

Interactive comment on “Impact of buildings on surface solar radiation over urban Beijing” by B. Zhao et al.

Anonymous Referee #3

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It is a pleasure to review the manuscript "Impact of buildings on surface solar radiation over urban Beijing" by Zhao et al. This manuscript addresses a challenging problem: How to take into account building effects for calculating downward solar radiation in complex urban areas, which is critical for estimating urban heat islands and for urban modeling. It examines the building effects on solar radiation by comparing, at different spatial resolutions (4 km and 800-m), results from a 3-D radiation parameterization with results from a relatively simple plane-parallel approach. The paper is well organized and well written, and the research quality is high. I suggest to accepting this manuscript after the authors clarify the following points:

- The deviations of radiation fluxes calculated from the above two models are remarkably small ($\sim 1\text{--}10\text{ W m}^{-2}$ at 800-m grid resolution and 1 W m^{-2} at 4-km resolution) from mesoscale modeling perspectives. Can the authors elaborate on the types of

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urban data are used in their 3-D model? Judging from Fig. 1, I understand that the SRTM data provides information regarding the average building height and perhaps gaps between buildings. Does this dataset also describe building width? A more general question is: does this 3-D radiation model take into account the building geometry? If not, what would be uncertainties of not account it in the calculated deviations?

- Section 3.1, page 2, Line 18, "these grids are": which grids are referring to here? It may be useful to add a figure to show the geometry features of grids, which is not obvious from Fig. 1.
- Section 3.2, Line 17: authors mentioned sky view factor (SVF). Does the 3-D model consider SVF and if yes, how? Does the calculation of SVF involve the use of building geometry characteristics?

- Section 3.3.1, Line 6: should "are now shown" be "are not shown"?

- Suggest including a plot of SRTM heights at 90-m resolution in Fig. 6.

- Section 3.3.2: authors briefly mentioned the limit of applying their models for high-resolution $< 1\text{-km}$? Can they elaborate more on the theoretical basis of such limitation (with reference perhaps)? It is an important issue because their models are used in this manuscript for 800-m resolution too.

- Section 3.3.3: albedo 0.15-0.2 from WRF. These albedo values likely are output of Pleim-Xue land model. Does that land model consider building effects on solar radiation (even in a crude way)? If yes, would the use of these albedo values in the 3-D model somewhat double account for building effects?

- WRF includes urban canopy models (Chen et al. 2011, International Journal of Climatology), which consider building geometry features to calculate sky view factor etc to determine effects of shadows and reflection on solar radiation. Detailed description of these models and their treatments of effects of buildings on solar radiation can be found in Kusaka and Kimura (2004, Journal of the Meteorological Society of Japan) and in Martilli and Rotach (2002, Boundary-Layer Meteorology). How does the 3-D

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model differ from these simplified building-radiation schemes in WRF? I think it would be useful to compare the 3-D model results with these calculated by WRF-urban at 1-4 km scales, which are commonly used in mesoscale models for urban areas.

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