Geophysical Research Abstracts
Vol. 13, EGU2011-7756, 2011
EGU General Assembly 2011

Estimating the influence of building volumetry in the urban thermal field in Lisbon (Portugal)

Henrique Andrade (1), Maria-João Alcoforado (), and Paulo Canário ()

(1) (henr.andr@gmail.com) Centre of Geographical Studies, University of Lisbon, Lisbon, Portugal, (2) (mjalcoforado@campus.ul.pt) Centre of Geographical Studies, University of Lisbon, Lisbon, Portugal, (3) (pmscanario@gmail.com) Centre of Geographical Studies, University of Lisbon, Lisbon, Portugal

The Urban Heath Island (UHI) is the main feature of the urban climate, having strong impacts in human health and thermal comfort and, therefore, in energy consumption, mainly in cities with warm summer, such as Lisbon (Portugal) and other cities with Mediterranean climate. Planning measures to control UHI should therefore be taken.

The urban thermal field is influenced by anthropogenic as well as by natural factors. Natural factors are very important in Lisbon, mainly those associated with the relief and the presence of large water bodies. Anthropogenic influence depends greatly on urban fabric and human activities, at local and microclimatic scales. A method was devised to split the urban and natural factors that influence Lisbon's thermal field.

Air temperature measurements were performed with fix devices during 1300 days, between 2004 and 2009, in seven Lisbon sites. A classification of the urban thermal field was then performed, using the k-means method. Seven classes of thermal patterns were obtained, each one associated predominantly with specific circulation patterns and periods of the day and the year. In the present analysis only two classes were selected: "northerly cool weather" and "warm nights". They are both associated predominantly with North or Northwest winds (prevailing wind directions in Lisbon), but clearly stronger in the case of the "northerly cool weather". This last class is the most frequent (48%) among the thermal patterns; the "warm nights" are less frequent (17%); however they have strong negative impacts in health and represent 29% of summer nights.

In a first step, a linear regression model was selected; for each of the two classes, between measured air temperatures (independent variable) and geographical factors, which can be either natural (such as altitude) or anthropogenic (such as building volumetry). Based on these models, Lisbon's thermal field was estimated using a GIS for the two classes. In both situations the building volumetry (calculated as the product of the height of the buildings by the surface of implantation of the buildings, averaged in a grid of 100x100m) has a significant influence in the thermal field, being dominant during "warm nights" and less important in "northerly cool weather". The influence of the building volumetry was estimated by calculating Lisbon's thermal field assuming the non existence of the urban fabric (therefore the thermal field depends only on natural factors). The influence of the buiding factor is generally under 1ºC in the dominant "northerly cool weather" situations, but it is much stronger in "warm nights" reaching an average value of 1.9ºC and a maximum value of 3.6ºC. The old centre, with a high building density of moderate height and a very uniform urban fabric, has the highest average building effect. However, the extreme values of the urban effect were found in the peripheral recently built city districts that have much taller buildings and a more open urban fabric. It is therefore possible, if appropriate measures are taken, to control the urban heath island, and to improve significantly the urban environmental quality.