

# GIS applications in research and governance: Urban Health Response and Interventions

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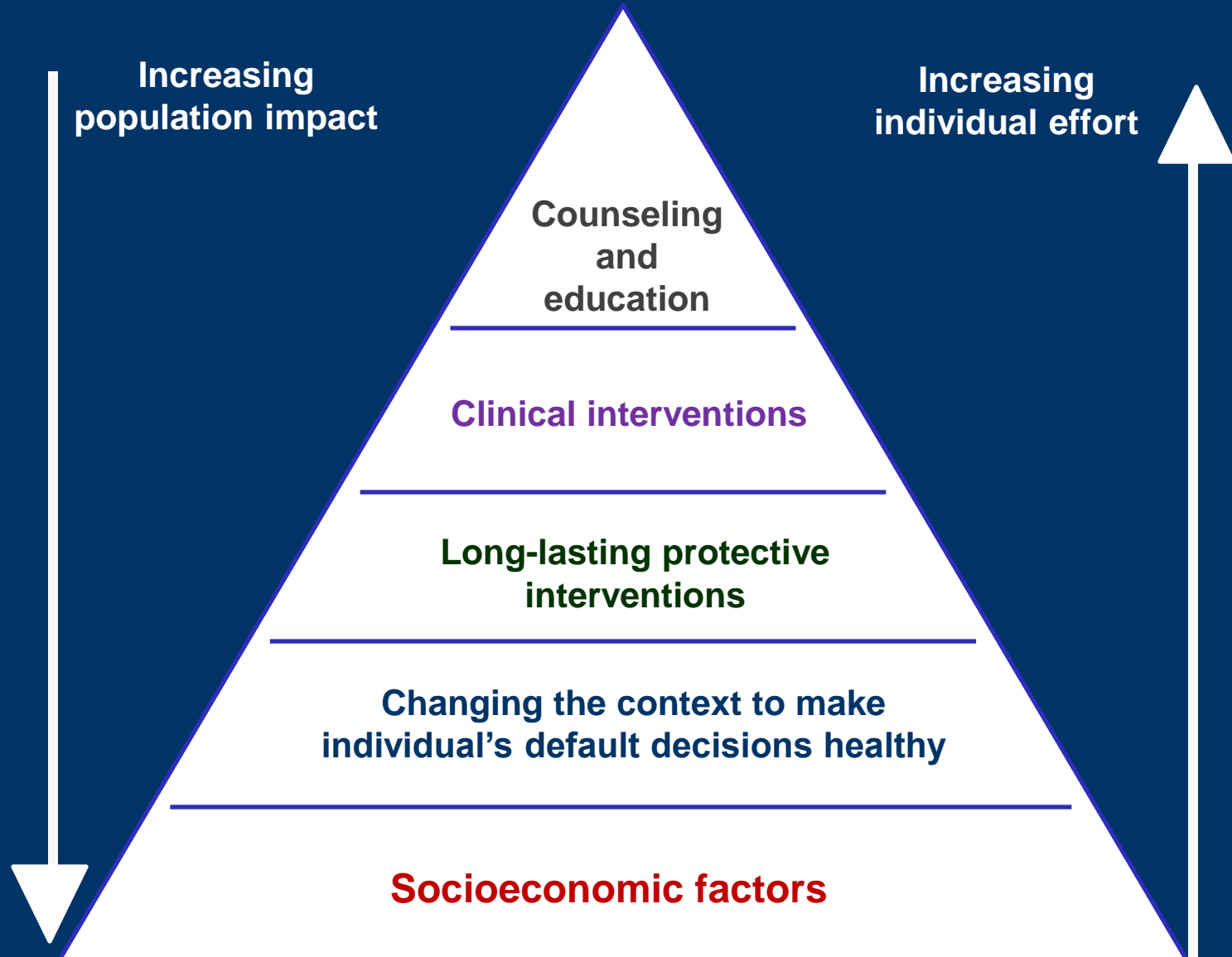
*IAI-NCAR colloquium*

