

Interactive comment on “Simulating CH₄ and CO₂ over South and East Asia using the zoomed chemistry transport model LMDzINCA” by Xin Lin et al.

Anonymous Referee #1

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This manuscript describes a detailed sensitivity simulation of CH₄/CO₂ in Asia with respect to horizontal resolution employing two different versions of the LMDzINCA model. This kind of study can be expected to contribute significantly to improving performance of data assimilation and accuracy of inverse modeling as the authors emphasize. The overall text is well written, and the authors very carefully discuss the results. However, most of the descriptions in this paper appear to be too detailed and sometime tedious although they may be needed to convey useful information to the data assimilation procedure. The subject of this paper seems to be appropriate to the ACP. However, I would like the authors to consider my questions and revise the manuscript before I recommend the publication of this paper. Details of my comments will be found in the

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following.

Major Comments:

*M1: For “abstract” and “conclusions” section, I’m not convinced about conclusions of this manuscript. The authors state that the finer horizontal resolution version improves Asian CH₄/CO₂ simulation only moderately. Are you saying that enhancing horizontal resolution is not that useful (not beneficial)? I think you could more clearly express the message/implication of this study at least in abstract and conclusions parts.

*M2: This study just showed that a finer horizontal resolution more or less contributes to improvement of CH₄/CO₂ simulation for Asia. But it is very unclear whether this improvement is really significant or meaningful in terms of regional budget and flux estimate. I think the authors should check the impacts of other factors (at least vertical resolution or NEE) on the simulation as well as horizontal resolution for more clearly appealing the advantages of your zoomed method in the LMDzINCA modeling framework.

*M3: For the moderate improvement with ZASIA, I do not yet understand the reason for it. The authors give several potential candidates like matching between the model’s grid and observation site, different transport, etc. But how much do they contribute? Or what is the most possible reason for the improvement?

*M4: The authors stated that the ZASIA version does not deteriorate the performance of CH₄/CO₂ outside the zoomed area (L383). But they seem to be looking only at the sites displayed in Figure 1 (mostly in Japan). How about the impacts on performance for other sites like in EU, US, Africa, and the southern hemisphere? This point should be clarified in the main text with an additional figure as supplementary material.

Minor Comments:

** L158 to L173: How do you represent diurnal variation in OH?

** L177 “The spin-up time of 6 years”: Don’t you have any trend or drift of global mean

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CH4 concentration during this 6 years?

** L179 “already realistic”: What do you mean by “realistic”? You should explain more about the initial conditions for CH4.

** L395 “better description of the surface fluxes and/or transport”: Given the fact that CO2 simulation is not improved by ZASIA, the improvement seen in CH4 seems to be resulting from non-transport process (surface fluxes?).

** L435: There appears no explanation for the abbreviation of “NEE”.

** L500 “rather coarse (19 layers)”: How do you get the model concentrations at the elevation of the observational site? The model layers are linearly interpolated?

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