Comment: This paper highlights the need for more aircraft-based measurements over India and adjacent regions and the improvement of emission inventories. Comparison of Ozone and carbon monoxide profiles from the CARIBIC aircraft with WRF-Chem simulations show that long-range transport of CO to southern India is significantly underestimated in WRF-Chem. I agree with authors that there is need of aircraft measurements over Asian summer monsoon region and the improvement of emission inventories. However this paper has neither tested the performance of different anthropogenic emission inventories over the Indian region nor explored in detail the transport of CO or ozone during the monsoon season. I suggest major revision of this manuscript.

Response: We thank the referee for constructive comments and suggestions. The point-by-point response to referee comments are given below and changes made in the manuscript are in red color. We would like to mention that this is the first attempt in which an online regional model with recent emission inventory (EDGAR-HTAP) is being evaluated against the high-quality aircraft measurements over India. Regarding the role of regional emissions, we have shown that 50% higher CO emissions over India do not explain the under-prediction of CO in the lower troposphere and therefore changes in the conclusions should not be expected, even if different emission inventories are used. Nevertheless, following the interesting suggestion of the referee, we have conducted additional simulation by using another regional inventory (INTEX-B, Amnuaylojaroen et al., 2014). We find that our conclusions are unaffected by the choice of emission inventory as also shown by EM_1.5x simulation. Now we clarify the gaps in the regional modeling work done previously and objectives of our study in the manuscript (Introduction section, Page 4-5).

Comment: It is not clear why authors chose regional model (WRF-Chem) and not GCM to analyze long range transport due to monsoon convection. If the objective of the paper is to show the WRF-Chem model performance and need for improvement of the emission inventory then model performance should have been tested during clam winter condition. WRF-Chem Model may perform better during winter season however, being a regional model it may not simulate the monsoon related long range transport as good as GCMs. The authors have shown that WRF simulations show good agreement with MOPITT during subdued convection time in June while biases are large during July and August when monsoon convection is very strong. This may be related to lateral forcing which is not the case in GCMs.

Response: The long-range transport in WRF-Chem model is controlled by the boundary conditions, i. e. by global model data. Beside that, regional model offer an opportunity to incorporate the high-resolution latest regional emissions into the model to see the effect of local and regional emissions. However, lack of observations (specially vertical profiles) has largely inhibited an evaluation of long-range transport and regional influences over Indian region. Its true that model can perform better in calm winter and also satellite retrievals are better in other seasons. This further highlights the importance of this work and in general the need of aircraft data in summer-monsoon. Additionally, as the referee correctly mention, as convection is very important during the monsoon period, we expect regional model to be more accurate (due to resolution) in representing convective transport, which can only be parameterized over large-scale in global model. Finally, the comparison of WRF-Chem (Figure 2) and MOZART (Supplementary material-Figure 1) with observations shows that the influences of regional emissions are better captured by regional model. We suggested that future improvement in global emissions will help improving the boundary conditions which when combined to

WRF-Chem will be better suited for budget studies.

Comment: I suggest adding results from few more simulations from latest regional emission inventories (for example Amnuaylojaroen et al., 2014) before arriving to conclusions. The ozonesonde (http://woudc.org/) and CAIPEEX aircraft data (CO and O3 –http://www.tropmet.res.in/~caipeex/about-data.php) is available over the Indian region during monsoon season. Authors should compare WRF-Chem simulations with these data sets.
Response: Thanks for the suggestion. It should be noted that the EDGAR-HTAP emissions are actually based on regional inventories only, and a sensitivity to the CO emissions has been presented by enhancing CO emissions by 50%. We conducted another simulation using a different regional emission inventory (INTEX-B) (revised Figures 3, 5, 8 and Supplementary material-Figure 2), and we found that our conclusions remain unaffected. A comparison of WRF-Chem with ozonesonde data available at WOUDC has been added (Section 3.2, Section 4.1.2 and Figure 5) following the suggestion of the referee. The comparison shows good agreement between model and ozonesonde climatology during summer monsoon in the lower and middle troposphere over Delhi and Pune, however, model overestimated ozone in the upper troposphere. Over southern Indian site Thiruvanathapuram, model showed a negative bias in the troposphere, as also seen with the CARIBIC observations. We have requested CAIPEEX data, however, it could not be received as of now. We will be keen and take up comparison of CAIPEEX as a separate follow up study.

Comment: Section 4.3 – This section is weak. I suggest adding figure showing the monsoon convection play an important role in lifting of boundary layer pollutants (from Indo-Gangetic plane or Bay of Bengal) into the monsoon anticyclone (see Randel et al., 2010; Park et al 2007; 2009; Fadnavis et al 2013, 2014). The effect of enhanced CO emissions (50%) on transport into the upper troposphere and lower stratosphere can be discussed in detail. I suggest adding a figure of lat-long sections in the UTLS and related discussions.
Response: Thanks. Suggestion has been incorporated (Section-4.2 and new Figure 9).

Comment: Section 4.3.1 – Authors have not mentioned the location of strong pollution event on 15 July 2008 and the reason for this. It is quite obvious that model will underestimate such event as emission inventory does not account it. One can assimilate satellite data and reproduce such event.
Response: We agree with the referee that a more detailed analysis on the causes of this pollution event should be present in the manuscript. Therefore, we have analyzed the wind fields over Chennai based on radiosonde measurements and we found that the model overestimates systematically the wind speed during the July period. Hence, there are indications that the simulated air parcels do not collect enough pollutants from the boundary layer due to low residence time. The effect of the wind overestimation is discussed in the revised manuscript (Page:19, Lines:12-21; Supplementary Material- Figures 3,4). The emissions in the model are not responsible for the misrepresentation of the pollution episode as in all sensitivity runs with different emissions (i. e. two different inventories and an increase in emissions), no significant changes of the model performances with respect to pollution event are seen.

Conclusion section – It should be revised thoroughly. I suggest authors to mention the outstanding results from this study.
Response: Conclusion section has been revised to include the key results. The

results from new analyses (e. g. comparison with ozonesondes, additional simulation with INTEX-B inventory, effect on Upper troposphere) suggested by referee are added in the conclusions.