Review of Frey et al, *Long-term column-averaged greenhouse gas observations using a COCCON spectrometer at the high surface albedo site Gobabeb, Namibia*

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1 Overview

It is great to see the start of long-term measurements of ground-based column-averaged greenhouse gases from the African continent; these measurements promise to be a valuable addition for satellite validation and carbon cycle science. The measurements to compare between GOSAT M- and H-gain retrievals are rare, and it is useful to see previously observed biases confirmed. It will be good to see these data made available to the scientific community.

In general, the work presented here is of good quality. While the language could be improved in many places, I don't find that there are many instances where the meaning is unclear and therefore the paper is understandable.

I recommend publication to AMT after addressing a number of changes. None are major, but many are still important to address.

2 General comments

- Do you assess the Gobabeb data for potential airmass dependences?

- For the CAMS evaluation, one could argue that restricting based on solar zenith angle rather than time is a better approach. Did you consider this?

- While the paper is understandable, it could be revised to be a bit more clearly written.

- For comparisons, it would also be good to see some plots of the differences as well as the scatter plots or comparative time series.

- The comparisons to Reunion and Lauder TCCON sites are somewhat reassuring, but also complicate matters. This is particularly true for the period where X_{CO_2} disagrees between Gobabeb and Reunion, in early 2017. I find

the postulated explanation and evidence for this unconvincing. I'm not suggesting it isn't the correct reason, just that it's not well-enough supported. I therefore suggest that the authors focus on eliminating instrument problems as a cause of the difference, which should be easy enough given the other gases don't deviate and the X_{air} is stable. Then leave the potential explanation as a hypothesis only and something that warrants further investigation to link it to African biosphere fluxes. Otherwise, at least examination of the CAMS posterior fluxes should be included.

- I missed an explanation of the data gaps early in the time series.

- It might be useful to present time series of the COCCON-CAMS comparisons and their differences.

3 Specific comments

- l31: sentence order - switch unprecendented and values

- l32: delete "it was stated" and "that"

- l35: "directly" might be overselling as you would need more than just the measurements themselves, so perhaps delete that word

- l43-44: change to "and CO; however, the measurements ..."

- l52: instrument $\rightarrow$ network

- l84-85: do you have data to illustrate or support the high albedo?

- l96: "parts ... were"

- l122 - 129: as this is different, it would be good to highlight the differences, and be more specific about the quality control/filtering applied

- l144: good to know there are plans to extend comparisons to other sites

- l149: TCCON doesn't require 0.0035 cm^{-1} spectral resolution, and indeed some instruments don't have that.

- l156: you could update to reflect the Pollard et al (2021) publication comparing the Lauder instruments

- l171: fix location of "e.g." - either inside parentheses with the references, or bring the citations out of the parentheses.

- l181-184: a time-series plot of ME @ Max OPD might be nice to support your statements

- l184: "not self-evident" - please clarify/revise wording.

- l338: while I assume that the bias referred to is between all data and noon-only data, it's not 100% clear, as it could equally apply to bias relative to CAMS. I suggest reworking this sentence: "Although using all COCCON data results in only a small bias of 0.2 ppm for XCO_2 and 2 ppb for XCH_4 relative to the noon-only data, ..."

- l347: "The absolute values..." - sentence needs revision. "The biases between the CAMS model simulation and the Gobabeb measurements are presented in Table 4." (or something like that)

- l349-350: aren't the end of 2016 and beginning of 2017 the same? I suggest "At the end of 2016 into the beginning of 2017..."

- I suggest combining Tables 2 and 3 to make it easier for the reader to compare between M- and H-gains

- Figure 1 - I have 2 comments. Firstly some broader context would be useful. Secondly, while there are clearly visible differences between the terrain to the NE and SW of the site, it would be nice to have some indicative albedos at the relevant wavelengths.

- Figure 3 - X_{air} is not in arbitrary units - it should be mol mol^{-1} or similar (or even unitless, though mol mol^{-1} is more informative) as the numerator and denominator will both have units of molecules cm^{-2}.

- Several locations: data set $\rightarrow$ dataset. Same for the plural

- l379: put "with different surface albedos" before "close to"

- Figure A1 appears to be missing

4 References

Pollard, D. F., Robinson, J., Shiona, H. and Smale, D.: Intercomparison of Total Carbon Column Observing Network (TCCON) data from two Fourier transform spectrometers at Lauder, New Zealand, Atmos. Meas. Tech., 14(2), 1501–1510, doi:10.5194/amt-14-1501-2021, 2021.