EGU24-7744, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-7744
EGU General Assembly 2024

Storylines for heat-mortality extremes

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Recent heat extremes reached records far out of the observational temperature range. These extremes challenged the risk view of climate scientists on what could be physically possible within the current climate conditions. However, it is precisely such unprecedented events that pose a large risk to underprepared societies. To better anticipate and prepare for such potential extreme events, the climate risk community started producing storylines which are designed to draw potential and plausible worst-case scenarios without aiming to quantify their probability of occurrence.

The recent development of the ensemble boosting method allows investigating physically plausible extreme heatwaves by re-initializing a climate model with random round-off perturbed atmospheric initial conditions shortly before the onset of a great heat anomaly. This allows for creating storylines whilst ensuring physical consistency. However, so far these storylines were only used to estimate the pure physical climate extreme without the additional quantification of impacts on society.

In this study, we therefore aim to produce several storylines for potential worst-case heat-mortality scenarios. For that, we aim to combine ensemble boosted climate model output with methods from environmental epidemiology to quantify heat-mortality. Concretely, we model the empirical relationship between daily mean temperature and daily mortality counts by using quasi-Poisson regression time series analyses with distributed lag nonlinear models, which is a well-established approach in climate change epidemiology. We then combine these empirical temperature-mortality relationships with the bias-corrected extreme storylines that we developed by ensemble boosting a fully-coupled free-running climate model (CESM2).

The findings of this study have significant implications for societies, particularly in the context of public health policy development, to effectively respond to unprecedented but anticipatable heat extremes.