

## ***Interactive comment on “High resolution air quality simulation over Europe with the chemistry transport model CHIMERE” by E. Terrenoire et al.***

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### General update

In the submitted version of the paper, the model resolution is referred as 7 km. This estimate was based on the geographical degree coordinates of the grid cells size ( $0.125^\circ \times 0.0625^\circ$ ) which are actually closer to 8 km at the centre of the domain. This new estimate is now used throughout the revised version of the paper.

First, we would like to thank the Referee #4 for its constructive remarks and suggestions. Here are the different answers regarding the Referee #4 comments.

This manuscript presents the application of the CHIMERE chemical transport model to an annual 2009 simulation over Europe. The manuscript includes an operational

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evaluation of the model results across the year, presenting various statistical metrics on a seasonal basis for a select number of pollutants. While there can be substantial value in such studies, especially for unique model applications and/or model updates, the manuscript in its current form falls short of presenting the results in a coherent and useful way. Having read the comments of the other reviewers, which already cover my primary concerns with the manuscript, I will only provide several other additional comments/suggestions on the manuscript. Sections 1 and 2 of the manuscript are generally well written from a grammatical standpoint, but sections 3 and 4 are poorly written and are at times difficult to understand what point the authors are trying to make. The other reviews have already commented on this, but the authors need to put considerable effort into improving the readability of sections 3 and 4. As noted by another reviewer, the introduction should include more examples of model applications and evaluations for Europe (e.g. Appel et al., 2012). It would be worthwhile to mention these papers in the introduction and perhaps compare/contrast the results of the two model applications where appropriate.

The paper has been restructured. The introduction has been rewritten to better address the research questions and more references to cover other studies in the region have been added. The method section includes a brief description of the CHIMERE version used for the study, the meteorology data used (including the urban correction), the methodology for the preparation of the anthropogenic emissions (including the SNAP2 temporal modulation), the observation data used and a description of the data analysis methodology. In order to make it clearer we address the main results in a more concise way. The description of model performance is done by species and if the agreement is poor, we address explanations for this behaviour.

### Specific Comments:

Pg 4142, Lines 1-5: What specific modifications were made to the Kz value? It wasn't clear in the manuscript exactly what changes were made.

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In order to integrate the influence of the urban canopy on meteorology, the wind speed and the vertical diffusion (dispersion coefficient,  $K_z$ ) are modified within the CHIMERE version used for this study. The description of the modification is available in the meteorological section and quantify in the discussion section using 2D concentration maps and time-series.

Pg 4149, Lines 14-29: Is  $\text{NO}_x$  underestimated through the entire day? It would be useful to know what the diurnal profiles of  $\text{NO}_x$  and  $\text{O}_3$  look like, especially since the instances of small bias values could be the result of compensating large positive and negative biases. Also, not sure that I would call a bias of 15% for ozone low (it might be relatively low compared to other seasons).

As suggested by the Referee, the daily cycle of  $\text{NO}_2$  and  $\text{O}_3$  were analysed in the section 3.2.2 and 3.2.3 respectively.

Section 3.3: Does CHIMERE include a mechanism for gravitational settling of  $\text{PM}_{10}$  between model layers? This is a mechanism that is lacking in some other CTMs and has been partially blamed for underestimations of  $\text{PM}_{10}$  surface concentrations by the model.

CHIMERE does not include a mechanism for gravitational settling of  $\text{PM}_{10}$  between model layers.

Page 4153, Lines 25-30: Are there any measurement artifacts relating to  $\text{NO}_3/\text{HNO}_3$  measurements? For example, so U.S. based networks that measure  $\text{NO}_3/\text{HNO}_3$  suffer from a nitrate volatilization issue from the filters (however those filers spend a week in field, which magnifies that problem).

As suggested, we added a paragraph about the uncertainty of  $\text{PM}$  measurement in the section 2.4.

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