*Quito, Ecuador*

# Climate Change and Health

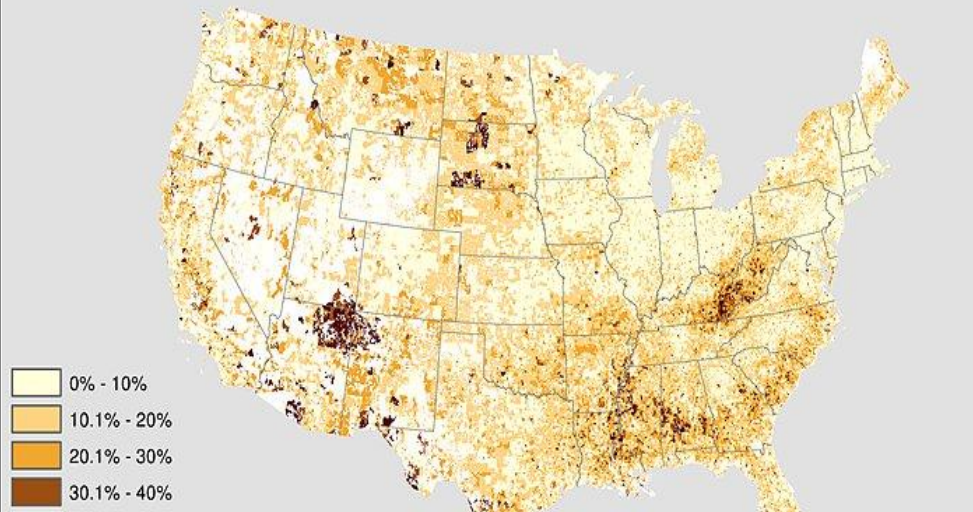
- ❖ The effects of climate change will vary considerably by region.
- ❖ They will vary by population group
- ❖ These effects are highly complex, and planning and action will need to be multidimensional.

# Public Health Interventions



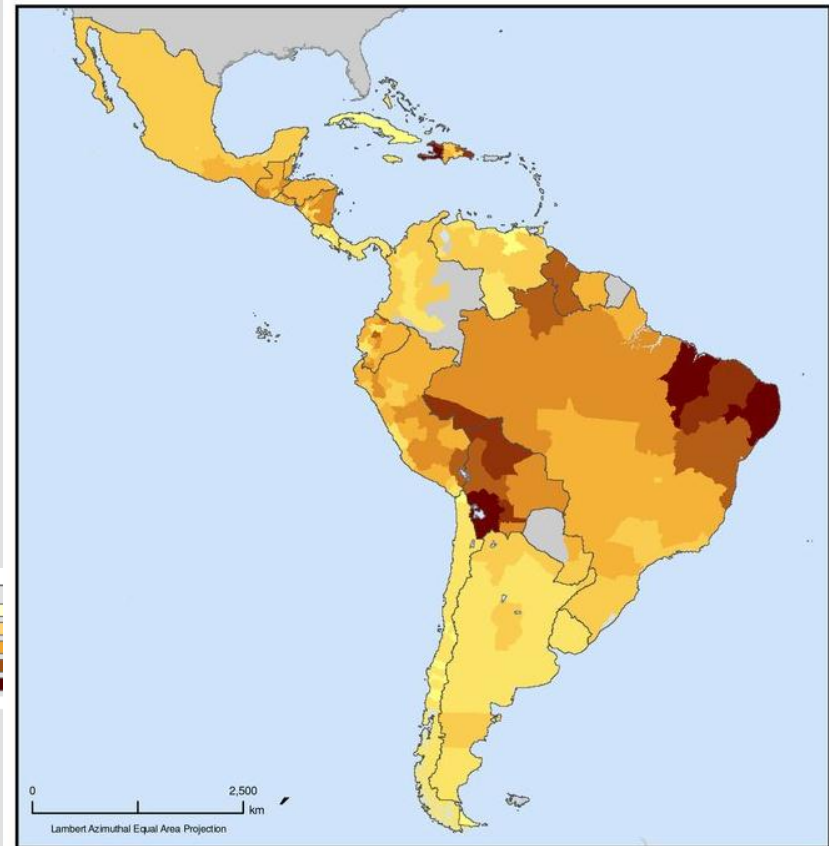
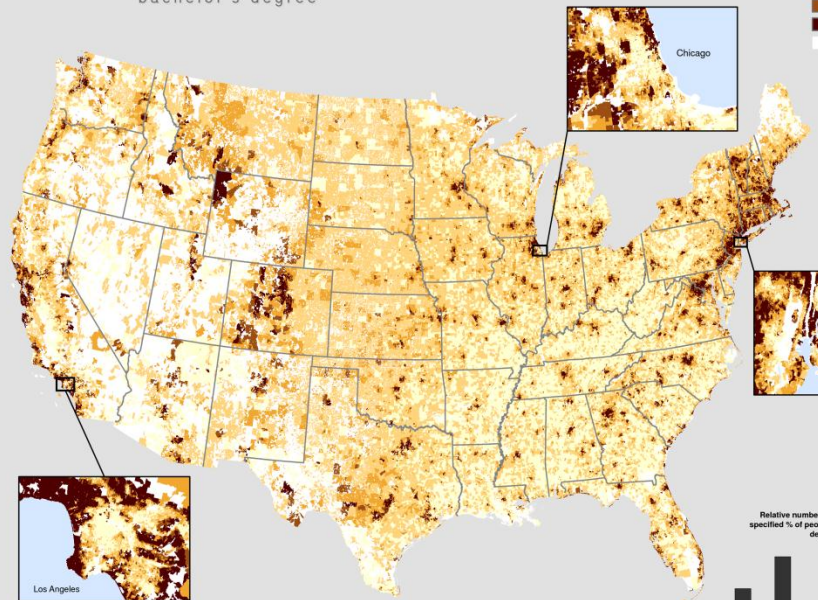
# Poverty

