Atmos. Chem. Phys. Discuss., 13, C10105–C10108, 2013
www.atmos-chem-phys-discuss.net/13/C10105/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Representing ozone extremes in European megacities: the importance of resolution in a global chemistry climate model" *by* Z. S. Stock et al.

Anonymous Referee #1

Received and published: 17 December 2013

The paper addresses an interesting topic of the importance of model resolution on ozone on global, regional and local scales. This has been studied several times in the past, but the authors have chosen a very relevant angle of ozone extremes in megacities. The paper is well written and most of the conclusions seem sound. However, some clarifications are needed before the paper can be considered for publication.

The conclusion that changes in boundary layer height due to model resolution are largely responsible for the observed differences between HR and CR is interesting, but requires some additional clarification. My concern is regarding the model setup, and more specifically, to what degree the impact of model resolution is a result of the free-

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

running mode, which would make the meteorology in the two model configurations (HR and CR) deviate. Because of this, and because the model has only been applied at two different model resolutions, I am not convinced about the robustness of the model results.

Specific comments:

Page 27427, lines 20-22. Are the meteorology (UKCA) and chemistry (UM) modules fully coupled (i.e., do changes in chemistry feed back to the meteorology), and if so, do you expect that to have a significant impact on the results?

Page 27428, lines 13-15. Is free-running model configuration suitable for this type of model experiment? As one month is relatively long in terms of numerical weather prediction, I would expect that differences in meteorology could arise not only from differences in model resolution (and associated changes due to model time step and parameterization parameters as have been mentioned), but also from the fact that small initial deviations may lead to substantially different meteorology in the long run. In an extreme case you may get, near the end of the simulation month, a stable high pressure system over Europe in one resolution and low pressure activity in the other. If this is the case, it would not make sense to compare the effect of model resolution on ozone chemistry on local and regional scales, and comparison to observations would not be meaningful. Can you comment on how different the meteorology (e.g., location and magnitude of pressure fields) over Europe is between the two model configurations near the end of the simulation period? If they are substantially different, which I may expect, one way to avoid this problem is to re-run the two model configurations in nudged mode, as long as the nudging is not so strong that the impact of model resolution on meteorology will become too small. Another option is to re-initialize the two model configurations from the same initial (nudged) field several times during each one-month simulation.

Page 27428, lines 15-17. Due to the limited time period simulated, a brief description,

ACPD
13, C10105–C10108, 2013

and perhaps a plot or two (for instance in an Appendix or Supplementary) illustrating the meteorological conditions during the two months (July and November) is needed. Can you say something about how representative the chosen months are for summer and winter conditions? Do you expect the results to be substantially different if other time periods were chosen?

Page 27429, line 21. This would be illustrated more clearly if two additional plots were included in Fig. 1, showing the absolute (or perhaps relative is better?) difference between HR and CR for each of July and November.

Page 27429, lines 23-26. It would be interesting to know whether or not your results for global scale are in agreement with previous studies presenting similar experiments (e.g., Wild and Prather, 2006). Can you compare your results, in terms of impact of model resolution on global ozone burden, to previous findings, and if so, are your results broadly in agreement?

Page 27430, lines 8-13. Meteorological and chemical processes also occur on scales smaller than those investigated here. Do the authors expect that the scales considered here ($\sim$150 km to $\sim$40 km) are the most important for ozone formation?

Page 27434, line 22. Note that weekly and diurnal emission profiles are available for Europe through EMEP (see Simpson et al., 2012, ACP).

Page 27439, line 9. The difference in boundary layer height between CR and HR is extremely large. Could this be a result of the model being run in free-running mode, and not only a result of the different model resolution? Would it be possible to run at additional resolution configurations, either coarser than CR or in between HR and CR (I suppose finer resolution than HR is not feasible for a global model), to see whether or not the model results converge when increasing the model resolution, and to get a feeling for how robust the results are?

Figure 1 caption. I would replace "Global mean tropospheric..." with "Global distribution

ACPD
13, C10105–C10108, 2013

of monthly mean tropospheric..."

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 27423, 2013.

ACPD

13, C10105–C10108, 2013