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Geoscientific
Model Development
Discussions

Interactive comment on "Sensitivity of the Community Multiscale Air Quality (CMAQ) Model v4.7 results for the eastern United States to MM5 and WRF meteorological drivers" *by* K. W. Appel et al.

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The authors would like to thank the reviewer for his/her time and effort reviewing this manuscript. The comments provided are insightful and several changes to the manuscript were made to account for the comments and questions posed. For example, the objectives of the study were clarified based on the reviewer's comments.

Specific Reviewer Comments:

Reviewer Comment: The paper may be accepted after some important revisions:

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Interactive Discussion

Discussion Paper

mainly, the goal of the study is not clear and, as a function of the important message to give, new simulations or new analysis are to realize.

Author Response: Text was added to the introduction to make clear what the objectives of the study are. In short, the objective of the work is to provide users of the CMAQ model some sense of the differences they might expect when transitioning from MM5 to WRF as the meteorological driver for CMAQ. The work was also intended to show that while differences in model performance exist, the combination of WRF and CMAQ results in reasonable air quality predictions. The study was not intended to be a rigorous diagnostic evaluation of the WRF-CMAQ modeling system. Instead, where significant differences existed between the MM5-CMAQ and WRF-CMAQ simulations, attempts were made to explain the possible reasons for the difference in order to inform both the user community and developers of the CMAQ and WRF models where performance issues may exist.

Reviewer Comment: The meaning of "better" includes a variety of solutions. Is it to systematically reduce the bias? Is it to ensure a realistic RMSE compared to the surface stations? And their corresponding local representativity? What is the most important pollutant to well reproduce? Is it possible to adjust one with no damage on the other? An "universal" configuration of a meteorological model to be used for air quality modeling doesn't exist.

Author Response: In many ways, model performance is in the eyes of the beholder. That is to say, where one person may think the model performs well, another may think it does not. It depends on the application. In this instance, the authors tried to avoid saying that one model performed better than another, but instead focused on the performance of the individual species and reported the bias and error statistics for each species. In some cases, it was clear that one simulation performed better than other (based on improvement in both bias and error), while in other cases the difference in performance may be mixed (improved bias but worse error or vice versa) or the difference in performance between the two simulation was very small. As far as which

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pollutant is most important to reproduce well, it again depends on your application and needs. As developers of the CMAQ model, we focus on the performance of all pollutants, and avoid making changes that improve on pollutant while negatively impacting another. However, it is inevitable that changes to improve on pollutant will negatively impact another. In this case, the change is made do to better science. Obviously, different configurations of the meteorological model (and CMAQ model for that matter) will lead to different performance results. Here we simply present a "typical" configuration of the CMAQ modeling system. The meteorological configuration used in this study was the one that gave the best operational performance for the time period that was simulated.

Reviewer Comment: The two meteorological modeling systems are very complex. A lot of floating parameterizations are included and the difference between the two sets of results may be due to several schemes, no linearly interacting. If the goal of the paper is to demonstrate a model's ability to systematically well model air quality, the duration is not sufficient. The authors have to model several years to really see all possible pollution events and thus make realistic statistics. If the goal of the paper is to finely search processes responsible to pollutants concentrations differences, the work must be done more thoroughly. For example, a conclusion is that concentrations are different due to different friction velocity diagnostics. The best way to quantify this impact is to use the u* for the two simulations, for test. Even if meteorology is non-linear, this would give a first interesting answer on the impact of this parameter on concentrations and, thus, will highlight the relative impact of other parameters.

Author Response: The authors agree that in order to demonstrate the model's ability to simulate a wide range of meteorological conditions a long duration simulation is required. The goal of this paper is to provide a example of the differences in performance that may be expected when transitioning from MM5 to WRF. Obviously, the performance of the system will vary depending on the time period modeled. However, MM5 and WRF, while different models, use many of the same schemes, and tend

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to perform consistently with each other. Therefore, the differences highlighted in this study may be systematic. The only way to confirm this would be to perform longer duration simulations, as suggested. Future work comparing MM5 and WRF with the CMAQ model will likely use longer duration simulations, such as year or possibly multiple years. However, that work is several years away at best. In the mean time, we feel that this work is useful as a first step into examining the differences between using MM5 and WRF to drive the CMAQ model. It would be an interesting diagnostic test to simulate using the same u*. However, this study presented here is intended to show the performance of the models as they would be used "out of the box", without changing the parameterizations in the models to match each other, since the majority of users are likely interested in knowing how the modeling systems will perform as they are configured by default. Future work examining the performance issues highlighted in this work may incorporate performing such diagnostic testing and possibly reexamining how parameters, such as friction velocity, are calculated in each model.

Interactive comment on Geosci. Model Dev. Discuss., 2, 1081, 2009.