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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observations of OH and HO_2 radicals over West Africa" *by* R. Commane et al.

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Reviewer 1:

We thank the reviewer for their constructive and helpful comments and address them below. Each comment is shown in bold, with our reply directly below it.

Measurement uncertainties and reliability
1) It is not clear from the presented data what was the uncertainty of the measurements. I would suggest presenting a short description of the procedure used for the estimation of the data accuracy and precision. The corresponding error bars, at least for several points, should be presented on Figures 9-20.

A section on the calculation of the instrumental uncertainty and the calibration uncertainty has been included (see Point 3 below). Error bars have been added to figure 9 to demonstrate the magnitude of this uncertainty.

2) To give more clear idea about measurements quality, it would be very helpful to include in the article the figure showing the raw signal and background data for one measurement cycle obtained during the flight. I would suggest adding this figure instead of Fig.3.
A figure of the raw signal and background data for OH and HO_2 will replace Fig. 3.

3) What is the influence of the humidity on the calibration coefficient and what was the range of the water vapour concentrations for different flights?
During AMMA, water vapour ranged from 300 ppmv at altitudes above 4 km to almost 30,000 ppmv on occasion in the boundary layer. In the laboratory during ground calibrations, the impact of humidity on the calibration coefficient of the aircraft FAGE instrument was determined. For water vapour mixing ratios between 500 ppmv and 10000 ppmv, changes of 11% and 9% were observed for OH and HO_2 radicals respectively. Although the mixing ratio of water vapour was observed on occasion to be higher than this during AMMA, calibrations of other configurations of FAGE instruments up to 20,000 ppmv in Leeds have not observed a significant further change in the calibration sensitivity beyond 10,000 ppmv. The effect of this humidity on the calibration coefficient has now been included in the calculation of the instrumental uncertainty (Section 3c below).

3b) How important is the influence of the gas temperature in the transport tube and in the fluorescence cell on the calibration coefficient?
The influence of temperature on the calibration coefficient has not been systematically characterised. However, the distance between the sampling pinhole and the fluorescence cell inside the aircraft (50 cm for the OH cell) should allow sufficient time for enough collisions to ensure equilibration to the temperature within the aircraft. In an earlier configuration of a ground-based FAGE instrument (similar nozzle diameter), the rotational temperature of the hydroxyl radical was measured as a function of distance between the sampling pinhole and the laser-excitation axis (Creasey et al., (1997) Appl. Phys., B, 65, 375-392). Following substantial cooling due to

expansion within a supersonic jet, the temperature rose to close to ambient at the Mach Disk, followed by a slight cooling before reaching ambient again at 20 cm. The first fluorescence cell (OH) is 50 cm from the inlet, and a thermocouple placed in the gas flow between the OH and HO_2 fluorescence cells observed room temperature when the instrument was sampling laboratory air. Therefore, it is expected that the temperature within the fluorescence cells will have reached a temperature close to that within the aircraft, although this has not been explicitly verified.

3c) How the uncertainty of the calibration coefficient has been estimated? Does the given in the article 20% uncertainty account for the uncertainties of the calibration parameters (lamp flux, humidity, etc)? Based on the data presented in Fig.6, it seems that alone the precision of the calibration measurements is about 20%.
As stated in Point 1 (above), a paragraph will be added describing the uncertainty in the generation of OH (and HO_2) for calibration. The original uncertainty quoted was the root-mean-square of the uncertainty in the determination of the flux (13% and includes N2O calibration, rate constants, lamp current, etc.), the hygrometer (1%), absorption cross-section of H_2O (2.8%), flow controller error (1%), excitation peak location (5%), laser power reading (3%) and fit to the multipoint calibration (9% for OH and 6% for HO_2). However, an updated uncertainty also includes the standard error in the fit in Figure 6 (15% for OH and 20% for HO_2) and the uncertainty due to effects of humidity (12% for OH and 9% for HO_2), leading to an overall uncertainty of 25% for OH and 26% for HO_2.

3d) How different were the calibration coefficients measured before and after the campaign? The calibration coefficients for a given pressure before and after the campaign were found to be within 5%, well within the calculated uncertainty.

4)Verify the values given in Table 1. I obtain quite different LDL using these values. The background deviation for use with equation (7) should be in units cts/s/mW. Thanks to the reviewer for spotting this. m and n should be functions of the measurement frequency and should both be 60. The calculated LOD is then 8×10^5 for OH and 1.6×10^6 for HO_2, and will be updated.

Presentation of the data.
5) Provide more detailed information about different flights. I suggest adding a Table with some flights details (altitude, location, time) and atmospheric conditions (range of concentrations of O3, CO, H_2O, NO_X, VOC, isoprene). Alternatively, the figures showing the individual flights data could be presented.
A table with the details from a selection of flights will be added. This should help put the measurements in context.

6) Fig.8. Add the legend explaining the correspondence of the colours and the radical concentrations.
Colorbar will be added to graph.

7) Fig.11, 12. Indicate by different colours the data corresponding to the identified specific cases (free troposphere, high isoprene, burning plume, clouds). Indicate error bars for the points corresponding to the median values on Fig.12.
Fig 11 and 12 will be updated to include the specific cases colours. Error bars indicating the the error bars will be added to Fig 12.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 7265, 2010.