

Interactive comment on “FTS measurements of column CO₂ at Sodankylä” by R. Kivi and P. Heikkinen

Anonymous Referee #1

Received and published: 17 February 2016

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Discussion paper



Review of Kivi and Heikkinen: *FTS measurements of column CO₂ at Sodankylä* for Geoscientific Instrumentation, Methods and Data Systems

February 17, 2016

1 General Comments

The paper by Kivi and Heikkinen describes the FTS instrument that operates at Sodankylä as part of the Total Carbon Column Observing Network (TCCON). TCCON measurements play a valuable role in carbon cycle science, largely through validation of satellite retrievals of XCO₂ and XCH₄ and as independent validation of model simulations, but also providing insights in their own right. Satellites such as OCO-2 and GOSAT use TCCON as their primary validation source for retrievals of these gases, and therefore ensuring intersite consistency within the TCCON is critical in eliminating biases in the spatial and temporal distributions of the satellite-derived maps, and perhaps more critically in any flux estimates derived using the satellite retrievals. As the only site sitting on the edge of the Arctic, Sodankylä provides an important assessment of the consistency of the satellite retrievals at higher latitudes, especially as these are very limited at Ny Ålesund and Eureka, the only TCCON sites at higher latitudes.

In that regard, it is excellent to see a publication describing the Sodankylä TCCON site. This work seems to be well worthy of publication, and I can imagine it being a good fit for the special issue within Geoscientific Instrumentation, Methods and Data Systems. I recommend publication after addressing a variety of substantive and technical issues. Specifically, there are a number of locations where the paper is not specific enough, and more detail is desirable. I have the following general concerns:

- TCCON can retrieve column abundances of a number of gases, as is mentioned within the manuscript. However, the manuscript only focusses on CO₂. I can see no reason why it should not be expanded to include the other gases and provide a data reference/citation for the Sodankylä TCCON data.
- There are a few calculations that are described in words. It would be helpful to see the relevant ones expressed as equations, particularly the derivation of the quantity “xAIR” and the calculation of the dry pressure column used within that.
- It would be good to include a plot of comparison of Sodankylä TCCON data with CarbonTracker. CarbonTracker is openly accessible, and therefore could be included rather than referring to other work that is focussed on wider-scale comparisons.
- Given that network-wide consistency is critical to TCCON’s utility for satellite validation, it is encouraging to know that activities are taking place at Sodankylä to validate the TCCON measurements using AirCore. I feel like presentation of these results is critical to assessment of Sodankylä as a site within the TCCON, and essential to an encompassing description of the data. I do, however, appreciate that they may be reserved for a separate publication - I hope that some compromise can be found to at least show some example profiles as measured by the AirCore.

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Please also refer to the work by Hase et al (2013) on quantifying the impact of ILS errors on $x\text{CO}_2$ retrievals and specifically mention in the text the magnitude of these potential impacts.

2 Technical Comments

Rather than listing the numerous technical comments here, I include an annotated version of the pdf as a supplement. Please also address these comments.

3 References

Hase, F., Drouin, B. J., Roehl, C. M., Toon, G. C., Wennberg, P. O., Wunch, D., Blumenstock, T., Desmet, F., Feist, D. G., Heikkinen, P., De Mazière, M., Rettinger, M., Robinson, J., Schneider, M., Sherlock, V., Sussmann, R., Té, Y., Warneke, T., and Weinzierl, C.: Calibration of sealed HCl cells used for TCCON instrumental line shape monitoring, *Atmos. Meas. Tech.*, 6, 3527-3537, doi:10.5194/amt-6-3527-2013, 2013.

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