Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Influence of CO$_2$ observations on the optimized CO$_2$ flux in an ensemble Kalman filter" *by* J. Kim et al.

Anonymous Referee #2

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The manuscript has examined the contribution of CO2 observations to the optimized CO2 flux within Carbon Tracker EnKF assimilation system. Quantitative analysis of which observation data give more correction to the prior is indeed very interesting trial, and would give an essential feedback to the community of data providers. Especially in Carbon Tracker, it would not be very easy due to a special assimilation window, which is still remained as the non-resolved problem to the authors. However, based on the methodology introduced by Liu et al. (2009), authors have made very useful tool to estimate observation impact on the analyzed CO2 fluxes. Although the paper was not written in a very exciting way, a revision focusing on the presentation would bring this manuscript qualified to the publication.

Specific comments: [1] Abstract of the manuscript needs serious revision. Major rea-

son may be because authors use several terminologies (e.g. self-sensitivity, analysis sensitivity, information content) which need their explanations or definitions, for general readers. The abstract of the manuscript contains too much detailed results that may not be appropriate for a general abstract. Thus, the current abstract does not concisely deliver what exactly you have done. This referee suggests to emphasize important findings of your research as a discerning summary.

[2] Isn't there any way to estimate the cumulative impact? Any idea? As the authors pointed out, the posterior flux seems to be determined mostly by the prior flux, not by the assimilation of the observation based on the analysis of self-sensitivity. However, there is just a statement saying that the cumulative impact would be greater. Can you "prove" it? Figure 12 lets us guess roughly how the cumulative impact would be though. Still, the first week seems to give the largest correction to the prior, doesn't it? It would be quite important message for Carbon Tracker users.

[3] Lines 19-22 of p.13568: What about the computational cost of this process? Are the authors doing this process at every analysis step?

[4] Equation (16) is just a case of l=j in Equation (17). Any reason to write exactly same equation twice? Unnecessary repetition makes the manuscript a little boring.

[5] Lines 19-22 of p.13572: Isn't there any possible link with the prescribed Pb in EnKF of Carbon Tracker?

[6] The reason why the inverse relationship between the average self-sensitivity and the number of observations is not shown was not explained. Authors said that is due to the insufficient number of observations. It does not make sense. It is just denying the statement of inverse relationship, because it is not valid when the number of observation is few. Thus, please find another reasonable reason within your experimental settings.

[7] Explaining Figure 6, authors continue to mention the inversely proportional relation-

ship between the number of observations and self-sensitivity even though the results do not show it consistently. It seems to this referee that it is just visible in Figure 6(d), because the increase rate of the number of Continuous observations is remarkable.

[8] Figure 7: it would be better to plot the reduction of self-sensitivity rather than the reduced ones.

[9] Lines 27-28 of p.13576: "and the seasonal variability of the surface . . . variation of the self-sensitivities" seems unnecessary repetition.

[10] Lines 8-9 of p.13577: Do the authors indicate the temporal resolution of the station? Please rephrase it.

[11] Some statements are so trivial, not worth pointing out: e.g. lines 21-22 of p.13577, lines 10-12 of p.13578.

[12] Line 3 of p.13579: have the authors really assimilated only surface CO_2 concentration data? What's the criterion of surface layer? Carbon Tracker assimilates observations which are located up in the air either.

[13] Lines 26-27 of p.13580: while statement needs to be rephrased.

[14] At the end of line 20 of p.13581, it would be better to mention a possible advanced data assimilation method which allows considering high-resolution data, because Carbon Tracker may not be able to assimilate those high-resolution data (such as remote-sensing data) easily with the current algorithm.

[15] Unit of MDM should be presented in Table 1 rather than Table 2.

[16] When explaining Figure 9 (section 3.3.1), please make sure there is no Continuous data in SH.