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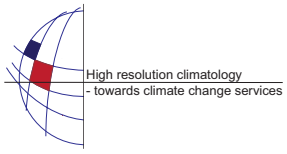

An assessment of heat stress in the Iberian Peninsula

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The analysis of human comfort requires the inclusion of additional parameters to air temperature, such as wind, humidity or radiation, especially in areas like the Iberian Peninsula, where the summer thermal differences between the marine surfaces and the continent promotes local circulations capable to modify locally the characteristics of the air masses. A variety of bioclimatic indices that relate atmospheric conditions to human sensations have been developed so far, being the Physiological Equivalent Temperature (PET, Matzarakis et al, 1999) one of the most popular.

Several objectives have guided this research. First, a basic climatology of PET over the Iberian Peninsula has been elaborated. Secondly, the main modes of spatial and temporal variability in the apparent temperature field have been obtained. Aditionally, the role of the regional atmospheric circulation and local surface variables in the spatial and temporal variability of PET has been analyzed through a synoptic climatological approach.

The data used have been 3 hourly synop reports from stations located in the Iberian Peninsula, Southern France and Northern Africa (Morocco and Argelia), for the period 1971-2007. 850 hPa geopotential heights, retrieved from NCEP Reanalysis web server (http://www.esrl.noaa.gov/psd/data/reanalysis/reanalysis.shtml) were used to devise a circulation pattern catalogue, obtained following a well-known procedure that combines Principal Component Analysis (PCA) for reduction purposes and clustering (Ward plus K-means) to define the types. Additional gridded variables, like 850 u/v wind components and 850 relative humidity fields were also used to obtain composites of the synoptic patterns.

The methodology followed comprised several steps. Initially, 3 hourly values of PET corresponding to selected stations was calculated with RayMan. The 12 UTC values were subsequently submitted to a regionalization using a Rotated Principal Component Analysis. The frequency of occurrence of heat extremes (PET > 35 °C) was compared with the occurrence of several circulation patterns, in other to validate the circulation pattern catalogue and obtain a regional signal.
In order to gain a comprehensive understanding of the sources and thermodynamic characteristics of the air masses involved in those events, the atmospheric circulation prior selected episodes of heat stress was analyzed using a sequential classification procedure (up to three days) and compared with the backward trajectories supplied by the HYSPLIT model (Hybrid Single-Particle Lagrangian Integrated Trajectory model; http://ready.arl.noaa.gov/HYSPLIT.php).

The dependence of the PET on some geographical controls (e.g. topography, latitude, distance to sea) results on marked variation between the values calculated for different stations. Low/middle-altitude continental stations (eg. Madrid, Seville) show much higher thermal stress than coastal stations (Barcelona, Málaga) or stations in elevated areas (e.g. Burgos, Navacerrada). Besides, coastal stations display an asymmetric monthly distribution, with larger probability in August, while July is the most typical month in the interior of Iberia. 5 regions resulted from the analysis of daily PET fields: Northern, Atlantic North, Atlantic South, Mediterranean North and Mediterranean South. The extreme heat events occurrence on each region showed strong links with the atmospheric circulation, but two basic mechanisms are involved in most of them. Coastal stations experience such events when the regional atmospheric circulation overrules local circulations, replacing the cooler and moist

air masses by continental downslope flows. In continental Iberia the advection of hot air masses from a diverse precedence and embedded into a weak atmospheric circulation (radiative processes) trigger most of the situations of heat stress.