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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A joint effort to deliver satellite retrieved atmospheric CO_2 concentrations for surface flux inversions : the ensemble median algorithm EMMA" by M. Reuter et al.

Anonymous Referee #2

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"A joint effort to deliver satellite retrieved atmospheric CO2 concentrations for surface flux inversions: the ensemble median algorithm EMMA" by Reuter et al. is a well-written manuscript, with figures and tables that nicely clarify the methodology and illustrate the resulting data product, which is a compilation of 7 retrieval algorithms for GOSAT CO2. I think it is quite important to consider, as the authors do here, how to account for the potentially large biases in individual retrievals of XCO2 from GOSAT. The paper is a nice introduction to EMMA as a methodology, but does not go so far as to address the more interesting scientific questions about what effect making a composite from several different retrievals will have on flux estimates.

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The authors claim that "EMMA is a promising candidate for inverse modeling studies" but do not address the question of how this data product might be used in an inverse experiment. The authors show that the EMMA algorithm smooths away much of the variability found among all the retrieval algorithms (which they attribute to bias in the retrieval algorithms), but in doing so I would suppose it smooths away some amount of real variability in XCO2 and returns XCO2 fields closer to the prior. The authors state that they have adjusted all retrieval results to a common a priori from SECM. What is the variability in EMMA compared to SECM?Depending on how much real variability EMMA smooths out, using it directly in an inverse model might not return much new information.

EMMA is compared against seasonal gradients and seasonal amplitudes in TCCON and in CarbonTracker (which is itself a data assimilation product and likely smooths some real variability). Seasonal gradients and seasonal amplitudes reflect large-scale flux and transport phenomena, so there is nothing in the paper to suggest how well EMMA is doing at retaining the type of small-scale variability that might be able to inform regional or continental scale fluxes. If I understand Table 2 correctly, the single measurement precision of EMMA relative to TCCON observations is larger than for the individual algorithms (except WFMD), which suggests that some smaller scale variability is being lost, even as it improves the seasonal cycle and seasonal gradients.

While the authors choose to compare the XCO2 from multiple retrieval algorithms and incorporate the median value into an XCO2 data product, 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?

Perhaps the authors are planning to rigorously test some of these ideas in a future paper, but simply using EMMA in an inversion based on this paper would not satisfactorily test the effects of the choices made in the EMMA algorithm. While this paper is suitable for publication, it would have significantly more scientific impact if the authors

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included more discussion of how the EMMA algorithm might affect flux distributions or how EMMA might be used in an inversion.

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