Concerns over projecting temperature-related deaths associated with injuries

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Parks et al[1] attempted to project the number of temperature-related deaths associated with injuries in the United States under the Paris Agreement climate goals. Parks et al reported that "a 1.5ºC anomalously warm year, as envisioned under the Paris Agreement, could be associated with an estimated 1,601 additional injury deaths", an increase that could inform adaptation and mitigation policies. However, we believe the analyses both misinterpret the Paris Agreement and have potential flaws in the epidemiological modelling that limit validity.

The Paris Agreement goals refer explicitly to "the increase in global average temperature … relative to pre-industrial levels", further clarified by the Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5ºC (SR1.5) as "an increase in multi-decade global mean surface temperature (GMST) above pre-industrial levels"[2], with pre-industrial defined as 1850-1900. However, the 1.5ºC and 2ºC values used in the main analysis of Parks et al were *local* temperature change relative to *1980-2017*. Local temperatures can be very different from global averaged temperatures; and the world had already warmed substantially by the 1980s. The increase in GMST between 1980-2017 and preindustrial times is ~0.7ºC [3], meaning that Parks et al. use a substantially warmer baseline period than that defined in the Paris Agreement.

In the USA, local temperature changes in a 1.5ºC future climate relative to 1980-2017 could vary between 0-2.5ºC depending on location and month (Figure 1). Extreme high temperatures are rising faster than mean temperatures in many land regions as the temperature distribution changes under global warming[4], so that simply considering a uniform 1.5ºC change at all locations, and in all months is inappropriate.

Further, the hypothesis of a causal relationship with temperature for some categories of injuries is unsupported. A range of environmental variables are likely to play a role, for example rainfall for transport accidents[5]. The temperature associations did not control for these variables or for changes in associations with additional climate change and adaptation.

Temperature and health relationships are often non-linear[6,7]. Assuming linearity would substantially bias the results. For instance, it can explain the different age patterns in the category 'falls', given the elderly can be more at risk during icy weather conditions for falls outside their residence (which were not differentiated from 'all falls').

The use of monthly averaged temperature and health data is of concern because exposure occurs on shorter timescales. The use of daily data would provide more power (there is very limited variability in exposure defined by monthly anomalies) and, more importantly, make the analysis less prone to ecological biases. The choice by Parks et al. was justified by computational limitation of the Bayesian model used, although two-stage designs and modelling tools are available that would increase confidence[9].

In summary, the authors interpretation of a future under the Paris Agreement climate goals is inaccurate, leading to the use of inappropriate climate data as input into the heat-injury assessment. We also identify several assumptions and approaches in the epidemiological analyses that bring into question their overall conclusions.

Reference

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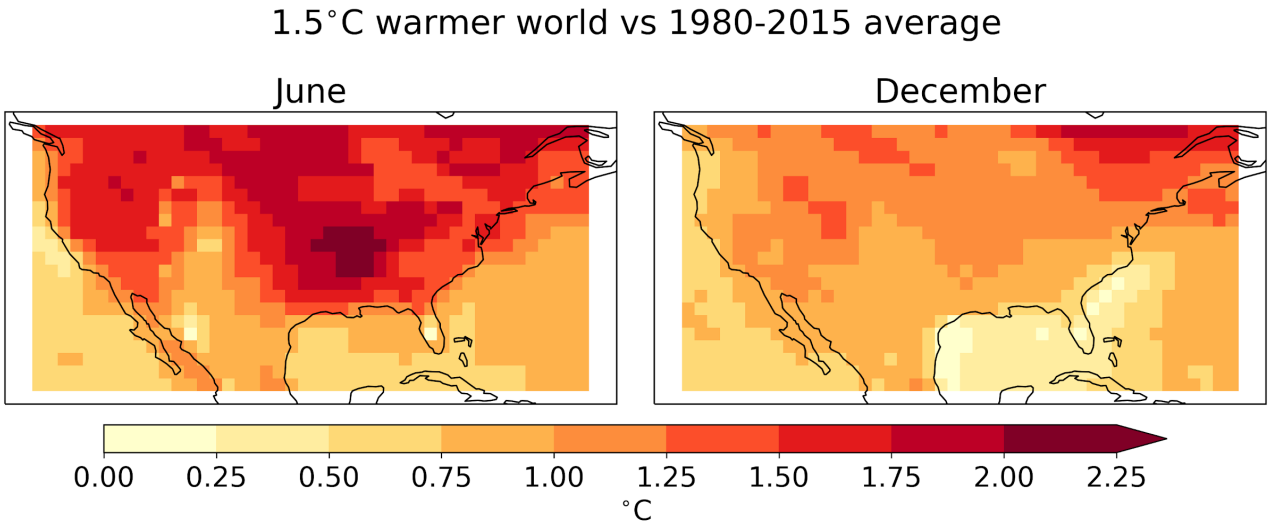

Figure 1: An example of monthly averaged temperature anomalies over the contiguous USA between 1980-2015 and a 1.5ºC world. Left panel is for June, and right is for December. Data is taken from the first 10 ensemble members of the MIROC5 model as part of the HAPPI project[9]. For data access see www.happimip.org.