Vulnerability Assessment to Extreme Heat in the Lisbon Metropolitan Area - an attempt of spatial modelling.

Paulo Canário (1), Helena Nogueira (2), and Henrique Andrade (1)

(1) Centrefor Geographical Studies, Portugal (ceg@campus.ul.pt), (2) Centre for Geographic Studies and Spatial Planning, Portugal (cegot_coimbra@fl.uc.pt)

The effects of extreme hot weather in health have been mainly studied at a national or regional level. However, local spatial variations in mortality exist either related with local climatic differences (attributable to urbanization and land use/land cover features) or with vulnerability factors (especially those dependent on the demographic and socioeconomic characteristics of the population). Recognizing that few studies had tried to investigate the mortality spatial variations in urban environments, at a fine scale, an ongoing research has been conceived to fill this gap. We have developed a conceptual geospatial analysis method of death risk during heat waves, which fits into the global risk assessment framework for natural disasters and is intended to be used primarily in urban areas. Risk is assessed taking into account the spatial intersection of information between the potential hazardous areas and the vulnerability indexes within those areas, in the Lisbon Metropolitan Area (Portugal).

Daily mortality data was supplied by the National Institute of Statistics, with description of age, sex and cause of death.

Hazard is represented mainly by temperature and air pollution (the influence of other atmospheric variables that affect the human energy balance, such as solar radiation and wind speed should be tested too). Small scale variation of meteorological features, in extreme thermal events, will be simulated with a Regional Atmospheric Model (Brazilian Regional Atmospheric Modeling System) and the results will be validated and calibrated using observation data from an urban network of termo-higrometers placed in sites with different urban characteristics.

Vulnerability is a function of population sensitivity and exposure that can be quantified from zero to one: zero being the absence of deaths attributable to climate extremes and one the complete loss of human lives due to a particular hazard.

Sensitivity is defined as the degree to which, before a given exposure, a population is affected by a given climate framework – it represents the dose-response relationship; it depends on several population characteristics such as individual and demographic factors, as well as social, cultural and economic variables at different action levels (scales).

In order to perform the analysis, days with maximum temperatures above 32ºC - temperatures recorded in Lisboa/Gago Coutinho weather station - were selected in the period between 1998 and 2008 (192 days were selected from May to September). The highest temperature recorded was 41.7ºC during 2003 heat wave. Vulnerability assessment was performed using different kinds of indicators: demographic, educational, socio-economic, urban and health related (selected according to their availability at the National Institute of Statistics). An environmental variable was added in order to introduce a hazardous item in the model.

A multiple regression was conducted with mortality rate as a dependent variable. 22 vulnerability indicators, together with the hazard variable, were the independent variables. The results strongly highlighted population ageing (strong relation with % widowed) as well as population and buildings density. In a second step, in order to control for the ageing effect in the mortality rates, the standard mortality ratios (SMR) were calculated and a discriminant analysis was performed. The results showed that SMR's were lower in civil parishes with less institutionalized population, low levels of deprivation, located near the ocean and with better access to hospitals.