Climate Adaptation in the Great Lakes Region: Milwaukee Metadata

Warm Season Climate Change Vulnerability and Green Infrastructure in Milwaukee, WI

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Introduction

The GIS component of this project sought to address resource limitations that many municipalities in the Great Lakes basin face. Great Lake cities have limited resources for climate change adaptation. Effective planning and deployment of adaptive techniques requires an understanding of the locations within a particular city that are most vulnerable to climate change. By targeting resources in this way cities can "get the most bang for their buck". This end goal is the guiding framework for the GIS analyses carried out by the Climate Ready Great Lakes team. Two methods of climate change vulnerability mapping are described in this section. The first is "extreme heat and flooding" or "warm season climate change vulnerability". The second is extreme cold and winter weather infrastructure damage or "cold season climate change vulnerability. The methodology for both types of maps is similar. Final discussion will focus on how cities may customize the analysis by providing their own data and/overlaying the results with suggested layers. There is also room for improving methodology which is discussed in the methods section of the appendix. [for website, same as Evanston doc]

Summary

The warm season climate vulnerability map was piloted in Milwaukee. The analysis was approached with the intention of lessening the major public health impacts of climate change in cities which is urban heat island effect (Luber et al, 2008). Furthermore, the analysis draws on the framework of co-production of science between practitioners and university researchers. Given Milwaukee's deep concern with storm water management and combined sewerage overflows the analysis used data provided by MMSD to show where residents of Milwaukee were most vulnerable to flooding impacts. This sort of collaborative methodological design helps to downscale climate science into tangible pieces that policy makers can use to make decisions (Corburn, 2009).

Zones that are both highly vulnerable to urban heat island effect and residential flooding can be considered vulnerable to climate change writ large. In this analysis we over analyzed the placement of green infrastructure based on climate vulnerability. Milwaukee has done an adequate job of placing green infrastructure in areas that are vulnerable to urban heat island effect, but could improve placement in terms of residential flooding. This map can be used to guide future rounds of green infrastructure funding. The map and the methodology used in the analysis can be found in the Appendix.

Raw data used:

ASTER Global Emissivity Database, North America, Summer, 100 meter, HDF5 V003

1. Obtained from NASA Reverb website in HDF file format.

2. Shows average temperature of each 100 M pixel in summer months from 2000-2008.

US Census Data, obtained as polygons from SimplyMap database.

- Housing Stock---Percent of housing in census tract built in 1939 or earlier.
- Percent of block group in poverty.
- Percent of block group over 65 years old.
- Percent of block group under 5 years old.

Green Infrastructure Points (provided as a KML file from Milwaukee Metropolitan Sewerage District)

Basement flooding points (provided as a shapefile from MMSD)

Methods

1. Convert ASTER Emissivity data into a GeoTiff using R or Python (working program deposited in archive folder).
2. Convert Census polygons to raster datasets
3. Stretch census and aster to to a standardized 0-100 relative grid.
4. Using raster calculator combine emissivity data and census data to create urban heat island effect vulnerability raster.
    a. Total UHI Vulnerability on a scale of 0-100: (TemperatureRisk * .34) + (HousingPre1939 * .165) + (poverty * .165) + (over65 * .165) + (under5*.165)
5. Place a 100 M buffer around basement flooding points to signify residential flooding zone.
6. Overlay residential flooding zone with urban heat island effect vulnerability. Intersection of high urban heat island effect vulnerability and residential flooding zone signifies overall summer season climate change vulnerability.
7. Overlay green infrastructure points onto existing map. This allows an evaluation of current green infrastructure geography, and allows planning for more targeted green infrastructure building.
8. Use Landsat 8 images to highlight hotspots down to a 30 M scale from the current 100 M scale. This allows users to pinpoint exact source of high relative temperature.
    a. Note that Landsat 8 images will not provide an average, but a snapshot in time. Use accordingly.

Suggestions for improved methodology and analysis

- Include more sociological and geographic context data in Urban Heat Island effect such as:
    - Distance to freeways.
    - Distance to major smokestacks.
    - Percentage of census tract able to walk ¼ mile without assistance.
    - Localized crime rates
    - Neighborhood stability index.
    - Percentage of census tract with asthma.

   - Percentage of census tract living alone
   - Normalized Difference Vegetation Index, tree cover.
- Overlay gray infrastructure for analysis, especially new lateral builds in the case of Milwaukee.
- Create a gentrification index by census tract neighborhood and overlay with green infrastructure points. Utilize to analyze links between green infrastructure and gentrification.

Corburn, J. (2009). Cities, climate change and urban heat island mitigation: Localising global environmental science. *Urban studies*, *46*(2), 413-427.

Luber, G., & McGeehin, M. (2008). Climate change and extreme heat events.*American journal of preventive medicine*, *35*(5), 429-435.