Relation between heat wave events, synoptic patterns and mortality rates for the Metropolitan Region of Rio de Janeiro.

Lucas Cesar Castro (1), Joao Lucas Geirinhas (2), Ricardo Trigo (2), Renata Libonati (1,4), Leonardo Peres (1,5), and Monica Magalhães (3)

(1) Federal University of Rio de Janeiro (UFRJ), Institute of Geosciences (IGEO), Department of Meteorology, Rio de Janeiro, Brazil, (2) Institute Dom Luiz, University of Lisbon, Lisbon, Portugal, (4) Centro de Estudos Florestais, Instituto Superior de Agronomia, Universidade de Lisboa, Lisboa, Portugal, (5) Portuguese Institute for Sea and Atmosphere (IPMA), Lisbon, Portugal, (3) Institute of Communication and Scientific and Technological Information in Health, FIOCRUZ, Rio de Janeiro, RJ, Brazil

During the last decades, extreme temperature conditions, such as heat waves (HW's), are becoming more intense, lasting and frequent over the globe. HW's are characterized by the occurrence of an extended period of excessively high temperatures associated with certain atmospheric synoptic patterns. Recent studies indicate that such extreme events have the potential to influence and aggravate environmental and socio-economic factors, with a direct impact on the public health sector. For instance, during the 2003 HW episode in Europe the observed mortality rate has exceeded the expected one for the same period. Poor population in developing countries are especially challenged by those climatic extremes due to the weak health infrastructure and the lack of investment in this sector. The Brazilian public health, especially the one from the Metropolitan Region of Rio de Janeiro (MRRJ), may be a vulnerable sector due to the occurrence of these events. The objective of this study is to analyze the 2010 HW event which occurred in the MRRJ, investigating its interrelationships with human natural deaths. This severe HW event was assessed by analyzing the associated synoptic patterns using ERA-INTERIM reanalysis and heat wave indexes based on temperature data from two surface meteorological stations, from 1961 to 2014, and daily mortality data from the Unified Health System (SUS) from 2000 to 2015, organized by gender and age groups. Results show that the HW episode of 2010 was associated with a prevailing large-scale anti-cyclonic anomaly over the South Atlantic Ocean, in the vicinities of south and southeast (SE) coast of Brazil. This anomaly, recorded throughout January and the HW period, was imposed by a large-scale teleconnection wave train formed over the southeastern Pacific Ocean. A stationary Rossby Wave train was then responsible for an absence of wet episodes related to South Atlantic Convergence Zone and for pronounced negative anomalies of soil moisture in SE Brazil. During the HW period, these dry soil conditions impinged high levels of sensible heat flux, generating a soil-atmosphere positive feedback mechanism that contributed to an amplification of the pre-imposed large-scale conditions over SE Brazil. High levels of solar radiation incidence and dry atmospheric conditions were then recorded, resulting in the formation of a hot and dry air mass over this region, transported by an anti-cyclonic surface wind configuration, from this interior region of the SE Brazil to the more coastal region and to Rio de Janeiro.

The assessment of the consequences of such hot environmental conditions on human health revealed an increase in the mortality rate mainly of the elderly, for both genders, from 30%(male) to 58% (female) in relation to what was expected for the same period. In general, the excessive human deaths were mainly associated with problems in the circulatory and respiratory systems. This study provides a novel and synergic assessment of heat waves, human mortality and associated atmospheric patterns in Rio de Janeiro and may serve to better understand, forecast and prevent the impacts of extreme temperatures in the region.