

Interactive comment on “XCO₂ retrieval for GOSAT and GOSAT-2 based on the FOCAL algorithm” by Stefan Noël et al.

Anonymous Referee #2

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This paper describes and evaluates the FOCAL algorithm for the retrieval of XCO₂ from GOSAT and GOSAT-2 measurements. It is said that the algorithm can retrieve other atmospheric parameters, but this is hardly described and the results are not evaluated. The paper can be of interest for the active community that develop retrieval algorithms for the spaceborne observations of atmospheric CO₂. However, there are several parts that deserve better description as described below. Also, many figures are not useful or are poorly designed and deserve additional work. I therefore recommend this paper to be “accepted with major revision”, accounting for the comments below.

Major comment Section 2.3 “True database” It remains unclear whether the actual TCCON measurements are used or not in the procedure. My current understanding is that the “valid” simulations are those where the total column, computed with an

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homogeneous weighting and the same with the TCCON averaging kernel, differ by less than 0.75 ppm. If my understanding is correct, then (i) I do not understand why this is a valid criterium to select the most accurate simulation data and (ii) there is no need to compute the “daily mean” TCCON. If my understanding is incorrect, the description needs some re-writing. Line 138-139 “which were confirmed by TCCON” is really unclear, especially since it is said above that there is “more data in the Southern hemisphere” that is notably poor in TCCON coverage. How can such data be confirmed by TCCON. As a consequence, it is really unclear why the database build as described, can be considered as a truth

Section 3.1.2 Cloud Filter It is said that the Cloud Filter is based on the fact that clouds are bright (OK) and higher in the atmosphere so that there is little water vapour above them. Then, one may expect that, when the water vapor estimate is low, a cloud presence is suspected. Yet the description of the test indicates that a cloud is detected when the water vapor estimates is **larger** than a threshold. This is inconsistent.

Section 3.3.2 Random Forest Filter The difference between the estimate and the “true” reference database is used. It is said that the difference is subtracted by the global monthly mean bias. This assumes that the global mean bias of the reference is zero which is a strong assumption. This section lacks a quantitative discussion : What are the mean values of the differences to the “true” reference dataset. What is the order of magnitude of the bias correction ? Does it has some spatial patterns. In the case of ACOS, the bias correction is similar to the signal which is an important information. Is it the same here ? It is then said (line 321) that the random forest classification is accurate in about two thirds of the cases. How is this evaluated ? How can one decide whether it is accurate or not ?

Figures There is certainly no need for Figure 3 to 6. A couple of examples would be sufficient rather than the 28 pannels that indicate similar behaviors (and differences that are not commented) Figure 9 to 12 provide no usefull information Figure 13 to 16 could be limited to a few examples rather than the 30 pannels. I strongly recomment

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to combine figure 9 and 13 so that one can identify whether the fine scale structures of the residuals correspond to absorption lines

Section 4; Results

This section contains several hypothetical statements “likely”, “most likely”, “which may explain”... that deserve investigations

Other comment

Abstract : Line 21 “regional bias”. There is no demonstration that TCCON is representative of a region, neither that the bias at the TCCON location is the same over a region

Section 2.2; line 111-112 Why a factor of 5 for H₂O “to reduce dependencies on the a-priori” but not the same factor for the CO₂ Line 117 “very accurate”. Please quantify Line 124 : “daily mean”. I understand the mean is over 4 hours. How can this be considered a daily mean ? Line 188 : “It is given by the ratio between the median radiance and the median of the estimated noise in this spectral range”. Unclear Line 278 : The case is rejected when the Angstrom coefficient is outside of the range [1 – 5]. This is strange. Clouds and aerosols can have Angstrom coefficients that are close to zero. Conversely, values larger than 2 have never been reported to my knowledge. Line 335 “But with this filter applied”. Which filter ? Line 343 : What is the order of magnitude of the bias correction ? Line 349 “On the derived XCO₂ bias”. What bias is that ? Is it before or after the correction ? The paragraph indicates it is after correction, but then how can it be evaluated ?

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