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Developing a Multivariate System for Predicting and Mitigating the Health Impacts of Heatwaves

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The **main purpose** of this study is to develop a heatwave **impact-based** forecasting system using a new multivariate index, that **also** encompasses **a mitigation action plan with** hydration-related measures. **Since 1990, heatwaves have become more frequent and intense** in various regions worldwide, particularly in Europe and Asia. The principal health effects of heatwaves include **organs' strain and damage, complications of** cardiovascular and kidney diseases, as well as adverse reproductive effects. These detrimental impacts are widespread and commonly affect individuals aged 65 and above. Many nations have established metrics to assess the prevalence of this occurrence within their borders. These metrics typically **use** specific threshold **values** and/or ranges **of the near-surface (2 m) air temperature**, **usually denoted by** the extreme values from past records. **To the best of our knowledge, only** some of these metrics **take into account** the persistence of the phenomenon and few consider the relative humidity. It is noteworthy that in most of these metrics the temperature thresholds lead to a linear escalation **of** the conditions posing a risk to the population, which **may lead to a misperception** of the actual level of risk involved. To thoroughly evaluate the health hazards associated with heatwaves, it is essential to **consider the climate variability and change at regional and local scales**, as well as the diverse responses of living organisms to extreme (**and long-lasting)** temperature and humidity conditions. Factors such as individuals' **sex**, **ancestry**, age, pre-existing medical conditions, and geographical location should be considered **too**. The first step of this **study consisted of the characterization of** the **monthly Cumulative Distribution Function** of the daily maximum near-surface air temperature ***(TX)* in summer, in recent climate. We used the ERA5-Land reanalysis dataset and performed the analysis** for each grid point**, considering 1960-1990 as baseline period.** Subsequently, **in order to compute the index,** the temperature **values** exceeding the **95th percentile (*TX95p*) *were subjected to a normalized scaling function whose values grow exponentially with the magnitude of the temperature and also*** depend on the **ambient** relative humidity. The **resulting index values range** from 0 to 1, only being greater than zero when the

temperature exceeds ***TX95p***. **To calibrate the index, we considered** the hours of the day during which the index deviates from zero and its correlation with hospitalization and mortality data, **mainly** related to **cardiovascular** diseases such as thrombosis. **The preliminary work concerned the Region of Murcia, in Spain. The index was validated in the period 2000-2022. Results show the sensitivity of the index, which displays its largest values in the summer of 2022, coinciding with the high number of heat-related deaths observed that year in Spain. Future research will be focused on index calibration and validation in other regions which are also subjected to extreme heat conditions.**