Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2017-40-RC2, 2017

Atmospheric Measurement Techniques Discussions
Open Access
EGU

Interactive comment on "The arctic seasonal cycle of total column CO_2 and CH_4 from ground-based solar and lunar FTIR absorption spectrometry" *by* Matthias Buschmann et al.

D. Wunch (Referee)

dwunch@atmosp.physics.utoronto.ca

Received and published: 20 March 2017

Buschmann_2017

This paper describes a new set up at the Ny Alesund NDACC/TCCON station to permit near infrared measurements of reflected sunlight off the moon. The authors installed a cooled InGaAs detector for this purpose (instead of the typical room-temperature InGaAs at most TCCON stations) and performed detailed analyses of the tradeoffs between spectral resolution, signal-to-noise ratio (SNR) and retrieved XCO2 and XCH4 abundances. They settled on a resolution and field stop size and recorded lunar measurements for several years. They then compared the lunar measurements to solar measurements during spring and autumn, and to models. The lunar measurements

Printer-friendly version

Discussion paper

are less precise and accurate than the solar measurements (as expected), but it appears as though, at least in the case of XCH4, that the lunar measurements may provide some interesting constraints on Arctic methane seasonal cycle amplitude.

General Comments:

The language needs tightening - some technical concepts that are specific to TCCON or Bruker 125HR instruments that may not be familiar to the wide AMT audience are glossed over and should be written in a clearer, more general way.

Night time validation with aircraft or AirCore profiles would be best, but appear to be unavailable (at least, they are not mentioned in the manuscript). Perhaps this should be mentioned in the discussion or conclusions section.

In Figure 14, you compare the XCH4 seasonal cycle from your lunar and solar measurements to the MACC model. It shows significant disagreement in summer, but not in winter, showing that the model isn't able to properly reproduce the Arctic methane seasonal cycle amplitude. Do you have any idea why? This, to me, is one of the most interesting figures/results of the paper.

Specific/Technical Comments:

P1L4: The moon isn't a light source - it's reflected sunlight off the moon.

P1L5: I don't think you mean "parallel".

P1L23: You don't need extended InGaAs detectors to measure above 5000 cm-1.

P2L18: Do you use the solar brightness fluctuation corrections for high cirrus typically employed by TCCON (embedded in I2S for DC-recorded interferograms)?

P2L22: 0.04 what units? mrad?

P2L22: This sentence may be too technical for this audience. Explain that this ME and phase error are consistent with a well aligned instrument.

L25-35: This is too technical - please explain further.

P4L11: Rework sentence beginning with “Generally speaking, . . .”

P4L14: The entrance aperture wasn’t always 3.15 mm? Please explain.

P7L1: Please note that the large deviations are at very high SZA that would be filtered out in a typical TCCON filter. Could you make this plot for days with lower SZAs? Does it look the same?

P7L11: This worry no longer holds, given that Bruker has provided two solutions to the ghost problem (the laser sampling board potentiometer and the new M16 controllers with the XSM option), and TCCON provides a ghost removal procedure with I2S, as long as you measure simultaneously on another detector with a spectral range that is entirely within a single alias. In fact, I believe Bruker recommends 20kHz as their preferred scanner speed.

Fig 5: I see what you’re trying to do with this figure, but I find it very difficult to read and interpret quantitatively. Perhaps you also need to show example slices through the 3D figures showing XCH4 vs resolution and XCH4 vs SNR.

Fig 6: Would the x-axis scale work better as a log10 scale? Also, with the low SNR error bars as large as they are, it’s difficult to see what the mean value is as a function of resolution. Perhaps you need to reduce the y-axis limits and show a representative error bar.

P10L10: The averaging kernel also depends on the retrieval methodology.

P12L1: Can you assume that the total columns do not change significantly during the 24-hour period? What about drawdown from the terrestrial biosphere throughout the day and respiration at night? Is night time respiration a feature of the carbon cycle you can hope to measure with your lunar measurements given the precision of your measurements? The y-axis scale is too large in Figure 9 to see whether there is any diurnal cycle in your data and models. Ditto for Figure 10.

P14L25: Remove the comma after “both”.

P14L25: The models don’t capture the secular trends in XCO2 and XCH4? Why not?

Fig 13, 14: I don’t see any green dots.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-40, 2017.

Printer-friendly version

Discussion paper