Percentage of people living below the poverty level



## Higher Education

Percentage of people, 25 or older, with a bachelor's degree



## Latin America

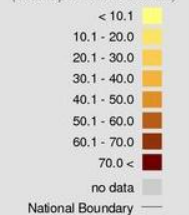
By Subnational Administrative Level

## Measures of Poverty

## Infant Mortality Rates [IMR]

Subnational mortality rates are adjusted to 2000 using national trend data. Original data for 96% of countries are from 1995 or later. All data are from 1990 or later.

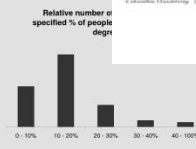
Infant mortality rate, 2000, (deaths per 1000 live births)



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Source: Center for International Earth Science Information Network (CIESIN),  
Columbia University. Global subnational infant mortality rates, maps and  
further documentation available at: <http://www.ciesin.columbia.edu/povmap>

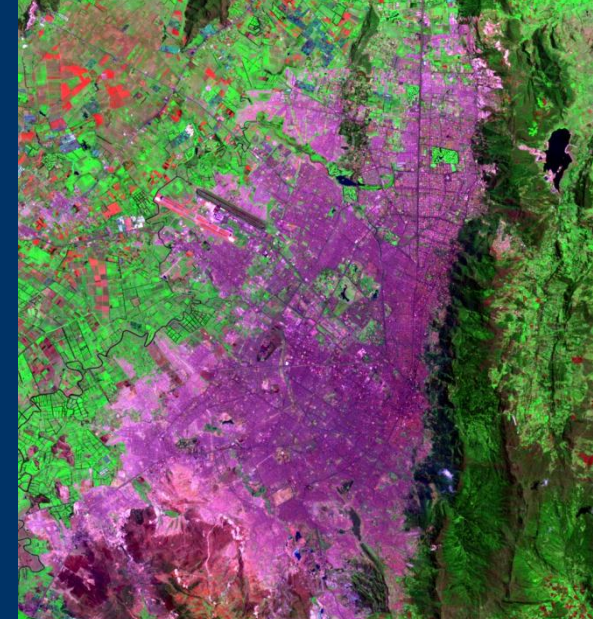
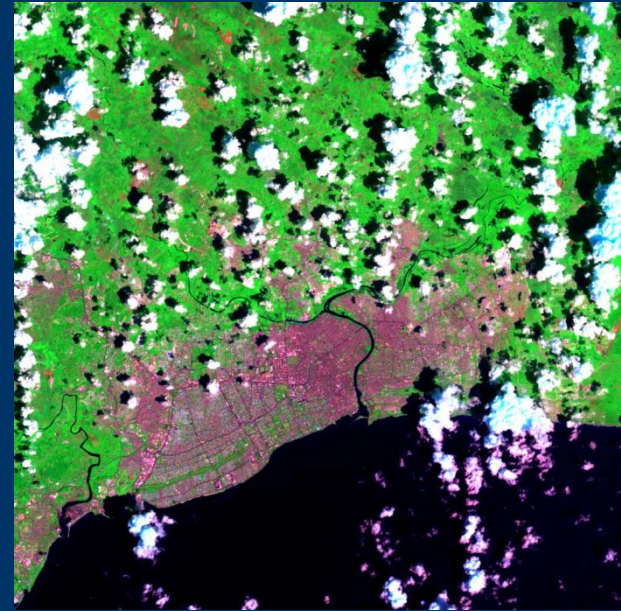
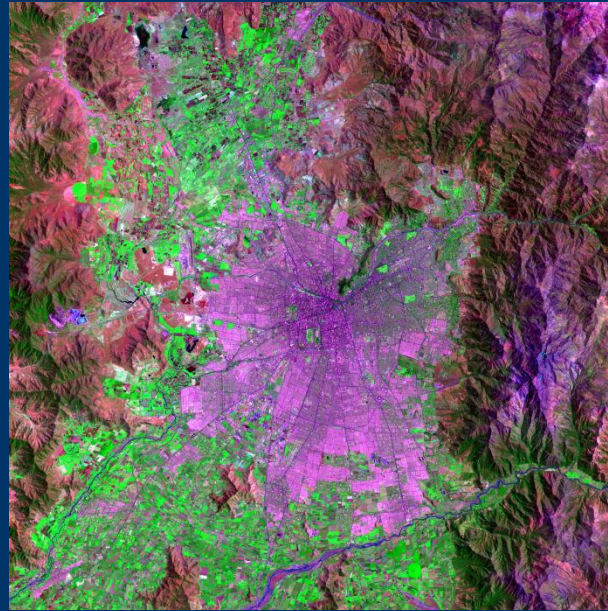
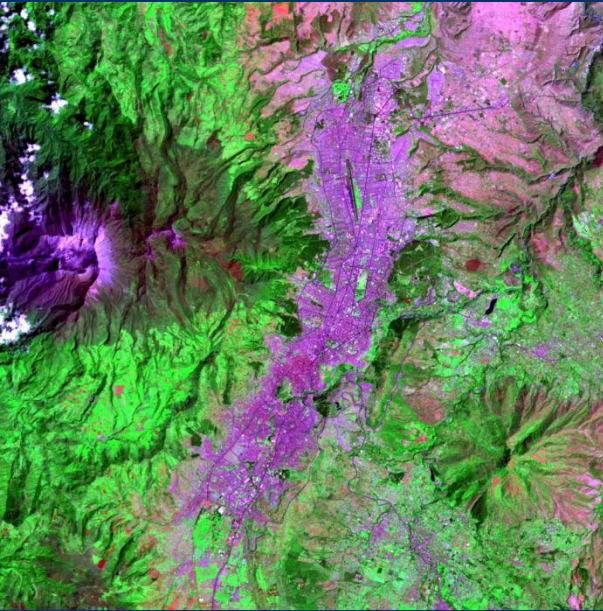


