Initial Response to Referee #1:

We thank the reviewer for the thoughtful and detailed comments. Here we will provide quick responses *only* to the major comments for the purpose of interactive discussion. We will respond to the other comments and update the paper text and supplement after the completion of the interactive discussion.

Summary:
Zhang et al. use the REAM chemistry transport model simulation to investigate transport of aromatics to the Tibetan plateau. Their work shows that the INTEX-B 2006 emissions of aromatics do not produce sufficient glyoxal concentrations compared to the SCIAMACHY retrieval. The authors apply a top-down estimate to update the emissions of aromatics, which are glyoxal precursors. The REAM model results of aromatics were compared with observations taken at several ground locations over a 3-week period. Samples in central Tibet had the highest aromatic concentrations and were attributed to meteorological conditions that increased southwesterly surface winds bringing high concentrations of aromatics from the Indo-Gangetic Plain to Tibet. The complex topography of this region makes for an especially challenging effort to represent transport into Tibet.
The investigation is important in terms of understanding transport of pollutants, especially black carbon, from population and industrial regions to the Himalayan glaciers. The results from this paper suggest the critical need to represent the airflow in complex terrain to predict black carbon transport accurately. While these conclusions are not unfamiliar, it is important to continue to highlight the role of meteorology on transport of pollutants. The presentation of the investigation is fair. One can understand the points being made, but it is not written as a compelling story. Several of the points below suggest ways to improve the paper.

Authors' response:
A main focus of this research is to show the enhanced inter-Himalayas transport towards Tibet in the presence of the cut-off low system. We apply the top-down emission estimate technique and find that the model underestimates of reactive aromatics during Period 2 result due to the underestimation of the emissions inventory. The WRF simulated and observed meteorology fields show that the rise of reactive aromatics concentrations during Oct 21-24 are related to the cut-off low system. We further analyze the geopotential heights and compare WRF simulated and observed surface winds during Period 1. The results imply a missing cut-off low system during Period 1, which is not captured by 36km resolution WRF model. It will be more challenging for climate models with coarser resolutions to capture the cut-off low systems. Thus, we suggest climate model results of inter-Himalayas transport of pollutants (including BC) must be evaluated with our findings in mind. Last, we point out that the model underestimation during Period 3 is due to the effects of complex terrains.

Major Comments
1. Aromatics are good markers of transport that occurs over 1 day period because of their chemical lifetime. However, aromatics are not subject to wet deposition because of their low solubilities (Sander, 2015), while black carbon can be removed by storms. Therefore, it makes sense to use aromatics to analyze transport (isolating the one process), but they are not good proxies for black carbon. The authors should explain this caveat in the paper.

Although air mass transport towards north of the Himalayas is enhanced during the presence of the cut-off low system, different species share various physical and chemical processes and are affected by the cut-off low system to different extents. Compared to aromatics, black carbon (BC) transport is also subject to wet scavenging, the efficiency of which depends on the hygroscopicity of BC. For freshly emitted BC from the industrialized Indo-Gangetic Plain (IGP), the scavenging effect requires in situ observation. Nonetheless, inter-Himalayas transport during Period 2 is clearly much faster than Period 1. If this process is not simulated correctly in the model, BC transport from India to Tibet will likely be underestimated. Further, Fig. 1 shows that the precipitation distribution for Oct 19-20 and Oct 21-24. The cut-off system and associated precipitation are to the northwest of Tibet. Precipitation south of Tibet is weak and thus the subsequent removal of BC during inter-Himalayas transport is limited.

