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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparison of ensemble Kalman filter and variational approaches for CO_2 *data assimilation" by A. Chatterjee and A. M. Michalak*

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The manuscript deals with computational methods to solve atmospheric CO2 source-sink estimation problem (although the numerical test case only contains synthetic sources). In particular, variational and ensemble Kalman filtering approaches for CO2 flux estimation are inter-compared to find their respective advantages and disadvantages. The topic is interesting, highly relevant and well scoped with respect to the Journal Subject Areas. As the Authors point out, this question is not well covered in the existing literature and there is thus need for further research on the estimation approaches to guide selection of methods in real applications.

The manuscript correctly describes the selected methodologies (a reference inverse modeling, and two computationally efficient approximations, i.e., 4d-variational data assimilation and ensemble square root filtering). These methods are implemented into

a 1-dimensional advection-diffusion problem of a passive tracer to emulate the CO2 flux estimation problem. The test case is thus highly simplified using synthetic observations in absence of models of atmospheric processes or dynamics. The setup is generic in a sense that it could be associated with CO2 or any other tracer in the atmosphere or in any medium.

The testing setup is highly simplified, and a question naturally arises whether it is sufficient to usefully contribute to better understand the estimation problem at hand. For testing a new estimation concept, the setup would definitely be sufficient before proceeding to more demanding implementations. For inter-comparing well established methods, the setup would be useful as a development environment at the initial stages of research. To further substantiate research of this type and obtain conclusive results one should definitely use a more realistic test setup. The research questions posed in the manuscript are relevant but this setup severely limits the applicability of the results. Additional questions related to real systems, such as sensitivity of the methods to observation and model biases, are difficult to cover properly using such a simplified test environment. (Incidentally, the word "bias" cannot be found in the manuscript). Conclusions thus remain very qualitative because there is no way to scale-up the results to more realistic cases.

This said I want to stress that the manuscript is very good but ACP is simply not the correct forum for it. Papers published in ACP are expected to contain atmospheric or laboratory measurements, models of atmospheric dynamics and processes, or new concepts which may not yet be supported by fresh observations. This submission unfortunately does not fulfill these expectations. Thus, my recommendation is to reject the manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 12825, 2013.