Geoscientific
Model Development
Discussions

Interactive comment on "On the parallelization of atmospheric inversions of CO$_2$ surface fluxes within a variational framework" *by* F. Chevallier

Anonymous Referee #1

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This paper describes a novel approach to parallelize the very computing-intensive running of the forward model in a CO2 flux inversion. It divides the multi-year window into many smaller windows with some overlap to account for the proper mixing of the various flux signals. This method allows much more efficient running of flux inversions, which can be used to increase for instance the spatial or time resolution. It also appears to be much more stable than the very long window inversions. I think this paper is very suitable for GMDD and I recommend publication after my comments below have been taken into account.

Main comments: Page 46, lines 14-18: This is a very worrying comment that deserves more emphasis. It means that long window inversions that have been done in the past can have very significant errors that have not been accounted for. It would be important

to know how these errors grow as a function of window length. Has this been properly documented elsewhere? Section 6: The method is formulated for both global and regional inversions and Section 6 discusses the implications for regional inversions. Did you test the regional set-up at all? Does it indeed perform as well as the global inversions. If you want to include the regional set-up, there should be more material documenting its performance.

Minor comments: P38, line 4: I suggest to rephrase this sentence slightly to "...the ensemble or analytical approaches." P38, line 24-25: I find this a strange sentence (..., but it is rigorously guided by the Bayesian paradigm.) The Bayesian framework forms just one way of solving inversion problems, making use of prior information. It sounds here as if it is the only way to do this. Also the next sentence ("It requires...") is not really embedded in this paragraph; it comes a bit out of the blue. Please consider rephrasing this paragraph. P39, line 21: I am not sure if "mid-00s" is a correct English expression. P43, line 10: I suggest to replace "gathers" with "comprises of". P43, line 11: The "a" before "software" should be removed P43, line 18: Which ECMWF analyses have been used? The operational or those from the reanalysis. If it was the former, would there be an impact of the changing output quality over the years 1979 - 2010? P44, lines 14 and 19: I suggest using "length scale" instead of "length". P45, lines 7-8: Could you please define "observation uncertainty" more carefully here. It stands for the observation-model differences and this might not be clear to all readers. P47:, lines 1-2: Could you explain the shown patterns a bit more? Figure 1: This figure is very hard to read and needs to be of better quality.

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