

INVESTIGATING HEATWAVE EFFECTS THROUGH MULTI-LEVEL MODELING: THE ROLES OF HEATWAVE VARIABILITY AND HEATWAVE CHARACTERISTICS

G. Brooke Anderson, *Yale University, USA*

Michelle L. Bell, *Yale University, USA*

Background and Aims: Research that jointly investigates effects of heat and heatwaves often models heatwaves using a binary distinction (a day either belongs to a heatwave or does not). However, this approach fails to distinguish among different heatwaves. Here, we investigate heterogeneity in the characteristics and health effects of different heatwaves.

Methods: We identify all heatwaves in 43 US communities, 1987--2005, (heatwaves are defined as ≥ 2 days at $\geq 95^{\text{th}}$ percentile of the community's May-September temperature). We use a Bayesian hierarchical model to quantify heatwave effects within each community. We explore heterogeneity between heatwaves both in heatwave characteristics (intensity, length, timing in summer) and in effects on human mortality.

Results: Heatwave intensities (measured as the average of mean daily temperature during the heatwave) ranged from $\sim 80^{\circ}\text{F}$ to 103°F (the most intense was in Phoenix, AZ, July 2003). Heatwaves ranged in length from 2 to 16 days (the longest heatwave was July 1998 in Dallas/Ft. Worth, Texas). Heatwaves also varied in their effects on human health: while many heatwaves had negligible added mortality effects (beyond effects explained by single days of heat), some heatwaves had substantial added effects. For example, the July 1995 heatwave was associated with a 134% increase in mortality beyond the effect expected for non-consecutive days of the same temperature.

Conclusions: Here we show substantial heterogeneity in heatwaves, both in heatwave characteristics and in their effects on human health. Our approach also helped identify unusual heatwave events (e.g., July 1995 in Chicago, IL; August 2003 in New York, NY) and generate new hypotheses based on these unusual events (in both cases, widespread power outages coincided with the heatwave).