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TOWARDS A DYNAMIC MODEL FOR THE URBAN HEAT ISLAND OF MADRID

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1. Introduction – Present research is framed within the project MODIFICA (MODelo predictivo - edIFIcios - Isla de Calor urbanA) aimed at developing a predictive model for dwelling energy performance under the urban heat island effect in order to implement it in the evaluation of real energy demand and consumption of dwellings as well as in the selection of energy retrofitting strategies. It is funded by *Programa de I+D+i orientada a los retos de la sociedad 'Retos Investigación'* 2013.

Despite great advances on building energy performance have been achieved during the last years, available climate data is derived from weather stations placed in the outskirts of the city. Hence, urban heat island effect is not considered in energy simulations, which implies an important lack of accuracy.

Since 1980's several international studies have been conducted on the urban heat island (UHI) phenomena, which modifies the atmospheric conditions of the urban centres due to urban agglomeration [1][2][3][4]. In the particular case of Madrid, multiple maps haven been generated using different methodologies during the last two decades [5][6][7]. These maps allow us to study the UHI phenomena from a wide perspective, offering however an static representation of it.

Consequently a dynamic model for Madrid UHI is proposed, in order to evaluate it in a continuous way, and to be able to integrate it in building energy simulations.

2. Methods – The project is built up in two phases, taking as its starting point the UHI study of Madrid from 1993. First, an update of the isotherm map is presented, based on thermographic airborne images of Madrid in addition to statistical data of urban density and rural temperatures over the last three decades.

Secondly, an hourly development of the isotherms is created, as well as the characterization of uniform thermal areas inside the city. In order to do that, weather stations from the city council and the national meteorological service were used. This data lead to an hourly and daily characterization of every area, and to its integration within the building's energy simulations.

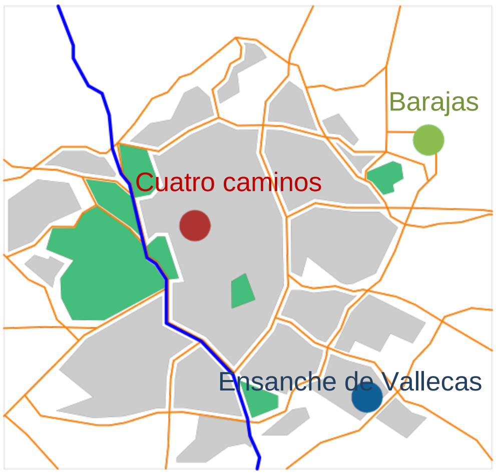

Figure 1 Location of sampling weather stations

3. Results and Discussion – Final results are expected to show a new dynamic map of isotherms for Madrid, linked to a climate correction database based on urban heat island effect. In order to show in this abstract the existing differences in daily temperatures, data from two weather stations is plotted in *Figure 1*, as well as current energy simulation weather data (Barajas' weather station).

Temperatures presented in *Figure 2* belong to a typical day from the hottest month of the year. It is noticeable not only a significant increase in temperatures from the downtown weather station (*Cuatro Caminos*), but a delay in the hour of peak temperatures due to city thermal inertia. In the suburbs of Madrid (*Ensanche de Vallecas*), there is not a significant increase in temperatures, but thermal inertia also delays temperatures, what poses an important factor to be taken into the implementation of passive strategies such as night thermal ventilation.

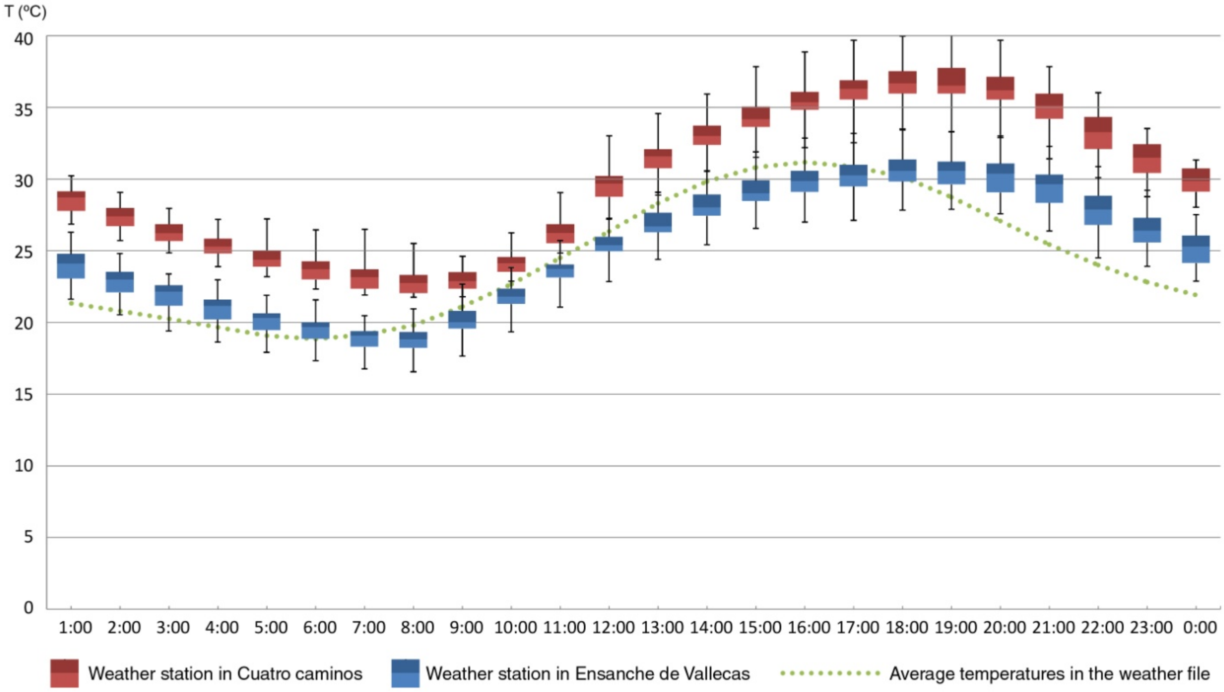

Figure 2 Daily behaviour of temperatures in July

3. Conclusions – The UHI phenomena is characterized by an spatial and temporary behaviour, being irregular through time. Data from local weather stations allow us to correct hour-by-hour values gathered in outskirts-weather stations normally used in energy simulations. The implementation of a dynamic model is required for energy simulations in order to improve decision-making, especially concerning passive design.

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