during July-August instead of June-September. We added a remark on this sensitivity in the discussion section of revised manuscript (P22).

4. ***Clearly Page 5 needs a lot of clarification. Since all of the rest of the paper is a function on how CLaMS was used here, I suggest the authors spend a little more time on the model set up and the assumptions behind it.***

A. Thanks for pointing this out. More details about model setup and assumptions are included in the revised version of the draft.

5. ***Minor comments: You don't need to tell us you used Python to make a figure.***

   A. The information about Python is removed.