

Interactive comment on “The regional EUROpean atmospheric transport inversion COMparison, EUROCOM: first results on European wide terrestrial carbon fluxes for the period 2006–2015” by Guillaume Monteil et al.

Anonymous Referee #2

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This paper presents the first results of the EuroCom project, with an inter-comparison of net terrestrial ecosystem exchange estimated by 6 regional inversion systems following a flexible protocol that allows maximum participation and sensitivities to different transport, priors and number of in situ observations assimilated.

General comments

The manuscript is well written and the explanations are clear overall. The paper would benefit by explaining in more detail what is the purpose of comparing such wide range

C1

of diverse systems which produce such large spread in the optimized fluxes. What do we learn from such exercise? It seems that one of the messages is that all these differences in the configuration of the inversion systems have a large influence on the resulting optimized fluxes, i.e. assumptions in prior uncertainty estimation and data assimilation methodology, transport model, temporal/spatial resolution, boundary conditions, number of observations used, ocean fluxes, etc. The results point that regional inversions using the currently available in situ data in Europe are not able to properly constrain the NEE at regional scale, and the spread between different optimized fluxes is as large as the mean or median flux. The other aspect that could be improved is the presentation of the uncertainty from each individual inversion system. I have not seen the posterior uncertainty in any of the plots. It would be useful to add this information in the bar plots where the estimate from each system is compared.

Specific comments/questions:

1. The ICOS network is currently not a high density in-situ surface observation network (with 19 stations run by 12 countries as described in line 64).
2. The paper only addresses large regional budgets at subcontinental scale, not country scale budgets. Why not look at budgets for a relatively large country where there are enough observations, e.g. France or Germany to demonstrate the capability at country scale?
3. The use of mesoscale transport model is not appropriate as mesoscale weather systems have scales of less than 100 km you need higher resolution than 10 to 100 km to resolve them. It would be best to replace mesoscale model with regional model.
4. What are the implications of not correcting for errors in the anthropogenic emissions and ocean fluxes? The signal of the anthropogenic emissions vary during the day. So if inversions use observations at slightly different times of day, the influence of the anthropogenic emission error on the optimized flux will also vary. Could this explain part of the divergence between the optimized fluxes from the different inversion systems?

C2

Minor comments:

-Line 26: Define NBP

-Line 56: ...that does not smooth ...

-Line 119: Replace “the find” by “finding”.

-Line 124: Please define “model error”, “representation error” and “aggregation error”.

-Line 186: Remove the extra “full”.

-Lines 193-203: Temporal resolution of ORCHIDEE prior is missing.

-Lines 193-209: Spatial resolution of the prior from ORCHIDEE and PJ-GUESS is missing.

-Line 228: PgC/months? Shouldn't the units be PgC/month?

-Line 233: Please include resolution of EDGARv4.3 inventory

-Lines 241-243: Biomass burning emissions can be large over the summer in the Mediterranean region over the summer (e.g. 2007 and 2015). Could this also explain part of the large divergence between optimized fluxes in that region?

-Lines 253-257: The Takahashi et al. (2009) climatology will underestimate the ocean sink for the period 2006-2015, so this will explain part of the discrepancy between NAME-HB and other inversion systems. Other relatively out-of-date ocean data sets might lead to also an underestimation of the ocean sink. Does this mean that in those systems that do not correct the ocean fluxes, the error in the ocean sink will be attributed to NEE?

-Line 304: What is the Rödenbeck approach?

-Line 405: Remove extra bracket after Radon.

-Line 409-411: What about the representation error associated with resolution of trans-

C3

port model? Shouldn't it be part of the observation uncertainty? Representation errors tend to be very large at sites close to anthropogenic emissions.

-Line 416: How much does the observation uncertainty vary from site to site?

-Line 427: Is FLEXINVERT+ the only inversion system in which the uncertainties in the fossil fuel emission estimates contribute to the observation error? It seems to be this is an important uncertainty to consider given that most in situ sites in Europe are affected by anthropogenic emissions.

-Line 479: “if” should be “it”.

-Line 486: “diagnostics” should be “diagnostic”.

-Figure 6: The differences between the prior and posterior appear to be very small at most sites. Does this mean that the prescription of the prior uncertainty is too small and transport uncertainty too large?

-Lines 600-603: The three sentences starting with “The figure...” would fit better in the caption of Figure 9.

-Line 608: The Central European NEE is only robust in the sign of the budget, but not the magnitude (as shown in lower right most panel in Figure 9).

-Figure 9: It is not possible to read the figure caption.

-Line 687: “an constraint” should be “a constraint”.

-Line 700: “the our four regions” should be “the four regions”.

-Lines 698-700: If there is a deterioration in the optimized fluxes with respect to the prior fluxes in data sparse regions, doesn't this mean that the assumptions in the inversion are not correct? One would expect that the optimized fluxes are always better or the same than the prior fluxes (where there are no observations).

-Line 730: The use of high resolution is relative. It's probably best if you specify the

C4

range of spatial and temporal scales resolved by the regional inversion systems. A resolution of 0.5 degrees is not considered by most as high spatial resolution. Temporal resolution is not high either if observations are filtered in time to short afternoon and nighttime windows.

-Line 731: Given the spread of the optimized fluxes is so large, can the data be used as a validation data set?

-Lines 735-736: Please include the associated uncertainty of the posterior estimate.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-1008>, 2019.