

Interactive comment on “The 2015–2016 Carbon Cycle As Seen from OCO-2 and the Global *In Situ* Network” by Sean Crowell et al.

Anonymous Referee #2

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Crowell et al. present results from an ensemble of atmospheric inversion modelling systems inverting column averaged XCO₂ observations from OCO-2 over the years 2015-16. They find that on global scale the inferred fluxes are consistent with results from in situ CO₂ inversions, however, on smaller regional scales, and especially in the tropics, the ensemble yields a large spread in the flux estimates.

The ensemble approach employed here is a major effort in understanding the shortcomings in current inversion systems and identifying robust carbon sources and sinks. However, the main outcome of this research essentially is that the inverse modelling community is still not in the position of providing robust flux estimates at regional scales even with the advent of having a huge increase in the observations provided by satellites. Admittedly the results here are based on a rather outdated version of the OCO-2

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XCO₂ retrievals, but I doubt that the spread will be smaller when using the most recent XCO₂ product because here it is mainly based on the ensemble, ie. different transport models, inversion methods and uncertainty correlation assumptions. This in itself is not a new finding. The paper fails at going the next step identifying in more detail the causes for the large differences in the flux estimates at regional scales. This is mainly due to the rather weak evaluation of the model results. A more rigorous evaluation of the modelling systems clearly demonstrating the skills of each system would certainly have helped to put the results in perspective.

The manuscript is mostly well written and structured but at some places it reads a bit unpleasant, e.g. having the figure captions not directly with the figures.

Some additional points: P 3 LI 6-8: Here you argue that the uncertainty in recent estimates was due to the lack of observations outside North America and Europe. But even with the large increase of observations outside these regions by OCO-2 you still find a similar spread with your ensemble.

P 5 L 21 and P 23 LI 13-19: What is the purpose of land glint observations? Why do you use these data if there are apparent shortcomings with them?

P 6 L 6: The impact of assimilation methodology is an interesting point but it is not systematically investigated in Peylin et al., 2013.

P 7 L 3: Shouldn't it be Table 1 here? There is no table referenced before.

P 9 LI 1-2: What are the 'lite' files and how are 'good' retrievals characterized?

P 9 L 3: Which variables are used for the IVE? I assume you don't use time, latitude, longitude etc.

P 20 LI 1-2: What are P13 and H15?

P 30 L5 and Figs 4-6: Maybe add a Figure of these regions in the appendix, not everyone is familiar with the Transcom regions.

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P 45 L 15: 'note' instead of 'not'

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-87>, 2019.