Atmos. Chem. Phys. Discuss., 9, C6538–C6543, 2009
www.atmos-chem-phys-discuss.net/9/C6538/2009/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: Characterisation of a DUALER instrument for the airborne measurement of peroxy radicals during AMMA 2006" *by* D. Kartal et al.

Anonymous Referee #2

Received and published: 2 November 2009

The paper by Kartal et al. is a technical note about the characterization of an airborne dual channel peroxy radical amplifier instrument utilizing a new common pre-reactor nozzle which allows both channels to sample air from a volume kept at a constant pressure throughout the flight mission. The pressure dependencies of the NO2 sensitivity and chain length are investigated, an algorithm for the retrieval of short-term fluctuations of the sensitivity from simultaneous ozone measurements is presented, and some ROx data measured with this instrument during the AMMA campaign 2006 are discussed. The paper presents new material, is interesting, and is within the scope of ACP. I suggest to accept the manuscript if the authors address the following issues.

General remark

This paper is submitted as a technical note. However, the present, very brief description of the instrumental setup and the experimental parameters make it very difficult to follow the discussion concerning the different pressure dependencies. Instead of using 3D-CAD screen shots of the apparatus I suggest to provide a schematic drawing of the instrumental setup used for the characterization experiments which shows the functional relationship between the different components. Adding labels like p_chamber, p_DUALER would help a lot to more easily understand the different figures in the paper. A table with important experimental parameters would ideally complement such a figure for quick reference which is difficult at the moment as the parameters are "hidden" in the text.

In detail

Abstract The authors claim to discuss the detection limit of the instrument. However, there is no discussion of the detection limit in the paper.

p. 18273, Line 11ff The quantitative and selective discrimination between HO2 and RO2 has been accomplished for a long time now by the Matrix Isolation Spin Resonance Technique (e.g. Mihelcic, D. et al.: Numerical analysis of ESR spectra from atmospheric samples, J. Atmos. Chem., 11, 271–297, 1990).

p. 18273, Line 29f The capital L is missing in the extension of the DUALER abbreviation.

2.1 Description of the set up I suggest to present the basic chemical reactions of the amplifier for those readers who are not familiar with the technique.

p. 18274, Line 25 ... radicals decay quickly and only a few ppt of NO2 are produced from the reaction of the sampled peroxy radicals with NO.

p. 18275, Line 12f What is the inlet diameter of the reactors?

ACPD

9, C6538–C6543, 2009

p. 18275, Line 25 Please be more specific: Data are acquired at a rate of ...Hz using a Data Translation interface ...

p. 18276, Line 12 Please be more specific: gas mixture added to the converter: 3 ppmv NO in N2 and 7.4% v/v CO in synth. air? What were the flow rates? (N.B. these parameters should all go into a table)

p. 18276, Line 21ff Please be more specific (numbers) why during AMMA the proven dependency of the CL on RH is not important. What were the relative humidity in the ambient air and in the reactor?

p. 18277, Line 12ff Please provide figure of experimental setup (s. also General remarks)

p. 18278, Line 23ff What was the variability of the ambient pressure?

p. 18279, Line 4ff better write: The extent of the chain reaction depends not only on the concentration of the reactants and the residence time in the reactor but also on the material ...

p. 18279, Line 10. Eq. (1) does not describe the pressure dependence of the CL.

p. 18279, Line 26f What is the minimum retention time in the reactor to complete the chain reaction at 200mbar/1000mbar?

p. 18280, Line 6ff I am confused by the different statements on how the pressure dependency of the wall loss is handled in the model: "The wall losses were constrained to the measurements at 1000 mbar and kept constant for the whole pressure range.", "From the comparison with the experimental results (Fig. 6) the variation of the wall losses with pressure is estimated to be k_wall = 1.5-(P1/10*P2) ...". Do the authors mean k_wall = 1.5-(P1/(10*P2))? How does this value compare to the number listed in Tab. 1?

p. 18281, Line 1 Reference should be to Fig. 7; P_sample should be P_chamber to be

ACPD

9, C6538–C6543, 2009

consistent with figure caption

p. 18281, Line 1ff The argument with the increasing gas velocity at increasing Delta_P is only true as long as P_DUALER > 0.5*P_chamber. A P_DUALER below this threshold will result in a supersonic gas expansion with no further increase in gas velocity.

p. 18281, Line 7ff Even if the pressure in the pre-reactor nozzle is not regulated I would still expect a pressure drop across the 1mm nozzle. Do you have pressure measurements from the DUALER reactors at different chamber pressures?

p. 18281, Line 12ff The authors discuss differences between the measurement series with and without pressure regulation which in view of the error bars are not significant. In fact, it is hard to see any difference at all between Fig. 7a and Fig 8. which is also evident from Fig. 9a.

p. 18283, Line 13ff Velocity of gas sample through nozzle of the pre-reactor: see comment above

p. 18284, Section 4 What chain length was used for the evaluation of the AMMA data, eCL for pure HO2 or for a HO2/RO2 mixture?

p. 18284, Line 17ff Please provide some quantitative information on the reproducibility of the in-flight NO2 calibrations and the accompanying NO2 calibrations prior and past the measurement flights.

p. 18285, Line 9f Better write: "Provided that the signal measured in the background mode is essentially defined by ambient O3 converted to NO2 by its reaction with the added NO ..."

p. 18288, Line 6ff It would be helpful to provide a figure which shows the application of this method to an actual set of data. I suggest to show for a particular flight level the ozone and NO2 traces, the measured background signal for one of the reactors, the derived a*(i) and b*(i) parameters (please provide number of data points used to calculate these parameters), and the A-value with standard deviation.

ACPD

9, C6538–C6543, 2009

Please provide numbers for all equations in this section.

p. 18289, Section 4.2 In this section you should comment on error contributions due to unknown HO2/RO2 mixing ratios in view of the eCL used for the data evaluation. The relative accuracies which are quoted refer to the reproducibility of the NO2 calibration under flight conditions (as descr. in Sect. 4.1) and the eCL calibrations in the laboratory. Please comment also on the accuracy of the RO2 concentration obtained from Eq. (1).

Figures and Tables

General remark: Some attention should be paid to the layout of the diagrams. I suggest to use a common font for the axis title / legends in the different figures.

The Figs. 1-3 are not very instructive and partly hard to "read" (identification of indices in figures, e.g. where is index 4 in Fig. 3?). I suggest to exchange the 3D-CAD screen dumps against diagrams which show the functional relationship between the components (e.g. gas flow diagram).

Fig. 4.: Missing unit on Y axis. Please change legend for dark blue / red symbols (e.g. reactor 1 / 2)

Fig. 5.: Missing parentheses around unit in Y axis title

Fig. 6. Caption: ... as measured and modelled ... Gridlines would be helpful

Fig. 7-9: All these figures show plots of effective chain length against chamber pressure. Please use common X-axis titles, Legend text, and Y-axis range

Fig. 7.: Please add information on the HO2/RO2 mixture to the figure caption

Fig. 8.: Y-Axis title should be eCL_NPR

Fig 15+16: It is very difficult to read the axis titles in yellow.

Tab. 1. Caption: ... are in units of ... Missing entry: unimolecular decomposition of

ACPD

9, C6538–C6543, 2009

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 18271, 2009.

ACPD

9, C6538–C6543, 2009

Interactive Comment