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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

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I thank the reviewer for her/his careful reading and for her/his constructive comments. I have addressed them all. They are copied hereafter with my answers inserted where appropriate.

> This paper presents a novel approach to parallelize model transport computations in the framework of variational atmospheric inversions. By dividing the whole assimilation window into several overlapped segments for forward and backward model transport computations, this approach can effectively reduce the wall clock time for varational inversions over a long time window (several decades) to that of a single sub-segment. This paper

> is well written, and should be accepted for publication.
>
> At the meantime, I suggest the authors to make several clarifications.
>
> 1.If I understand correctly, Eq.2 has indeed approximated effects of all analysis increments in previous segments to current atmospheric concentrations by using a mean global bias. While the inversion results have been shown in good agreement with reference experiments (in particular, with the short window one), I want to know how accurate this approximation itself is. My concerns are:
>
> a) If we have a dense observation network to capture more detailed spatial variations, this approximation could degrade the ability of a variational inversion system to estimate small-scale surface fluxes unbiasedly.

A dense network better distinguishes between the signal from the errors from the recent prior fluxes and that from the distant ones and therefore would improve the ability of the system to estimate small-scale fluxes unbiasedly. I will clarify this point.

> b) For other trace gases such as CH4 and CO, analysis increments may be difficult to be replaced by a change to their annual global growth rates.

For reactive gases, the method requires introducing a life-time to the global-mean increment, that can be easily computed from the chemistry 3D fields. Quantifying the accuracy of the result is the next phase of this research.

> 2.It is right for the author to point out errors in modelling atmospheric transport. To this end, is it more suitable to use even shorter segments (maybe together with more complicated bias terms) ?

I do not see how shorter segments can address transport errors.

Interactive comment on Geosci. Model Dev. Discuss., 6, 37, 2013.