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Real-time forecast of temperature-related excess mortality at small-area level: A conceptual framework

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Development of innovative tools for real-time monitoring and forecast of environmental health impacts is central to effective public health interventions and resource allocation strategies. Though a need for such generic tools has been previously echoed by public health planners and regional authorities responsible for issuing anticipatory alerts, a comprehensive, robust and scalable real-time operational framework for predicting temperature-related excess deaths at local scale has not been developed yet. Filling this gap, we propose a flexible conceptual framework for coupling publicly available operational weather forecasts with temperature-mortality risk functions specific to small census-based zones, the latter derived using state-of-the-art environmental epidemiological models. Utilising high-resolution temperature data forecast by a leading European meteorological centre, we demonstrate a real-time application to forecast the excess mortality during the July 2022 heatwave over England and Wales. The output by way of expected temperature-related excess deaths at small geographic areas on different lead times, can be automated to generate maps at various spatio-temporal scales, thus facilitating preventive action and allocation of public-health resources in advance. While the real-case example discussed here demonstrates an application for predicting (expected) heat-related excess deaths, the framework can also be adapted to other weather-related health risks and to different geographical areas, provided data on both meteorological exposure and the underlying health outcomes are available to calibrate the associated risk functions. The proposed framework addresses an urgent need for predicting the short-term environmental health burden on public health systems globally, especially in low- and middle-income regions, where rapid response to mitigate adverse exposures and impacts to extreme temperatures are often constrained by available resources.