

Interactive comment on “Frontiers in air quality modelling” by A. Colette et al.

Anonymous Referee #2

Received and published: 23 September 2013

General comments

This paper presents results from a high resolution (2x2km²) model simulation over the European domain with the CHIMERE offline chemistry transport model. In order to highlight the strength and weaknesses of this high resolution simulation it is compared to model simulations using a grid resolution of 7x7km² and 50x50km² as well as to observations. In previous studies high resolution simulations were mostly limited to urban regions, in the present study the first continental scale (Europe) atmospheric chemistry simulation at 2km grid resolution is introduced. Next to the technical challenge it also contributes to the subject of interaction between the urban and rural scale and the impact of emission on urban scale to the continental wide air pollution burden.

In general the paper is clearly structured but several important issues are only briefly mentioned and not explained in enough detail. It lacks for example a detailed descrip-

C1503

tion of the model set-up and the set-up of the high resolution emission database. One concern about the presented work is the use of meteorological input fields with a comparable coarse resolution of 16km. The impact of the low resolution meteorological input data and how this data is interpolated on the 2x2km² grid should be discussed in more detail as this is an important issue as it limits the possible improvement of the simulations.

It is difficult to comprehend the motivation of this study beside the technical aspect, therefore a more elaborated motivation and discussion of the additional value of high resolution simulation especially over rural regions and on the continental scale would be good. In this context the study should also be better embedded in the current research related to this topic by giving more references to relevant studies.

The presentation of the results is rather short and mostly limited to the Paris area without a clear motivation. Several findings are only explained or mentioned in the text and not shown in tables and figures although this would help the reader to comprehend the discussed findings and conclusions in the paper.

CTMs, comparable to the CHIMERE model, are frequently used for simulations covering at least one year, e.g. for emission scenarios studies, this is also reflected in the complexity in such offline coupled CTMS. Therefore it is difficult to compare the value of such 25x25km² resolution simulations to the presented 2x2km² simulation covering only nine days.

Specific comments:

1 Introduction

- Please, add more references in the introduction, e.g. literature on high resolution modeling studies over urban areas
- l. 15, p. 4191: You mention findings from a ‘previous study’ which study is that? Please, give a reference.

C1504

- Please, add a few more discussion/motivation sentences on the advantages of high resolution modeling on a continental scale.
- Somewhere in the introduction it should be mentioned that the CTM CHIMERE was used in the study.
- It would be helpful to have a short outline of the paper and a short description of the study (e.g., comparison of 2km simulation to 7km and 50km simulations with CHIMERE focusing on NO₂ and PM₁₀ etc.) in the introduction.

Paragraph 2 (pp. 4190, l. 23 – p. 4191, l. 2):

- This paragraph is rather isolated; please relate it more to the issue of the paper (high resolution air quality modeling).
- In this paragraph NO₂ and PM_{2.5} are explicitly discussed – Are the reasons for showing the modeling results for NO₂ and PM_{2.5}/PM₁₀ mentioned here? If so please mention it somewhere.

Paragraph 3 (p. 4191, ll. 3 – 18): This time period is explicitly chosen for the simulation mainly due to the high concentrations of several air pollutants resulting from unfavorable weather conditions and resulting high anthropogenic emissions. As the meteorological input fields are not on a higher resolution grid for the 2km simulation the improvement, especially concerning the simulation of peak concentrations, might be underestimated in this simulation. Is the dependence of emissions from meteorological conditions explicitly taken into account in the model?

Paragraph 4 (p. 4191, l. 19 – p. 4192, l. 2): The emission inventories are explicitly mentioned as the limiting factor of the horizontal resolution of model, what about the meteorology at that scale?

2 Method

- Please, add a description of the evaluation method of the simulation presented in this

C1505

paper, e.g. which stations are used, which pollutants are discussed and why etc. This would help to follow the description of the results in section 3.

