

Interactive comment on “Evaluation of NU-WRF Performance on Air Quality Simulation under Various Model Resolutions – An Investigation within Framework of MICS-Asia Phase III” by Zhining Tao et al.

Anonymous Referee #1

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General comments: This is a model evaluation paper with a focus on impact of model grid-spacing on meteorological and air quality simulations at regional scale. In this manuscript, the authors present extensive evaluations and inter-resolution comparisons of a year-long meteorological and air quality simulations conducted with the NANA Unified WRF model over the three nested domains in 2010 to identify the model uncertainties. The study represents a great interest by providing more evidence to further improvement of model performance on air quality prediction over heavily polluted regions such as North China Plain. The authors argue that no single resolution

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can yield the best performance for all the variables across all the simulation and improvement of air quality prediction is not linear with increase in grid-spacing. Overall the paper is well written. However, some conclusions such as the recommendation of 15-km resolution may not be true in some important cases. More detailed information about model configuration and additional analyses are required to better quantify the impact of grid-spacing on both meteorological and air quality simulations. A major revision is suggested with a few reasons.

Major comments 1. The simulations conducted over the three nested domains are used in this study for comparisons and evaluations of meteorological and air quality simulations among three different grid-spacings. The way of nesting used in the simulations may have a large impact on the sensitivity of simulation results to grid spacing. Which nesting way is used in the simulations? One-way nesting or two-way nesting? If two-way nesting is selected in the simulations which I doubt according to results presented in the manuscript (e.g., L175-176), how your conclusion or findings can be affected by this selection?

2. The impact of grid-spacing on met or air quality simulations is highly dependent on terrain complexity of the study region. Given the relatively flat terrain of North China Plain (NCP), the impact of the grid-spacing on the simulations over land cannot be as large as expected. We believe that complex terrain and the situations with a large surface-cover contrast such as coastal regions do require high-resolution simulations. 15-km horizontal resolution that the authors suggest for the MICS-Asia study is definitely not enough to resolve the detailed local wind structures such as land-sea breeze or lake-breeze over the coastal regions which many large cities (e.g., Shanghai and Hong Kong) are located and air pollution is a big concern. It would be very helpful if the authors can shed little bit light on discussion of model performance with three grid-spacings at those sites along or near coastal regions.

3. Taylor diagram (Figure 2) is a useful way to present model performance, but it is not enough to represent model performance over a large region such as NCP and long-

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time simulation period such as one year since model performs differently in different sub-regions like urban or rural areas and at time periods (e.g., different seasons). It will be helpful if the authors can provide any model performance in terms of spatial pattern (e.g., prediction biases) or time series of observation-simulation comparison. The result can be added in an appendix part if pages are limited.

4. Figure 7: It seems that simulated O₃ spatial patterns are not matched well with that of its precursors including NO_x simulations and isoprene emissions (see Fig.6) at different grid-spacing. For instance, the simulated surface NO_x concentrations at the grid-spacings of 15-km and 5-km grids look very similar to those at the grid-spacing of 45-km. However, the simulated O₃ concentrations out of the 15-km and 5-km grids are much smaller than those at the grid-spacing of 45-km. More explanations will be helpful to readers for better understanding their relationship and the model performance at varying grid-spacings.

5. L430-432: How the maximum PBLH can be observed in Mongolian Plain where surface cover is dominated by grass?

6. Table 3: Is it possible to add any available observational data for a comparison? The values presented in Table 3 represent domain average. It is not clear whether the simulations at those grids over ocean were included in the calculations.

Minor comments 1. L60: Is “CHIMERE” defined? Please check similar issue for other abbreviation terms. 2. L120: Is “off” correct? 3. L208: “simulated the best precipitation” or “simulated the precipitation best”? I recommend the latter. Please check the similar issue in several other places.

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