**Atmospheric
Chemistry
and Physics**
Discussions

Interactive comment on "Regional inversion of CO$_2$ ecosystem fluxes from atmospheric measurements: reliability of the uncertainty estimates" *by* G. Broquet et al.

Anonymous Referee #2

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In the context of an inversion of atmospheric CO2 data to estimate CO2 fluxes in Europe, Broquet and colleagues assess the uncertainty estimates from the Bayesian inversion by comparing them to misfits between the fluxes and independent flux measurements from eddy covariance sites. As the meaning of Bayesian uncertainty estimates is controversially discussed in the inversion community, this is a relevant and interesting study. Broquet and colleagues present evidence that their Bayesian uncertainty estimates are compatible with the independent data. Method and findings are well described. I would like to recommend publication of this study.

My only concern is the conclusions about the interannual variations (Broquet and col-

leagues conclude that IAV cannot be estimated reliably in Europe). In contrast to the assessment of the seasonal cycle, I found the IAV discussion much less convincing, either because of the less clear formuations which I may have misunderstood, or because the evidence does not support the conclusion as general as stated (see below for details).

Though the paper reads nicely, a few places may profit from slight reformulation for clarity (see some suggestions below).

Specific comments:

p5775 l 11: re-entering?

p5775 l 24: "Bayesian formula" should be briefly explained.

p5777 l 3-4: Not fully clear - the temporal correlation refers to corresponding 6hr intervals in consecutive days?

p5777 l 15-16: Not clear what index i refers to.

p5777 l 19-24: Is the same offset used in all yearly inversions? If so, mention explicitly.

p5777 l 26: Does "synthetic" refer to pseudo-random? If so, it would be important to mention.

p5779 l 4: Mention here over what the averaging is done (even though it becomes clear later).

p5781 l 4-8: Not sure I understand correctly - is it about the disaggregation of correlated errors? Consider reformulating.

p5781 l 13: Not fully clear what "quadratic mean" refers to.

p5781 l 17-21: I did not understand this part (maybe a grammar issue?).

p5782 l 21: "Consequently" rather than "Subsequently"?

p5783 l 27: Does "regular increase" mean "rising trend"?

p5784 l 25: "positive result" for "passing the test" may be misunderstandable.

p5786 l 10-25: The arguments are a bit hard to follow because the numbers are given as Table rather than as Figure. As the IAV topic is important, I would strongly suggest to replace Table 3 by a time series plot.

p5787 l 23 - p 5788 l 4: I did not understand at all this paragraph, can you reformulate?

sect 5.2:

- Is is unclear to me how the monthly uncertainties can be used to judge about IAV, due to possible temporal correlations. (what is the obstacle in directly looking at uncertainties for yearly fluxes?)

- I did not understand the point raised in lines 23-25.

- I am puzzled about the finding for 2003, as other inversions do see the reduced uptake during the heat wave. As this signal is directly seen in the data (both concentrations and eddy fluxes, Ciais et al 2005), I find it hard to believe that it was insignificant within the uncertainties. I feel that the conclusion that /no/ IAV can be estimated reliably (as stated in the abstract) is not supported by the findings, and should be formulated much weaker.

p5789 l 21: "uncertainty bounds"