

Interactive comment on “The potential of OCO-2 data to reduce the uncertainties in CO₂ surface fluxes over Australia using a variational assimilation scheme” by Yohanna Villalobos et al.

Anonymous Referee #1

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General comments:

Authors apply a regional grid-based inversion system built around CMAQ model and its adjoint to conduct OSSE simulations of the CO₂ flux uncertainty reduction for Australia using actual OCO-2 retrievals.

The work has high methodological value as authors give sufficient detail on the design and operation of the inverse modeling system, so that it can become valuable learning material for those interested in using surface and satellite observation data in the regional inverse modeling studies with the variational optimization approach. Useful results include the impact of increasing prior flux uncertainties versus changing the

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spatial correlation length for fluxes. The manuscript is well written and appears to be suitable for publications after technical corrections.

Detailed comments:

Page 2 Line 29 Authors wrote, “Liang et al. (2017) found that GOSAT had a mean bias of -0.62 ...”. Different GOSAT retrievals have their own biases, so it would be fair to give more detail, mentioning which product was used and the version number.

Page 19 Line 3 Sentence “The differences are only partly explained by the combination of prior uncertainty and total number of soundings.” Authors may need to mention that due to prevailing winds, surface flux footprints for many OCO-2 soundings made over Australia lay over arid land thus contributing little to uncertainty reduction.

Page 25 Lines 15-18 Removing more observations on the edges of the grid cell in case of finer resolution does not seem to be the only possible way of mapping observations to the model grid. This limitation can be omitted from discussion.

Technical corrections

Page 7 Line 11 In a sentence which is related to Eq 7 it is written “J is the number of those 1-second values”, while in the Eq. 7 the sum runs from 1 to n, so it is likely that n should be in place of J. On the contrary J appears as a number of elements in the next Eq. 8.

Page 7 Line 14 Omit “be” in “uncertainty of about be 0.5 ppm”

Page 10 Figure 3 caption: suggest writing as “prior CO₂ flux uncertainty” rather than “prior CO₂ uncertainty”

Page 16 Figure 5 caption: The statement on “The fractional error reduction is defined as ...” looks somewhat out of place as figure shows percentage error reduction.

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