

# ***Interactive comment on “Ensemble-based satellite-derived carbon dioxide and methane column-averaged dry-air mole fraction data sets (2003-2018) for carbon and climate applications” by M. Reuter et al.***

**M. Reuter et al.**

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Many thanks for taking the time to review our manuscript and for providing very useful feedback.

Referee: Reuter et al. have updated and extended the first EMMA paper (Reuter et al., 2013). No breaking news for those who already read the first opus: the second one may even look a bit boring. For the newcomers, this is a solid and well-written text that synthesizes the state of the art in XCO<sub>2</sub> and XCH<sub>4</sub> retrieval performance from the

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point of view of a “community” retrieval product.

Author's response: Many thanks for this positive review.

Referee: There are a few typos or awkward expressions that deserve attention (l. 10, 99, 115, 127, 140, 206, 233, 359).

Author's response: l. 10: We change Dave (Pollard) to David F. We removed a wrong comma (after Laura).

Author's response: l. 99: We have improved the sentence. The new sentence is: “The spatio-temporal characteristics of the merged data - e.g., the spatial sampling - reflect the characteristics of the underlying individual sensor satellite data (described in the data section, Sect. 2).”

Author's response: l. 115: We have added this additional explanation at the end of the sentence (in brackets): “(because the median of a set of elements is not defined for two elements)”.

Author's response: l. 127: We have slightly improved this sentence. The new sentence is: “All individual sensor input L2 data products have been generated using retrieval algorithms based on minimizing the difference between a modelled radiance spectrum and the observed spectrum by modifying so called state vector elements (for details we refer to the references listed in Tab. 1; for additional information see also the Algorithm Theoretical Basis Documents (ATBDs) Buchwitz et al., 2019b, and Reuter et al., 2019b).”.

Author's response: l. 140: We have replaced “is currently is still” by “is currently”. We have splitted the sentence into smaller ones. The new text is: “For future updates it is also planned to include XCH<sub>4</sub> from the Sentinel-5 Precursor (S5P) satellite (Veefkind et al., 2012), but S5P XCH<sub>4</sub> (Hu et al., 2018; Schnieising et al., 2019) has not yet been included as the time period covered by these products is currently quite short (less than 2 years). However, we aim to include S5P XCH<sub>4</sub> for one of the next updates of

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the merged methane products."

Author's response: I. 206: In the revised version of the manuscript we will replace "The method is based on limiting the number of data points (per grid cell and month) chosen from this algorithm. This is done by computing SEOM for each month, grid cell and algorithm. For each grid cell and month we then compute a SEOM threshold by the 25th percentile of SEOMs divided by  $\sqrt{2}$ . If SEOM of an algorithm is smaller than the computed threshold, a subset of soundings is randomly chosen such that SEOM becomes just larger than the threshold." by "The method is based on limiting the number of L2 data points. For each grid cell and month, we perform the following steps: First, we compute SEOM for each algorithm. From these values, we compute the 25th percentile and divide it by  $\sqrt{2}$ . The result is used as minimum-SEOM-threshold. If SEOM of an individual algorithm is smaller than this threshold, a subset of soundings is randomly chosen such that SEOM becomes just larger than the threshold".

Author's response: I. 233: We have improved this sentence. The new sentence is: "For each individual product, the gridding is based on computing an arithmetic, unweighted average of all soundings falling in a grid box."

Author's response: I. 359: We have improved this sentence by breaking it down into two smaller sentences. These new sentences are: "This does not necessarily mean that these sites have the largest biases. This does only mean that the derived biases at these sites are (independent of their magnitude) the most consistent across all satellite products used for comparison."

Referee: I also regret that the authors have dropped the information about the data weight of each algorithm in EMMA.

Author's response: We have added two figures, one for XCO<sub>2</sub> and another for XCH<sub>4</sub>, to the revised version of the manuscript. They show time series of data weight and number of soundings for each algorithm.

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Referee: Table 6: data numbers and period covered are missing. Actually is 0.02 ppm for FOCAL at SOD significantly different from 0 (I. 360)?

Author's response: Adding additional information on data numbers and period covered would significantly enhance the complexity of this table. Please note that the temporal coverage of the satellite data products is provided in Tab. 1 and the start date of availability of the TCCON data is provided in Tab. 3. Because of this and because we think that this additional information is not absolutely necessary for the purpose of providing additional information in the context of the discussion of Fig. 11, we have not extended Table 6. Concerning the question related to FOCAL at SOD: This very small bias is likely not significant. We will add a remark related to this in the revised version of the manuscript.

Referee: I. 382-5: repeated information

Author's response: We have removed these sentences to avoid repetition.

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