Interactive comment on “Diode laser-based cavity ring-down instrument for NO$_3$, N$_2$O$_5$, NO, NO$_2$ and O$_3$ from aircraft” by N. L. Wagner et al.

Anonymous Referee #2

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The authors present a new, two-colour, laser-diode-powered multi-channel CRD set up for airborne measurement of NOx, NO$_3$ / N$_2$O$_5$ and O$_3$. The device combines features of previously described ∼400 nm laser-diode instruments for NOx and O$_3$ and also presents for the first time use of 662 nm laser-diodes for the NO$_3$ and N$_2$O$_5$ 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 “NO$_3$ then”

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 NO$_3$ in remote or rural locations. NO is also not a DIRECT sink for N$_2$O$_5$. 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 O$_3$ cross section is 10000 times smaller than that of NO$_2$. However, 30 ppb O$_3$ 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 ppthv ?

P1568 The measurements rely on zero air for ring down times in the absence of NO$_2$. How do you know that the “zero air” has zero NO$_2$. 50 ppt of NO$_2$ is not untypical in zero air. This implies an underestimation of NO$_2$ by the amount in the “zero air” bottle, which is an important source of potential error at low NO$_2$ mixing ratios.

P1575 calibration The inlet transmission (calibration) for NO$_3$ is performed using several ppbv of NO$_3$. NO$_3$ 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...
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 muddied (integration time on log scale?)