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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of urban parameterization on high resolution air quality forecast with the GEM – AQ model" *by* J. Struzewska and J. W. Kaminski

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We would like to thank Referee #1 for the review and valuable comments which to considerably improve the quality of the manuscript.

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Referee #1:

First, it should be noted, that for better judgment on operational use a longer (at least, a few months) runs with GEM-AQ-urbanized are needed to decide/ find if TEB module is useful/ applicable for that (authors mentioned this issue). Changes seen from analysis

of specific cases considered here might not be seen at all after averaging over a longer period of simulations.

Authors:

We have investigated a possible impact of the TEB parameterization on the short term meteorological and air quality forecast in the meso-gamma scale. Obtained results show that the presence of urbanized area modifies model results. However, the magnitude of the Urban Heat Island (UHI) and its semi direct influence on transport and transformation of chemical species differs significantly depending on weather pattern. The purpose of the short term forecast was to reproduce diurnal variation. The averaging of the results over a longer period of time will not add any information on the model performance in this respect.

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Referee #1:

For long-term runs and evaluation, the additional statistical measures including a hit rate for forecasts of meteo.parameters will be useful to add, at least.

Authors:

The objective of our research was to present the impact of the TEB module in GEM-AQ for several cases representing different meteorological conditions for short term meteorological and air quality forecast in the meso-gamma scale.

We do agree that statistical evaluation is an important part of a model assessment process. However, the length of model record available for comparison with observations must be sufficient to give statistically significant results. The hit rate and false alarm rate indexes are very useful, especially in the case of parameters like precipitation or the occurrence of exceeding the threshold concentration values. However, the differences between urban and non-urban scenarios are not that significant and probably it is not clear whether HR/FAR indexes will be significantly different. As the EcoFore-

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cast system is operational, an evaluation for a 1-year period of operation is performed against measurements from rural background and suburban station and was presented in annual reports and conference presentation listed below.

Struzewska J., Kaminski J.W., Durka P., Operational evaluation of a high resolution air quality forecast over Southern Poland, EGU General Assembly 2012

Struzewska J. and Kaminski J.W., Application of Model Output Statistics technique to a high resolution air quality forecast, EGU Assembly 2011.

Regulski P., Struzewska J., Kaminski J.W., Szymankiewicz K., Distribution of PM10 concentrations over Southern Poland in winter period - observations and GEM-AQ model results, EGU Assembly 2011

Kaminski J.W., Struzewska J., Development and Performance of a Semi-Operational Chemical Weather Forecasting System EcoForecast.EU, EGU Assembly 2011

Struzewska J., Kaminski J.W. Semi-operational air quality forecast for Poland and Central Europe with the GEM-AQ model. Proceedings of the 13th International Conference on Harmonization within Atmospheric Dispersion Modelling for Regulatory Purposes, June 2010, ISBN 2-8681-5062-4

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Referee #1:

Second, there are, for sure, more than 3 meteorological stations in Poland, and hence, comparison for meteorology (at least, air temperature and wind speed, plus humidity, as authors selected) should be done using more number of stations. These could divided into urban and rural (probably, also adding suburban stations) for mentioned Polish urban areas in section 4.1. This could show on how well the meteorological model performs without/with TEB urban module.

Authors:

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Complex structure of city land cover may result in relatively large differences between observations taken at different locations in a given city. The idea of the comparison was to use only urban background monitoring stations measuring meteorological and air quality parameters. Unfortunately, meteorological measurements are not taken at most stations in the national monitoring network or were not available for selected days. Three stations chosen for the comparison represent cities characterized by noticeable modelled UHI effects. We will add other stations located in smaller cities; however, the differences due to inclusion of the TEB parameterization might be small.

The idea of the presented analysis was to combine the evaluation aspect with sensitivity analysis. In the case of suburban and rural stations there will be no difference between TEB and non-urban scenarios.

The assessment of the model performance in terms of meteorological parameters and air pollutants concentration is the key motivation of the presented work. It should be stressed that model evaluation at a resolution of a few kilometres over a city is very difficult, as general features of the urban boundary layer are reproduced, but surface description is not sufficient to capture variability observed in street canyons or in locations surrounded by buildings. On the other hand, at that resolution a model without urban parameterization cannot demonstrate satisfactory performance over the city.

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Referee #1:

Third, sections 4.1 and 4.2 can be combined with section 4.1 reduced into Table; and reference should be given to original database from which all mentioned urban characteristics for Polish cities and urban classes/categories were extracted.

Authors:

As per reviewer's suggestion we will combine sections 4.1 and 4.2. There is no national database with a description of urban characteristics for cities in Poland. The description

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is based on our studies and information obtained from the Spatial Planning Offices in different cities.

