

Interactive comment on “Optimizing global CO emissions using a four-dimensional variational data assimilation system and surface network observations” by P. B. Hooghiemstra et al.

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We like to thank both reviewers for the extensive review reports we received. Specific comments and suggestions have been used to improve the manuscript accordingly.

The main comment in both review reports was on our treatment of the NOAA flask observations. In the revised manuscript we emphasized on our investigation of the model error that is included in the observation error. We added a new paragraph (§4.1) in the discussion, in which we elaborate on the observation error. We seek a compromise between rejection of (a large number of) observations and assigning very large errors to the observations (resulting in less constraints on the emissions). We use an

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advanced model error representation to account for possible model errors due to close by emissions and sub-grid variability. On top of this we reject observations outside a 3 standard deviation range of the posterior simulation. In this study, approximately 15–20% of the observations are rejected. We found that the main reason for the rejection of the large amount of observational data is the coarse model resolution, in which both high and low observations are poorly reproduced. We would like to stress here once more, that it remains extremely challenging to define a model error representation that works well for all stations.

Furthermore we changed the discussion paragraph on separation of the sources. The main conclusion is that the available observations constrain total CO emissions and therefore, the uncertainty reduction in the total emissions is larger than in the individual emission categories. Hence, in the posterior solution, the source categories are negatively correlated. We now more clearly emphasize that this implies a solution space in which the different source categories can hardly be separated.

Since the topic of the current paper is a thorough testing of the 4D-VAR system, we acknowledge current shortcomings and apply improvements in future work.

The answers to specific comments are treated in the two accompanying documents.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 11, 341, 2011.