

## ***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.***

### **Anonymous Referee #2**

Received and published: 24 January 2009

General comments: Carouge et al. have performed a study, which should have been done a long time ago, that is crucial for understanding the spatial resolution from which surface fluxes can be resolved with the current network of 10 tall towers in Western Europe. The clear gap left by this paper and the companion paper is the fact that it is not clear to what extent the prior will affect the conclusions. While the prior estimate for this inversion was specifically picked because it does not match the conclusion it unclear from this study how much the a 'bad' prior will impact the need for aggregation.

Specific comments: Abstract: needs to be more explicit. In particular, it is important to note that the prior used in this inversion was significantly different and may not

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represent how an inversion would be set up.

Conclusions: It is stated that "Further improvements can come from more accurate prior flux scenarios, including knowledge of prior flux error covariance, both for NEE and for fossil fuel emissions." While this is an obvious conclusion, this study does not prove this to be the case.

Technical comments: Overall: It is unclear in the text whether all the R and NSD statistics that are referred to are smoothed to take seasonal variability out.

P. 18592 Line 1 This not a very accurate description of the method used. The inversion model provides daily flux estimates that best match observations and a prior guess assuming a known transport field and simple least squares minimization

Line 12 performance no s. Line 18 not sure what is meant by the term "local knowledge"  
Line 19 not sure what is meant by "instantiated"- how about "In the bottom-up approach process models based on observations at very small scales are scaled up to regions of interest".

Line 21 "structure" should be spatial and temporal distribution.

P. 18593 Line 3-5 "The use of [continous] data [creates] stringent demands [for] atmospheric transport models (Geels et al., 2007; Gerbig et al., 2003), [] requiring higher spatial resolution, [] ability..."

Line 10 "prescribing prior error correlations for fluxes in order to limit [biases caused by lack of spatial resolution in the data] and the generation of non-physical solution[s]..."

Line 15 "In order to calculate the Jacobian matrices [] for the inversion problem, [it is necessary to know the ] sensitivity of each concentration measurement to fluxes at all preceding times and places."

P. 18594 Line 22 "[For this study] we describe the inverse setup that is used to assimilate daily atmospheric CO2 pseudo-data over Europe and retrieve daily fluxes at the

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model resolution (50 km)".

P. 18595 Line 8 "[The] pseudo-data [experiment] allows [] the accuracy of the solution and the impact of different inverse setups [to be tested] by comparing the inverted fluxes to the "true" fluxes"

Line 15 "Thus, we do not need [to perform] a global inversion with all stations and [the appropriate?] fluxes, as Peylin et al., 2005 did, [using] real data." This needs more work ...

P. 18596 Line 3 "We choose a white noise of relatively small amplitude (0.3 ppm) as illustrative of an ideal case where the " why is this "illustrative of an ideal case"? explain.

Line 13 "Finally, model winds are relaxed towards analyzed fields of the European Center for Medium Range Weather Forecasting (ECMWF) for the year 2001 in order to remain as close as possible to the observed synoptic events (with a time constant of 2.5 h). " How does this effect mass conservation?

P. 18597 Line 1 "The sensitivity of one [measurement]

P. 18599 Line 17 "Most global inversion studies, have [] prescribed"

p. 18604 Line 7 "The SP pixel [starts out with] a large [of]  $R_{\text{APR}}$  (0.56) [and] a large NSD ..." Line 18 "In summary, the estimation of daily CO<sub>2</sub> fluxes at the grid-scale level is found to [add little information to] the 2001 European network, ..."

P. 18605 Line 21 "Overall, correlations only increase from 0.05 to a maximum of 0.35 and NSD values increase from 1.25 to 1.45, suggesting degradation with spatial aggregation."

P. 18606

Line 14 "indicating that [the] inversion introduces large short-term"

Line 19 "On the [other hand]"

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P. 18607

Line 16 "This is the case for the Mediterranean Europe region (Fig. 5.1), with a maximum RAPO of 0.5 (12-day aggregation over the whole region) and a [] large NSD for all aggregations.

Line 24 "However, the relatively good agreement between estimated and true fluxes is [in Scandanavia] due to the initial agreement between prior and true fluxes and only partially [due] to additional information delivered by atmospheric data.

P. 18609 Line 7 "[ ] Given the overwhelming number of unknown fluxes compared to the amount of data [,it is clear that aggregation is necessary].

Table 2. Redefine SP.

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