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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The constraint of CO_2 measurements made onboard passenger aircraft on surface-atmosphere fluxes: the impact of transport model errors in vertical mixing" *by* Shreeya Verma et al.

Anonymous Referee #1

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General comments.

The paper presents an observing system simulation study investigating the information content of the planned IAGOS aircraft observations of atmospheric CO2 profiles, and projected impact of IAGOS observations on reducing uncertainty of surface CO2 flux estimates by inverse modeling. Paper is written well and useful, and can be published after revision. A minor revision is needed to address few weaknesses to the study and its presentation.

Detailed comments.

Page 2-Line 37 It would be useful to note that Niwa et al (2012) and Patra et al (2011) relied mostly on free-tropospheric part of the profiles. There are some earlier studies looking at aircraft vertical profiles and their use in inversions. Gloor et al (2000) have considered aircraft vertical profiles in their studies on observing network extension. A difference between fluxes estimated using near-surface observations and column average of the vertical profiles was discussed by Nakatsuka and Maksyutov (2009).

P3-L37 Equation 1 is written or described incorrectly; in place of Cini should be the result of forward simulation with initial concentration Cini.

P4-25 Equations 4b and 6 give impression that prior flux error covariance matrix is omitted. These equations look different from Jena inversion system described by Rodenbeck et al (2005). Authors should review the Equations (3-6, 14) in (Rodenbeck et al 2005) and explain the changes, in case there are some.

P10-L35 More discussion can be added on this topic. The transport model used in this study may not be best one for actually analyzing the IAGOS observations in PBL, due to a need to resolve plumes of anthropogenic CO2 transported from large cities near the airports. A relatively high model-observation mismatch of 5 ppm at 1 km as shown on Fig. 1 was found for CONTRAIL data. High model data mismatch (mdm) could partly be a result of applying low resolution (with respect to city plume size) model and meteorology, thus it should be considered as upper bound on mdm. Using the data uncertainty based on CONTRAIL mismatch for IAGOS looks justifiable with current transport model, and large data uncertainty may have resulted in relatively low flux uncertainty reductions in the order of 10

The ability of the low resolution model to simulate CO2 concentration in the megacity plumes is questionable, with possible underestimation of fossil CO2 component due to low model resolution (model is low biased), affecting the estimated fluxes.

Technical corrections.

P1-L14 Suggest correcting “ground- based” to “ground-based”

P1-L19 Suggest correcting “under constrained” to “underconstrained”

P2-L2 In “unevenly distributed observation network of observation can result” – sounds like “network of observation sites” would fit better.

P2-L16 Suggest correcting “Checa- Garcia” to “Checa-Garcia”

References

Gloor, M., S.-M. Fan, S. Pacala, and J. Sarmiento, Optimal sampling of the atmosphere for purpose of inverse modeling: A model study, Global Biogeochem. Cycles, 14(1), 407–428, doi:10.1029/1999GB900052, 2000.

Nakatsuka, Y. and Maksyutov, S.: Optimization of the seasonal cycles of simulated CO2 flux by fitting simulated atmospheric CO2 to observed vertical profiles, Biogeosciences, 6, 2733-2741, doi:10.5194/bg-6-2733-2009, 2009.

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