

## ***Interactive comment on “Decadal evaluation of regional climate, air quality, and their interactions using WRF/Chem Version 3.6.1” by K. Yahya et al.***

**K. Yahya et al.**

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Reply to Reviewer #1

Anonymous Referee #1

Received and published: 4 September 2015

The subject is appropriate to GMD. This manuscript presents results of the first decadal application of WRF/Chem v3.6.1 with CB05 from 2001 to 2010 over the continental US using the Representative Concentration Path- way (RCP 8.5) emissions. The capability and appropriateness for long term climatological simulations are assessed on the basis of meteorological, chemical, and aerosol-cloud-radiation variables against data from surface networks and satellite retrievals. The results showed that the model performs

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very well for the 2m temperature (T2) for the 10 year period with only a small cold bias of -0.3 0C. They also found that in general, the model performs relatively well for chemical and meteorological variables, and not as well for aerosol-cloud-radiation variables. A lot of model evaluations have been done with tremendous observational data. Therefore I recommend clearly the acceptance for publication of this manuscript after minor revisions.

Reply:

We thank the reviewer for careful review of this manuscript and valuable comments to improve the quality of manuscript.

We have carefully addressed all the comments raised by the reviewer to improve the presentation quality and organization of our paper. Please see below our point-by-point replies. All page and line numbers in this reply refer to those in the revised manuscript in the track mode.

Several editorial comments for improving the information content C1877 and presentation of the paper are listed as follows:

1. Title: It should be “Decadal evaluation of regional climate, air quality, and their interactions over the continental U.S. using WRF/Chem Version 3.6.1” because this is your study area.

Reply:

The title has been modified as suggested.

2. Abstract: Please summarize the results quantitatively instead of qualitatively such as what do you mean by “slightly overpredicted”?

Reply:

The abstract has been modified to summarize the results quantitatively by including more statistical measures such as values of NMBs and MBs.

3. P6709, L20-24-61: Regarding the online-coupled models, please add discussions about the recent work for the two-way coupled WRF-CMAQ (such as Yu, Shaocai, R.Mathur, J. Pleim, D. Wong, R. Gilliam, K. Alapaty, C. Zhao, and X. Liu, 2014. Aerosol indirect effect on the grid-scale clouds in the two-way coupled WRF-CMAQ: model description, development, evaluation and regional analysis. Atmos. Chem. Phys. 14, 11247–11285, doi:10.5194/acp-14-1-2014.)

Reply:

The above paper has been added to reference and a brief discussion regarding the work is described in lines 70-72 of page 4 as follows:

“For example, the WRF model has been coupled online to the CMAQ model with the inclusion of aerosol indirect effects to study chemistry and climate interactions (Yu et al., 2014).”

4. P6715, L180-21: Please cite the definitions of MB, NMB, RMSE etc for some references (such as Yu, Shaocai, Brian Eder, Robin Dennis, Shao-hang Chu, Stephen Schwartz, 2006. New unbiased symmetric metrics for evaluation of air quality models. Atmospheric Science Letter, 7, 26-34.)

Reply:

The above reference has been added.

5. P6727, L25-25-593: Regarding the bad performance of NO<sub>3</sub><sup>-</sup>, one of the reasons is because of partition of total (HNO<sub>3</sub>+NO<sub>3</sub>) between gas and aerosol phases as discussed by Yu et al. (Yu, Shaocai, Robin Dennis, Shawn Roselle Athanasios Nenes, John Walker, Brian Eder, Kenneth Schere, Jenise Swall, Wayne Robarge, 2005. An assessment of the ability of 3-D air quality models with current thermodynamic equilibrium models to predict aerosol NO<sub>3</sub><sup>-</sup> Journal of Geophysical Research, 110, D07S13, doi:10.1029/2004JD004718.). Please add this discussion.

Reply:

The additional discussion regarding the performance of NO<sub>3</sub><sup>-</sup> has been added as suggested by the reviewer to lines 566 to 571 of pages 25-26, as follows: “Other possible reasons for the underpredictions of NO<sub>3</sub><sup>-</sup> concentrations include both prediction and measurement errors associated with SO<sub>4</sub><sup>2-</sup> and TNH<sub>4</sub> that can greatly affect the performance of NO<sub>3</sub><sup>-</sup>, inaccuracies in the assumptions used in the thermodynamic model (e.g., the assumption that inorganic ions are internally mixed and the equilibrium assumption might not be representative, especially for particles with larger diameters), as well as inaccuracies in T2 and RH predictions (Yu et al., 2005)”.

6. Regarding the captions of Figures 1, 7 and 8: Please one sentence to say “the observations are represented by diamonds in the figures”.

Reply:

The markers in Figure 1 are not just the observational data, but rather are the spatial distribution of mean biases (MBs) as stated in the figure caption. To avoid the confusion, we added the following sentence into the caption of Figure 1 “Each marker represents the MB of each variable at each observational site”. For Figures 7 and 8, we indicated in the captions that the observation is represented by markers and simulation is represented by the background.

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Interactive comment on Geosci. Model Dev. Discuss., 8, 6707, 2015.

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