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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Comparing the CarbonTracker and TM5-4DVar data assimilation systems for CO_2 surface flux inversions" *by* A. Babenhauserheide et al.

Anonymous Referee #1

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The comparison of the carbon flux inversion systems Carbontracker and TM5-4dvar made in the study provides a timely step forward towards reaching a consensus over comparative advantages and disadvantages of grid-based inversion versus Ensemble Kalman filter approach in the field of surface CO_2 flux inversion. Authors did a through job to configure the two systems as close as possible and to elaborate on the reasons for differences in the results. On one part, good match between the two systems was achieved by adjusting the data screening, assimilation window size and flux time step in Carbontracker, which allows getting similar estimated fluxes to TM5-4dvar. The paper is well written, and can be accepted after minor revision.

Comments on the text.

p8887 Line 15. Exactly speaking, neither TM5-4Dvar nor Carbontracker took part in the intercomparison by Gurney et al, 2004. It was TM3 model at that time.

p8893 Line 11 Author's statement "the 4DVar method leaves the dimension of the state vector intact and instead approaches the minimum of the cost function step-by-step" is not accurate, as they use Lanczos method that implements truncated singular value decomposition with limited number of singular vectors, thus reducing a dimension of the problem. The state vector dimension is reduced to number of reconstructed singular vectors. The statement should be reformulated accordingly.

p8893 Line 14 Equivalence between conjugate gradient algorithm and the Lanczos method is not trivial. Fisher and Courtier (1995) who worked on the code used in Meirink et al (2008) had to come up with a proof of the equivalence. Adding reference to Fisher and Courtier (1995) or similar text would help

p8894 Line 19 Length scale choice of 200km for biosphere fluxes was referred to as standard setting, but it is different from one used in other studies with the same model. Pandey et al 2015 used 1000 km, and Basu et al 2013 used 500 km. If there is a reason to use 200 km it is worth mentioning. The choice of using relatively short distance is related to the conclusion which states a potential benefit of reusing in TM5-4Dvar the correlation structures found in Carbontracker. That suggests indirectly that the selected flux correlation length in TM5-4Dvar may be too short.

Minor corrections:

p8886 line 25. Add "and" between ESRL and Oak Ridge

p8890 line 19 Expression in Eq. (12) was introduced without explaining the notation. Reader may guess the expression in brackets is actually a matrix of size E by dimension of x, but it is better to explain.

References

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 8883, 2015.