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A climate-driven mortality modelling tool for Europe

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The impact of climate change on human health is a serious concern. In particular, changes in the frequency and intensity of heat waves and cold spells are of high relevance in terms of mortality and morbidity. This demonstrates the urgent need for reliable early-warning systems to help authorities prepare and respond to emergency situations. In this study, we evaluate the performance of a climate-driven mortality model to provide probabilistic predictions of exceeding emergency mortality thresholds for heat wave and cold spell scenarios. Daily mortality data corresponding to 187 NUTS2 regions across 16 countries in Europe were obtained from 1998–2003. Data were aggregated to 54 larger regions in Europe, defined according to similarities in population structure and climate. Location-specific average mortality rates, at given temperature intervals over the time period, were modelled to account for the increased mortality observed during both high and low temperature extremes and differing comfort temperatures between regions. Model parameters were estimated in a Bayesian framework, in order to generate probabilistic simulations of mortality across Europe for time periods of interest. For the heat wave scenario (1–15 August 2003), the model was successfully able to anticipate the occurrence or non-occurrence of mortality rates exceeding the emergency threshold (75th percentile of the mortality distribution) for 89% of the 54 regions, given a probability decision threshold of 70%. For the cold spell scenario (1–15 January 2003), mortality events in 69% of the regions were correctly anticipated with a probability decision threshold of 70%. By using a more conservative decision threshold of 30%, this proportion increased to 87%. Overall, the model performed better for the heat wave scenario. By replacing observed temperature data in the model with forecast temperature, from state-of-the-art European forecasting systems, probabilistic mortality predictions could potentially be made several months ahead of imminent heat waves and cold spells.