Geosci. Model Dev. Discuss.,
doi:10.5194/gmd-2016-10-SC1, 2016

Geoscientific Model Development Discussions
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EGU

Interactive comment on "Advantages of using a fast urban canopy model as compared to a full mesoscale model to simulate the urban heat island of Barcelona" *by* M. García-Díez et al.

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Received and published: 1 April 2016

General Comments:

The paper addresses advantages of using a fast Urban Climate Model (UrbClim) over a full scale mesoscale model (WRF) by using a case study depicting UHI simulation for the city of Barcelona. Urban Climate Model is relatively of high resolution that is driven by ERA interim reanalysis data or GFM of ECMWF. The model has earlier been validated for other European cities and now being implemented for Barcelona and utilized for climate projections. The model is demonstrated to be computationally efficient with higher resolution than a mesoscale model. However, as mentioned in the title, the model (UrbClim) is not a urban canopy model as canopy features are

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Discussion paper

not included in the true sense and the mesoscale model WRF does not include WRF-UCM. Hence the title needs to be appropriately modified with direct usage of UrbClim Though UHI is derived from the temperature differences, the paper presntlly lacks the robustness of estimating UHI. Further, model validation shall include meteorological parameters such as Wind speed and PBL etc. to demonstrate the efficacy of the two models. It would be interesting to see the performance of all the key meteorological parameters from the two models to examine the comparable performance and infer of the desired efficiency of UrbClim and this model comparison alone is adequate to make this point. The comments are elaborated below:

1. Line 90 onwards: Station number 6 is located on a rooftop at 33m while Station number 5 which is a rural station in located in a delta. The thermal properties of land surface and a land use predominently reflecting a water body is drastically different and the fact that no inversion is observed over rural station (considered here as reference station for UHI) would lead to erroneous representation of estimated UHI of the city. 2. Figure 1 a and 1 b: Figure 1 b should also depict the rural and urban stations. Both figures should depict coordinates (lat/long) using ArcGIS or another appropriate software. It appears that Urban and rural stations are not within the same nest and with similar resolution. This might affect the results somewhat. This needs to be clarified. 3. Brief description of incorporation of urban canopy model (physics/key eq.) in UrbClim model shall be included to explain the science and for comparison with mesoscale model to understand level of simplification. What are the time step for running these two models? A climate model run needs larger time step and a weather model like WRF requires lower time step to run. If this difference is large between the two models, UrbClim will obviously be computationally much more efficient. It would be more appropriate to compare UrbClim with another Climate model with similar or comparable time step resolution for depicting it's efficiency for predicting average temperatures from May to Sept. 2011. Essentially, this efficiency is one of the major claim by the authors in this paper and that is not shown by considering two dissimilar type of models in terms of phenomenal applicability of UHI. Further by including other meteorological

parameters such as wind speed, fluxes and PBL and demonstrating the comparative model performance would prove the point more effectively.

4. UHI requires detailed description of measurement sites including station pictures with surroundings. 2 station data will not be sufficient for robustness. Thus, it is suggested that model implementation and efficacy claim is limited to temperature predictions and other met. parameters shall also be included for this purpose. Further, authors claim that there are 11 met. stations in the domain; however data for only 2 stations is being used to depict UHI. Were the chosen stations showed the maximum UHI? How about UHI for other stations ? Could they reflect justifiable trends vis-a- vis their LULC? Most of the study would use 25 or more stations for UHI(Mohan et al., 2013:, Assessment of urban heat island effect for different land use–land cover from micrometeorological measurements and remote sensing data for megacity Delhi, Theoretical and Applied Climatology, 112, 647-658. DOI 10.1007/s00704-012- 0758-z). On line 190, authors mention that " The measurement of the UHI with only two points has some limitations, as it may be sensitive to very local features such as the land use in the vicinity of the stations. However, the representativeness of these points has been carefully checked with high resolution satellite images". No details are provided as to how it has been checked. In addition, the agreement with previous studies increases our confidence in the results here presented. No details of any previous studies provided here. Satellite data would represent LST and not air temperature while UHI estimated and shown are based on air temperature.

5. Does the same trend in UHI was seen based on LST also? It is not clear. UHI phenomena occurs on a diurnal scale for which WRF-UCM is applied (Bhati and Mohan, 2015; TAC; doi:10.1007/s00704-015-1589-5). RMSE of temperature of about 2 deg. is acceptable as per WMO guidelines on shorter time scales of an hour or day as demonstrated in this study. Therefore results can be sufficiently robust for temperatures averaged over 5 months but the differences of 2.5 deg. as in UHI may not be ; hence model application seems appropriate for temperatures and not for UHI. More-

over, different heights of urban and rural stations will further add to this uncertainty. 6. Simulations are carried out from May to Sept, 2011. It is not clear for statistical paired analysis what temporal and spatial resolution and how many data points are used? 7. It will be good to include the monthly variations of UHI considering seasonality in May to Sept. data and examine the trends ? Similarly for the air temperatures and LST as well the monthly variations could be included. 8. Based on model simulations the spatial variation of UHI needs to be studied. It shall be shown whether spatial variation shows maximum difference at the two selected points and other places in the domain are depicting lower UHI so that urban -rural contrast can be deciphered. 9. The title mentions fast Urban Canopy Model while the abstract and text categorises this as Urban Climate Model and the mesoscale model used is WRF and not WRF-UCM. As per the text, WRF includes USGS LULC and no mention of WRF UCM is made. WRF has tremendous scope of improvement by using recent LULC other than USGS and including Urban Canopy as demonstrated by Bhati and Mohan (2015). Thus urban canopy model in the title may be replaced with urban climate model.

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