

Interactive comment on “Regional CO₂ Fluxes during 2010–2015 Inferred from GOSAT XCO₂ retrievals using a new version of Global Carbon Assimilation System” by Fei Jiang et al.

Anonymous Referee #1

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General comments.

Authors present estimates of regional carbon dioxide flux variability based on assimilating GOSAT satellite observations of CO₂ with ensemble-based data assimilation system. The estimated CO₂ fluxes were evaluated by comparison to indexes of climate variability, and published top-down and bottom-up estimates. The analysis of the carbon cycle variability and comparison with data on climate variability makes a strong point of the study. On the other hand, the description of the ensemble-based data assimilation system can be improved. The paper is well written and can be accepted after minor revisions addressing the review suggestions.

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Detailed comments.

Lines 130-139 Suggest clarifying, what becomes a state vector to optimize, currently it is implicit. Some details emerge much later on Lines 358-366, when uncertainties are discussed.

Lines 232-236 The logic behind selecting 1-week data assimilation window doesn't look solid, as the other ensemble-based assimilation systems use longer window in order of 12 weeks, (Peters et al. 2005, Feng et al. 2009, Jacobson et al. 2020. The notice that there was a problem reproducing CO₂ growth rate with a longer window in Zhang et al (2015) doesn't look like a strong argument, if considered in comparison with other studies.

Technical corrections

Lines 119-120 Need to clarify, written that fluxes “are perturbed with a Gaussian random distribution” – better add more detail on whether perturbation is applied independently to each grid or over regions.

Line 216 As resolutions of the transport model and fluxes are apparently different, suggest writing which of them are referred as ‘model grids’.

Line 584 Revise ‘a very stronger carbon sink’ as ‘a stronger carbon sink’ or ‘a very strong carbon sink’

Line 594 Suggest revising ‘weak’ to ‘weaker’

References

Feng, L., Palmer, P. I., Bösch, H., and Dance, S.: Estimating surface CO₂ fluxes from space-borne CO₂ dry air mole fraction observations using an ensemble Kalman Filter, *Atmos. Chem. Phys.*, 9, 2619–2633, <https://doi.org/10.5194/acp-9-2619-2009>, 2009.

Peters, W., Miller, J. B., Whitaker, J., Denning, A. S., Hirsch, A., Krol, M. C., Zupanski, D., Bruhwiler, L., and Tans, P. P. (2005), An ensemble data assimilation system to

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estimate CO₂ surface fluxes from atmospheric trace gas observations, J. Geophys. Res., 110, D24304, doi:10.1029/2005JD006157.

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