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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Development of a fast, urban chemistry metamodel for inclusion in global models" *by* J. B. Cohen and R. G. Prinn

Anonymous Referee #1

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Major Comments:

The authors present a method to treat urban-scale air quality phenomena in a global modeling system in a computationally efficient manner. The study expands upon earlier work in the field. While the general conceptual framework is sound, I do have some concerns about its particular implementation in this study. I also believe that the organization should be improved and the overall length of the manuscript reduced before final publication. My major comments are as follows:

The use of assimilated meteorology rather than a grid-based prognostic meteorological model to drive CAMx does not reflect current best practices for regional- and urban scale photochemical modeling. It would be preferable to apply prognostic Eulerian mesoscale models such as MM5 or WRF to drive the CAMx simulations used to gen-

erate the urban metamodel.

The assumption that all anthropogenic emissions scale linearly with either CO or BC seems oversimplified. For typical CAMx applications, a more detailed emissions processing approach is employed to reflect the mix of source sectors and their temporal and spatial variability.

Given that both the preparation of input meteorology and emissions for CAMx appear simplified compared to typical regional- and urban scale CAMx applications, output from the CAMx simulations performed in this study should be compared to observations before being used to develop a metamodel for use within a global model. While the metamodel output is compared to observations in Section 8, similar analysis should be performed for the underlying CAMx runs. In particular, the authors state that some of the discrepancies between the metamodel output and observations arise from the incompatibility between ground-level measurements vs. column-integrated metamodel outputs. By directly comparing CAMx output for the first model layer against observations these incompatibility could be reduced and the credibility of the CAMx setup used in this study could be established. If similar discrepancies exist even between the actual CAMx output and observations (i.e. large overestimation of ozone, underestimation of CO), it is hard to justify the use of these CAMx outputs for developing the metamodel.

The introduction section should be shortened. The order of figures some figures and tables is out of sequence, e.g. Table 5 is referenced before Table 3, and Figure 8 is referenced before Figure 7. The CAMx setup should be fully described in Section 3, yet most details of the setup are only described in Sections 5 and 6. Sections 2 and 6 both deal with prior work and should be combined, i.e. Section 6 should be folded into Section 2.

Specific Comments:

Pages 4633 – 4636: There should be some references to mod-

eling systems that pursue global-to-urban nesting approaches (e.g. GATOR http://www.stanford.edu/group/efmh/jacobson/PDF%20files/GATOR-GCMOM1008.pdf; GU-WRF, http://www.cmascenter.org/conference/2010/slides/karamchanc in-grid_2010.ppt) rather than sub-grid scale parameterizations to characterize urban-scale phenomena in global modeling studies. Please provide some brief discussion on the advantages and disadvantages of each approach.

Page 4634, line 29: replace “areas” with “area’s”

Page 4639, line 28 – page 4640, line 2: please provide more details on the procedure used to assimilate the meteorological data. Which two days were simulated? The OTAG episode lasted for about a week. Why wasn’t a prognostic model used, possibly in data assimilation mode? How many sites were developed to generate the assimilated meteorological fields for the 4km CAMx domain described in Section 5?

Page 4640, line 15-16: please provide more details or a reference for the “newer and more detailed representation”

Page 4641, line 8: what are some of the other mathematical techniques? What are the advantages and disadvantages of the method chosen for this study?

Section 3 (pages 4642 – 4647), CAMx model: please provide more details on the setup of CAMx: height of vertical layers, model top, size of horizontal modeling domain, number of grid cells, grid cell spacing, lateral boundary conditions etc. Some of this information is later provided in Sections 5 and 6 and Table 4 but should be provided upfront.

Page 4644, line 2. The assumption that all emissions are proportional to either CO or BC does not generally hold true, at least not when considering complex urban areas at a fine spatial scale. Please provide a justification for making this simplifying assumption and discuss how it may affect the accuracy of the model outputs when compared to observations.

Page 4644, lines 15: please provide a reference that found the chosen approach to be “superior” to that of Mayer et al. (2000).

Page 4645, line 1: what is the top of the urban modeling domain? This information is provided in subsequent sections but should be presented upfront.

Page 4648, lines 26-28: While 72 hours may be sufficient to dampen the effect of initial conditions, boundary conditions are expected to be very important for a modeling domain covering only 108 km x 108 km. How were boundary conditions specified, and how sensitive are the CAMx results to these boundary conditions?

Page 4652, line 1: The CAMx studies listed in Section 3 were for a more sophisticated setup of CAMx, including prognostic meteorology. As stated in my major comments, the authors do need to show that the more simplified CAMx setup used in this study is accurate with respect to observations.

Page 4656, line 22 – Page 4658, line 27: Figures 6,8,10,12: The panels in these figures are too small. The dots representing the median values of the metamodel runs are barely visible. It is unclear which range of observations is represented by the lines: Page 4656, line 27 states that the minima, medians, means, and maxima for the measurements are shown on these plots, but only a single line is shown for each site. Furthermore, what were the sampling periods and number of sites for each of the observed ranges? For example, what is represented by the line labeled “Delhi BC”? A single site or multiple sites? The range between minimum and maximum observed values? Over which time period? Why is only a single observational site used for ozone for all four metamodels? “Guadalajara” is misspelled in the figure legend. The figure captions do not state that the plots also contain observational results. Why are no observational results shown for BC and OC even though they are discussed in the text? I am also confused about the results presented in Table 6: assuming the ranges reflect the results from the 50,000 metamodel runs, how are the median and maximum values defined? As the median/maximum values over all grid cells over the entire

simulation period for each metamodel run?

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 4631, 2011.