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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 #2

Received and published: 14 January 2020

General Comments

The manuscript 'Characterizing model errors in chemical transport modelling of methane: Impact of model resolution in version v9-02 of GEOS-Chem and v35j of its adjoint model' by Stanevich et al. describes the impact of model resolution on tracer transport and optimised surface CH4 fluxes in GEOS-Chem. Initially, model simulations of CH4 at two different resolutions were compared with satellite and TCCON data. Large differences in simulated methane column abundances were found between the two resolutions, which resulted in differences in optimised regional methane fluxes of

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up to 30%. Further simulations using additional tracers then assessed the causes of differences in transport between the two resolutions. Results from this study suggest that model resolution can have a significant impact on the location and magnitude of optimised methane fluxes, introducing a latitudinal bias.

The manuscript is in general well-structured and well-written. The figures are useful and mostly clear, although the text could do with enlarging on many of them. Although the manuscript is model-specific, the results are relevant and significant for the methane modelling community, highlighting the potential magnitude and importance of model errors when trying to constrain the methane budget. I recommend this manuscript for publication following the minor revisions outlined below.

Specific / Technical Comments

Page 1, line 8: change ‘columns’ to ‘column’

Page 1, line 15: The sentence starting ‘We also identified..’ repeats what is said in the previous sentence.

Page 3, line 33: change ‘winds field’ to wind fields’

Page 4, line 6: change ‘Because’ to ‘As’ or alternative.

Page 5, line 33: How is soil absorption determined / or can a reference be provided for this?

Figure 1: The labels are currently too small to read. The XCO2 proxy fields could be removed to allow better viewing of the remaining plots.

Page 7, Section 3.1: As I understand it, the authors spun up the model using standard GEOS-Chem methane emissions for 5.5 years, then switched to optimised emissions (from the 4 x 5 degree resolution model) for the remaining 7 months of the initialisation period, and then for the analysis period switched back to using the standard GEOS-Chem emissions. If the magnitude of the differences between the optimised and stan-

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dard emissions is similar to those shown in Figure 4, the changes are quite large, and seven months is short relative to the methane lifetime; it would be helpful here if the authors could clarify the aim and influence of switching to optimised emissions for 7 months before the analysis period?

Page 8, line 19: reference missing (‘ A similar stratospheric bias was reported by ??’).

Page 11, line 22: change to ‘be a useful indicator’

Page 13, lines 5-10, Section 5.3: How were these simulations initialised and what period were they run for? Do they use the optimised emissions? Quite a few different simulations are described in this paper, perhaps a table listing all/a subset of the different simulations and their set ups would help.

Figure 13: I cannot see a grey vertical band or read the labels on the white contours. Fewer contours with larger labels could help make them more readable.

Page 17, line 12: Mention ‘R3’ in the text here (simulation R3 is used in the label and caption in Fig 6, but not specifically mentioned in the text).

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