

Interactive comment on “Impact of physical parameterizations and initial conditions on simulated atmospheric transport and CO₂ mole fractions in the US Midwest” by Liza I. Díaz-Isaac et al.

Anonymous Referee #1

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Díaz-Isaac et al. studied the impact of transport errors on simulated CO₂ mole fractions in the US Midwest, which is very relevant to the goal of improving the estimate of surface CO₂ fluxes, since transport models are used to derive surface CO₂ fluxes in an inverse analysis. The authors tested a series of physical parameterizations and initial conditions and pointed out that most tested physical parameters and initial conditions have a significant impact on simulated CO₂, either influencing the planetary boundary layer height (PBLH) that confirms the previous finding that the correct representation of PBLH is important for accurate CO₂ simulations or changing wind speed and direction.

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The paper is well structured and clearly written. The reviewer suggests publication after the following concerns have been addressed.

One of the major conclusions that “all physics parameterization except for microphysics have a significant impact on both CO₂ mole fraction and meteorological variables” is based on the magnitude of the simulated CO₂ root mean square difference (RMSD). The authors mentioned that it was computed for each model ensemble member by varying only the type of physics parameterization. My understanding is that for the LSM scheme, multiple sets of ensemble members can be used for the computation, e.g. models nos. 1&7, nos. 2&8, nos. 3&9, nos. 22&40&43, nos.23&41&44, nos.24&42&45. Was the presented RMSD for LSM the mean of all different sets of ensemble members? For the calculation of the mean of the ensemble for day *i* in equation 1, are all 45 ensembles used or only the sets with varying one type of physics parameterization? This should be clarified.

I agree with the concerns raised by reviewer #2 on the use of the 14 radiosounding sites. The vertical profiles of temperature and CO₂ mole fractions at multiple sites from the NOAA aircraft program and/or from other intensive campaigns could be looked into, at least for the PBLH.

P5/L6: use longwave instead of long wave

P12/L22, P13/L5, P15/L21: use the plural form “show” instead of “shows”

L15/22: “We did not find any relationship between error correlation and distance”. It would be convincing to show a scatter plot, error correlation vs. distance for each grid in Figure 13, or at least present the correlation of error correlation vs. distance.

L16/11-12: provide evidence of PBL winds impacting the distribution and magnitude of the inverse CO₂ fluxes over the region.

The reviewer found it difficult to obtain any meaningful information from the figures 7,10&14 where the results of all 45 model results are presented for three selected

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sites. The results should be first summarized before being presented, or simply be moved to the supplementary.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-117>, 2018.

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