Using NASA Earth Science Datasets for National Climate Assessment Indicators:

Urban Impacts of Heat Waves Associated with Climate Change

Objective: *Engage urban stakeholders in a process to develop a set of vulnerability indicators that are focused on heat waves in urban areas. Elucidate for urban governments the degree to which heat waves are changing, the real-life impacts of heat waves on urban populations, and the effectiveness of adaptation actions to reduce urban temperatures. Integrate physical, ecological, and socioeconomic information into a set of five related indicators that address vulnerability.*

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Process and Data

Identify and Engage Stakeholders
- *Urban health and planning departments*
- *City, county, state governments*

Refine Indicator Methodology

Calculate Indicators
- *Generate unique visualizations*
- *Vet results with stakeholders*

Assess National Scale-Up

To ensure policy relevance, we assembled an Advisory Group of local officials and experts who suggested key datasets and partners, and identified a need for local maps and data to guide planning and evaluation of adaptation efforts.

PHILADELPHIA STAKEHOLDER ORGANIZATIONS
Philadelphia Department of Public Health
Philadelphia Planning Department
City of Philadelphia, Office of Sustainability
University of Pennsylvania
Drexel University
The Franklin Institute
University of Pennsylvania School of Design

NASA SATELLITE DATASETS
Land Surface Temperature (LST) (8-day composite; 1 km)
Land Cover/Urban Extent (Annual; 500 m)
NDVI (16-day composite; 1 km)
SUPPLEMENTAL DATSAETS
NCDC Station Temperature
NWS Heat Products
ACS Socioeconomic Data
EPA Urban Heat Island Community Actions Database

Heat Wave Vulnerability Indicators

EXPOSURE	+	SENSITIVITY	=	VULNERABILITY	(	ADAPTIVE CAPACITY	)

EXPOSURE
- Physical exposure of urban populations to increasing heat waves associated with climate change

SENSITIVITY
- Higher likelihood of health impacts for a given heat exposure, for certain population subsets such as elderly or low-income
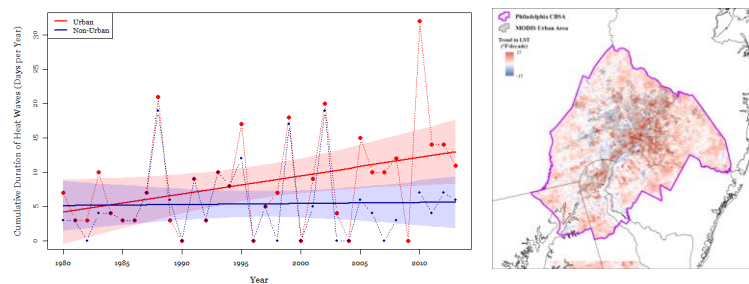
VULNERABILITY
- Overall susceptibility of urban populations to heat wave health impacts
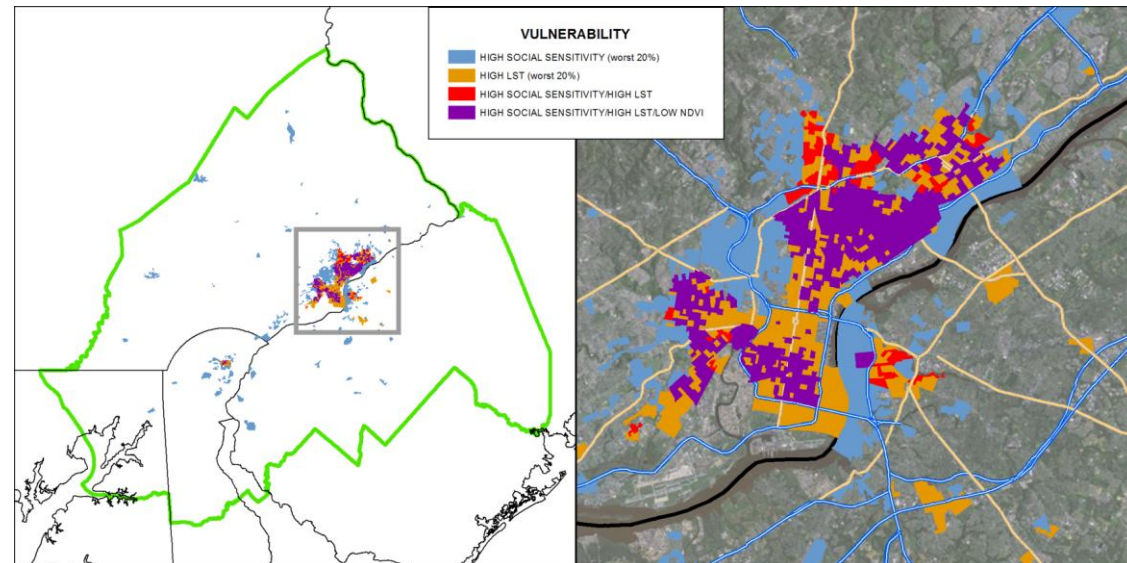
ADAPTIVE CAPACITY
- Ability to anticipate, cope with, or respond to climate stresses such as urban heat waves

