Geoscientific Model Development Discussions

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Comment on gmd-2022-145

Anonymous Referee #2

Referee comment on "Evaluation of high-resolution predictions of fine particulate matter and its composition in an urban area using PMCAMx-v2.0" by Brian T. Dinkelacker et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-145-RC2, 2022

Dinkelacker et al 2022 investigates the benefit of high-resolution modeling and emissions surrogates for the prediction of PM2.5 and its composition using PMCAMx. The authors present model results and measurement comparisons for model simulation at 36 km, 12 km, 4 km and 1 km simulations, to southwestern Pennsylvania while applying novel surrogates for on-road and commercial cooking emissions. Previously in the work of Rivera et al 2022 evaluated the effects of grid resolution for model predictions of particulate matter. This study enhances that work performing a model evaluation by comparing the modeling approach against EPA and low-cost sensor measurements. The study compares PM2.5 in Winter and Summer and for EPA monitor sites shows that fractional error and fractional bias improved by increasing resolution from 36 km to 1 km. In general, PM2.5 prediction performance improved in almost all cases. The underpredictions of PM2.5 at urban sites and overpredictions at rural sites were reduce as a result of increasing resolution.

Overall this paper is well written and logically organized. The subject matter is one that should appeal to atmospheric chemistry and air quality modelers. This study is valuable in showing the importance in developing improved emission inputs for models in particular for the spatial distribution to emissions from an inventory to a model grid. While a focus on improving model resolution to improve model results has its clear benefits, this study shows clearly that when we increase spatial resolution, it should be accompanied by improved and more accurate emission inputs.

Comments:

- While it is clear that the different spatial distribution has an impact on the distribution of emissions for commercial cooking and on-road traffic, how are these two sectors typically distributed in the default surrogates? Please consider elaborating in Section 3

to provide some context to the reader.

- In the PMCAMX model simulations, are there removal processes such as dry deposition and wet scavenging? If so, how were these handled between the different grid resolutions? Are these something that must be interpolated from WRF or is it something that PMCAMx explicitly captures?
- The WRF simulations were conducted at 12 km resolution with the information interpolated to higher resolutions of 1 km and 4 km. First, what was the procedure to create 36 km inputs for PMCAMx? Second, why was this design choice made rather than simulating WRF at 36 km and interpolating for all higher resolution grids? Or perhaps simulate meteorology at 4 km with interpolating to 1 km grid and extrapolating to 12 and 36 km grids?
- For those unfamiliar with emissions processing and emission surrogates, it may prove useful to further emphasis how using different surrogates merely change the spatial distribution of the total amount. The authors perhaps made this clear in Section 6 and the Supplementary material but the reader could benefit from this stated more clearly and earlier.
- Related to the previous point, at times in the paper it reads like the novel surrogates for commercial cooking and on-road emissions were applied to all grid resolution configurations and other times it reads like they were only applied to 1 and 4 km simulations (see Line 183-184).
- There is no mention of the novel emission surrogates for commercial cooking and on-road emissions in the abstract. I feel like this point could use some emphasis in terms of mentioning that these were used and developed and briefly mention the evaluation of these novel surrogates.
- The paper could in general benefit from making it more clear how this study is both related and also different from Rivera et al 2022.

Minor comments:

- Table 4 could benefit from explicitly mentioning in the caption that it is for the 1×1 km resolution.
- In supplementary material, the captions for Figure S7 and S8 should be checked and corrected to avoid any confusion. Figures S7 and S8 captions incorrectly start off with mentioned commercial cooking and also both for February 2017. Presumably, S7 and S8 are for on-road traffic for February and July respectively as they mention using simulated traffic approach.