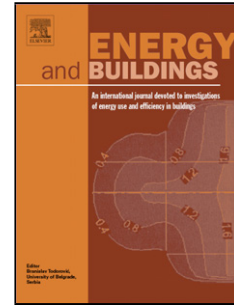


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1 From urban climate to energy consumption. Enhancing 2 building performance simulation by including the urban 3 heat island effect

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11 **ABSTRACT**

12 Cities are dissipative structures. As such, cities generate heat, a phenomenon known
13 as urban heat island (UHI). Even though the UHI is one of the most relevant effects of
14 urbanization on urban climate, up-to-date methodologies to include it in the
15 estimation of buildings' energy consumption are still scarce. During the last 30 years,
16 different methods and software have been developed to measure a thermal building's
17 demand. Building performance simulation is commonly used to calculate heating and
18 cooling demand. However, such techniques do not adequately include the urban heat
19 island effect, which could have an extreme impact on a building's energy consumption.
20 In fact, building operation is doubly connected with the urban environment: on the
21 one hand, buildings generate heat that warms up the environment, and on the other
22 hand, the urban environment alters building performance by the influence of UHI. In
23 this paper, a methodology to incorporate the UHI effect in building performance
24 simulation is proposed. Urban weather data were downscaled at the urban
25 morphology building level to estimate the cooling demand of different types of
26 residential buildings. The global energy penalty for the whole residential building
27 stock was estimated in four South American Pacific coastal cities. The results indicate
28 that when UHI is incorporated, an increase in energy demand between 15 % and 200
29 % can be expected. These results challenge the validity of current assessments
30 performed in absence of the UHI effect. At the same time, these results open up the
31 discussion for the inclusion of urban planning measures aiming at reducing the UHI
32 effect on a building's energy demand.

33 **KEYWORDS**

34 Cooling demand; urban weather generator; GIS; spatial analysis; building
35 performance simulation; weather data, Antofagasta, Lima, Guayaquil, Valparaíso

36 **HIGHLIGHTS**

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43 - A methodology to downscale the urban climate to the building level is
44 proposed.

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