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# Mapping urban environments



Data source <http://sedac.ciesin.columbia.edu>



# URBAN EXTENTS



## Global Rural-Urban Mapping Project

- Urban Extent
- Administrative Units
- National Boundaries



Urban extents illustrate the shape and area of urbanized places. Urbanized localities are defined as places with 5,000 or more inhabitants that are delineated by stable night-time lights. For poorly lit areas, alternate sources are used to estimate the extent of cities.

Note: National boundaries are derived from the population grids and thus may appear coarse.



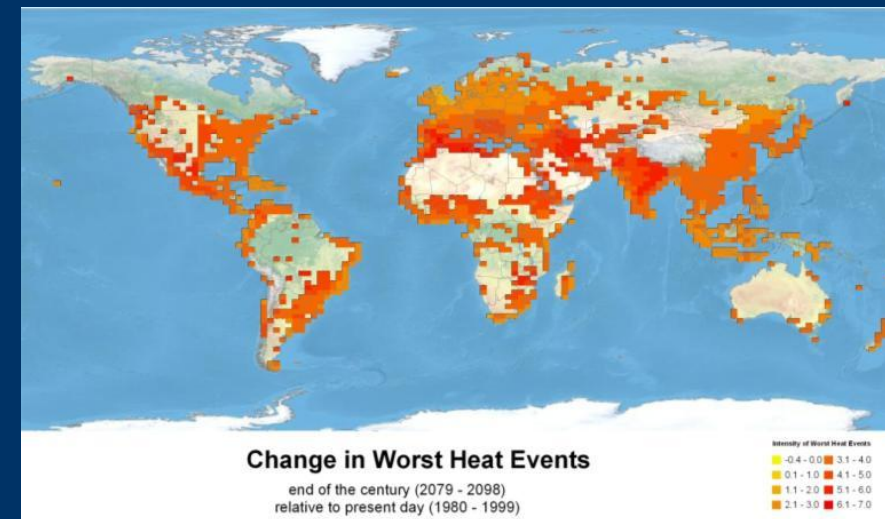
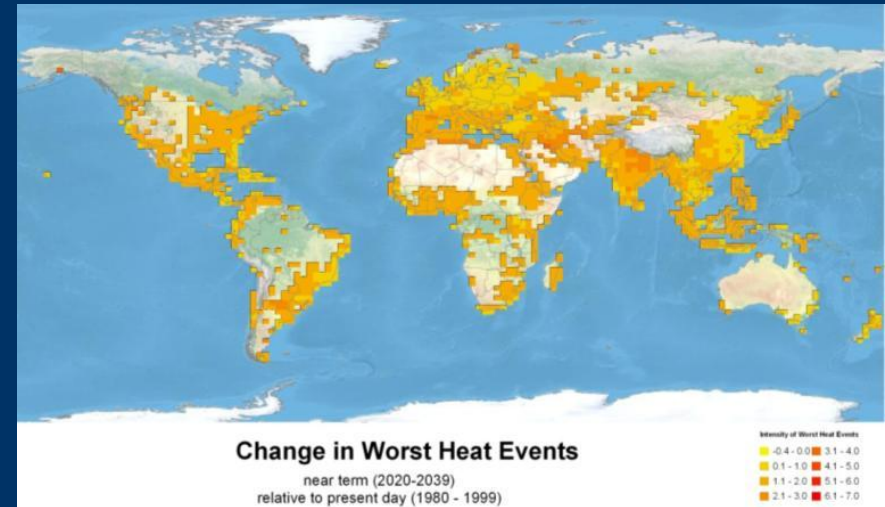
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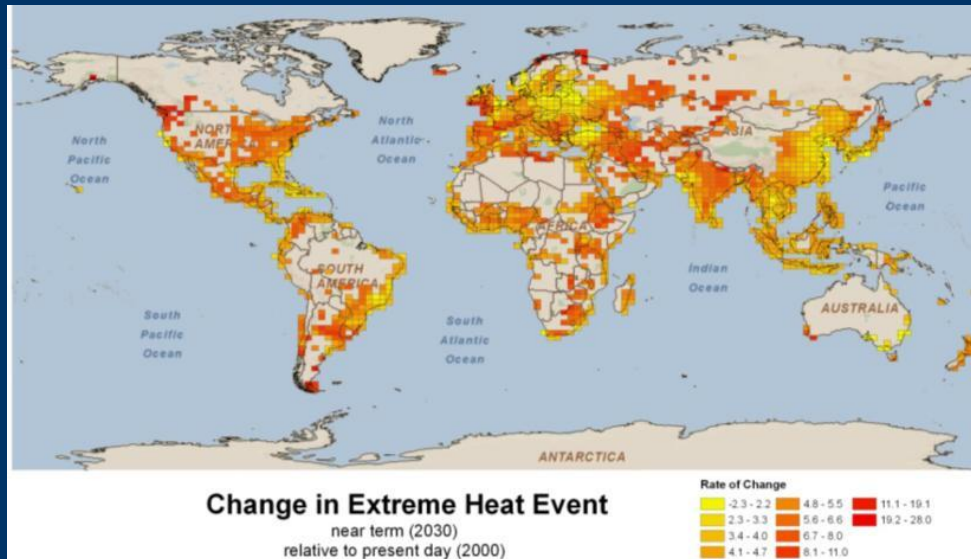
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# Change in intensity of extreme heat

