

***Interactive comment on “A joint effort to deliver
satellite retrieved atmospheric
CO₂ concentrations for surface flux inversions:
the ensemble median algorithm EMMA” by M. Reuter et al.***

M. Reuter et al.

reuterm@loz.de

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Many thanks for the constructive review which will be discussed in the following:

Reviewer 2: *...but do not address the question of how this data product might be used in an inverse experiment.*

Authors: The paper described that the EMMA database consists of individual XCO₂ retrievals. This means that it can be used as any other XCO₂ satellite retrieval. In the revised version we tried to make this clearer by stating within the conclusions: “The EMMA database (June 2009 - May 2010) includes all information needed for inverse modeling (geo-location, time, averaging kernels, etc.). As it consists of individual

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XCO2 retrievals, it can be used in the same manner as any other XCO2 satellite retrieval.”

Reviewer 2: *I would suppose it smooths away some amount of real variability in XCO2 and returns XCO2 fields closer to the prior.*

Authors: Given the assumptions made in Sec. 3 (“Outliers are assumed to be seldom and there is a high chance that a grid box includes no or only one outlying algorithm.”), we don’t see why EMMA should smooth out real variability. There is no spatial averaging applied, EMMA consists of individual soundings. The median is only used to select a non-outlying algorithm. If there is a natural feature which can be detected with the majority of algorithms, it will be included in EMMA. Additionally, the result fields will not depend any stronger on the prior than the individual algorithms. SECM is only introduced to get XCO2 values which can be inter-compared with only little influence of the smoothing error (see Sec. 2, Rodgers 2000). Please also note that: i) the influence of SECM is small (typicall a few tenths of a ppm, see Sec. 2), ii) the influence of SECM is removed if XCO2 retrievals are used in an inverse modeling framework, accurately employing sounding-by-sounding averaging kernels within the assimilation process.

Reviewer 2: *What is the variability in EMMA compared to SECM?*

Authors: SECM reproduces large scale features such as the year-to-year increase, the north/south gradient, and the seasonal cycle. Therefore, its overall variability is comparable to SECM. However, SECM is only empirically extrapolating from past XCO2 fields. New or changing phenomena cannot be within SECM. Please also note that: i) the influence of SECM is small (typicall a few tenths of a ppm, see Sec. 2), ii) the influence of SECM is removed if XCO2 retrievals are used in an inverse modeling framework, accurately employing sounding-by-sounding averaging kernels within the assimilation process.

Reviewer 2: ...which suggests that some smaller scale variability is being lost, even as it improves the seasonal cycle and seasonal gradients.

Authors: EMMA v1.3a has more measurements than most of the GOSAT algorithms so that the information content according to $(\sigma/\text{sqrt}(n))$ is comparable. As discussed in Sec. 4, the larger scatter is mainly resulting from EMMA's WFMD component. EMMA v1.3b and v1.3c (not including WFMD) have a precision of about 2ppm, but also less measurements (comparable to the GOSAT retrievals). Therefore, we expect that the total information content is comparable to the GOSAT retrievals. Additionally it should be noted that regional biases are currently the most critical issue for surface flux inversions rather than the single measurement precision. EMMA's great benefit is that it has the potential to reduce such biases.

Reviewer 2: ...the variance in retrievals from multiple algorithms could also have been used simply to inform an error covariance structure for an inversion of one XCO₂ data product. How might the choice of either of these procedures change the flux fields that would be estimated in an inversion?

Authors: Using all retrievals and calculating their variance implicitly assumes Gaussian errors. This stands in contrast to the main assumption of EMMA: "Outliers are assumed to be seldom and there is a high chance that a grid box includes no or only one outlying algorithm." This means that cancellation of errors cannot be expected by calculating the average or by including all retrievals in one inversion.

Reviewer 2: ...it would have significantly more scientific impact if the authors included more discussion of how the EMMA algorithm might affect flux distributions or how EMMA might be used in an inversion.

Authors: Our paper focuses on setting up and validating the ensemble, retrieval inter-comparisons, and comparisons with a model. With our paper, we set a solid basis for inverse modeling scientist using the EMMA product for flux inversion experiments. EMMA's effect on such experiments (if successful) will likely be described in

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corresponding future publications. As mentioned earlier, in the revised version we tried to make it clearer how EMMA can be used in an inversion: “As it consists of individual XCO₂ retrievals, it can be used in the same manner as any other XCO₂ satellite retrieval.”

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 23195, 2012.

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