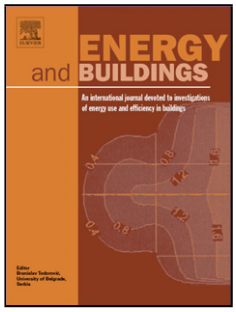

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From urban climate to energy consumption. Enhancing building performance simulation by including the urban heat island effect

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ABSTRACT

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

KEYWORDS

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

HIGHLIGHTS

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