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Referee #1:

Clarification is needed for <5, 5-35, > 35% - does it mean that in each greed cell (what about presence of both, or even 3 urban classes within one grid cell; clarify)

Authors:

We have decided to skip the comparison of different urban cover approaches (UF_1 vs. UF_2) and to focus on UF_1 results. We will clarify the description of the methodology adopted to describe the urban cover classes.

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Referee #1:

Fourth, the number of chemistry measurement stations, of course, is more limited (only 3?) and attributed to studied urban areas. But observed vs. modeled concentrations of selected chemical species would be also useful to include (as it has been done for meteorology – Figures 14-15). This could show on how well the chemical transport model performs taking into account outputs from meteorological model without/with TEB urban module.

Authors:

As mentioned before, we will add more urban background stations for the analysis. All stations used for the comparison are dedicated to air quality measurements. We will add comparison for NO2, O3 and CO. However, concentrations of these species are not available at all monitoring sites. We will add a table (or augment Table.3) presenting the extent of measurements at each of the presented stations.

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It should be noted that the GEM-AQ model is not a “chemical transport model” but presents an on-line approach where chemical processes are built into the meteorological model.

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Referee #1:

Firth, in section 5.5, the chemistry measurements are taken near the surface (what is the exact height? clarify). The meteorology measurements are also taken there: air temperature at 2 m? wind speed at 10 m? But the comparison is done for averaged values within the 1st model level (i.e. from surface to 27 m). Such way of comparison is too crude. Or simply the modeled temperature and wind should be recalculated at levels of measurements at 3 stations for correct comparison. Hence, evaluation given in this section might have completely different results/outcomes. That part of analysis should be re-done in a correct way.

Authors:

According to the CAFE Directive (Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe), there is no fixed / standardized height for the air quality measurements. This parameter is set between 1.5 and 4 meters (Annex III, point C). As for temperature and wind, it is difficult to say whether measurements taken at air quality stations always fulfil standards set for synoptic WMO stations. Modelled parameters are taken from ‘surface level’ (sigma = 1). In the case of the GEM model these fields are scaled according to the Monin-Obukhov similarity theory. However, mixing ratios of minor constituents (air quality prognostic fields) are not subject to a similar ‘surface diagnostic’ approach. Interpolation to 1.5 m or 4 m (probable observation heights) does not mean the analysis will be done in the “correct way”. Interpolation or extrapolation could be considered as a sub-model for ‘surface diagnostics’. However, there is no additional (new) information generated that would justify any re-analysis (interpolation) of the presented results.

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Referee #1:

Moreover, in Ch.5 in each of the previous sections although differences between 2 types of runs – urban vs. non-urban - are shown in Figures (5-6, 8-9, 11-12), but a comparison with observations is missing (only between urban vs. non-urban); so, additional information is needed, and hence, it could be useful to add re-evaluation of modelling results taking into account observations.

Authors:

First part of Chapter 5 includes the description of the sensitivity study in terms of differences between urban and non-urban scenarios with the meteorological context taken into account (Ch 5.2, 2.3, 5.4). The comparison with measurements is presented in section 5.5. To improve the paper we will:

-) Skip the description of the analysis of urban cover approach (UF_1 vs. UF_2) section 5.1 will be removed and we will focus on UF_1 results.

-) Reorganize Chapter 5 to include subchapters for each case – with three sections – case description / sensitivity study / evaluation.

-) We will add a description of modelling results in terms of meteorological patterns over areas of interest as well as pollutant concentrations.

-) We will consider expanding the analysis presenting the vertical structure of temperature and selected pollutant concentrations.

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Referee #1:

Illustrative material: too many Figures, some of which could be combined together into one (see suggestions and details below); and moreover, Figures are shown at different

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UTC times – some unification for selected times would be needed (or explanation why these specific UTCs are selected);

Authors:

For graphical presentation the periods with most significant temperature anomaly were selected. We will provide more information for the figures.

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Referee #1:

Figures with synoptical maps could be omitted and only corresponding text describing meteorological situation is necessary (the focus is on the modelling domain with Polland) – see comments below;

Authors:

We will remove weather maps (Fig 4, Fig 7, Fig 10). The description of the meteorological situation will be expanded, with special focus on weather patterns over the analysed region.

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Referee #1:

Table 1 - in reality is not necessary/used (partly info from this table can be moved into Table 2 – see comments below);

Authors:

We will combine Table 1 and Table 2 and expand the description of the urban cover in the TEB module in the manuscript text.

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Referee #1:

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Table 3 – info on measurement stations can be also included into text and Table excluded.

Authors:

As mentioned, we will add more stations for the evaluation analysis. Pollutants concentrations will also be taken into account. As the list of available parameters varies at different monitoring sites, we will expand Table 3 to include the information on the set of parameters used for the analysis at each station.

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Referee #1:

Minor comments to text of the manuscript:

Authors:

With respect to the "Minor comments to text of the manuscript" (starting on page C3340) we will address the vast majority of the suggested changes and will present a consistent text in the revised manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 9517, 2012.