



Mortality Incidence levels associated with extremely high temperatures for the Metropolitan Region of Rio de Janeiro, Brazil

João L. Geirinhas (1), Ricardo M. Trigo (1), Renata Libonati (2,1), Pedro M. Sousa (1), Lucas C.O Castro (2), Ana Russo (1), Caio A.S Coelho (3), Leonardo F. Peres (2), and Mônica de Avelar F.M. Magalhães (4)

(1) Instituto Dom Luiz, Lisbon, Portugal (jlgeirinhas@fc.ul.pt; rmtrigo@fc.ul.pt; ppsousa@fc.ul.pt; acrusso@fc.ul.pt), (2) Instituto de Geociências, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil (renata.libonati@igeo.ufrj.br; lucas.coc95@gmail.com; leonardo.peres@igeo.ufrj.br), (3) Weather Forecasts and Climate Studies - CPTEC/INPE, São Paulo, Brazil (caio.coelho@cptec.inpe.br), (4) Institute of Communication and Scientific and Technological Information in Health, Rio de Janeiro, Brazil (monica.magalhaes@icict.fiocruz.br)

Temperature record-breaking events, such as heat waves (HWs), pose a significant challenge to the health sector. Considering the observed and expected increments of mean and extreme temperature levels, under different climate scenarios, HWs are expected to increase in frequency, duration and intensity during the next decades and throughout most regions of the World (Fischer and Knutti, 2015). The HWs impacts are more effective over high densely populated urban centers, where the joined contribution of the urban heat island effect and the worsened air pollution levels induce an excessive mortality incidence. According to the United Nations, half of the World's population is currently living in these urban settlements, and demographic projections indicate that in 2050 this number will increase to circa two-thirds. Considering such pronounced demographic trends, strategies accounting for the occurrence of HWs are urgently needed in order to mitigate the associated potential health impacts. This is particularly relevant in regions like South America and Brazil, where there is still a lack of studies analyzing the relationship of natural mortality concerning extreme heat events and where many people with low social-economic conditions live within metropolitan regions of mega-cities.

Here we outline the statistical relationship between temperature extremes and daily mortality levels for a Brazilian highly populated urban area, the Metropolitan Region of Rio de Janeiro (MRRJ), from 2000 to 2015. The analysis was conducted for several age groups and considering general cause-specific mortality cases. Our results show that mortality tends to increase significantly during prolonged extreme hot periods, in particular, when preceded by a cooler period. Deaths caused by respiratory diseases were identified as showing the most prevailing increment during extreme heat stress conditions.

A special emphasis was paid to a particular HW event (from 2 to 9 Feb 2010) associated with the highest mortality peak recorded throughout all the 16-year mortality considered. This episode was responsible for a total excess of 737 deaths within the MRRJ, with the elderlies being the most vulnerable age group. Through the analysis of ERA-Interim reanalysis anomaly composites, a detailed characterization of the atmospheric circulation mechanisms responsible for this episode was performed (Geirinhas et al., 2019). The contribution during the preceding weeks, of an anomalous dry accumulated surface scenario for the HW amplification through land-atmosphere feedbacks was also observed and discussed. The obtained results represent a serious warning and should be used by authorities as a guideline to predict and minimize the future impacts of climate change, allowing society to timely adapt to a range of different climate scenarios.

Fischer E.M. Knutti R., 2015. Anthropogenic contribution to global occurrence of heavy-precipitation and high-temperature extremes. *Nature Climate Change*, 5, 560-564. Doi: 10.1038/NCLIMATE2617.

Geirinhas J.L., Trigo R.M., Libonati R., Castro L.C.O., Sousa P.M., Coelho C.A.S., Peres L.F., Magalhães M. de A.F.M., 2019. Characterizing the atmospheric conditions during the 2010 heatwave in Rio de Janeiro marked by excessive mortality rates. *Sci. Total Environ.*, 650, 796-808. <https://doi.org/10.1016/j.scitotenv.2018.09.060>

Acknowledgements: The study was funded by Serrapilheira Institute (grant number Serra-1708-15159). Ana Russo thank FCT for grant SFRH/BPD/99757/2014.