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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Study of the footprints of short-term variation in XCO_2 observed by TCCON sites using NIES and FLEXPART atmospheric transport models" *by* D. A. Belikov et al.

Anonymous Referee #2

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This manuscript presents a new method for selecting satellite data for validation against the ground-based TCCON sites. This method is based on calculated footprints that represent the sensitivity of the site to surrounding CO2 concentrations. This new method is compared to simpler geographic-based data selection methods. This paper is methodologically sound but needs a few improvements in the description of the method, therefore, I recommend this manuscript for publication after minor changes have been made.

General comments

Method: more explanation of the FLEXPART modelling should be given. Specifically, which meteorological data were used, how the footprints are calculated and at what

temporal and spatial resolution. Also, how the NIES TM model was used to initialize the FLEXPART simulations.

The authors state that the TCCON observations are mostly sensitive to the lower troposphere, and that is why virtual particles were released at 1000 m. The authors however, do not take into account the vertical sensitivity of the TCCON measurements. What is the influence of assuming that the measurements are only sensitive to heights of circa 1000 m? Could the authors include a sensitivity test using multiple releases in FLEXPART to represent the averaging kernel?

The colocation methods are compared for different GOSAT retrieval products. If the footprint-based method is considered the most comprehensive colocation method, would it be useful for also validating/assessing the different retrieval products by comparing these against the TCCON data. It would be interesting to include this comparison between retrieval products in the manuscript. This would also make the manuscript of greater interest to the community.

Specific comments

P3, L4-8: Suggest adding the years when data are available from each satellite, e.g., SCIAMACHY was discontinued in 2012 and OCO-2 is only available since mid-2014.

P3, L28-32: I suggest that the authors make it clear here that the region and time period selected is for selecting the satellite data, just to make it unambiguous.

P4, L10-11: This sentence needs a bit more explanation. It should be stated that Bremen, Garmisch etc. are TCCON sites, and the acronym JPL should be explained. Also, it is not clear in which averages these sites are not included – is this a different method again, if so it needs explanation.

P4, L11-12: It looks here as though the authors forgot to remove their own comment?

P5, L4-5: It is unclear how the CO2 concentration fields from NIES TM are used to initialize the backward simulations with the LPDM. Also, the LPDM, FLEXPART, needs

wind fields from e.g. meteorological reanalysis, which wind fields were used?

P6, L11-14: It needs to be explained more clearly what the FLEXPART calculated footprints represent. Only from the figures is shown that the footprints are sensitivities to CO2 concentrations (at 1 km?) and have units of ppm per umol/m2/s but this is not explained in the methods. Is it true that the footprints can be understood to represent a type of averaging kernel of the CO2 concentrations surrounding the site?

P8, L28: I think the authors mean “additional use of CO2 observations”?

P9, L24-29: Some clarification is perhaps needed here; cases C1-4 were using a cut-off limit of the footprint and cases C5-8 were standard geographical comparisons?

P10, L12-13: While it is true that the bias is smallest with one observation, this could just be by chance? How significant are the differences between the biases?

P11, L2: It’s not clear what the authors mean by “colocation efficiency” if they mean the method, then there is a quite strong influence on the number of observations include in the comparison. Or do the author’s rather mean that there is no dependence of the TCCON-GOSAT agreement on the colocation method?

Figure 7 and 10. By showing the difference between the two methods it is not clear which performs better. Instead it would be clearer and more meaningful to show these parameters (correlation etc.) for both methods. It would also be helpful to briefly state again what each method is in the caption.

Technical comments

P11, L1: please change to “differs by approximately a factor of 5”

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