- From 1980-2013, the number of "heat wave" days per year in Philadelphia increased from 4 to 12 in urban areas, and stayed relatively constant at 5 in non-urban areas.
- Approx. 10% of the population in the Philadelphia core based statistical area (CBSA) lives within the most vulnerable areas to heat wave health impacts, as mapped in red on the Vulnerability map, facilitating targeting of cooling adaptation measures.
- Isolated examples of adaption (urban cooling) measures were provided by local officials, but none are yet at the scale or concentration to be measured by decreased LST or increased NDVI at the scale of the satellite data used (1 km).

VULNERABILITY
- HIGH SOCIAL SENSITIVITY (worst 20%)
- HIGH LST (worst 20%)
- HIGH SOCIAL SENSITIVITY/HIGH LST
- HIGH SOCIAL SENSITIVITY/HIGH LST/LOW NDVI
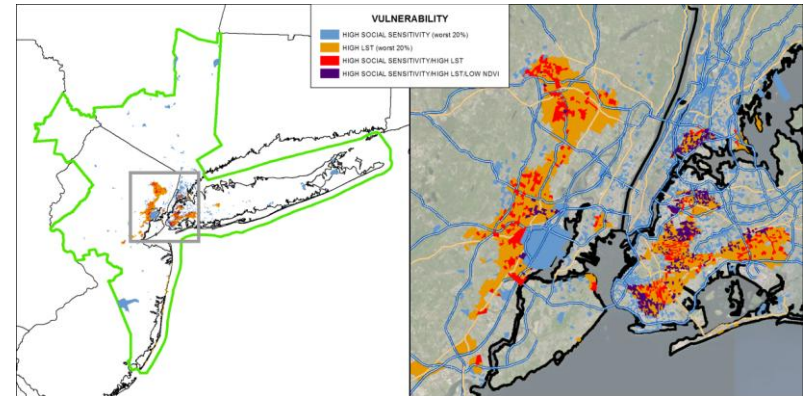
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Assessing National Scale-up and Future Work

- Can the same methodology be applied to other cities?
  - **Example: New York City**
  - Issues:
    - Large CBSA – different weather patterns
    - Effects of low-resolution data are more obvious with the complex geography (coastlines)

- Project Wrap-Up and Future Work
  - Coordinate teleconference with Advisory Group in Philadelphia to discuss the indicator results
  - Prepare journal article highlighting methodology, results and applications of heat vulnerability indicator in Philadelphia.
  - Determine sustainability plan for the set of indicators
    - Relies on MODIS LST and NDVI data – can other instruments (e.g. VIIRS) fill the gap after MODIS?
  - Explore the use of higher-resolution satellite products
  - Incorporate energy sector aspects of adaptation and mitigation