

***Interactive comment on* “What can we learn from European continuous atmospheric CO₂ measurements to quantify regional fluxes – Part 2: Sensitivity of flux accuracy to inverse setup” by C. Carouge et al.**

Anonymous Referee #1

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General comments

This is the second part of an interesting pioneering study to determine fluxes from concentrations on a small scale. This part is in general well written, but some points need clarification. The methods section contains much repetition from Part 1, but this is in the interest of the readability of the paper. The results are an interesting stepping stone for future work. The conclusions section should be augmented. I recommend the publication of this paper after some revision.

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Specific comments

p.18623, line 4: “the density of the network”: Reformulate this, only one network has been tested.

line 17: “region”: Here the word is used in the sense of “patch” or something like that, whereas e.g. in the caption of figure 1 it is used in the more usual sense, corresponding to an aggregation of patches. This kind of ambiguity should be removed from the paper.

line 27: “correlated”: what kind of correlation is meant here? The previous lines suggest only temporal correlation.

p.18627: The set up of SP2 and SP3 should be explained better. It is suggested elsewhere (e.g. at the end of section 3.2) that correlation becomes higher than for S0 since the factor 1/2 is not involved here. A full explanation is needed at this place.

Same page: The set-up of SP4 seems not entirely in tune with the rules of the game: (1) By using a window of only 5 days, the averaging is over an ensemble which may be too short to be statistically meaningful; (2) On the other hand, knowledge of the “real” flux for the concerned time is smuggled in (though this works well only if the difference between the two compared fluxes is small). I consider this experiment as a weak element in the paper. Would it not be interesting to replace it with a different one, e.g. with a much longer time window?

p.18628, lines 20-24: Can something be said about the causes of the great differences between the sites?

p.18631, line 26: “...similar to that of S0”: Maybe one should add: “(but weaker)”.

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lines 27-28: “the inversion accuracy is dramatically improved”: Unfortunately this cannot be concluded, since it coincides with a small value of R .

p.16832, lines 21-23: But at small spatial scale the SP4 NSD is worse, see figure and lines 26-28.

lines 25-26: What are “true residual variances”?

p.18632 end-p.18633 begin: The first half of the sentence is unclear.

p.16834, lines 10-13: This sounds speculative. It is unclear whether the result is improved, since R is still small. Further, thus far nothing has been tested concerning the inclusion of cross-correlations.

Section 3.4: The description of the procedure to find ER is somewhat unclear. Is it correct that the true flux is not involved? If so, why not, and is the name “error reduction” appropriate?

p.18637, line 10: See remark at p.18623 line 17.

p.18638, lines 10-12: Explain what twofold increase says about transport model errors.

p.18639, Conclusions: This section should be considerably extended. A recapitulation of all the experiments should be included. The comparison of different networks is especially important.

Tables: A table with all the stations would be welcome.

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Table 1: This table only concerns those inversions for which the flux error correlations are varied. The caption should be modified, or (preferably) the table should be supplemented with the other inversions.

Figure 4, caption: The vocabulary should correspond better to the one of the text (section 3.3).

Figure 5: Same remark.

Technical corrections

General: The experiments introduced as SP1-SP4 in section 2.2.1 are called S1-S4 at the end of the section, in table 1 and in the caption of figure 3. Check the whole paper to remove all inconsistencies of this kind.

p.18624, lines 1-2: unusual symbol “/”

p.18625, line 18: “Hourdin et al. 2006”: check reference.

p.18629, line 1: “station” : “stations”.

p.18631, line 2: Saporta 1990: Not in list.

lines 12-13: similar for SP1 as for S0

p.18632, line 22: replace “than” with “as”

p.18638, line 15: delete “the”

line 20: check 2004

p.18640, line 27: “2006a”: check.

Table 1: For the spatial correlation length one should not use “ τ ” but “ λ ” or something like that.

Figure 2, colorbar: First “1” should be “-1” (not so important)

Figure 3: Second colorbar is ambiguous.

Figure 4: Caption: replace “than” with “as”.

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