Atmos. Meas. Tech. Discuss., 5, C2175–C2178, 2012
www.atmos-meas-tech-discuss.net/5/C2175/2012/

Atmospheric Measurement Techniques Discussions

Interactive comment on "An airborne amplitude-modulated 1.57 μm differential laser absorption spectrometry: simultaneous measurement of partial column-averaged dry air mixing ratio of CO_2 and target range" *by* D. Sakaizawa et al.

C. Frankenberg (Referee)

christian.frankenberg@jpl.nasa.gov

Received and published: 13 September 2012

The manuscript by Sakaizawa et al presents some interesting and encouraging results from airborne campaigns using amplitude-modulated differential laser absorption spectrometry (LAS). Especially the range detection system seems to work very well and results seem robust and scientifically sound (though I cannot judge the instrument

section, which should be evaluated by a differential laser specialist). The manuscript is well suited for AMT and I recommend publication after some minor comments are taken into account:

Specific comments:

Nomenclature: I find the symbol q (with a bar) somewhat misleading, why not use XCO2 as column averaged mixing ratio (as is done in most of the column average remote sensing and ground-based community)? This would help avoid some misunderstandings (even though you only plot partial columns but you could indicate this by a superscript indicating the actual height up to which is integrated)

Page 4852:

Line 7: The high correlation is mainly caused by variations in topography, not CO2. Depending on the kind of terrain you are flying over, it is very easy to get good correlations but is not necessarily a proof that you can measure XCO2 well (see later comments)

Line 13: "highly distributed": do you mean "enhanced"?

Line 17: Please provide a reference for this statement, it seems rather vague and not fully justified.

Page 4853:

line 5: There are more original references to GOSAT (e.g. Kuze et al and Hamazaki et al; you have GOSAT scientists on the team, please consult with them

line 9: precision or accuracy?

line 17: Please rephrase, it sounds as if NIR spectrometers are essentially useless (which is not the case).

line 25: "at a specific position *to* less than..."

Page 4855

line 20: iwf is a somewhat unfortunate symbol I think.

Page 4856

Line 2: Water vapor may be highly variable. What is you estimated error induced by this uncertainty (same holds for changes in surface pressure)?

Page 4861:

line 24: spectroscopy error of "0.13%"! How do you you know this error to two digits? It seems very low. How would a deviation from a Voigt line-shape (speed dependent line-shape, line-mixing, etc) play into your retrieved column?

Page 4862

line 8: Did you plot sub-columns in Figure 9? I.e. did you also integrate the profile for the in-situ data (up to the respective height of the LAS system)?

line 17-18: "return from nearby airplanes": don't understand what you mean

Page 4864

line 3: "significant similarity": You didn't really show this yet though I think you should be able to easily do this. First of all, it is somewhat unclear what you mean by q profile (as all of those are subcolumn just with a different integration ceiling). Looking at your figure 9 and table 3, you should be able to create a correlation plot of XCO2(LAS) and XCO2 (VAL) using datapoints for different days and flight altitude (ideally, days and heights are somehow visible in such a scatterplot, e.g. by using different symbols per day and height indicated by color-scaling). If you can show how well these correlate (maybe exclude the 2009 flight as it has so much less CO2), you can really strengthen the manuscript and corroborate your claims (with the naked eye, it looks like they should but it is not easily obvious from your plots).

Figure 5 (and 6): Is the lowest panel really the difference between the two curves in the second lowest panel? differences of only about 20m seem very low and judging

by eye, the scatter looks larger. Also: How many XCO2 measurements did you get per day? Judging from Fig 5, you should be able to record quite a lot per day but you don't seem to show them. Why can't you show a plot like Fig 5 and 6 and also plot the retrieved XCO2 along the track? This would make it much more convincing, otherwise it looks like some data points are "hidden". This is a crucial point I think! If noise is an issue, you can smooth the XCO2 time-series.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 4851, 2012.