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Atmospheric Chemistry and Physics Discussions

Interactive comment on "High resolution modelling of aerosol dispersion regimes during the CAPITOUL field experiment: from regional to local scale interactions" *by* B. Aouizerats et al.

Anonymous Referee #1

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Review for ACPD of:

Aouizerats, B., P. Tulet, G. Pigeon, V. Masson, and L. Gomes, 2011: High resolution modelling of aerosol dispersion regimes during the CAPITOUL field experiment: from regional to local scale interactions. Atmos. Chem. Phys. Disc., in review.

Aouizerats et al. use an LES resolution model to drive an air quality model. They then use this simulation to demonstrate the variability in the aerosol field caused by differing mesoscale structures that develop on two consecutive days. The paper contains a straightforward, although extremely concise, description of the modeling results and only minimal observations are used to ground the simulation in reality.

Scientific comments

The abstract states that "Observations show that local dynamics is driven either by convective cells coexisting with rolls or only by rolls depending on the day-regime." This statement is not directly backed up in the text of the paper. A discussion is given about the ratio between the boundary layer height and the Monin-Obukhov length. However, no direct observations of the convective plumes or roll structures is presented. This is important because the regional topography could impact the type of mesoscales structures that form. For example the wind conditions identified by one of the soundings may not be representative of the larger region when the flow is channeled through mountains, e.g. the Autan wind from the southeast.

The major regional emission sources are due to cities on the corners of the middle domain, as shown in Figure 1. Are the domains configured with two-way interactions so that the plumes from the middle grid can advect out onto the outer grid? By having the cities on the very edge of the domain there could be issues with recirculation patterns in and out of the domain edge causing the emissions from the cities to not be advected into the correct areas of the inner domain. Because the middle domain boundary appears to go through areas of complex topography this could become an issue.

Is the model properly spun up by 3 July? The aerosol concentrations shown in Figure 2a appear like they are still evolving to establish the proper regional background characteristics. If the model were started a day earlier, would the aerosol field on 3 July 10 UTC be very close to what has been used for this study?

The model is used from a resolution of 10 km down to 500 m. How is the turbulence and clouds handled differently between these scales? 500 m is essentially LES and requires appropriate sub-grid handling of turbulence that is different from a PBL parameterization used with 10-km grid spacing. Does Meso-NH produce a proper energy cascade for use as an LES model?

Accurately handling secondary organic aerosols is difficult in models. How accurate

are the secondary organic aerosols in this simulation? Results are shown comparing "secondary" vs. "primary" aerosols. These need to be defined. What species are included in each of them? Do the secondary species only include the SOA species? Or, do the authors also include the other secondary species such as sulfate?

p. 29571 l. 5 Coarseness of a model grid does not imply the model results are averaged over several hours as stated in the text. Does the author mean that coarse model grids are best compared to observations averaged over several hours, assuming that variability in space and time can be considered similar under certain conditions? This should be stated more clearly.

p. 29574 l. 16 The statement is made that the background aerosols are set up using CO concentration. More detail is needed since the two are not directly comparable, even though they have similar emission sources. This is of particular concern because the background concentration of BC appears high in the model. In Figure 5a the modeled values are higher than the observations during the low-concentration periods.

The regional and sub-regional sections of the paper add little to the analysis beyond a basic description of the meteorological conditions. They could be significantly strengthened if they included observational comparisons for both meteorology and aerosols. This would help readers know how well the model reproduced reality on the larger scale feeding into the boundaries of the high-resolution domain. Also, the two sections could probably be combined.

Figure 5 shows the range of model observations within the Toulouse region along with averaged observations. How much range is there in the observations? And, how many observation stations are included in the comparison? Because the study compares the model at 500-m resolution this detail is important. Is the high-resolution domain able to properly capture the small-scale variability? Some statistics showing the difference between the different model resolutions would help with this comparison.

