

## ***Interactive comment on “Intercomparison of aircraft instruments on board the C-130 and Falcon 20 over southern Germany during EXPORT 2000” by N. Brough et al.***

**N. Brough et al.**

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Anonymous Referee #1 Received and published: 8 September 2003 Review of "Intercomparison of aircraft instruments on board the C-130 and Falcon 20 over southern Germany during EXPORT 2000", Brough et al., Atmos. Chem. Phys. Discuss., 3, 3589-3623, 2003

Referee Comment: Largest differences are observed for the NO and NO<sub>y</sub> measurements. In order to judge whether these differences are significant, a careful evaluation of the precision and accuracy of the used instruments is mandatory. Here the paper could be improved: Although in-flight calibrations, zero and artifact measurements are described in great detail for the UEA instruments quantified by citing mean values and standard deviations the calculation of the overall accuracy in Tables 1 and 2 is not

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reproducible. For the DLR instrument precision, zero gas measurements and artifact measurement reproducibility are not quantified at all. In particular a detailed discussion of the rather poor accuracy of the UEA NO/NO<sub>y</sub> measurements is important to explain the systematic differences found during the comparison

Response: The estimated uncertainties of the NO and NO<sub>y</sub> channels on the UEA instrument have been recalculated. They remain unchanged as the 3% gas standard uncertainty is based on the intercomparison of both instruments with the two NO standards. The error in the UEA calibration standard quoted in the original manuscript was incorrect (used 3% in the original MS not 1% as quoted by BOC, the actual supplier) and the error in the NO channel sensitivity has been changed from 0.9 to 0.09 (0.1) this was a typographic error in the original manuscript.

For the DLR instrument the zero air artifacts for the NO and NO<sub>y</sub> channels were determined in a similar way to those of the UEA NO<sub>x</sub>. The artifacts being of the order of 3 +/- 1 ppt for the NO channel and 28 +/- 6 ppt for the NO<sub>y</sub> channel. This has been added to the manuscript.

The accuracy of the UEA instrument described by the reviewer as poor is acceptable when compared to the reported inaccuracies in similar instruments, For example: Williams et al. (JGR 1997) quote estimated inaccuracies of 19% in NO and 15% in NO<sub>y</sub>; Parrish et al. (JGR 1993) quote an inaccuracy of 15% in NO<sub>y</sub> measurements made under similar conditions. Stehr et al. (JGR 2000) using similar methods with a molybdenum catalyst report an inaccuracy in their NO<sub>y</sub> measurements of 30%, Kondo et al (JGR 1997), also using a Molybdenum catalyst report estimated uncertainties of 12% in NO and 27% in NO<sub>y</sub>. Text containing this information has been added to the paper

Referee Comment: In addition, although the conversion efficiency of the Au converters for NO<sub>2</sub> is specified, similar information for HNO<sub>3</sub> and interfering species like HCN, NH<sub>3</sub> and N<sub>2</sub>O are missing. Quantitative conversion of these interfering non-NO<sub>y</sub>

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species in one of the converters could add to the observed discrepancies.

Response: Text added to paper with following information Conversion of HNO<sub>3</sub> to NO occurs with efficiency greater than 90% on the hot gold surface. The conversion of N<sub>2</sub>O to NO under the same conditions is less than 5% efficient. NH<sub>3</sub> is not converted to NO at all on the gold surface and HCN is converted with an efficiency of 8% in dry air but this is lowered as relative humidity is raised. (Even if the sampled air was completely dry the air in the reaction chamber would be at 11% RH due to the humidification of the ozone gas stream.). The DLR group have performed conversion efficiency tests on their NO<sub>y</sub> converter for HCN, N<sub>2</sub>O, CH<sub>3</sub>CH and NH<sub>3</sub>. Of these only HCN was a possible source of interference of around 2% under the conditions of the intercomparison flight. Assuming a background concentration of HCN of 200 pptv this would lead to an interference of about 4 pptv.

Referee comment: Finally I would like to add a cautionary remark: Although this intercomparison demonstrated good agreement between individual instruments, one should keep in mind that similar instruments relying on identical physical detection processes have been used, so that in particular interferences cannot be excluded. More information on the reliability of atmospheric measurements of these species can only be gained by intercomparing instruments with different detection schemes, e.g. VUV versus TDLAS in the case of CO, UV-absorption vs. CLD in the case of O<sub>3</sub>, and CLD vs. LIF in the case of NO.

Response: It is true that interferences particular to this method of measurement cannot be fully excluded and this could only be done by intercomparing different techniques.

Technical corrections all made as suggested.

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Interactive comment on Atmos. Chem. Phys. Discuss., 3, 3589, 2003.

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