- ❖ Community Land Model as part of Community Climate System Model (CCSM) provides climate and climate-change information for urban environments (Oleson et al. 2010)
- ❖ CLMU simulations of annual “worst heat events”
  - three consecutive warmest nights in a given year (Meehl and Tebaldi, 2004)
  - SRES A2 scenario
- ❖ Increased intensity in most urban areas by 2030 and by the end of century

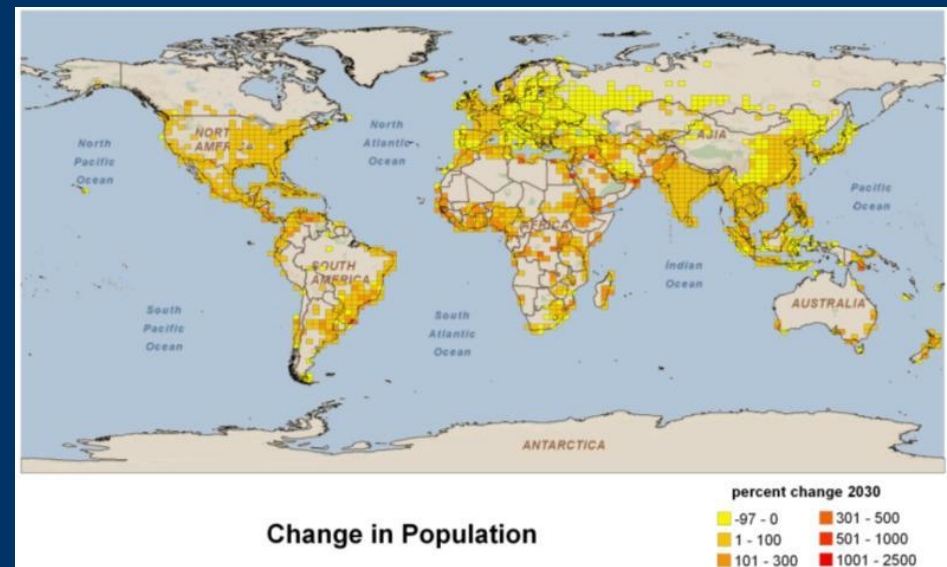


# Rate of change



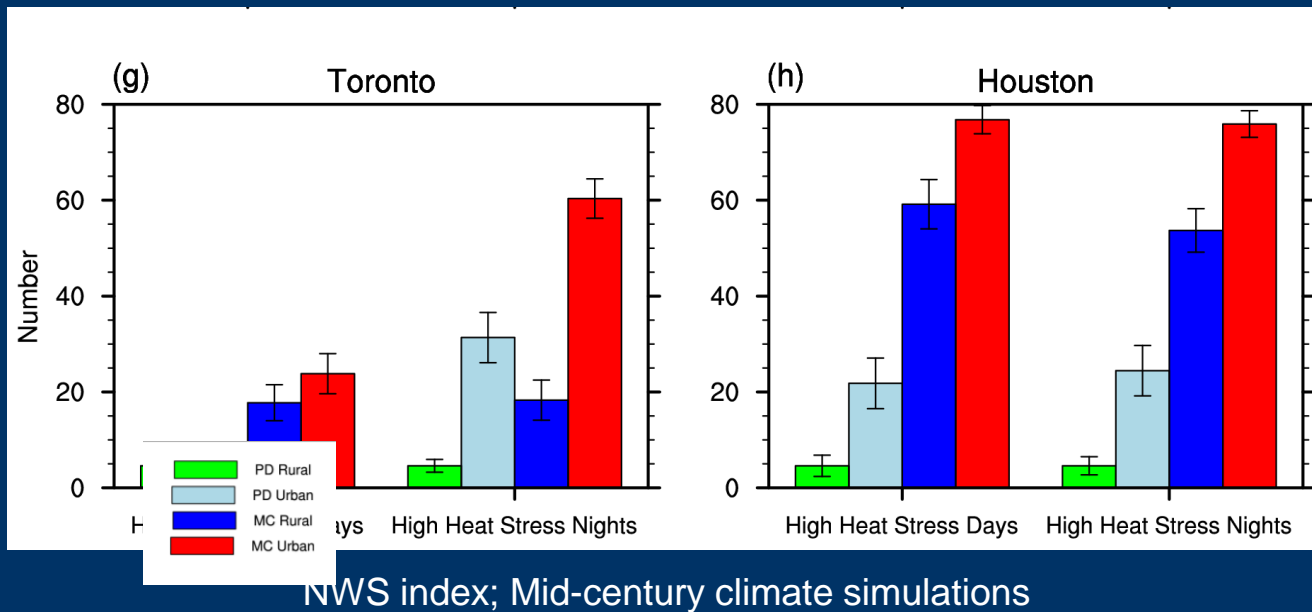
