

## Response to Referee 2

We would like to thank the reviewer for his/her fruitful comments that helped to improve the manuscript.

General comments: An evaluation study is presented to assess the capability of the air quality model CAMx to describe the aerosol conditions over Thessaloniki. The model simulations are compared to combined sun photometer and lidar observations. Backward trajectories and results of a sophisticated dust forecast model are used to attribute shortcomings to a poor representation of biomass burning and desert dust aerosol. In principle, I like the idea of using different tools, not only measurements, to evaluate the simulations of a specific model and track down shortcomings to suggest model improvements. The evaluation is properly done, although the focus on the comparison with LIRIC data from Thessaloniki only may be too one-sided.

Maybe other observations could be additionally included to underpin the findings.

Unfortunately there weren't any other LIRIC estimates available from lidar stations that are included in the modelling domain.

However, my essential criticism is that the CAMx model is evaluated regarding two aerosol types, which, by design, are not directly computed or only poorly represented. Biomass burning emissions are highly variable in time and space. The actual pollution will largely depend on specific events. Of course, it is not to be expected that the TNO emission database from 2007 in detail is representative for the fire emissions in 2013 – 2015. The same holds for Saharan dust that is not online computed based on modelled winds but input as boundary condition. This must be considered when evaluating the model results, and the conclusions have to be revised in this regard. How exactly is the CAMx model suggested to be improved with this in mind, and based on the evaluation results?

Our aim was not to evaluate CAMx for its performance regarding smoke and desert dust. At a first step we tried to use all available measurements for the period under study in order to investigate whether there is a good agreement between the model and the LIRIC estimates. From the analysis we concluded that the agreement is very good for fine mode aerosols excluding the smoke incidents and dust events, which means that most other sources (anthropogenic and natural) are reasonably represented in the model. Concerning the smoke we suggest that we cannot expect an agreement, since the emission inventory has not such on-line module. Concerning the

Saharan dust, indeed any desert dust in CAMx simulations results from the boundary conditions. Following the reviewer's suggestion we examined maps of CAMx for selective cases that were affected by desert dust and it seems that, for some of them there are issues in the transportation of CAMx PM<sub>2.5-10</sub> from the boundaries to long distances. However, the small number of cases available for such an analysis does not allow to draw firm conclusions on this issue, especially to distinguish what is the main issue, the boundaries themselves or the transport. A relevant discussion is added in sections 4.1 and 4.2 and in the conclusions. The figures 3c and 3d and 6 on the left as well as tables 5 and 6 were also modified.

#### Specific comments:

1. Page 4, line 10: A plot showing the model domains would be very helpful, in particular, to show if relevant Saharan dust sources are included.

The domains of CAMx have been included in the manuscript (Figure 1). The figure numbering has been adjusted in the text.

The text has been modified according to the reviewer's suggestion: "The domains of CAMx are presented in figure 1."

2. Page 11, lines 5 – 8: Here and later in Section 4, the study period 2013 – 2015 should be mentioned in order to clearly separate example cases from the broader statistical analysis.

The text was modified according to the reviewers suggestion:

Page 11, line 5: "An ensemble of 24 measurements in the period 2013-2015."

Page 11, line 10: "In this section the simulated profiles of CAMx are compared against the observational profiles of LIRIC in the period 2013-2015."

3. Figures 1 and 3 – 7: Please indicate in each figure caption whether the results refer to a specific case or the entire period 2013 – 2015.

The text was modified according to the reviewers suggestion.

The phrase "the period 2013-2015" was added to all the aforementioned figures.