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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characterization of non-methane hydrocarbons in Asian summer monsoon outflow observed by the CARIBIC aircraft" *by* A. K. Baker et al.

Anonymous Referee #3

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This paper uses measurements from the CARBIC program to show that NMHCs are enhanced in the Asian monsoon outflow over large areas. The CARIBIC project is the only program that can provide in-situ observations of trace gases and aerosols over a full seasonal cycle in the upper troposphere/lower stratosphere and therefore the information obtained during these measurements as shown in this paper a very valuable. The authors use established methods to determine the transport time of the pollution to the measurement location in the monsoon outflow and to identify the sources such as biofuel burning and other combustion and evaporative sources. I have a few specific comments detailed below that need to be addressed before I recommend publication.

General Comments:

- The paper should make better use of all the other measurements from CARIBIC. The importance for ozone production is discussed, but no ozone data are shown. What is the ozone inside the monsoon outflow and what is observed in other places and times? How does this change the oxidative capacity of the atmosphere? Also I thought the CARIBIC package includes a PTR-MS and measurements of the biomass burning marker acetonitrile should be available. This would greatly improve the source identification of biofuel burning versus anthropogenic/urban sources or LPG.

- I am surprised by the strong enhancements of i-butane and n-butane compared to the other small NMHCs. Also ethane enhancements are somewhat larger than expected from the comparison to other measurements, but propane not as much. The authors conclude that there are additional sources due to the use of natural gas and LPG and that this source is increasing over the past 10 years. Natural gas is usually mainly composed of ethane and LPG mainly of propane. If natural gas and LPG use were the main source for i-butane and n-butane , ethane and propane should be even more enhanced. Besides combustion sources, gasoline evaporation is a very strong source of i-butane and n-butane together with i-pentane. I would suggest looking at the enhancements (possibly age corrected) of those five compounds together and compare those carefully to source profiles of all evaporative and combustion sources to see, if they are consistent with the strong propane source from LPG and natural gas use.

- I would like to see a better error estimate of the airmass age calculation. The different samples give ages between 3-8 days, which is a rather wide range. There are large errors associated with the use of climatological OH (Spivakovsky et 2000), mixing with ambient air (described in Figure 7) and the use of emission ratios estimated from the ground measurements. The uncertainties for all those should be clearly explained and the combined error estimate should be given and compared to the range of ages that are calculated.

Minor comments:

- Page 18105: line 1: OH abbreviation should be given here not on line 8. Also see page 18109 line4. - Page 18104: line3: typo: there exists - Page 18107 line20: typo: and these sampled through the same inlet - Table 1: it would be good to add CO here, especially the appropriate kOH. Table 3: typo: propane/CO also why is there no age corrected value for propane? Figure 4: I think it would be better to show all the data points for the butanes and pentanes.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 18101, 2010.