- ❖ Majority of cities with greatest rate of change are located in mid- and high latitude countries
- ❖ Majority of cities with greatest rate of change in urban population are in low-latitude countries

- ❖ Change in Intensity of extreme heat events and the rate of change can inform climate and heat adaptation strategies

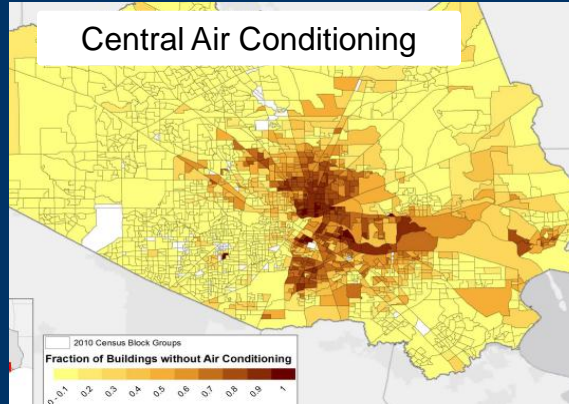
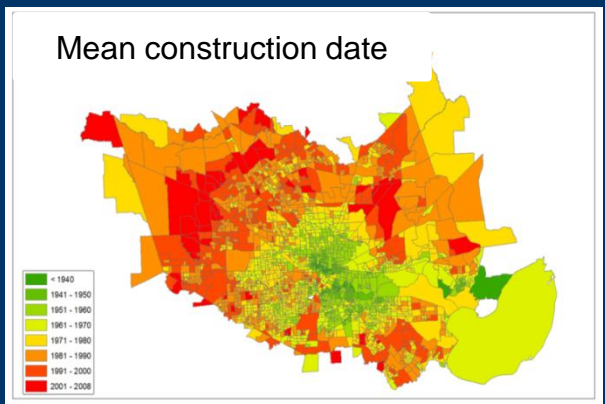
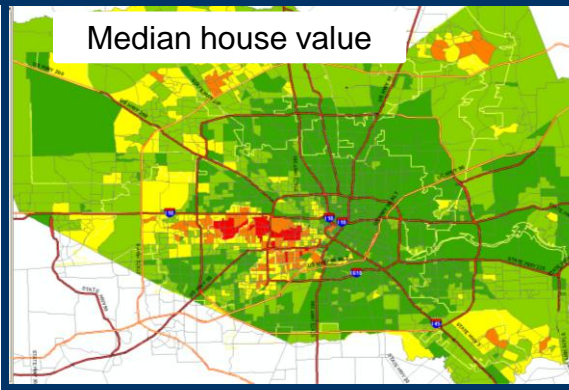
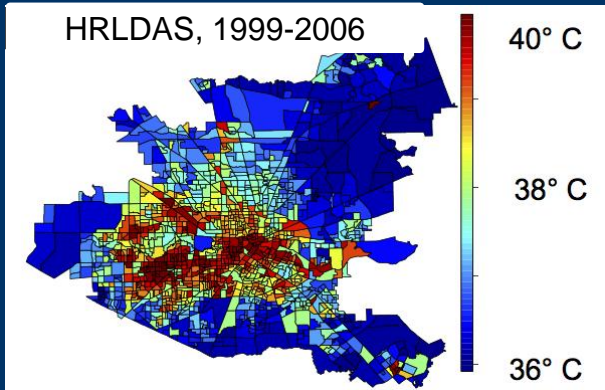
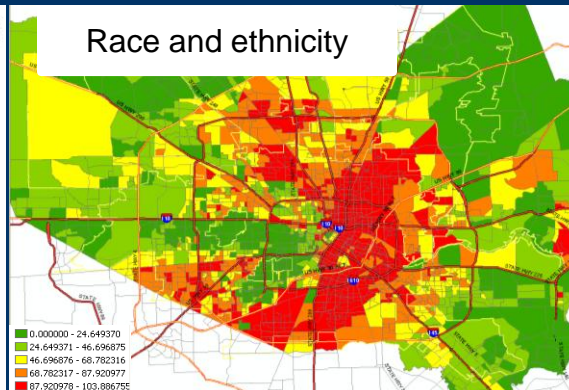
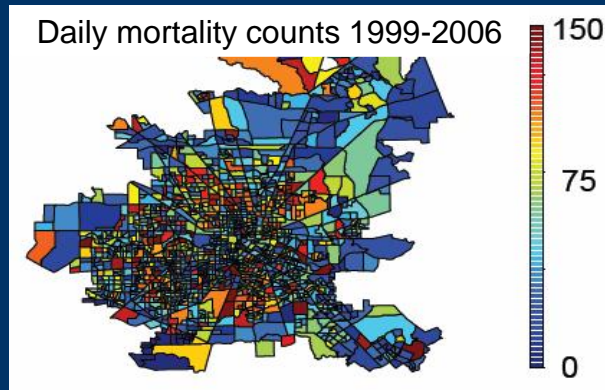




