Atmos. Meas. Tech. Discuss., 7, C1391–C1393, 2014
www.atmos-meas-tech-discuss.net/7/C1391/2014/

Atmospheric Measurement Techniques Discussions

Interactive comment on "A DOAS-like method for total column of CO_2 from ground-based FTS measurements of the direct solar beam" *by* Y. F. Huo et al.

Anonymous Referee #2

Received and published: 23 June 2014

Overview

The paper by Huo et al reports on data from an FTS at the Xi'Chong astronomical observatory and introduces a new method for XCO2 analysis. Because of China's critical role in future CO2 emissions and hence climate impacts, data from China and reports by Chinese authors are a very welcome addition to this important topic. This paper however has a number of shortcomings that need to be addressed. The level of their English is quite poor, and therefore at times difficult to follow. The comparison of their new method against an optimal estimation method would be fine if the latter method was described. The authors test their new method against GOSAT data, but

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strangely do not use the well-established TCCON algorithms on the same FTS data. These issues must be addressed by the authors before this paper can be published in AMTD.

Detailed Response

The specific issues will now be addressed in detail.

1) There are too many basic grammatical errors in the paper to be corrected by the referee. The authors must rewrite the paper to a suitable standard.

2) The authors refer to an optimal estimation method. The paper does not address any details about how they implement this comparison method. Is this similar to the optimal estimation methods used by the closely related NDACC network, namely SFIT4 and PROFFIT? Incidentally, the method used by TCCON, using the GFIT suite of software, is a non-linear least squares fit. A more basic question is why develop such a method in the first place. Is it the intention of the authors to use this DOAS like method instead of a full line-by-line radiative transfer calculation used by GFIT?

3) New method: for the new method to be acceptable to the community, and by this it is meant the TCCON community, it must be demonstrated that this new derivation of XCO2 has at least the same precision and accuracy as the current dry-air-mole fraction (XCO2). The authors do not formally define what they mean by XCO2 in the paper; it is introduced in equation 9 but not clearly defined. This also applies to NCO2, which is not the number of CO2 molecules as stated on line 5 of page 2409, but the column (molecules cm-2). While the surface pressure is known quite accurately and in principle is more precise than the O2 column, by ratioing the CO2 column by the O2 column there are a number of systematic errors that are removed (for example pointing errors of the solar tracker and instrument lineshape errors to name two). This is the method adopted by TCCON so how does this modified DOAS method deal with these issues?

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4) This leads to another issue with the paper; while it is good and necessary to compare their derived XCO2 with GOSAT (section 4), it would make much more sense to also compute the XCO2 as derived with the official TCCON software. The software is freely available. A direct comparison of the two different ground-based XCO2 products would be very instructive exercise for the purposes of this paper. The authors should also note that the Bruker 125M instrument is not currently an accepted instrument for TCCON work as it does not meet the strict TCCON requirements, rather, the Bruker 125HR is used throughout the network.

5) Why would the selection of channels eliminate aerosol scattering effects? If this data is in the direct solar beam then these are very much minor effects, which can be ignored. Given the comments above about the use of O2 to produce an XCO2 as defined by TCCON, would it not be possible to modify the approach here to select appropriate pairs of lines in the O2 band and produce an XCO2 that would eliminate the systematic errors also alluded to above? This would be another interesting exercise and an important test of this method.

6) Why does the optimal estimation method, as it appears in figures 5, 6, and 7 have less sensitivity to temperature and pressure? There are no details given on the optimal estimation, but in principle the method should be sensitive to the spectral information like any other method depending on how it is implemented of course. This needs to be fully described.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 2405, 2014.