Atmos. Chem. Phys. Discuss., 13, C7626–C7629, 2013
www.atmos-chem-phys-discuss.net/13/C7626/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The role of horizontal model resolution in assessing the transport of CO in a middle latitude cyclone using WRF-Chem" *by* C. A. Klich and H. E. Fuelberg

C. A. Klich and H. E. Fuelberg

hfuelberg@fsu.edu

Received and published: 3 October 2013

Responses to Referee 1

Thank you for the kind words about our manuscript and for noting the errors in it.

p.14876, l.3—The wording about Lin et al. has been changed as suggested.

p. 14879, l. 19– What do you mean by "imported"? If the biogenic (isoprene) emissions were calculated online in WRF-chem using the MEGAN algorithm, then say that. If they were calculated with MEGAN offline and then read in, state that explicitly and explain exactly how that was done, or where the emissions were obtained.

We did a poor job of explaining this. We have revised the wording to read, "Biogenic emissions were calculated online within WRF-Chem based on atmospheric conditions and land use data from the Model of Emissions of Gases and Aerosols from Nature (MEGAN, Guenther et al., 2006). MEGAN is a high-resolution ($\sim$ 1 km2) dataset that includes leaf area index, vegetation type, and specific emission factors."

p. 14894, l. 24–The typographical error has been corrected ('front' not 'from')

Responses to Referee 2

Thank you for the inquiries that improved the clarity of our manuscript.

1. "What was the purpose of doing a full chemistry? Why didn't you use a passive tracer option available in WRF-CHEM? - Is there any advantage of simulating aerosols?"

Using the passive tracer option almost certainly would have produced very similar results to those from full chemistry. It would have been simpler to run, and is a very reasonable option. However, since we wanted to have the best simulation possible, using WRF-CHEM would rule out any criticisms that we had not done our very best. As Grell et al. (Atmos. Env., 2005) state : "The simulation and prediction of air quality is a complicated problem, involving both meteorological factors (such as wind speed and direction, turbulence, radiation, clouds, and precipitation) and chemical processes (such as deposition, and transformations). In the real atmosphere, the chemical and physical processes are coupled. The chemistry can affect the meteorology, for example, through its effect on the radiation budget, as well as the interaction of aerosols with cloud condensation nuclei (CCN). Likewise, clouds and precipitation strongly influence chemical transformation and removal processes, and localized changes in the wind or turbulence fields continuously affect the chemical transport."

We probably received very little 'bang for the buck' by simulating aerosols, but we know of no way in which our results could be compromised by going this extra step to produce

a high quality simulation.

We have added a sentence at the beginning of Section 2.2 to explain our choice.

2. "Did the aerosols feedback on meteorology and/or photolysis in the model? "

As noted in item 1 above, these feedbacks certainly did occur. They are incorporated into the full chemistry option of WRF-CHEM.

3. "The simulated concentrations of CO (consequently fluxes) will be affected by chemical loss and production. I suggest the authors to conduct simulations with the same model configurations, but gas chemistry turned off. Perhaps the numbers won't change drastically, however, such a simulation will allow to interpret the simulation results of CO for different resolutions based solely on transport."

Running with gas chemistry turned off would certainly allow such an interpretation about CO. However, CO has a lifetime of several months (Jacob, 1999). It also has a low solubility. Mari et al. (JGR, 2000) used a 1D convective model and observations from TRACE-A to show that 0% of CO is scavenged in a convective cloud due to the low solubility. This and other studies suggest that the CO loss/production terms would be negligible. Thus we considered CO to be an inert tracer for our short study period. The literature shows that this is a widely used assumption. We believe that results with without gas chemistry would be so similar to those presented that separate runs without gas chemistry are not justified.

We added a sentence to the paragraph before Section 2, "Since CO has a lifetime of several months (Jacob, 1999), it was considered an inert tracer."

4. "Also you report that the calculated fluxes between the D1 and D2 domains are very similar. In Section 2.2 you say that 2-way nesting between those domains was used. Did you present the results for the 2-way nesting runs? If so, the difference between CO concentrations from those domains over the same area will be small anyway."

The last paragraph of Section 4.2 briefly describes results from D2 and their compar-

ison to those from D1 and D3. Much more information is given in the 4th and 5th paragraphs of Section 4.3—including a comparison of their vertical fluxes. Figs. 14 and 15 are used to document the comparisons between the three domains.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 14871, 2013.