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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 #1

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Comment on Li et al (2013) "Atmospheric column CO2 measurement from a new automatic ground-based sun photometer in Beijing from 2010 to 2012" for AMT

This paper by Li et al reports on measurements made with a sun photometer system at a site in China. While the instrument itself is not unique, the spectral data is, through a series of filters, effectively a very low resolved spectrum. The authors describe the system, data quality (cloud removal), and then develop a relative index to relate the observed CO2 absorption (in a single channel) to a background. This index (DAI), is then interpreted in terms of perceived changes in daily and annual CO2. A validation of

sorts is undertaken with respect to the model CarbonTacker. The potential usefulness of this work is the possible deployment of a large number of automatic and low cost sensors as a ground network for CO2 validation of satellite data, a task that is currently undertaken by the sparse TCCON network.

While such a network of new sensors would be invaluable to the CO2 community, this paper has a number of short comings that need to be addressed. A major issue concerns the analysis procedure used in the paper and what it actually provides in terms of useful measure of CO2. The standard of English in the paper is highly variable, with some sections acceptable, while other large sections of the manuscript need significant re-writing. In general the paper is quite well organised, and figures clear and concise. This is an interesting paper which addresses an important area of CO2 measurements. The dataset is very useful in terms of where low spectrally resolved measurements fit in with current ground based measurement techniques. If a more careful analysis was done addressing the points made below, this paper could make a valuable contribution to this effort. This manuscript is therefore not currently acceptable for publication in AMT until the following issues are addressed:

1. The DAI index seems to represent the slant column CO2 amount. At no point in the manuscript do the authors mention that they have taken into account the fact that since their measurement is direct sun, the CO2 column that needs to be computed is the vertical column. This can be done either through a radiative transfer model, or more simply, an off-line airmass calculation given the known location and time of the measurements. Until this is done, the CO2 presented here is driven mostly by airmass dependence. This particular issue therefore affects all subsequent discussion in the manuscript with respect to diurnal, seasonal and model comparisons.

2. So, based on issue 1) above, the comparison with CarbonTacker invariably is comparing the dry air mode fraction (xCO2) against a slant column (figure 10). The correlation is largely driven by the seasonal cycle in the airmass rather than changes in the XCO2.

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3. Since this is a measurement paper, there must be a full description of the errors. This not addressed at all in this paper.

4. The authors use MODTRAN to compare a spectrum with the filter curves (figure 5). Why not produce a spectrum from MODTRAN at the effective resolution of the filters? By inspection the filter widths are about 4 nm (or around 16cm-1). In doing so this would be very instructive; this would show how the filters are sampling the CO2 1.6 micron band, how independent the base filter is, and more importantly, potentially provide a forward model that could be used in the analysis.

5. The use of English throughout the manuscript needs significant improvement. There are too many sections that need a complete rewrite that makes it untenable for any referee to attempt correction.

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