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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Civil aircraft for the regular investigation of the atmosphere based on an instrumented container: the new CARIBIC system" *by* C. A. M. Brenninkmeijer et al.

Anonymous Referee #4

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Review of the manuscript "Civil aircraft for the regular investigation of the atmosphere based on an instrumented container: the new CARIBIC system" by C. A. M. Brenninkmeijer et al.

The paper describes in detail a very impressive second generation instrument package for the ambient measurement of a large variety of important chemical species and aerosol parameters. The deployment on civil aircraft produces measurements taken regularly over an extended time period, mainly in the UT/LS region, with profiles over destination and origin airport regions. The manuscript provides a detailed description of the installation and the instruments themselves and presents some preliminary

data aimed at demonstrating the current capabilities of the package under real-world conditions.

I agree with reviewer #2 that the level of technical detail is somewhat excessive for publication in ACP. Although the authors are - understandably - proud of the outcome of this impressive engineering project I concur that figures 4, 5, and figure 8 should be removed. I also recommend that the photograph portion of figure 6 should be removed as it is too small to see any detail. I further recommend to combine figures 7 and 9 into one, as it is important to look at the inlet system as a whole (see additional comments below).

I also agree with reviwer #2 that the entire text should be carefully scanned for too much non-scientific (mechanical and aeronautical engineering) detail and shortened wherever possible, and these details could be made available on the CARIBIC web site or published elsewhere if so desired. I would not go quite as far as reviewer#2 suggested as I believe that efficient instrument cooling has a major influence on the quality of the data but good judgment should be used as to what is of importance for the quality of the results.

I further agree with reviewer #2 about some lack of details and performance parameters. While I do not want to touch again on all issues already raised by reviewer #2 in the interest of keeping this review as short as possible I do have some additional concerns focused on the chemistry instrumentation:

O3 I'm a little puzzled by the remark on the O3 scrubber redesign. In section 4.2 the authors state that they use a novel scrubber design with significantly reduced surface area for water absorption. It would seem that the ozone removal efficiency of the scrubber is also a function of the total surface area and therefore reducing the surface area would be limited to a large extent. Can the authors comment on this? Also, recently, Huntrieser et al. (ACPD 7, 2561-2621, 2007) reported ozone measurement problems during cloud penetration using the DLR Falcon instrument. Is the same type

ACPD

7, S1630–S1633, 2007

of scrubber used in this instrument?

CO: While I believe the excellent results obtained in laboratory comparison tests with the AL5002, under flight conditions the performance of the AL5002 may be quite a bit reduced compared to a bench-top test. Has data obtained while flying in uniform, clean air masses (i.e., as indicated by other tracers), demonstrated instrument precision as described in section 4.3? What are the zero counts (and their fraction of a typical sample) and how do they vary in flight?

NO/NOy: From the description in section 4.4 several details are not clear to me: Is water added to the NOx analyzer? If not, how are the sensitivity changes with ambient water mixing ratio in flight accounted for? It appears from the description that the gold converter is located in the instrument container. Has the transmission of HNO3 through the inlet itself and the very long inlet lines to the instrument been tested under conditions of varying pressure and humidity levels? How often is the artifact checked in flight? What is the temperature of the PMT's with just Peltier cooling? What are the typical background counts and how much do they vary in flight? Is the conversion efficiency for HNO3 checked on the ground in addition to the NO2 conversion efficiency? In summary I find the estimates for detection limit and uncertainty for NO and especially NOy rather optimistic. Without more extensive testing the authors should at least add some caveats to the NO and NOy measurement accuracy and precision due to the factors mentioned above.

Flask samples (section 4.12): Please add a plumbing diagram of the flask samples. Do all flasks have an inlet and outlet and two valves since the description mentions air flowing through the flasks before sampling? It seems that the additional effort involved in using glass for the flasks could be somewhat offset by the surface of the Stainless Steel valves (what are the sealing surfaces?) , SS tube studs, and the cement used to connect them to the glass flasks. What is the influence of the SS surfaces of the valves and tubing studs on the stability of sampled compounds? When exactly is the pump turned on for sampling? Is some time being allowed to flush the flasks out before the

ACPD

7, S1630–S1633, 2007

sample is taken? How was the stability of compounds (like the alkyl nitrates mentioned in section 4.12) determined? Repeated analysis? This would not take into account fast losses which could occur before the canisters are analyzed for the first time. What is the purpose of taking samples on the outbound flight and then venting them to take samples on the return flight?

Minor Comments:

Page 5290 line 18 replace “rhyme” with “rime”

Page 5295 line 18 replace “flight angles” with “aircraft state parameters”

Page 5296 line 10 - statement about 175% supersaturation over ice - please insert reference

Page 5299 line 7 - how quickly does sensitivity of O3-flourescence detector change - if faster than UV absorption O3 time resolution false O3 variability could be introduced if water vapor or other ambient parameters change quickly

Page 5299 line 17 replace “crossing the LS” with “crossing into the LS”

Page 5301 last line - delete “itself”.

Page 5336 caption for figure 11 - the link to data URL does not work

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 5277, 2007.