Evaluating Mortality through Composite Mapping: A Seasonal Perspective

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Background

Much emphasis is appropriately placed on summer and heat-related mortality. Fewer studies focus on the winter season as mortality is confounded by other factors such as higher disease rates and an enhanced lag effect. Examining large scale atmospheric patterns, this study considers the impact of weather on short term increases in mortality. Research has indicated that changes in weather may lead to increases in mortality.

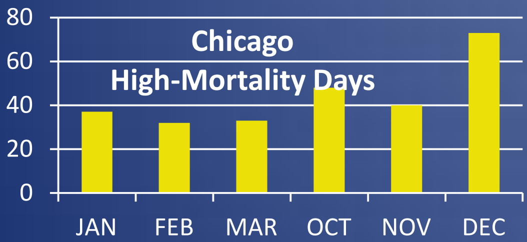

Figure 1. Total high-mortality days for Chicago (1975-2004).

Data

-Daily cardiovascular mortality (NCHS 1975-2004)
-Daily mean surface temperature and SLP (NNR)
-Spatial Domain: 65°W -100°W and 55°N -20°N
-Spatial Resolution: 5° by 5°
-Winter Season (October – March)

Methodology

High-mortality days were days in which mortality was at least 1.5 standard deviations above the seasonal winter mean. In this analysis, two atmospheric anomalies were calculated:

- Deseasonalized: Subtracted the 31-day centered moving average for each grid point for each day's raw value
- One-Day Anomaly: Subtracted yesterday's (Lag 1) raw value from today's (Lag 0)
- Composite maps of each anomaly (deseasonalized & one-day) were created using the Kriging interpolation tool in ArcMap.
- A one-sample difference of means t-test for testing the significance of whether each grid point composite (of spike days, or lag 1 from spike days, etc.) mean was significantly different from zero. We also used a two-sample difference of means t-test for testing whether each grid point composite mean was significantly different from the 'non-composited' (non spike days) mean. We completed this for both the deseasonalized and the 1-day anomalies.

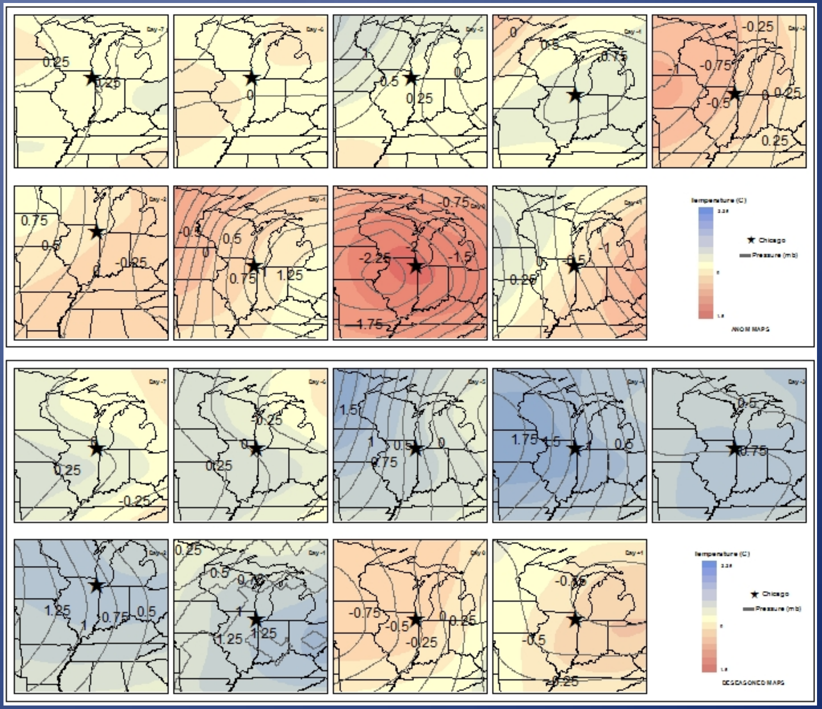

Figure 2. Anamolous (top) and deseasonalized (bottom) composite maps for temperature and pressure. Reading across, the days preceding a high-mortality day (e.g. Day -7) through Day +1 are shown.

Results

Consistently, this study shows short term increases in mortality are associated with sustained cold periods. Deseasonalized maps show a large dome of cold temperature over the study location in several days leading up to a high-mortality day. Significant relationships were most consistent for Chicago, thus the results are only displayed for this location. As shown by the anomalous patterns, a gradual warming in the days immediately before are also indicative of the environmental response. Additionally, in some capacity, pressure decreases often lead to increases in mortality although the amount of correlation between temperature and pressure remains unresolved.

Conclusions

While acknowledging that other confounding factors such as socioeconomic status, race, and the lagged physiological response to weather conditions plays an important role in human-health relationship, this study places the emphasis on the weather conditions that influence human health. Particularly, locations dominated by cold air for a sustained period of time often see increases in mortality following a warming trend. Although variable, this overall trend was found for Minneapolis, Pittsburgh, St. Louis, and Atlanta and Miami. These results are not shown.

Sources: National Center for Health Statistics, 1975-2004; NCEP/NCAR Reanalysis (NNR; Kalnay et al. 1996); Spatial Synoptic Classification (http://sheridan.geog.kent.edu/ssc/data)