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The exceedance of physiologically relevant thresholds in South Asia

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Since the pioneering work in the early 2000s, there has been interest in the climate science community in using the compounding effects of heat and humidity (in the form of wet-bulb temperatures or other meteorological indices such as heat index) to understand health risks due to thermal stress on humans. For instance it has been suggested that the combination of high heat and humidity was responsible for the high mortality observed during the 2015 heatwaves in South Asia. However, assessing health impacts of temperature and humidity is challenging in South Asia since the health data required for epidemiological work is rarely available or reliable for robust analyses.

Using quality-controlled surface observations, we show that the humidity (or equivalently, wet-bulb temperatures) was in fact lower during most high impact heatwaves in South Asia -- the daily maximum was very close to its monthly mean value whereas the daily minimum dropped to much lower values. We show that this is due to a deeper boundary layer which dilutes the near-surface water vapour concentrations. Therefore, our analysis suggests that one-dimensional indices such as wet-bulb temperature may not be accurate in predicting health risks across the wide variety of meteorological conditions that South Asia experiences.

Using recent experimental results that demonstrate that hazardous conditions can occur at lower humidity values, we show that thresholds derived from these experiments produce a more realistic spatial and temporal distribution of hazardous conditions in South Asia as compared to wet-bulb temperatures alone. Furthermore, we show that hazardous exposure during the day extends to times not usually considered hazardous in public health messaging. Our results suggest that physiological thresholds provide a complementary way to assess health risk due to heat along with epidemiological regression studies.