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Atmospheric Measurement Techniques Discussions

Interactive comment on "Atmospheric column CO_2 measurement from a new automatic ground-based sun photometer in Beijing from 2010 to 2012" *by* Z. Q. Li et al.

Anonymous Referee #2

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This paper treats a topic of high relevance: the development of novel ground-based instrumentation for measuring atmospheric XCO2. Simple, robust, and affordable instrumentation is required to achieve a significantly improved global coverage of ground-based XCO2 records. The Total Carbon Column Observing Network (TCCON), which currently provides the reference XCO2 dataset applies high-resolution FTIR spectrometers. The TCCON dataset is of utmost importance for satellite validation and inversion studies. However, the approach applied by the TCCON stations, as Li et al. correctly state, is not a promising candidate for a future global XCO2 observation network with a considerably better sampling density. The spectrometers used by TCCON are expen-

sive, immobile, require regular qualified on-site maintenance and rely on a considerable logistic infrastructure.

Therefore, if XCO2 measurements of useful quality would be achievable with the simple sun photometers investigated by Li et al., this would be a remarkable achievement. Unfortunately, the current version of the paper fails short to provide a reasonable proof for this claim. The authors do not make any serious attempt to derive a useful XCO2 product from their raw spectral data, instead, they simply discuss a “difference absorption index” (DAI), without establishing a connection of this quantity with a meaningful physical result. In my opinion, the correction of the airmass dependency would be a minimum requirement to enter into a sensible discussion of diurnal or seasonal variations and a model comparison.

Error sources and cross sensitivities which are likely inherent to the method presented are all covered by the huge airmass-induced variation of DAI (e.g. H2O column, ground-pressure, temperature profile, instrumental problems, e.g. spectral shift of filter response as fct of ambient temperature). However, to rank the sun photometer among the serious candidates for a network method, an XCO2 precision in the order of < 0.25% needs to be demonstrated.

No attempt is made to relate the own investigations to relevant prior work. It is not clear to me whether the authors are aware of e.g. the following contributions:

Kobayashi et al.: "Remotely operable compact instruments for measuring atmospheric CO2 and CH4 column densities at surface monitoring sites", AMT, 2010

Petri et al.: "Remote sensing of CO2 and CH4 using solar absorption spectrometry with a low resolution spectrometer", AMT, 2012

Gisi et al.: "XCO2-measurements with a tabletop FTS using solar absorption spectroscopy", AMT, 2012

In my opinion, in contrast to earlier studies, it becomes pretty clear that sections 3.2.2

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and 4 of the paper do not meet the state of the art. Therefore, I cannot recommend publication of the current version of the paper in AMT.

Major revisions required:

1) As pointed out by anonymous referee #1, the use of English needs significant revision.

2) Insert a new section following 3.2.2: explain how to further process a DAI to achieve an estimate of the CO2 column.

3) Insert a new section concerning error estimation and internal consistency before section 4. A few items: how consistent are CO2 columns derived from different combination of channels (different DAIs)? Do the CO2 columns behave as expected (the CO2 column should correlate with ground pressure)? In the next step, calculate the XCO2 (using ground pressure and H2O column): is there an apparent unphysical correlation between XCO2 and H2O column or airmass?

4) In section 4, discuss the XCO2 results indicated by your measurements. It is improper to interpret DAI values as if they were XCO2 values.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 8313, 2012.