Review of Baró et al.

Regional effects of atmospheric aerosols on temperature: an evaluation of an ensemble of on-line coupled models

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This paper describes the results of a model intercomparison study involving a handful of models comparing the impact of including aerosol direct and indirect effects on surface temperature. The paper is myopic, as it only describes the comparison of simulated surface temperatures against a single gridded temperature data set for daily mean, minimum, and maximum temperatures. No attempt is made to provide any attribution for the identified differences in model behaviors. As such, the paper is simplistic and does not add a lot to the published base of research. The paper basically shows that including aerosol effects generally leads to a small improvement in the simulated surface temperature. Whether this is sufficient for justifying publication in ACP will need to be determined by the editor.

Grammatically, the paper is fairly well written with only a handful of necessary corrections in this area. I found about a dozen issues of extra words, bad commas, and the like. As the reviewer's task is to focus primarily on the science, fixing these issues will be left to a copy editor who can be more thorough.

Major Comments

The paper could be greatly strengthened by looking at why the model results improve, or at least by providing additional information to help readers gain context. This could be done by looking at the energy budgets. The benefit of having the range of models in the intercomparison is that one can examine if the aerosol-related improvements occur for the same reason in each model, or if there are compensating effects that lead to interesting nonlinearities.

Another way the paper could be improved is by looking beyond daily values. Only looking at daily values hides a lot of model deficiencies. Comparing the models against hourly temperature data, as well as moisture and PM2.5 amounts, would provide much more detail for understanding why the models change when including aerosol feedbacks. This would also bring the plume behavior of local aerosol sources more into play.

Gridded temperature data sets typically show a range of uncertainties due to different methodologies used to spatially distribute and average point observations. What is the uncertainty of the E-OBS data set? How does it compare to other gridded data sets available for the region? How does it compare to analyses, such as from the IFS model, that incorporate the observations with data assimilation? Most likely, the differences identified between running the models with and without aerosol feedbacks is smaller than the differences between observation data sets.

The figures with maps are presented in such a way that one cannot gain a clear quantitative understanding of how the models differ beyond very large differences. Readers are asked to look for differences on the order of tenths or hundredths of a degree in a color scale ranging across 5 K while the maps are essentially postage stamp size. In most cases, the maps look identical without extremely close examination. A better way needs to be found to present this information. One or two figures like this can be used to make the overall point and give the spatial structure of the typical bias. However, nine of these figures becomes tedious to read and they end up not conveying the intended information.

Top of p. 5: The "third" configuration needs to be defined in relation to the handling of aerosol and/or cloud droplet assumptions when aerosol-cloud interactions are disabled. Otherwise, the results are just a sensitivity test of a particular model that are not comparable to other models. The results and any subsequent conclusions are dependent upon how the models are tuned when the interactions are disabled. One needs to define an appropriate scenario for the comparison. This differs from comparisons of configurations 1 and 2 for the aerosol-radiation interactions because it is possible to run a model without aerosol impacting radiation and still get a physically reasonable result. However, one cannot run a model without aerosol and still form clouds, since the aerosols are required for forming cloud droplets in almost all physically relevant conditions. So, even "without" aerosol-cloud interactions there are still significant assumptions built into the models to account for the ACI processes.

Minor Comments

p. 4, l. 27: "Three different cases" is better phrased as "Three different configurations." "Cases" implies different dates and "configurations" is more specific to what is being described.

p. 5, l. 10: The WRF-Chem citations need to include those relevant to the aerosol direct and indirect effects, particularly because those processes are the focus of this paper. The standard citations for this purpose are *Chapman et al.* [2009]; *Fast et al.* [2006]; *Gustafson et al.* [2007].

p. 5, l. 12: "Resolution" needs to be changed to "grid spacing." The two are not interchangeable.

p. 5, l. 15: The authors presumably meant "grid spacing" and not "width."

p. 8, l. 4: The "p" should be subscripted.

p. 11, l. 5: I do not understand what is trying to be conveyed by "…presenting the ensemble always maximum time…" This appears to be a garbled sentence.

p. 15, l. 9: Reference to Forkel et al. (2015) is mistyped.

References

Chapman, E. G., W. I. Gustafson, R. C. Easter, J. C. Barnard, S. J. Ghan, M. S. Pekour, and J. D. Fast (2009), Coupling aerosol-cloud-radiative processes in the WRF-Chem model: Investigating the radiative impact of elevated point sources, *Atmos. Chem. Phys.*, *9*, 945–964, doi:10.5194/acp-9-945-2009.

Fast, J. D., W. I. Gustafson, R. C. Easter, R. A. Zaveri, J. C. Barnard, E. G. Chapman, G. A. Grell, and S. E. Peckham (2006), Evolution of ozone, particulates, and aerosol direct radiative forcing in the vicinity of Houston using a fully coupled meteorology-chemistry-aerosol model, *J. Geophys. Res.*, *111*, D21305, doi:10.1029/2005jd006721.

Gustafson, W. I., E. G. Chapman, S. J. Ghan, R. C. Easter, and J. D. Fast (2007), Impact on modeled cloud characteristics due to simplified treatment of uniform cloud condensation nuclei during NEAQS 2004, *Geophys. Res. Lett.*, *34*, L19809, doi:10.1029/2007gl0300321.