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Atmospheric Measurement Techniques Discussions

Interactive comment on "Retrieval of xCO₂ from ground-based mid-infrared (NDACC) solar absorption spectra and comparison to TCCON" *by* M. Buschmann et al.

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We would like to thank the referee for the comment. We acknowledge that we should have pointed out the differences to the Barthlott et al. 2015 paper that make our analysis distinct from the previous work in more depth.

Barthlott et al. performed a study on NDACC and TCCON spectra with the goal of establishing a new method for monitoring the long term stability of the FTIR spectrometers. To achieve this, they propose to retrieve xCO2 from mid-infrared spectral win-

dows and compare the results to expected values for xCO2 that are calculated using a simple model. In principle they use the MIR xCO2 time series to obtain information about the instrument, not the atmospheric state.

In Section 2.2 Barthlott et al. conclude that the low sensitivity of the MIR averaging kernels in the lower troposphere is sufficient to perform comparisons to the model on longer than monthly time scales, and therefore appropriate for monitoring instrument stability. We, however, investigate the suitability of the MIR product as a direct substitute for TCCON measurements, that could also complement the existing time series. The annual increase of xCO2 is already well known and in order to gain new insights, information on shorter time scales needs to be compared with model data. We show that this information cannot be obtained from the MIR spectra.

In Section 4 the comparison of their NDACC (fixed and varying prior) and TCCON (varying prior) products are presented. The analysis of systematic differences is performed using monthly means. The dampening of the seasonal cycle amplitude is proposed to be addressed using a dampening factor derived from the shape of the site's pressure profile. Although this is adequate for the paper's goal of monitoring instrument stability, a complete analysis of the different sensitivities of the MIR and NIR retrievals is necessary for the retrieval of information relevant to carbon cycle research.

In our study we show that the strong influence the choice of the prior has on the retrieval results originates from the large difference in the shape of the averaging kernels in MIR and NIR, using the same retrieval code in both cases. The information content of the MIR total column retrieval is simply too small in the troposphere to constrain the prior adequately. We continue to show that the application of appropriate averaging kernel smoothing can not resolve this issue. This was not done in the Barthlott et al. 2015 paper and is a necessary step in proving that a direct substitution of a NIR xCO2 product or usage of the MIR product as a complementary source of information is not possible.

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We agree that the NDACC FTIR measurements are valuable and a profile retrieval approach to obtain partial columns might benefit carbon cycle research, as stated in our conclusions. It should be noted, however, that such an approach would also only give these partial columns reliably on monthly-yearly time scales with the precision and accuracy necessary for tropospheric carbon cycle science.

To conclude, we argue that there are significant differences between the two studies (Barthlott et al. 2015 and this one) and the publication of this work is indeed justified.

Citation: Barthlott, S., Schneider, M., Hase, F., Wiegele, A., Christner, E., González, Y., Blumenstock, T., Dohe, S., García, O. E., Sepúlveda, E., Strong, K., Mendonca, J., Weaver, D., Palm, M., Deutscher, N. M., Warneke, T., Notholt, J., Lejeune, B., Mahieu, E., Jones, N., Griffith, D. W. T., Velazco, V. A., Smale, D., Robinson, J., Kivi, R., Heikkinen, P., and Raffalski, U.: Using XCO2 retrievals for assessing the long-term consistency of NDACC/FTIR data sets, Atmos. Meas. Tech., 8, 1555-1573, doi:10.5194/amt-8-1555-2015, 2015.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 10523, 2015.