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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Trapping, chemistry and export of trace gases in the South Asian summer monsoon observed during CARIBIC flights in 2008" *by* A. Rauthe-Schöch et al.

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Answers to Reviewer #2:

We would like to thank referee #2 for his thorough review of our manuscript and his helpful suggestions for improving the manuscript. In the following, we will answer his specific comments.

General remarks

The reviewer makes two main points. One is that more information on the emissions should be given. Therefore we now have included plots of emission distributions from the Regional Emission inventory in ASia (REAS) version 2.1 for CO and the sum of all non-methane volatile organic compounds (NMVOC) for India and the surrounding region for August 2008 as a new Figure 2. A complete emission inventory is beyond the scope of our paper. In the meantime a modeling paper on CO emissions and a comparison of CO and O_3 with the CARIBIC data has been published (*Ohja et al., Atmos. Chem. Phys. Discuss., 15(15), 21133–21176, 2015*).

The second point is that although convection and scavenging are often referred to, neither vertical wind speeds nor precipitation patterns are part of the meteorological parameters described. We indeed referred often to convection but did not give vertical wind data. We rather have indicated the general feature of the strongest convection being over the Bay of Bengal. For a more detailed link between observed pollution and convection one indeed needs the emission distribution. In the case of convection a detailed analysis of the measurements along the flight track would need to be made in comparison to the meteorological data. One would need to have a map of the true location and strength of all convective cells, the emissions from the inventory and the trajectories, which themselves again are dependent on knowing the exact distribution of the convection (which in the FLEXPART trajectory model is parameterized using meteorological information from ECMWF at $1^\circ \times 1^\circ$ spacial resolution which is not resolving the single convective cells). We consider the amount of chemical measurement data not sufficient for justifying such a study and the detailed knowledge about the convection hard to get. Such work is more within the realms of dedicated measurement campaigns and research aircraft. Similarly, we argue that scavenging studies are likewise too detailed for the dataset we have. The very short lifetimes of scavenged species, e.g. the nucleation mode aerosol particles N_{4-12} in Figure 6E (in the revised manuscript) (which also are formed rapidly) show the complexity of

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linking precipitation with our data in detail. In addition we discuss the differences of the nucleation mode aerosol particle concentrations N_{4-12} in the northern and southern part of the UTAC in the supplement (Sect. S5 and Figs S23 & S24).

Other comments

p 972 line 7: Our description was incomplete, we now have remedied this.

p 6973 line 20: We now have added more information on the wind field in the revised manuscript.

p 6975 line 27: We are interested in the air mass origin along the flight track. Therefore we start many single trajectories/particles along the flight track and track the particle/trajectory position instead of releasing many particles from one point along the flight track and calculating the footprint for this one single point.

p 6979 line 9: As in the previous studies by *Schuck et al. (2010)* and *Baker et al. (2011)*, we used thresholds of 1.3 PVU and 150 ppb for PV and ozone, respectively. These numbers have been added to the text.

p 6979 line 15: We have added mean numbers and variabilities when describing the revised version of Fig. 6.

p 6981 line 27: Figure 1 has already a high density of information and this information is for 250 hPa and not the lower level of the Somali jet (which has its maximum around 850 hPa). We would need another more general figure for the overall meteorological

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description, including the Somali Jet. Instead we refer to *Chakraborty et al., Int. J. Climatol., 29, 983–992, 2009,* for a study showing the horizontal and vertical extent of the Somali Jet.

p 6985 line 7: Reviewer #1 made a similar point. We also have used levels below 5 km but it makes little difference. We have now used all points below the 5 km threshold for creating the source region distribution plots in Fig. 11 in the revised manuscript. It now shows the mean distribution together with its month-to-month variability. We do not quantify the amount of boundary layer air that had become entrained rather us this simple approach.

p 6989 line 19: Figure 16 shows that more and more trajectories "join" the UTAC in the 10 days prior to the flight and that they leave the UTAC again, indicative of "leaking". The fraction of trajectories in the UTAC increases from 60–70 % 10 days before the flight to 100 % (by definition) at the flight and then decreases again to 30–50 % 10 days after the flight. We modified the text.

p 6991 line 17: We have changed the formulation

p 6992 line 24: We have changed the formulation

Figure 9 (now 10): The starting points of the trajectory are now marked with black dots.

Figure 9b (now 10b): Fig. 11 in the revised manuscript shows that the source regions are rather split north-east / south-west for the northern and the southern section of the UTAC. In that respect, our relative latitude coordinate already divides the

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measurements by source region (e.g. in Figs. 6, 7, 14 & 15).

Figure 11, 12: We agree that to estimate the impact of the monsoon air on a receptor region, one needs to work backwards from the receptor region to find out how big the influence of the monsoon is. However, we find it still instructive to see where and how far the monsoon air can be transported in certain cases. So even when sampling air over the eastern coast of Canada, one should keep in mind that it may be influenced by the monsoon (see "North America" receptor region and our CARIBIC observations in September 2007 described in the Supplement Sect. S1). Therefore we would like to keep this section in the main text. We have added some text discussion the issue of influence on the receptor region.

Technical comments

Abbreviations: This has been corrected unless the abbreviation would stand in the beginning of a sentence.

3.1.1 in the heading maybe add "aircraft" or "measurement" position is: Heading has been changed to "Measurement position in ..."

p 6978 line 4: which flight in August - add date: The date (14 August 2008) has been added.

p 6982 line 16: write Fig 8b instead of Panel B - makes it better readable: This has been changed in the whole manuscript not only for Fig. 8.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 6967, 2015.