Facilitate the understanding of extreme weather related hospitalization with a GIS tool

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Introduction

Extreme weather related health outcome (e.g. morbidity and mortality) has attracted a lot of attentions. The global climate change to some extent increase the frequency and intensity of extreme weather events (e.g. cold spell and heat wave), which seriously threat human health, even life, and elderly population is more vulnerable than other groups. In this way, the basis for accurate prediction is to understand the distribution of extreme weather related hospitalization and population demographics in each location. We take Boston Metropolitan Statistical Area as an example to explain how to apply GIS tool to facilitate our understanding of association between extreme weather related hospitalization and population conditions.

We have 16-year long (from year1991-2006) zip-code based hypothermia/heatstroke related hospitalization records from CMS, and demographic data for each zip code from US census. We mapped the population density, elderly population, hospitalization cases, and hospitalization rates based on zip code. Then we analyzed the hotspots of population, population density, hospitalization cases, and hospitalization rates, so that we can better understand the association among one and another.

Methodology

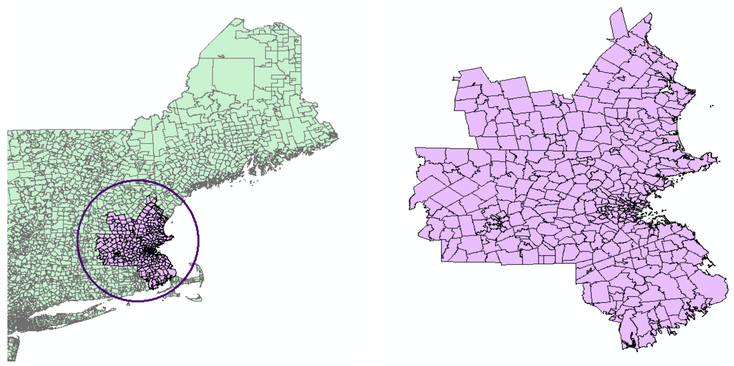
Our first task is to verify our research location: this is an issue which is both simple and complicated. It is simple, because we have a list of zip codes, and we can dig out those locations from a map. However, this issue is also complicated, because we are discussing 16-year long records, and the zip code has been changed several times, consequently, based on different census years, some zip codes disappear, change, or appear.

Step 1: We used the GIS online database to download a zip-code based basic map for the US, then we related our list of zip codes of Boston MSA to the original table to extract the Boston MSA from the whole map.

Step 2: We compared our "Boston MSA" with the MSA map given by US census to make sure we didn't miss or add more counties and areas.

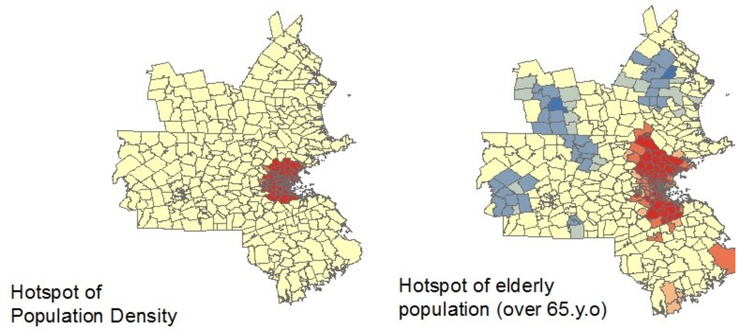
Step 3: We related our zip-code based, 16-year long hypothermia/heatstroke related hospitalization cases/rates to the basic maps. Then we built layers for the total population density, elderly (over 65.y.o) population, hospitalization cases, and hospitalization rates(for hypothermia

