A Dasymetric Method to Estimate Tornado Casualties Spatially

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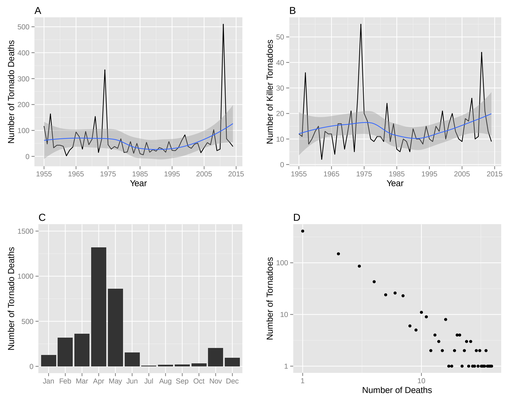
Why Did We Do This?

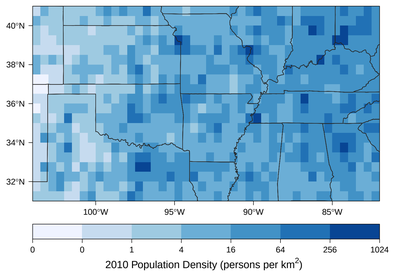
Ashley (2007) provides a spatial and temporal analysis of tornado fatalities using location information provided by Grazulis (1990) and *Storm Data*. The locations are by either the nearest town (if available) or the nearest county seat (when only the county where the fatality occurred is known). Using these data over the period 1950 to 2004 and grouping by 60 km cells they map tornado deaths across the United States, although locational accuracy may be variable, most notably of data collected before 1985, where the location of some fatalities is incorrectly coded in Storm Data.

In response, we suggest a technique that allocates the total number of casualties reported for each separate tornado in proportion to the underlying population geography that contains its path. The technique uses dasymetric mapping principles in that volumetric data (total casualties and total population) are spatially reapportioned across areal data (buffered tornado tracks and census zones) respectively. Dasymetric calculations for an individual tornado are then summed across all tornadoes to create maps that represent casualties.

What Do the Data Look Like?

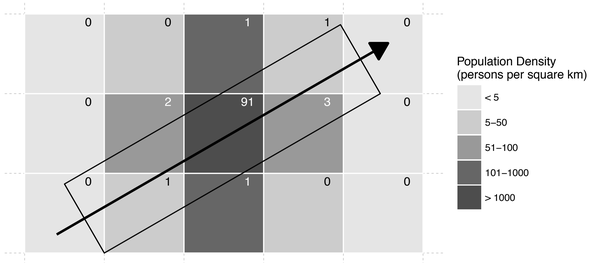


Where Do People Live?

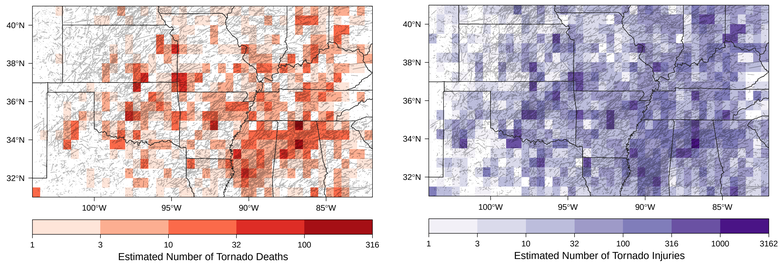


How Do We Do It?

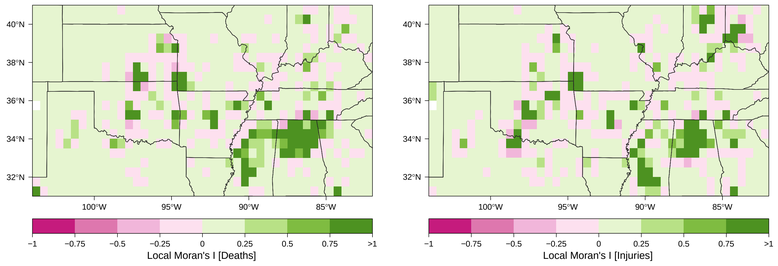
We apply a **dasymetric** method that spatially integrates tornado paths with the underlying population. Our central premise is that the likelihood of casualties increases the greater the population, therefore we assign to each grid cell within the tornado path a fraction of the total number of casualties associated with the tornado. This fraction is based on the area of the tornado path that falls within the cell and the cell's population density. The fractional number of casualties are summed over each tornado-casualty event affecting the cell over the study period to get an estimated number of casualties.



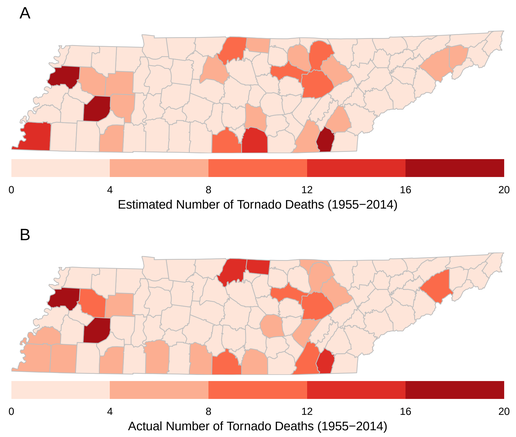
Maps of Tornado Casualties



Clusters of Higher Casualties



How Good is the Method?



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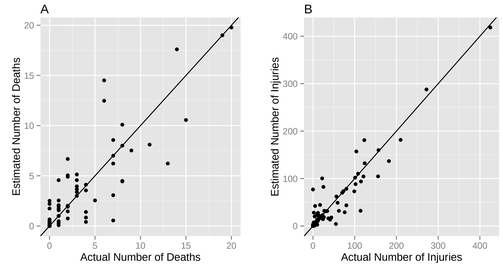

Conclusions

Casualty statistics are well documented at the level of individual tornadoes, but less is known at a more local level, especially along the tornado path. We outline a methodology that applies a dasymetric principle to link tornado paths with tornado-induced casualty data and disaggregated population to create maps of estimated numbers of casualties, both deaths and injuries. Results show a relatively uniform distribution of across a large area covering "Tornado Alley" with slightly higher rates in the mid South, particularly in northern Mississippi and Alabama, and in many metropolitan areas.

The method is validated using county-level casualty data (here shown as the state of Tennessee). Better maps can be achieved with better data. For instance, population density at the year the tornado occurred would likely improve the spatial depiction of casualties especially for tornadoes with paths across areas where population *gradients* have changed dramatically. Additionally not all tornadoes create a straight-line damage path. Greater detail on the path polygon would improve the results, especially if the method is applied to a grid with small cells.