Geosci. Model Dev. Discuss.,
https://doi.org/10.5194/gmd-2019-185-RC1, 2019

Geoscientific Model Development Discussions

Interactive comment on "Geostatistical inverse modeling with very large datasets: an example from the OCO-2 satellite" *by* Scot M. Miller et al.

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Received and published: 2 December 2019

This is a valuable paper and the analysis is suitable for publication. However more careful wording is needed for a number of aspects.

This is a synthetic data study. That is an entirely reasonable thing to be doing. However, to say that the analysis is "using CO_2 observations from .. OCO-2" (as the authors do in the abstract and in the conclusion) is simply not true.

A complicating aspect is that the fluxes from carbon-tracker are themselves the product of an inverse calculation and so will have different spatio-temporal correlations than actual fluxes.

I would strongly disagree with the claims of uniqueness of GIM with regard to including

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other types of information.
There are two different things:
1. The geostatistical approach of using spatio-temporal correlation structure as a technique for regularising an ill-conditioned inverse problem; and
2. the inclusion of additional information about fluxes (incorporated into GIM through β).

There is nothing to prevent the inclusion of additional information into inversion techniques that do not use geostatistical constraints.

While the specific form of $p(\mathbf{S}|\beta)$ that is used leads to linear equations and a direct solution, once direct solutions are replaced by 'variational' approaches, more general forms of $p(\mathbf{S}|\beta)$ can be incorporated, either with or without the use of regularisation by imposing a spatio-temporal correlation structure.

page 11, Line 5. The Miller et al. (2018) study doesn't seem to provide much information about the actual spatio-temporal correlation structure of the OCO-2 data (i.e. the structure of **R**. More discussion of this would be desirable.

Ian Enting, December 2019.

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