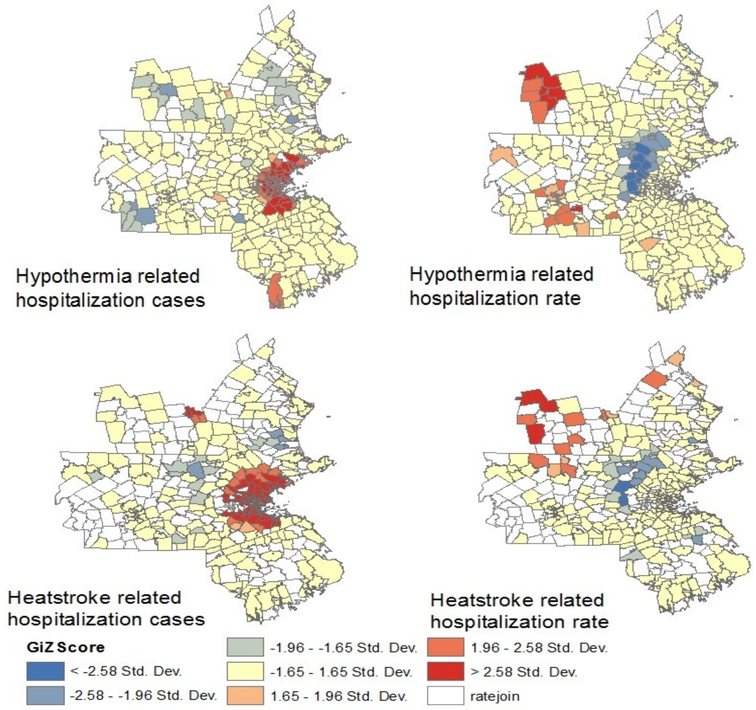
Extract Boston MSA from a US map based on zip code



Boston MSA is one of the most populated locations in the US. We started our analysis from our neighbors and attempt to build up our systematic method to analyze other populated MSAs in the US.

Hotspots analysis

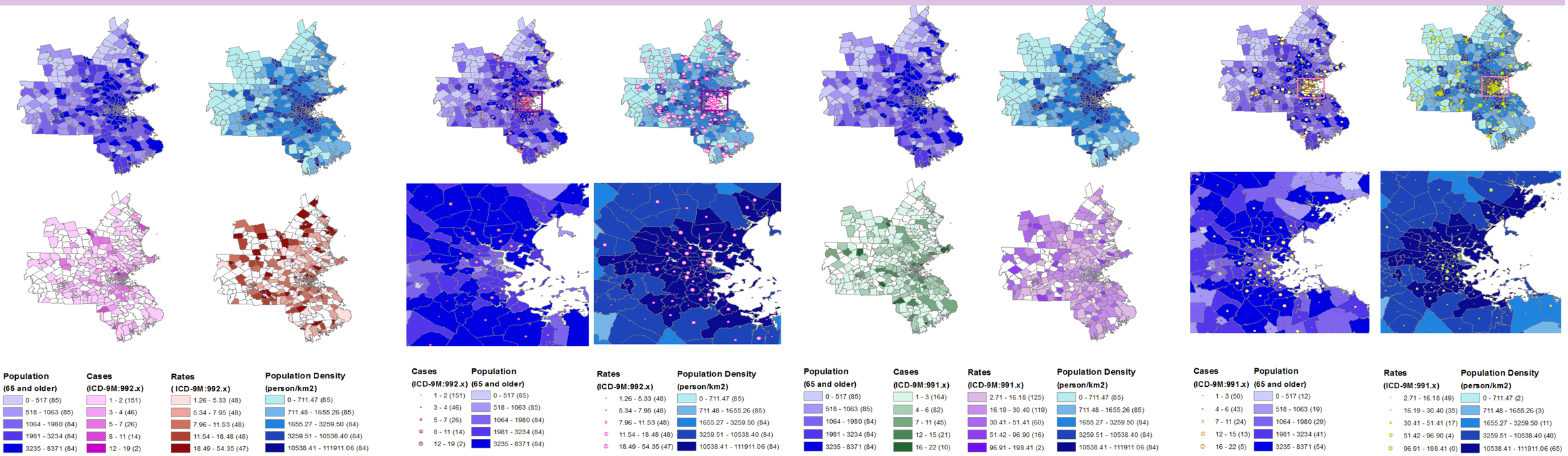




The hotspots analysis shows the most populated location (downtown) is also the location where the most hospitalization happened, which is reasonable. However, when normalized by elderly population, the hospitalization rate tells quite different stories from the hospitalization cases. This can be explained as that elderly people are unlikely to live in downtown.

Once we understand the spatial distribution of hospitalization, we can further continue sensitivity analysis by just focus on those hotspots locations and compare the results with the that generated from whole locations.

Mapping the population conditions and Hypothermia/Heatstroke related hospitalization cases/count



From those maps above, we found the distributions of events were highly skewed. Understanding the spatial distribution of population and hospitalization make a solid basis for us to analyze the application of meteorological data. What's more, also helps to point out potential heat/cold islands.