Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-329-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Extending the Community Multiscale Air Quality (CMAQ) Modeling System to Hemispheric Scales: Overview of Process Considerations and Initial Applications" *by* Rohit Mathur et al.

Anonymous Referee #1

Received and published: 20 June 2017

In this article, the authors describe the hemispheric version of the Community Multiscale Air Quality (CMAQ) modeling system and present a variety of applications of the system for evaluation. In general, the paper is of good quality and should be published with minor revisions as detailed below, although it is a description paper of a new model version and does not contain any truly new science.

Comments

I think the authors should make it clearer in the Introduction that Figure 1 is simply a

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characterization of the regional-scale CMAQ model and does not necessarily represent the what actually happens in the real atmosphere. CMAQ is known to be rather diffusive (Emery et al. 2011; Garcia-Menendez et al. 2010; Mathur 2008) and probably does not represent this transport very faithfully. Some readers might be fooled into believing that the fractions presented in Figure 1 are realistic, when they are probably not.

The results of Figure 3 are fascinating. Increasing the vertical resolution from 35 layers to 44 layers substantially reduced ozone profiles in the lower atmosphere. This immediately begs the question as to what would happen if the number of layers was increased to 60 or 70! A pet peeve of this reviewer is that air quality and atmospheric chemistry models are not rigorously evaluated as numerical models. In any basic numerical modeling class, one is taught to increase grid resolutions until the solution converges to a consistent result. This is _never_ done in 3-D atmospheric chemistry modeling! How much different would the results be if this simple numerical procedure was carried out? My guess is quite different.

In the description of the model, the authors in several cases describe what is in the version being presented in this paper, but also describe improvements that are or have been worked on. Examples of this include ... (i) seven NTR species rather than 1; (ii) the marine environment chemistry and deposition; (iii) windblown dust parameterization; and, (iv) the ozone-PV parameterization. In these discussions, it's not always clear what's included in this model version used in this paper and what's just an "advertisement" of the improvements to come in the future.

For Figure 6c, the authors make the dubious statement ... "The comparisons in Figure 6c further show that CMAQ captures the SO4 enhancements in the free troposphere associated with this episodic event." In looking at this figure, I find it very hard to not laugh out loud when reading this sentence! The observed and modeled SO4 values are of the same general magnitude, but don't seem to be correlated at ALL. I think the authors should be more truthful in their comments about this figure.

It is admirable that the authors have implemented the RACM2 chemical mechanism into the hemispheric version of CMAQ, which is likely more suitable than CB05 for larger domain applications. However, the authors should give thought to taking the next step and implementing a mechanism that is even more applicable for domains containing regions remote from major sources. Both CB05 and RACM2 were designed for regional-scale applications where NOx concentrations are relatively large compared to values found in the remote troposphere.

Emery et al. (2011) Atmos. Environ. 45, 7341-7351.

Garcia-Menendez et al. (2010) Atmos. Poll. Res. 1, 239-249.

Mathur (2008) JGR-Atmos.113, D17302, doi:10.1029/2007JD009767.

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