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Atmospheric Measurement Techniques Discussions

Interactive comment on "Greenhouse gas analysis of air samples collected onboard the CARIBIC passenger aircraft" *by* T. J. Schuck et al.

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We thank referee2 for the comment on our manuscript.

The comment addressed the influence of humidity on the measurements of CO_2. The discussion of this (section 3.2) has been modified in the revised manuscript in order to state more clearly that the water content of the samples has not been found to be problematic. It was noted in the referee's comment that the direction of the inlet opening is relevant in this context. The CARIBIC inlet for trace gas measurements is forward facing. It also has a backward opening so that it is continuously flushed with ambient air. From this flow, that is parallel to the flight direction, the air is sampled at low speed through a perpendicular tube from the center of the flow. This information has been added to the text. In the inlet the air flow is slowed down from $\sim$250 m/s (speed of

aircraft) to values around 2 –3 m/s over a distance of a few cm. Most water droplets will quickly evaporate in the inlet so that no liquid water enters the sampling line. Because sampling is perpendicular to the flow, solid particles or ice will not enter the sampling line.

For the measurement of the discussed greenhouse gases drying of the sampled air during the flight would indeed be favorable. However, it is difficult to dry without changing the isotopic composition of CO_2 or affect NMHCs and halocarbons (e.g. Colman 2001). For most of the air samples (over 75 %) the water content can be calculated from the parallel measurements of water. For samples not covered by a parallel water measurement the ECMWF analysis performed for each flight allows for an estimate of the water content. CARIBIC samples are mostly pressurized at altitudes above 9 km and mixing ratios of water are low. The highest mixing ratio calculated for a CARIBIC whole air sample up to now was 5600 ppm, corresponding to a correction for CO_2 of 2.11 ppm. For the observed range of the H_2O mixing ratio the relative humidity in the samples under laboratory conditions is always below 100 %, so that negative effects during analysis can also be excluded. From this, we conclude that wet samples are not a problem in the CARIBIC CO_2 data set. The comparison of the corrected CO_2 mixing ratio from the air samples with the mixing ratio measured continuously using infrared absorption (section 3.3. of the manuscript) shows good agreement. The in-situ device uses Nafion membrane tubes for drying. No correlation of the difference of the CO_2 content with the water content of the sample has been found. This confirms that wet samples are not a problem.

The second major concern in the referee's comment was the discussion of more science. We think that the main intention of the manuscript should remain the presentation of the sampling device and the sample greenhouse gas analysis. Therefore, the revised manuscript still gives a rather detailed description of the sampling and the laboratory analysis, discussing the question of synchronization with continuous measurements, the influence of water and comparisons. In addition the representativeness

of the samples is discussed, using CO_2 as main tracer for pollution plumes. The revised manuscript also contains a more detailed discussion of the seasonal cycle of CO_2 and the latitudinal variations. Especially, the comparison with other results was extended. In addition, the discussion of the two example flights was extended.

Reference J.J. Colman, A.L. Swanson, S. Meinardi, B.C. Sive, D.R. Blake, F.S. Rowland: Description of the analysis of a wide range of volatile organic compound in whole air samples collected during PEM-Tropics A and B, Anal. Chem. 73, 3723-3731, 2001.

Interactive comment on Atmos. Meas. Tech. Discuss., 2, 915, 2009.