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Interactive comment on "Impact of an improved WRF-urban canopy model on diurnal air temperature simulation over northern Taiwan" *by* C.-Y. Lin et al.

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Reviewer 2#

1) the first point regards the simulated temperature the authors used for comparison. The authors did not mention in any part of the paper how they calculated T(2m) and T(10m). What is the elevation of the first grid level? and, what is the average building eight in each grid cell in correspondence of the urban canopy? As the authors well know, one of the main problems in testing urban canopies simulations is the choice of the height used for the comparison. Since the first grid node of WRF is, I presume, well above the canopy, the authors would have used some similarity laws to calculate

the simulated temperatures at 2m and 10m. Please clarify. 2) Over the last few years, approaches alternative to the UCM scheme have been developed to simulate urban heat island effect. In spite of this, the authors did not mention any other urban canopy layer scheme. I suggest to add in the Introduction a brief discussion on that issue.

R: (1) In this study, only simulated air temperature at 2-m elevation is employed to compare with the observation (L233). The WRF thermodynamic variables are not directly simulated at 2 m, but diagnosed from values at the land surface and the lowest model layer (Hu et al. 2010). WRF-UCM further considers the forcing from artificial surface (building, roof, wall and road). Building canopy is assumed to resemble aerodynamic roughness, thus implying that the complex urban canopy layer is replaced by a roughness number rendering information regarding the quantities within the canopy layer unavailable (Mirzaei and Haghighat, 2010). Characteristics within the roughness sub-layer vary with a horizontal distance scale determined by inter-element spacing, rather than height and vertical temperature gradient (Arnfield, 2003). In this study, the building height, i.e., the canopy layer, is 6 m. The elevation of the lowest model layer is 25 m in this study. The "2-m diagnostic air temperature" is calculated using the energy budget equation in the urban copy model expressed as equation (1) (Line 388). The Fsh from Noah LSM is averaged with the sensible heat flux from UCM weighted by the urban fraction to yield the representative Fsh (Chen et al. 2011) (L382-393). The representative skin temperature (Tsk) of a model grid is averaged with the Tsk from Noah LSM and the skin temperature of the artificial surfaces (i.e., roof, wall and road) in the UCM weighted by their respective coverage (Chen et al. 2011). A schematic of the single-layer UCM from Chen et al. (2011) is shown below (Figure S1).

(2) Thanks for the suggestions. To improve the urban air temperature simulation, WRF (V3.2) has been integrated including (a) A bulk urban parameterization in Noah to represent zero-order effects of urban surface (Liu et al. 2006) (b) Single-layer urban canopy model by Kusaka et al. (2001) and Kusaka and Kimura (2004) (c) multi-layer urban canopy (BEP) and indoor-outdoor exchange (BEM) models by Martilli et al. (2002).

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Chen et al. (2011) had reviewed the integration of Weather Research and Forecasting (WRF) model with different urban canopy schemes. (A schematic figure is shown below). We cited in the introduction in this revision (L75-80).

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 28483, 2015.

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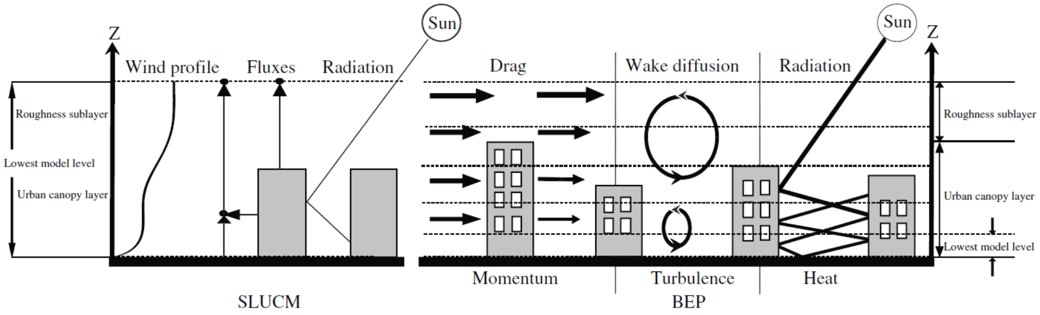

Figure 2. A schematic of the SLUCM (on the left-hand side) and the multi-layer BEP models (on the right-hand side).

(Figure S1 Taken from Chen et al. 2011)