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Geoscientific Model Development Discussions

Interactive comment on "Characterizing model errors in chemical transport modeling of methane: Impact of model resolution in versions v9-02 of GEOS-Chem and v35j of its adjoint model" *by* Ilya Stanevich et al.

Anonymous Referee #1

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Overview: The manuscript "Characterizing model errors in chemical transport modeling of methane: Impact of model resolution in versions v9-02 of GEOS-Chem and v35j of its adjoint model" by Stenevich et al. describes the effect of model resolution on the forward and inverse modelling of methane in the GEOS-Chem model, and the potential effect on the model's estimation of posterior fluxes after data assimilation. The forward model was used to run short simulations of methane, which were then compared to a number of remote sensing sources. Following this, simulations of species representative of atmospheric transport at various scales were carried out in order to assess the

causes of the differences in transport caused by the changing resolution. The paper suggests that, for this particular model at least, the resolution of the simulations is very important and could significantly affect conclusions drawn through forward and inverse modelling using GEOS-Chem.

Overall the manuscript is very well written, with few technical corrections necessary. The figures are generally quite clear and well chosen, although some further detail needs to be provided for some of them. The methods used within the manuscript are appropriate for such a study, are able to provide assessment of the effect of model resolution on inverse modelling, and should provide pause for thought for all modellers. Although the paper is relatively niche in its focus, which describes the effects of transport parameterisations which are specific to GEOS-Chem, it does flag up an issue which will be of interest to the GEOS-Chem modelling community, and might cause other modellers to assess these issues within their own models.

My main reservation is that the quantity of plots is quite large, whilst the quality of some of them is a little low. The authors have a tendency to overwhelm the reader with information in these plots, at the risk of the main message being lost. Generally, the clarity of figures should be maximised, both in terms of literal clarity and clarity of message. Once this is fixed, I suggest that this paper is suitable for publication in this journal as long as the following small revisions are carried out.

Comments:

Figure 1: There is a lot of information here, so each individual plot is quite small. This means that the panel labels and the labels of the colour bars are illegible. I'd suggest making the text for each panel larger. I'd also suggest that, for improved clarity, the CO2 panels could be removed from this figure.

Figures 7 - 9: These plots could easily be combined by reducing the number of panels in each plot. Figures 7 and 9, for example, do not require the NH summer panels to be included, whilst Figure 9 also shows a number of panels with no features.

Figure 12: similar to figure 1, most figure text is unclear. Also, I'd suggest that clearer context here would be provided by showing the differences between the 'fixed' model simulations and the satellite, rather than the 'fixed' and 'unfixed' model simulations. As it stands, it is difficult to see what improvements are being provided by the fixes.

Figure 13: whilst the grey bars are visible on my computer screen, they were not visible at all when I printed out the manuscript, so I'd suggest that a clearer method should be used to indicate the regions displayed in the second and third rows here.

Technical corrections: Page 1 line 8: columns abundances -> column abundances

Figure 2 caption: rght -> right

Page 8 line 19: missing reference

Page 8 line 23: relative -> relative to

Figure 3 bottom panel label (and other figures): 25 -> 2.5

Figure 10 caption: note different colour bar scales for panels 2 and 4

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