

Interactive comment on “Diode laser-based cavity ring-down instrument for NO₃, N₂O₅, NO, NO₂ and O₃ from aircraft” by N. L. Wagner et al.

Anonymous Referee #2

Received and published: 18 April 2011

The authors present a new, two-colour, laser-diode-powered multi-channel CRD set up for airborne measurement of NO_x, NO₃ / N₂O₅ and O₃. The device combines features of previously described ~400 nm laser-diode instruments for NO_x and O₃ and also presents for the first time use of 662 nm laser-diodes for the NO₃ and N₂O₅ channels. The detection limits and precision are more than adequate for most environments and the use of a single instrument (with a single calibration standard) for airborne investigation of nighttime chemistry is an important development.

The operational features of the new device are described clearly and in sufficient detail and are backed up with data from an airborne campaign. The authors should consider following comments and minor corrections.

P157 L4 delete “NO₃ then“

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P1557 L8 very modest ? Be more quantitative

P1558 L17 please include the weight, footprint and power consumption of the pulsed laser system for comparison

P1559 L20 As the authors are fully aware, NO is rarely the most important reactive partner for NO₃ in remote or rural locations. NO is also not a DIRECT sink for N₂O₅. Please elucidate.

P1560 L1 “quickly turned off” Please be more quantitative (even if hard numbers appear later).

P1560 L7 “centre wavelength” Not sure what this means in the context of a multi-mode laser.

P1560 L14 “centered at”

P1561 L21 Does the laser mode structure vary with modulation frequency (as described on page 1562 L19)?

P1565 L1 The O₃ cross section is 10000 times smaller than that of NO₂. However, 30 ppb O₃ is 3000 times the mixing ratio of 10 ppt NO. How does this influence the LOD for NO ?

P1567 L2 0.3 % is better than 3 pptv ?

P1568 The measurements rely on zero air for ring down times in the absence of NO₂. How do you know that the “zero air” has zero NO₂. 50 ppt of NO₂ is not untypical in zero air. This implies an underestimation of NO₂ by the amount in the “zero air” bottle, which is an important source of potential error at low NO₂ mixing ratios.

P1575 calibration The inlet transmission (calibration) for NO₃ is performed using several ppbv of NO₃. NO₃ at these high levels could have a passivating effect on the walls (e.g. oxidation of organics) and thus result in lower loss rates than would be determined at an atmospheric mixing ratio of e.g. 20 ppt. How can you be sure that this loss

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rate is transferable. I guess that simultaneous measurements of N₂O₅ and equilibrium calculations could help here. Might be worthwhile mentioning this aspect.

Fig 5 caption. "The N₂O₅ calibration is 99 %" (transmission is 99 %)

Fig 6. The upper and lower captions appear to have got muddled (integration time on log scale ?)

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 1555, 2011.