Atmos. Meas. Tech. Discuss., 7, C1410–C1413, 2014
www.atmos-meas-tech-discuss.net/7/C1410/2014/

Atmospheric Measurement Techniques Discussions
Open Access

AMTD
7, C1410–C1413, 2014

Interactive Comment

Interactive comment on "Rapid, optical measurement of the atmospheric pressure on a fast research aircraft using open-path TDLAS" *by* B. Buchholz et al.

Anonymous Referee #3

Received and published: 25 June 2014

Review of Buchholz et al., AMTD, 2014

This manuscript is an innovative and thorough description of an in-situ, optical-based pressure sensor using ambient water vapor spectra. The basis of the approach is measuring the spectra of the ambient water vapor and comparing the observed lineshape to experimentally-measured spectral properties. The lineshape is a complex function of broadening terms (superposition of Gaussian and Lorentzian shapes, which yield a Voigt linewidth) – foreign, self-broadening, collisional, velocity. Because the lineshape is so strongly determined by collisional (foreign) broadening, the authors show that by accounting for temperature effects on the lineshape and the effects of self-broadening,

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

the ambient pressure can be retrieved. The authors show that an accurate retrieval of temperature – which is difficult to measure on an aircraft intrinsically – is not necessary for the quoted accuracy of the pressure measurement (150-800 hPa of $\sim$ 3-5%). For example, an error of 7 K in the temperature leads to an overall uncertainty of 5.1% in the retrieved pressure. While this may seem large to some in the research aircraft community, the authors make a good point (here they demonstrate it with pressure) that nominal state specified sensors on an aircraft are only good under some "nominal" flight conditions – so in this regard, I find the 7 K temperature uncertainty to be realistic in extreme conditions. And yet such a large uncertainty still allows for an accurate pressure retrieval. Overall, I find the manuscript to be excellent and only have a few comments/questions that may help in the final editing.

Section 2.1 to 2.2, esp p. 4780, line 13-16 / Figure 1: A more detailed description of HALO would be helpful since no reference exists for this instrument. Sections 2.1 and 2.2 have been published in detail by the authors (and others) whereas HALO has yet to be described in any detail. Figure 1 is generic to any laser-based measurement and serves little purpose. I recommend including a more detailed schematic of HALO itself – a short summary of its design/components (e.g. how large is the pylon, what is the pathlength, how long of a fiber is needed, how far the pressure sensor is mounted above fuselage and below the optical cell; what are typical detector signal voltages in-flight). The photo of Fig. 6 was helpful but is really tiny – more general information is needed. For example, I had a hard time understanding about the "rectangular" pressure sensor (MMP) and why it would have lower pressure. I certainly understand how the airflow rapidly goes around the pylon and thereby decreases the pressure, but then a square interface in that flow should cause RAM pressure and increase it. I clearly don't understand the geometric design, and these matters are important in interpreting the data – or at least need clarity to those unfamiliar with the HAI pylon/instrument. I understand a full instrument paper for HAI is forthcoming, but given that it isn't available to the community, some general information is needed for this manuscript to stand alone.

Sect. 2.3: modeling and modeled (spelling – check elsewhere, too)

End of section 2.5: Can the authors quantify how clouds/optical disturbances would increase the width and hence pressure uncertainty? What are typical detector signals in-flight, and how often do they get to a value in which the pressure retrieval would be affected (e.g. if a typical voltage is 5 volts, then how does the SNR change at 1 volt, 0.5 volts, and 0.1 volts – perhaps only quote the lowest 10% of signal strengths or some other relevant matter – but the authors probably have some idea on this).

p. 4791, line 26: HAI (capitalization)

p. 4793, line 9: Because select people cite a number out of context, I would emphasize here again that the detection sensitivity is only for the 1.4 micron channel and the 2.6 micron channel has higher sensitivity for water vapor. This is especially true since there is no HAI paper yet, and people may be desperate to quote a published number (even if that is not the point of this paper).

p. 2795, line 7-9: solar radiation isn't quantified at all – can the authors bracket a typical solar signal or variance in the background radiance from their existing flight data (e.g. a circle over a clear sky ocean)? Does it typically change the detector signal by 1%, 0.1% or ???

Fig. 3 caption: Use "Example" or "Select" instead of "exemplary".

Fig. 7 caption and elsewhere: "It has to be kept in mind that the gas flow is passing through the open-path cell at approximately 900 km/hr". This has been mentioned numerous (six) times in the text and doesn't need to be repeated continually (once at the start, or to really emphasize a key point later, perhaps). High speed aircraft work is hard, no one will argue this – but the continual references distract from the work.

Fig. 8: The atmospheric science community of AMT will not be surprised that H2O measurements for the troposphere need to be on a log-scale – so an exclamation point isn't necessary.

Can the authors in the conclusions make any extrapolations to expected performance (improvement) of the pressure measurement at high altitudes (P<200) due to the higher SNR of the 2.6 micron line? Is there hope for measurements in the 130-200 hPa range with accuracies of <3% (note a 9 hPa offset at 130 hPa is getting large).

Overall, the paper will provide a benchmark for optical pressure sensing on airborne aircraft and also provides means for future improvements (using a gas with steady concentrations like CH4, N2O, or CO2 – though probably not possible on HALO due to other constraints). I enjoyed reading this immensely and found it innovative.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 4775, 2014.