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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

Anonymous Referee #2

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The paper describes a set of sensitivity simulations of an on-line air-quality model, in which an existing meteorological parameterization for radiative transfer in urban environments (the Town Energy Balance) was turned on or off and the effects on the meteorology and chemistry were noted. There are problems with the methodology employed in the work, which need to be addressed by the authors, as follows:

Main Issue with the paper: The authors state on page 9520 that changes in meteorological and air quality parameters due to urban effects were analysed extensively. An extensive analysis is one in which a large number of measurement stations (hundreds) are compared to model predictions, for both air-quality and meteorological parameters

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over a long time period (weeks to months, even up to and over a year). Good examples of these sort of studies include the model intercomparisons in North America for TexasAQ and ICARTT (McKeen et al papers), and the multi-model comparison of the Air Quality Model Evaluation International Initiative (AQMEII – see recent papers in Atmospheric Environment). These examples give some of the key methodologies for a comparison of models and their parameterizations: a.Large numbers of observation stations are compared to the models. b.The comparisons are quantitative: standard measures of model performance are used (correlation coefficient, slope, intercept, mean bias, normalized mean bias, normalized mean error, root mean square error, index of agreement, etc.). c.The comparison is over a sufficiently long time period to allow these statistics to be meaningful (a few weeks in the case of measurement intensives, year-long simulations in the case of the AQMEII model intercomparison). d.Analysis of episodes are done in the context of case studies, following the main analysis over the longer time period and across stations.

By comparison, in the authors' work, three tests of duration of a single day are used, and no statistical measures are made of the model's performance. No comparisons to observations for air pollutants are made. Qualitative comparisons to observations for only two meteorological variables are made (wind speed and temperature), at only three stations. Comparisons between the different model scenarios are only made for image snapshots at particular hours – with no reasoning for why those hours were chosen. Insufficient analysis has been carried out for the authors to be able to state clearly whether the use of TEB has improved the model's air pollution or meteorological forecasts (Conclusions, page 9531, lines 9-11). In order for the paper to be acceptable, the following work needs to be carried out: a.The authors need to run the model for a longer time period (at least a week, and preferably a month) for the original model and the two urban setups for the TEB. b.The observations and model values should be compared using standard statistical measures such as noted above. c.The comparison to observations should be done for more than 3 stations, preferably with urban/suburban and rural stations separated out, to show the relative impacts in these

different environments.

The main issue I have with the paper is that the duration of the simulations and the comparisons to observations are insufficient to be able to really conclude whether or not the TEB improves the model predictions. This needs to be addressed before I can recommend publication.

Other issues: (1) Urban-land use: the source of data for section 4.1 needs to be stated (e.g. are these based on observations by the authors, what database was used [aerial photographs, satellite mapping, surface based obs, etc.)? The connection between sections 4.1 and 4.2 is not clear. The authors need to: (a) state their reasoning for their choices of mix of urban land use classes UF1 and UF2; (b) state the connection to those choices and the observations made in 4.1; (c) describe how these urban land cover choices were applied in the model. For example, was the given assumed fractionation of building types from Table 2 used for all grid squares containing an urban land fraction, specifically modifying that fraction's surface properties? Another choice would be to have different TEB urban cover dependant on the relative fraction of urban land use in the grid square. This needs to be clarified in the text.

(2)Page 9524, line 10: a better phrase than "non-stationary" would be "time invariant"; the former implies motion in space, the latter a variation over time.

(3)Page 9524, lines 19 to 22: more description of these three case studies should be carried out in the opening paragraphs of this section, along with reasoning as to why they are representative of the region.

(4)Section 5.1. Figure 3 is incomplete in that it shows the difference between the different scenarios, but not the difference between each scenario and the version of the model which is not running the TEB code. This is necessary: the authors conclude that the differences between the scenarios is insignificant, but that can only be done in comparison to the differences for the same fields carried out with and without the TEB (i.e. as opposed to [(UF_2 – UF_1) = (UF_2 – original) – (UF_1 – original)], also show

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UF_2 – original and UF_1 – original. If the value of |UF_2 – UF_1| « |UF_2 – original| and |UF_1 – original|, then the impact of the two different scenarios can be said to be insignificant.

(5)Sections 5.2, 5.3, 5.4: In each of these case studies (which as noted above should follow a more detailed statistical analysis of the model performance), the authors base their analysis on comparisons of model runs with and without TEB. The figures (5, 6, 8, 9, 11,12) need improvement: a.Each set of two panels should also show the non-urban scenario values – allowing the authors to demonstrate to the reader the relative magnitude of the anomaly compared to the base case unmodified model. b.All colour scales should include units of the field being displayed. c.Font size on the colour bar keys should be increased. Figures 5 & 6 have different snap-shot times, while 8 & 9, 10 & 11 were for the same time – why? Were the authors looking for the maximum impact during the time span (this should be stated in the text if so).

(6)Page 9527, line16: "lack of this effect" not clear which effect the authors are referring to, here. Perhaps the lack of UHI in the non-urban run?

(7)Section 5.5: a.Section title should be "Comparison with meteorological measurements". Are any air pollution measurements available? The authors need to give more justification as to why these three stations were used – in what way are they representative of the area? Were no other station data available? b.Figure 13 (or a companion figure) should also show the equivalent panels for the non-TEB simulation. c.Either on the figures, or in an accompanying table, the authors should give the statistical summary numbers for each day (see point 1 for the metrics to be applied): did the TEB improve the forecast?

(8)Conclusions: a.Page 9259, line 19: "In each case": here, "case" could be taken to mean either the scenario (UHI or not) or the simulated day. Maybe "In each period simulated"? b.Its not clear why the authors believe only two factors could influence the results. For example, the stability of the PBL in the surrounding (non-urban-influenced)

environment could also play a role. What about the building height distribution, or the assumed thermal properties of the buildings themselves? i.e. there needs to be a justification for why the authors feel these two factors are the most likely to influence their results. Note that on the next page (9530, line 13), the authors mention the role of stability vis-à-vis the impact of increased surface temperatures on stability: if the atmosphere is already unstable, is the UHI likely to have a significant impact? c.Page 9530, lines 25-27: "might indicate": I have seen other papers in which the anthropogenic energy release was up to 100 W/m2: how representative of the range of values are the standard values in the TEB? How well do they represent heat emissions in the region simulated? d.Page 9530, line 28 to page 9531, line 1: this needs to be demonstrated quantitatively, see earlier comments.

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