Assessment of the climatic comfort in the city of Madrid

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The aim of this analysis is to explore differences in thermal comfort conditions between the city of Madrid and nearby areas, and between the different urban spaces within the city, developing an empirical model to generalize the results to the different districts of the city, under different weather conditions and extreme events, such as cold and heat waves., through a GIS. The differences in thermal conditions existing between rural and urban areas are quantified by using a bio-climatological index termed physiologically equivalent temperature (PET), calculated with the aid of the PC software RayMan. This index is based on the human energy balance and builds a relevant index for the quantification of the thermal environment of humans. The meteorological data used have been the hourly records of temperature, relative humidity, wind and radiation from 2000 to 2009, available from the synoptic network of the Spanish meteorological office (AeMet) and two other automated networks, one regional (Comunidad de Madrid) and another local (Ayuntamiento de Madrid). Land use was extracted from two sources: CORINE land cover database and information from the Plan de Ordenación Urbana de Madrid. To match both sources, the following three land-use categories were adopted: urban (dense, single houses, residential), green and recreation areas and others (including here industrial, working premises and large markets surfaces). The GIS tool to combine the different sources of information was ArcView 9.1.

For the entire study period, urban and rural day-time PET reached similar maximal values. Strong differences in PET, however, were observed between the rural and urban areas at night-time, with extreme thermal contrasts during heat waves. Within the city, we have found significant differences between three areas. The coolest corresponds to the green areas (urban green parks, like El Retiro); conversely, the central built-up areas, densely urbanized and lacking of green surfaces, are the warmest.