Intra-Urban Heat Vulnerability Assessment for Toronto: Lessons from a Community-University Partnership

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Abstract

This contribution reviews an ongoing project aimed at supporting Toronto Public Health with a neighbourhood-level assessment of heat vulnerability. Heat-related illness and mortality are increasing with the frequency of extreme hot weather due to climate change. This work started out as a consulting project but made its way into the scholarly GIScience literature as well as the Geography classroom. The paper reflects on the synergistic nature of research, teaching, and practice of GIS that was experienced in this partnership with municipal government and community stakeholders.

Background and Relevance

Global environmental change brings with it an increased frequency of extreme heat events (Easterling et al. 2000). Hot summer weather threatens human health, in particular in higher latitudes where people are not prepared for oppressive heat (e.g. Luber & McGeehin 2008). Pengelly et al. (2007) estimate that in both, Toronto and Montreal, 120 persons die prematurely on average each year from heat-related illness such as heat stroke. In the United States, heat/drought is the deadliest natural hazard (Borden & Cutter 2008). As a consequence of striking events such as the 1995 Chicago heat wave with 700 deaths (Semenza et al. 1996) and the 2003 European heat wave with nearly 40,000 deaths (Sardon 2007), researchers became interested in the population-level and place-based risk factors that made some people more susceptible to heat-related illness than others. Heat vulnerability assessments at intra-urban geographic levels include studies by Wilhelmi et al. (2008), Johnson & Wilson (2009), Wolf et al. (2009), and Loughnan et al (2010).

Methods and Data

In a six-month pilot project in 2008/09, recommendations for a Toronto-specific, geographically explicit heat vulnerability assessment were developed (full report at http://www.toronto.ca/health/hphe/air_quality/pdf/finalreport.pdf), some of which are summarized in Rinner et al. (2010). The article focuses on the role of maps to support the visual analysis of social, environmental, and health-related indicators of heat exposure and heat sensitivity in the population. Indicator selection was based on a literature review, and includes surface temperature, lack of green spaces, concentrations of renter households in older high-rise buildings, low-income seniors living alone, young children in low-income families, and lack of educational attainment to name a few. In the article (Rinner et al. 2010), we discuss a number of recommendations pertaining to the geographic level of detail, the use of cross-tabulated Census data rather than Census

profile variables, and the options for creating composite indices of heat vulnerability by urban neighbourhoods.

In contrast, in the present paper I am taking a step back to report on this consulting project as a personal learning experience in applied GIS research, and as an opportunity to enrich the undergraduate Geography curriculum at Ryerson University.

Results

This collaboration started with an invitation to bid on a formal request for proposals issued by the City of Toronto. The invitation was received because the RfP cited a previous publication of mine in the context of multi-criteria analysis of public health data (Rinner & Taranu 2006). Although Ryerson's Geography Department is well-known for its applied, career-relevant orientation, this consulting project was my first significant experience in this direction. With clear deadlines and deliverables that were critiqued in client meetings, and with our maps being subject to stakeholder feedback, I faced exam situations for the first time in years!

The staff at Toronto Public Health turned out to be experienced with, and interested in, academic publishing, which resulted in a collaborative effort on the above-mentioned article in a special issue of CaGIS on "New Directions in Hazards and Disaster Research" (Rinner et al. 2010). Another academic outcome of the pilot project is the participation of several members of the project team as international collaborators in a NASA project on developing a "System for Integrated Modeling of Metropolitan Extreme Heat Risk".

Closer to home, first-year Geographic Analysis students were given a series of GIS lab assignments that mimicked parts of the project and resulted in a mini-atlas of heat vulnerability. The assignments combined raster data handling (e.g. for surface temperature from thermal remote sensing imagery) with vector data from the Census, and required students to understand spatial patterns and clustering of environmental and socio-economic indicators. The labs also introduced the students to GIS use in the City of Toronto administration and to the City's open data initiative (http://www.toronto.ca/open/).

Conclusions

This paper tells the story of a successful partnership between University researchers and municipal government analysts and decision-makers. If anything, I want to encourage colleagues and graduate students to participate in knowledge exchange with their communities, and reap the benefits of such collaborations for their academic progress.

Phase II of the consulting project is ongoing under the title "Implementation of a Map-Based Heat Vulnerability Assessment and Decision Support System", and substantial results may be reported in the scholarly literature in the near future.

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