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Discussions

Interactive comment on "Investigating the performance of a greenhouse gas observatory in Hefei, China" *by* Wei Wang et al.

Anonymous Referee #1

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This paper introduces a new greenhouse gas observing station in Hefei, China. Having high quality ground-based measurements from this part of the world will be very interesting to the carbon cycle scientific community, once the data are made publicly available.

The paper clearly describes the instrument setup and some promising preliminary comparisons with GOSAT and OCO-2 measurements of XCO2. The authors also show a brief analysis of CO2/CO ratios from the Hefei data.

General comments:

Do your InSb spectra show any signs of nonlinearity (e.g., zero level offsets in saturated windows)? I would be surprised if there were no signs of nonlinearity using such a large wavenumber range on a single detector. There do seem to be signs of continuum

curvature in your spectral fits with the InSb detector (Figs 8 and 9 especially) which could impact your retrievals. I would be cautious using the results generated from the InSb spectra in scientific analyses.

I see a couple of potential problems with your tracer-tracer analysis. To look at these sorts of tracer-tracer slopes over the course of more than one day, you need to remove the seasonal cycle and long-term trends in the data, and thus most analysis of this type is done using anomalies. Furthermore, TCCON (or TCCON-like) data are subject to airmass dependencies due to spectroscopic line list inadequacies, which are removed to first order by an airmass-dependence correction. There are residual airmass dependencies that remain in the data after correction, and these can influence your tracer-tracer slopes. Computing daily anomalies by subtracting data in the morning at a given airmass from the afternoon data at the same airmass further reduces the possibility of spuriously folding airmass dependent errors into your tracer-tracer relationships. In light of this, please rework this section of the analyses.

Technical comments:

L16-18: I'm not sure whether the two numbers are for the two seasons, or the two separate years. Please clarify: "The CO2/CO correlation slope was 126.62 and 94.32 ppm/ppm in winter and spring for 2014-2015 and 2015-2016, respectively."

L61: Define all acronyms.

L62: There's no need to mention that OCO-2 is a set of grating spectrometers when you don't mention the instrument types of GOSAT and SCIAMACHY.

L67: add (FTS) after "Fourier transform spectrometers"

L75: Please explain where the 0.1% number comes from.

L77: Where is the accuracy claimed to be 1%? Is this before bias correction or after?

L90: I agree that a TCCON station in China would be very helpful, but you aren't

claiming your data are "TCCON" data in this paper. For your data to be considered to be part of the TCCON dataset, your data must be delivered to the TCCON archive, inspected to ensure the dataset is of high quality and distributed freely to the public. I strongly suggest that you take these additional steps - it would strengthen the paper and make the dataset much more scientifically valuable.

L127: How frequently is "regularly"? How many lamp spectra are recorded for each cell measurement? Is the HCl cell in the solar beam as well (as strongly recommended by the TCCON data protocol: https://tccon-wiki.caltech.edu/Network_Policy/Data_Protocol#Requirements)? Did you take lamp measurements with the HCl cell in place with the InSb detector? Those results would be interesting as well.

L128: The latest version of LINEFIT that I'm aware of is LINEFIT 14.5. I suggest you redo your ILS analysis with LINEFIT 14.5 to ensure that the results are consistent with your LINEFIT12 results, unless you have a reason to believe the LINEFIT12 results are superior.

L136: Are these forward and backward scans averaged together or processed separately (as recommended)?

L159: Explain what you mean by "O2 as an internal standard".

L168-169: I hope you are using the GGG2014 software suite; please state this clearly. In the GGG2014 software, the "calibration factor" is 0.9898 for XCO2. What factor did you use for XCO?

L212: The phrase "scanner failure" is a technical term that is likely understandable only to those who use FTS instruments regularly. I recommend either defining what a "scanner failure" means, or just saying "instrument mechanical failure".

S5.2: I'm not sure why you are showing columns in molecules/cm^2 instead of Xgas amounts. What additional point are you trying to make that could not be made showing

Xgas and Xair?

S5.3: This section needs editing for grammar.

L232-233: Please include uncertainty estimates on these numbers.

L234-243: This is a confusing set of sentences. Please rework. The XCO2 measurements are sensitive at the scale of hundreds to thousands of kilometres, and thus the local growing season is not the only driver of the seasonal cycle. Respiration occurs at all times of the year. That the site may be influenced by regional anthropogenic emissions is interesting, and can be tested using CO2/CO anomaly analysis under the correct prevailing wind directions.

L259: Why is the seasonal amplitude larger in your measurements than in other TCCON stations at similar latitudes? It seems comparable to the Tsukuba station (L319), so please clarify this statement. Have you compared with the Pasadena (urban, 34N) and Dryden (rural, 34N) TCCON data?

L300: What does the 23-38 ppm/ppm indicate about the relative contributions of anthropogenic emissions and biospheric activities? How do I interpret the 107 ppm/ppm number in light of the previous studies?

S5.4: It would be helpful to see two additional plots with the Tsukuba and Hefei daily mean time series on the same axes. One plot for XCO2, the other for XCO.

L370: Clarify the phrase: "Although not all FTS spectra were collected for GOSAT overpass"

L371: Are you comparing the GOSAT data with the daily mean ground-based data? This may not be the best choice, since the GOSAT orbit is sun-synchronous with an equator crossing time of ∼1 pm local (Morino et al., 2011). A near-1pm or at least daily median value may be a better choice. Why do you not include a comparison of XCH4 with GOSAT?

L407: Is your coincidence criteria the same for OCO-2 as it is for GOSAT? Which Warn Level data did you select?

L420: This does not seem like a significant result, given that your error bars are so much larger than your biases. Unless I am missing something, I would suggest removing the analyses with the uncorrected OCO-2 data.

References: The Tsukuba TCCON data should be properly cited:

Morino, I., Matsuzaki, T., and Shishime, A.: TCCON data from Tsukuba, Ibaraki, Japan, 125HR, Release GGG2014R1, TCCON data archive, hosted by CDIAC, http://dx.doi.org/10.14291/tccon.ggg2014.tsukuba02.R1/1241486, doi:10.14291/tccon.ggg2014.tsukuba02.R1/1241486, 2014

Fig 12: In 150330-150930 time range, there are some significant outliers in Xair from the daily mean. What is the cause of those outliers?

Figs 18-19: Tsukuba should have a "b" in the name.

References:

Morino, I. et al. (2011), Preliminary validation of column-averaged volume mixing ratios of carbon dioxide and methane retrieved from GOSAT short-wavelength infrared spectra, Atmos. Meas. Tech., 4(6), 1061–1076, doi:10.5194/amt-4-1061-2011.

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