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Atmospheric
Measurement
Techniques
Discussions

# *Interactive comment on* "Characterizing a Quantum Cascade Tunable Infrared Laser Differential Absorption Spectrometer (QC-TILDAS) for measurements of atmospheric ammonia" *by* R. A. Ellis et al.

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The detection limit of the QC-TILDAS is estimated from plots of the Allen variance of standard measurements at rather high concentrations (ppbv range). As pointed out in the manuscript this is a technique suitable for conditions that are dominated by random noise, but Fig. 7c nicely shows that most probably this is not the case. Instead, background drifts are limiting precision and detection limit of the instrument. Have you checked the detection by other methods performed at low concentrations, i.e.

noise level at low ambient concentrations of the reproducibility of zero gas background measurements?

We have also calculated Allan variance for ammonia-free background gas measurements and achieved the same results as with the 4 ppb NH3 standard shown in Figure 2. However, one might get a different result if the relative humidity of the gas were changed with constant ammonia or if the temperature of the instrument were changed. These are probably the biggest factors that affect the baseline drift. The detection limits inferred from Figure 2 should be obtainable with frequent backgrounds using an ammonia removal technique that does not perturb the humidity. We may also use the standard definition of detection limit (3*$\sigma$ of the blank) where sigma is the Allan variance for the averaging time used. For the data in Figure 2, this would result in a detection limit of 0.7 ppb for a 1 s measurement.

Although, you give numbers for the precision and the detection limit of the instrument, you should also provide an estimate for the total uncertainty of ambient NH3 measurements, including effects such as instrument drifts, inlet transmission and memory effects, and accuracy of standards.

Uncertainty in our measurements may arise from uncertainties in the permeation tube source, stability of the permeation oven, the laser output voltage dependant correction factor we use based on our calibrations, the measurement of the temperature and pressure in the optical cell and the spectroscopic data given in the HITRAN database. Of all these, the biggest source of uncertainty should be the output of the permeation tube source, which can be determined offline using an ion chromatograph to better than 10%.

The discussion of Figure 6 should include some information on the nature of the correlation fir (single- or double sided fit) and fit errors to slope and offset to allow the reader to judge on the significance of differences between the two instruments. Here again, a measure for the total uncertainty would help.

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The original plot was made using a single sided fit. However, in response to the reviewer comments we reanalyzed the data using a double sided fit using the methods described by Cantrell (2008). We used an iterative bivariate least-squares method that takes into account errors in both x and y. We achieved a slope of 1.031 ± 0.002, R2 of 0.85 and offset of -0.392 ± 0.005 using 1 minute averaged data.

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Interactive comment on Atmos. Meas. Tech. Discuss., 2, 3309, 2009.

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