Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-106

Anonymous Referee #2

Referee comment on "Analysis of CO_2, CH_4, and CO surface and column concentrations observed at Réunion Island by assessing WRF-Chem simulations" by Sieglinde Callewaert et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-106-RC2, 2022

Callewaert et al. present a comparison of modelled and observed in-situ dry air mole fraction and the total column-averaged dry-air mole fraction of CO2, CO and CH4 at two sites on Reunion Island (St-Denis and Maido observatory). The atmospheric composition is modelled using a nested version of WRF-GHG with different emission priors, while observations are performed using cavity ring-down spectrometers and solar tracking FTIR systems.

The study demonstrates a good ability for WRF-GHG to reproduce atmospheric temperature and a limited ability to reconstruct atmospheric wind patterns (with a significant high bias in wind speed). Total column and in-situ observations correlate well for atmospheric CO and CO2, while CH4 data shows a surprisingly low correlation coefficient.

Overall, the paper is well written and nicely structured, so readers can follow the logic of the comparison. It presents and discusses atmospheric data from a chronically under-sampled region (Indian Ocean) with the aid of a state of the art atmospheric transport model. The analysis is sound and the scope of the paper well suited for ACP and its readers. After addressing the suggestions and technical correction below, I can fully recommend the paper for publication.

General comments:

Some results warrant a more detailed discussion, especially the issue of the low correlation of CH_4. Looking at Figure 6 (b) and (d) seems to suggest that there could be two apparent distributions for CH_4 that, if fitted separately, could produce much more reasonable slopes and improved coefficients. Have you attempted to separate the data based on external drivers that could explain the two distributions?

Minor and technical comments:

L1: The authors should consider changing the title as they report modelling result using WRF-GHG (passive tracer) rather than the version of WRF with active chemistry (WRF-CHEM).

L14: please add that the Pearson's correlation coefficient was used here.

L67: please correct "etc…"

L83: please elaborate on what "…" refers to or just give the elements in the brackets as an example.

L225, Figure 2: please consider adding the information on the vertical resolution and top of the domain in the caption of Figure 2

L309: please change to "… agree less well …"

L337: Please elaborate on the assumption that there is "no vegetation within the city".

A simple search of aerial photos of St. Denis reveals multiple parks and vegetation along the shoreline. Maybe the assumption is rather that the impact of local vegetation is negligible compared to fossil fuel combustion?

L368: Is the statement related to the nighttime respiration true in general or here

specifically for a local imbalance in the boundary layer.

Please also note the supplement to this comment:
https://acp.copernicus.org/preprints/acp-2022-106/acp-2022-106-RC2-supplement.pdf