- One would expect a more detailed description of the CTM as it is in the focus of this study. Please, add information on the model set-up (aerosols and chemistry module, vertical resolution, boundary data), e.g. in a table.

p. 4192, ll. 12 – 15: Please, describe how the modification for the urban areas is done in the model. How does it influence the model results? Is this method also used in the other model simulations the 2km run is compared to?

p. 4192, l. 14: Please change to Terrenoire et al., (2013).

p. 4192, ll. 18 – 20: Please, give a short description on how the meteorological fields are interpolated to the CTM grid. Furthermore, one would expect a discussion on the possible impact of the comparable coarse resolution of the meteorological input fields on the CTM simulation results.

Paragraph 3 (p. 4192, l. 21 – p. 4193, l. 27): It is mentioned in this paragraph that a focus of the model development was on improving the emission database. A more detailed discussion on the impact of the high resolution emission database on the model results would be nice to see somewhere in the paper. It could for example include a figure comparing the emitted mass of e.g. primary PM components for the 50 – 7 -2 km simulations.

3 Results

- The high spatial grid resolution is expected to increase the model performance among different stations, but in the paper all available stations in the domain or for Paris were averaged. It would be interesting to see whether the model performance at individual stations also increases for the high resolution run. (Are there differences in the model performance for different regions?)
- The presented results in this section refer to either the urban or the rural region.

C1506

So far high resolution simulations are mostly limited to the urban scale. It would be interesting to get more information on what the benefit of the high resolution simulation for the rural regions is and if the interaction between the urban and rural scale is better represented.

- One could expect the limited improvement from 7x7km² to 2x2km² due to the coarse resolution of the meteorology so a more elaborated discussion on this would be desirable.

p. 4194 l.12: Why is in Figure 1 the simulation with 2km resolution compared to a simulation with 50km resolution although in the introduction it is mentioned that it is current practice to use a resolution of about 10km (p. 4191, l. 24)?

p. 4191 l.13: As the high-resolution domain is nested in a coarser (50km) simulation the two domains are not the same. What is the domain of the 2km simulation? This information should be added in the method part.

p. 4194, l. 20: Are the individual roads and isolated point sources visible in the fine resolution run?

Paragraph 2 (p. 4194, l. 23 – p. 4195, l. 4): Please, give an example for this in Figure 1. Where is this especially relevant?

p. 4195, l. 6: Why is Paris chosen here? Please, add some explanation in the method section. A comparison between different urban areas, cities would be interesting and would support and generalize the findings more.

p. 4195, ll. 6 -14: An improvement in the model performance for urban stations has also been described in other studies dealing with high resolution modeling over urban areas. What is the impact at rural stations? A similar figure as figure 2 for rural stations would be nice to see.

p. 4195, l 15:

C1507

- How many stations (per urban, suburban and rural station type) are included in the average in table 1? Are the results from the model grid the station is located in used, or are the model results interpolated to the station location?

- The correlation coefficient in table 1 are hardly mentioned and interpreted in the text. How is the daily spatial correlation coefficients calculated – how can it be interpreted? Could one expect rather an increase of the correlation coefficient for NO₂ at the urban rather than at the rural stations as it is very local? It would also be interesting to include the temporal correlation coefficient based on hourly data.

p. 4196, l. 4-5: This is an important point which should be taken up and discussed more in the conclusion section.

p. 4196, l. 1: What do you mean with 'netRMSE'?

p. 4196, ll. 11 – 16: Interesting and important point. It would be clearer if these numbers are presented in a table.

p. 4196, ll. 17-21: This is an interesting point!

Paragraph 8 (p. 4196 l. 22 – p. 4197 l. 8): Before only results for PM₁₀ and NO₂ are shown, here PM_{2.5} is introduced – why?

4 Conclusions

p. 4198 l. 1 – 5: These shortcomings should be discussed before.

p. 4198, ll. 7 – 9: Where has this been shown in the paper?

Interactive comment on Geosci. Model Dev. Discuss., 6, 4189, 2013.

C1508