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Atmospheric Measurement Techniques Discussions

Interactive comment on "The development and evaluation of airborne in situ N₂O and CH₄ sampling using a Quantum Cascade Laser Absorption Spectrometer (QCLAS)" *by* J. R. Pitt et al.

Anonymous Referee #1

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The manuscript by Pitt et al. describes the deployment of a commercial quantum cascade laser absorption spectrometer on an atmospheric research aircraft. Measurements of nitrous oxide and methane are reported and both laboratory and in-flight data are used to evaluate the total uncertainty of the data. Deployment of QLAS on an aircraft in general suffers from changing environmental parameters. Here the dependencies on changing ambient water vapor concentration and cabin pressure, are investigated in detail. In general the paper is suitable for publication in AMT. It is well written and should be published after some minor modifications.

From my point of view it seems that the strong dependency of the cell pressure on changing ambient pressure could be avoided. Why don't you use a forward facing inlet? The additional ram pressure would result in a wider dynamic range over which the cell pressure could be held constant. Also, the cell pressure of ca. 70 hPa could be further reduced, which would also enhance the dynamical range and reduce the pressure broadening of the absorption line, without affecting the sensitivity strongly.

In the chapter dealing with the water vapor correction the authors use two different methods to correct ambient data in order to achieve dry mole fractions of the trace gases under investigation: laboratory measurements with humidified standard air and simultaneous QLAS based H2O measurements. I would assume that the laboratory results should be representative of all processes affecting the measured volume mixing ratio (density and pressure broadening effect). Nevertheless it seems that the "calculated" correction is superior. Why is that?

I am quite surprised that the dependency of the measurements on changing cabin pressure is so strong. Although we also observe some dependency of the optical alignment on pressure changes, this effect is much smaller in our set-up. I wonder whether there are other factors that affect the measurements here. Unfortunately, detailed information on the pressure regulation ahead of the cell and the pressure measurement in the cell itself are not provided. Pressure measurements in general depend on the kind of sensor used and in our experience often suffer from changing environmental conditions (T,P). Is the pressure reading of the sensors used in your set-up absolute or relative to ambient pressure? In the later case, the strong dependency on cabin pressure might be due to pressure measurement principle.

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