# Climate change and urban heat

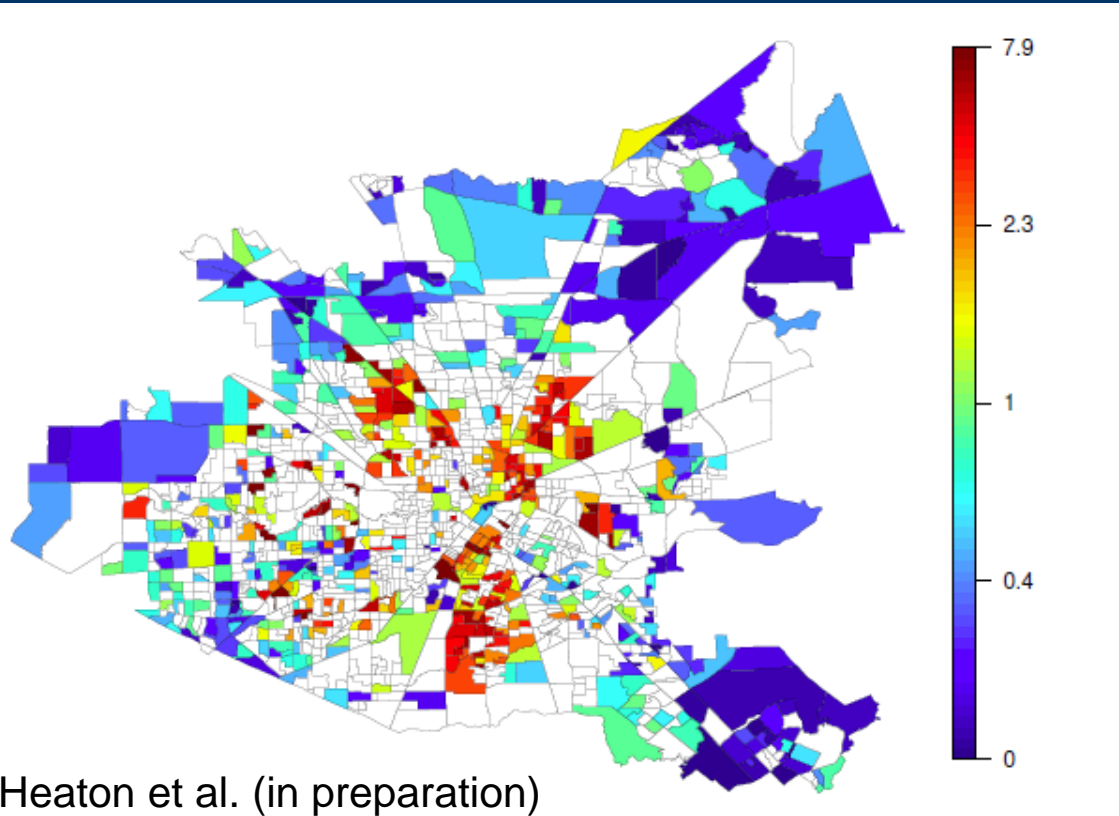


# Population exposure and sensitivity to heat



- ❖ Focus on Houston, TX
- ❖ Quantitative analysis of spatial and temporal patterns of vulnerability indicators
- ❖ Incorporate high-resolution numerical models, satellite data, parcel data, census data, survey data and health outcomes into a spatial statistical model for public-health end-points

# Integrating diverse data into empirical heat-health models



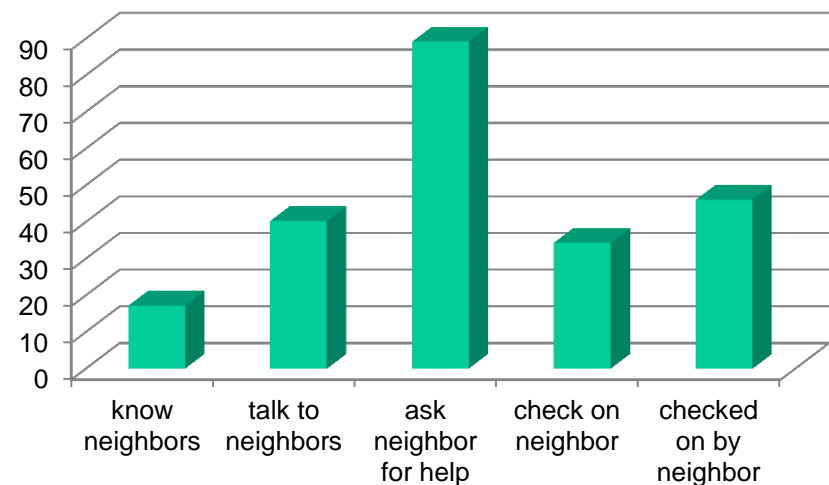
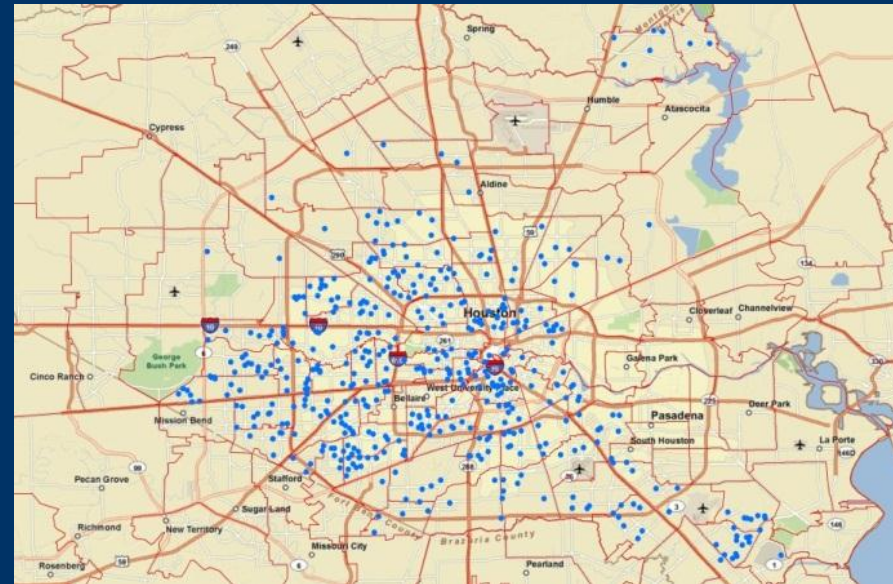
- ❖ **Multi-level statistical model**
- ❖ **Response variable: heat-related mortality**
- ❖ **Covariates: factors of exposure and sensitivity**
- ❖ **Which populations are associated with an elevated risk of heat-related mortality?**

- ❖ Strongest positive associations with heat-related mortality in Houston were in Census block groups with high percentage of elderly, living alone, African American, low income populations, residents without central air conditioning and people who commute using public transportation



# Adaptive capacity and adaptation

- ❖ 901 households in Houston (2011)
- ❖ In explaining risk of “feeling hot” in one's home access to resources was the most important factor, but the impact of knowledge and social networks was equal – an important consideration in developing public health interventions



# Scale

- ❖ **National and regional assessments provide big picture, but can mask communities living in marginal conditions**
- ❖ **Adaptation measures have to be adjusted for local ecology and appropriate level of decision making**
- ❖ **Local level assessments ensure more targeted short-term interventions and long-term planning**