The conclusion talks about the importance of high resolution. Models do reproduce

more detail at high resolution, but is the detail realistic? No observations have been given to demonstrate that the detail is realistic. Also, when smoothed back out to the coarser scale that can be resolved in the outer grids, is the added detail adding any value by improving the mean value of the concentration on the coarser grid?

p. 29585 l. 26 It is stated that the model "correctly reproduced" the dynamical and aerosol fields. This was never clearly shown in the paper. One figure was given that shows the BC and total aerosol concentrations for the Toulouse region as a time series. However, this is insufficient to know how well the mesoscale features were reproduced. Of particular concern to this reviewer is the issue of spinning up the small-scale features within the model domain. A relatively few number of grid points are in the high-resolution domain, which uses LES type resolution. Unlike typical LES simulations, this paper uses a model with realistic topography and inflow outflow boundaries. Because of this, a much larger domain is required than in a traditional LES model because the small-scale structures must develop from the coarse inflow conditions. Both on 3 July and 4 July it appears that the structures shown in Figures 8 and 9, respectively, develop about half way into the domain and then blow out the outflow boundary. Should these structures have developed closer to the inflow boundary? Is the structure just becoming evident because emissions from Toulouse are injected from around the middle of the domain? It is very hard to tell from the figures whether the features are just plumes from point sources or if they are due to mesoscale flow patterns. A figure showing back trajectories from the high and low aerosol regions of the features would be helpful.

Minor comments

The first paragraph of the introduction is awkward and should be rewritten.

p. 29571 l. 16 IOP should be defined before the first use and not the second.

p. 29572 l. 18 Commas would be more appropriate than parentheses for the dates.

p. 29572 l. 19 Does the holiday weekend have higher traffic than a typical work day?

This seems unrealistic, but this reviewer does not live in the area to know for sure. It seems more likely that the traffic would be higher than a typical weekend but lower than a typical work day. Some quantitative context would be helpful for the emissions during the simulation period.

p. 29573 l. 4-5 The acronyms used in these lines are not defined.

p. 29574 l. 15 The acronyms used on this line is not defined.

p. 29577 l. 1. blows from the northwest over Toulouse

p. 29578 l. 7 Define the acronym UHF.

p. 29579 l. 17 “Another” instead of “An other”

p. 29579 l. 18ff The mixed use of parentheses to mean parenthetical comments, alternative meanings of the sentence, and as label markers all within a couple lines is confusing to the reader. It would be better to expand the text and not use the parentheses to imply alternative meaning.

p. 29581 l. 18 situations such as convective rolls

p. 29583 l. 25 Awkward sentence.

p. 29584 top Are the authors trying to describe the issue of aspect ratio between the horizontal and vertical scales? Just stating that the aspect ratio between the horizontal and vertical dimensions is 13, and that the velocities are scaled by the same ratio, is basically sufficient. Wind vectors in this sort of vertical cross section are representative of direction and are not easily interpreted for wind speed because of the aspect issue.

p. 29585 l. 1 presented as a red line in Figures 9b

p. 29585 l. 8 Awkward sentence. Maybe this would work better: “There is also a region of high aerosol concentration above the boundary layer.”

p. 29585 l. 15 The first sentence of the conclusion is awkward.

p. 29585 l. 23 interaction amongst cities

p. 29585 l. 24 domain permits investigation of the role of

p. 29586 l. 2 Awkward sentence.

Figure 2 The color bar label’s text and numbers are running into each other and getting chopped.

Figure 4 The caption uses the term “wind force” but the figure and main body of the text use “wind speed”. Please make consistent.

Figure 5 All the talk about different colors gets confusing. It would be better to just use one color and put a label on the plot that indicates what each plot shows. Also, the caption needs to indicate which domain is shown for the model results. The reviewer assumes the figure shows results from the high-resolution domain.

Figure 6 Indicate the location of the comparison in the figure caption.

Figure 8 Panel (c) is showing an isosurface. A better label for this part of the figure would be “aerosol mass concentration for 1 ug m-3 isosurface.” What is “primary” aerosol mass?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 29569, 2010.