

## ***Interactive comment on “What can we learn from European continuous atmospheric CO<sub>2</sub> measurements to quantify regional fluxes – Part 1: Potential of the network” by C. Carouge et al.***

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Reply to reviewer #2 on: What can we learn from European continuous atmospheric CO<sub>2</sub> measurements to quantify regional fluxes, Part 1: Potential of the 2001 network.

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Specific comments: Abstract: The reviewer makes an important point here. The choice of prior or, more strictly, the relationship between the differences of the prior and truth compared to the prior errors, was the most difficult part of this study. The classical Observing System Simulation Experiment has these two quantities consistent (Chevallier et al., 2007) or uses the linearity of the inversion to ignore the prior fluxes themselves (e.g. Rayner and O'Brien, 2001). Of course the real world is never so kind so it is

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almost certain we will make errors in these statistics. Gerbig et al., 2006 pointed out what could go wrong with these kind of errors. Having said all this, we think that this paper is not the correct place for this treatment. The important quantity is the difference between the prior and true fluxes normalized (in some generalized sense) by the prior uncertainties. Thus the comments on the effect of the prior can as easily be made by consideration of the prior uncertainty. This question is taken up at some length in the companion paper and we should defer such a discussion until then.

Conclusions: A conditional was added changing "can come" by "would probably come".

Technical comments: Overall: In section 3.1, we discuss both total and deseasonalized fluxes. We indicate on p.18604, line 25-27 we only consider deseasonalized fluxes in subsequent sections. However, we added few "deseasonalized fluxes" here and there to help fixing the mind of the reader.

P.18592, line 1: We do not understand the reviewer's concern here. The expression "not very accurate" suggests there is something in the original text the reviewer thinks is wrong but unfortunately he doesn't tell us what it is. The text is not a very precise description that is true but this is the abstract, such precision belongs in the methods section. We have left the abstract unchanged pending further guidance.

P.18592, line 12: "s" removed

P.18592, line 18-19: The sentence was replaced

P.18592, line 21: We replaced "structure" by "spatial and temporal distribution"

P.18593, line 3-5: The sentence was corrected.

P.18593, line 10, P.18593, line 15, P.18594, line 22: The changes suggested by the reviewer were done.

P.18595, line 8: We do not understand the reviewer's request here.

P.18595, line 15: On line 14, we added the sentence "We consider fluxes from other

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regions are null in building the pseudo-data and performing the inversion". We thus assert the influence from other regions on the pseudo-data is null. A global inversion is thus unnecessary. Only an inversion over Europe is relevant.

P.18596, line 3: A small noise of 0.3 ppm is only representative of the data error. Thus we consider the atmospheric transport is perfect, building an ideal case.

P.18596, line 13: The wind relaxation was studied to maintain the mass conservation in the model. In fact LMDZT is an offline model driven by mass fluxes from an online run. It is this online run which is nudged towards the ECMWF analyses so that, provided the advection is conservative, mass-conservation in the offline run isn't a problem.

P.18597, line 1: "concentration data" was changed to "measurement".

P.18599, line 17: "insofar" was removed.

P.18604, line 7: "The SP pixel [starts out with] a [pretty good] RAPR (0.58) [and] a too large NSD"

P.18604, line 18: The formulation given by the referee was not kept because it leads to a misinterpretation. We do not expect to add information to the station network but the measurements from the station to add information to the fluxes. We preferred to change with: "the 2001 European network does not contain enough information to reliably estimate daily CO<sub>2</sub> fluxes at the grid-scale level"

P.18605, line 21: In this sentence, we removed the comma before "degrading". "Degrading with spatial aggregation" is meant to apply only to the NSD and not the overall comparison between the estimated and true fluxes.

P.18606, line 14: "the" was added.

P.18606, line 19: "opposite" was replaced by "other hand".

P.18607, line 16: "too" was removed.

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P.18607, line 24: "here" was replaced by "in Scandinavia" and "due" was added after "only partially".

P.18609, line 7: The sentence was changed according to the referee's suggestion.

Table 2: The definition of SP was added to the caption.

References: Chevallier, F., Impact of correlated observation errors on inverted CO<sub>2</sub> surface fluxes from OCO measurements, *Geophys. Res. Lett.*, 34 (24), L24804, 2007

Gerbig, C., Lin, J. C., Munger, J. W., Wofsy, S. C., What can tracer observations in the continental boundary layer tell us about surface-atmosphere fluxes?, *Atmos. Chem. Phys.*, 6, p. 539-554, 2006

Rayner, P. J., O'Brien, D. M., The utility of remotely sensed CO<sub>2</sub> concentration data in surface source inversions, *Geophys. Res. Lett.*, 28 (12), p. 2429-2429, 2001

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