Atmos. Chem. Phys. Discuss., 15, C1921–C1923, 2015
www.atmos-chem-phys-discuss.net/15/C1921/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Climate forced air-quality modeling at urban scale: sensitivity to model resolution, emissions and meteorology" *by* K. Markakis et al.

Anonymous Referee #1

Received and published: 27 April 2015

In this study, Markakis et al., conduct a series of sensitivity calculations using WRF and CHIMERE to downscale global inputs (IPSL-CM5A-MR an LMDz-INCA) to 0.44 and 0.11 degrees (for the met) and 4 km (for air quality). The sensitivity calculations conducted are used to assess the response of the modeling system to various different ways of processing inputs (e.g., resolution, which emissions, climate/reanalysis inputs). For those involved in such calculations the manuscript provides useful information.

General Comments: One issue I found throughout the manuscript is the struggle for what is the appropriate way to evaluate models when conducting such an exercise. There is always a temptation to suggest that the close the model results are to the

observations, the better, which is typically true. However, then one has to decide upon a set of metrics, of which there are many. It is not always the case that finer resolution is better (for numerical and other reasons... e.g., potential spatial misalignment in inputs). Further, there is the issue of compensatory errors. Thus, one is left with the question of what should be the standard for comparison, and what is the "best" result. This manuscript does well at showing sensitivities, but also discusses bias, with the implicit assumption that a smaller bias means that the simulation is better. However, it could just be that it does a better job at having errors compensate for each other. The manuscript should better deal with this issue. They should also consider doing a dynamic analysis of the model responses (e.g., the work by Dennis et al., at the US EPA and as part of AQMEII).

The authors would also serve the community by digging in to the results of the multiple simulations (and possibly conducting some additional simulations),to provide a more general understanding of the spatio-temporal patterns of model responses. At present, they give specific results for their set up, which may be all they are limited to at present. It would be great if they could better say "our results show that, in general, model resolution will tend to have the following effects on model results: (list of effects, with some indication of spatio-temporal trends). This will likely require looking at distributions of model results. Indeed, as demonstrated by the work from Harvard, when looking at air quality and climate impacts, distributions of air quality responses are very informative (e.g., Wu et al., (2008) JGR, DOI: 10.1029/2007JD008917). This is done, to some degree in Fig. 7, but that does not give a spatio-temporal understanding.

One of the most important questions is not addressed by this manuscript: that is, how do these changes (resolution, emissions processing, meteorology) impact how the model responds to emissions changes, e.g., how ozone, PM and NO2 respond to NOx, VOC and SO2 emissions changes.

Specific Comments:

The base air quality model was run with 8 layers, with a sensitivity run at 12 layers. Many model are now run, as a base, with signficantly more layers (e.g., Simon et al., Environ Sci Technol. 2013 Mar 5;47(5):2304-13. doi: 10.1021 use 24 layers). It would have been of interest to have an even higher vertical resolution analysis.

The article is opaque at times, e.g., "As regards PM2.5 modeling . . . regional realization canno tselectively incorporate any combination of local scale features. . ." is tough to parse. "By principle" is not standard English. Likewise, many areas still in need of editing for grammar.

They should make clear what they mean by "top-down" vs. "bottom-up" emissions inventories. Some people might use "top-down" to refer to using observations. Also, the discussion of the weaknesses of various emissions inventory approaches predate Markakais 2010, and should be referenced (e.g., look back at the NARSTO reports, as well as Gilliland, JGR, v. 108).

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 4767, 2015.