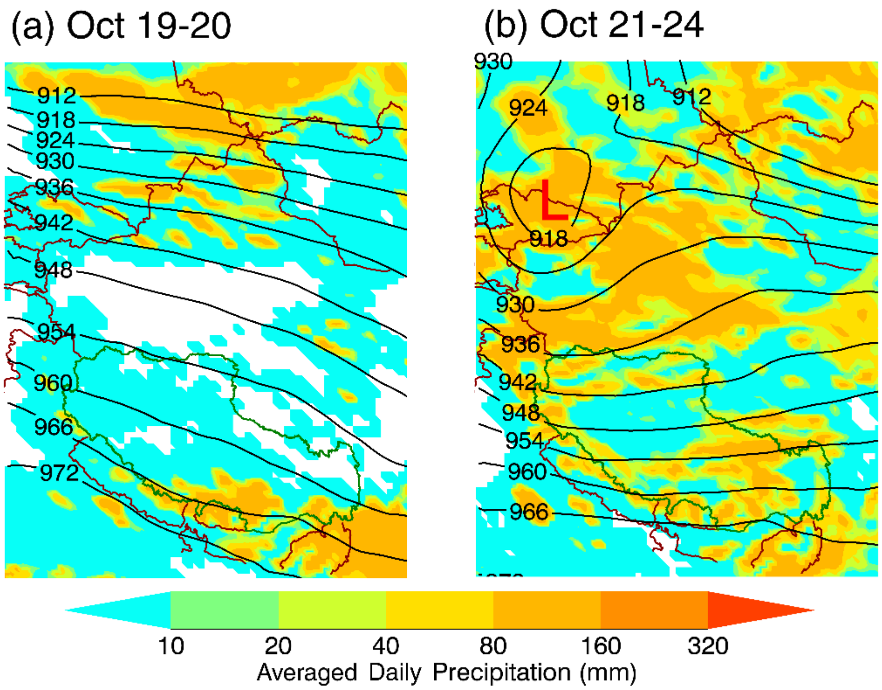

Figure 1: WRF simulated averaged daily precipitation for Oct 19-20 (a) and Oct 21-24 (b), respectively.

In addition, we conducted a sensitivity test in order to address the influence of different emission distributions between aromatics and BC to our conclusion. We redistributed total aromatics emissions over China and other South Asia countries using the BC emission distribution. The resulting aromatics emissions distribution resembles that of BC. We compare the source contribution results using original and the redistributed aromatics emissions (Fig. S8). Transport of BC from South Asia clearly dominates inner Tibet during the cut-off low event.

Thus, we conclude that the BC transport is enhanced by the cut-off low. We will clarify these issues in the revision.

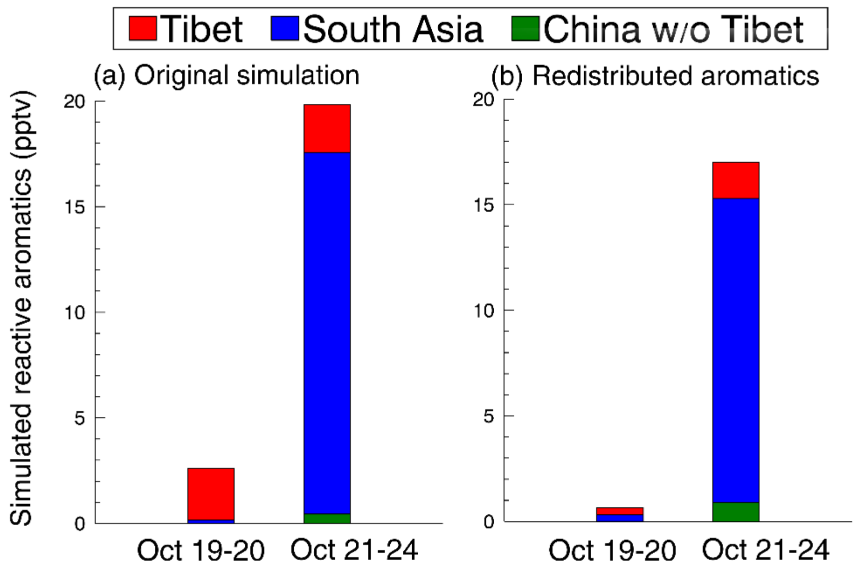

Figure S8: Averages of simulated reactive aromatics emitted from Tibet (red), India and nearby countries ("South Asia", blue) and China excluding Tibet ("China w/o Tibet", green) corresponding to in situ observations during Oct 19-20 and Oct 21-24. REAM simulations are conducted with original emissions (a) and the aromatics emissions redistributed to be the same as BC (b), respectively.

2. There is a lack of recognition of previous studies, especially of regional chemistry transport modeling in South Asia and western China. Some previous papers to consider are listed in the references.

We will do another search of literature. Our research focuses on the inter-Himalayas transport from South Asia to Tibet. We will check if there are papers on inter-Himalayas transport that we missed.

3. When figures are discussed in enough detail, it is better to place them in the main part of the paper. In my opinion, the supplement should not contain information that is needed to support the conclusions of the paper. For example, Figure S2 should be part of the main paper because it supports the conclusion that the INTEX-A aromatics emission estimates are much lower than values determined from a top-down estimate. Please write the paper so that the reader can easily understand the main points of the study.

Thanks for the suggestion. We will combine Fig. S2 and Fig. 2 in the main text to support our top-down estimate. Please note that we did not use INTEX-A emission estimates in this work. Only INTEX-B data are used.