NASA NCA Team Meeting
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Using NASA Earth Science Datasets for National Climate Assessment Indicators: Urban Impacts of Heat Waves Associated with Climate Change

Natasha Sadoff and Stephanie Weber
Battelle Memorial Institute

Alex de Sherbinin
CIESIN, Columbia University

Battelle
The Business of Innovation

Center for International Earth Science Information Network
EARTH INSTITUTE | COLUMBIA UNIVERSITY

Proposed Indicators

- **Exposure indicators:**
  - *Urban Heat Wave Indicator:* To the extent possible, quantify the intensity and total duration of heat waves in metropolitan region (i.e. periods of 3+ days) within a given year
  - *Urban Heat Island Indicator:* Quantify the temperature difference between the urban and rural areas during periods of extreme heat
  - *Air Quality Indicator:* Examine the impacts of heat events on the air quality, as a proxy for health impacts (not directly related to the heat)
- **Sensitivity indicator:**
  - *Urban Socioeconomic and Hotspot Indicator:* Determine where populations are most vulnerable to extreme heat events
- **Adaptive capacity indicator:**
  - *Urban Adaptation Effectiveness Indicator:* Quantify how adaptation/improvement plans are affecting local UHI

Tasks

- Task 1. Identify and Engage Stakeholders 
- Task 2. Refine Indicator Methodology 
- Task 3. Calculate Indicators 
- Task 4. Visualize the Indicators and Vet Results 
- Task 5. Finalize the Indicators and Assess National Scale-Up

TASKS 1 & 2:

Identify and Engage Stakeholders and Refine Indicator Methodology

Task 1: Advisory Group of Stakeholders

Meeting on January 30 in Philadelphia, PA

- Participating organizations:
  - University of Pennsylvania
  - Franklin Institute
  - PA Dept. of Public Health
  - PECO
  - Philadelphia City Planning
  - Azavea
  - Others
- Presentation of the indicators, proposed methodology, Philadelphia-specific considerations, and communication and dissemination strategies

Task 1: Stakeholder Input

- There is an interest in **spatially disaggregated indicators** that can identify status and trends in localities
- There is an interest to use the spatial indicators to evaluate whether Philadelphia's efforts at tree planting and "cool roofs" are resulting in lower surface temperatures
- There is interest in using the spatial indicators in a mapping tool for **public communication** at the Franklin Institute; one participant suggested 3D mapping and fly-throughs of the heat island
- Heat impacts on health associated with poor air quality are major concerns in Philadelphia
  - **Health impact mapping** may be more difficult because data are restricted owing to confidentiality concerns

Task 2: Refining the Indicators

Based on Stakeholder Feedback

- Make indicators more policy relevant and locally significant → map trends to adaptation programs in the area
- Define vulnerability → review the literature to refine the definition of and methodology for calculating vulnerability
- Make the indicators turn-key and user-friendly → review options for mapping and visualizing

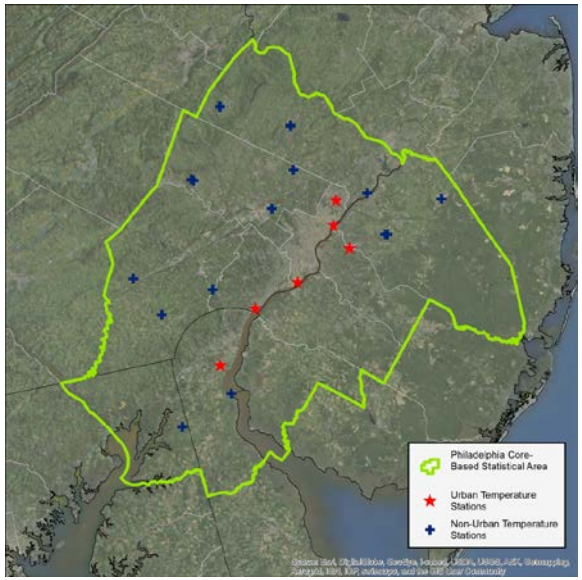
TASKS 3 & 4:

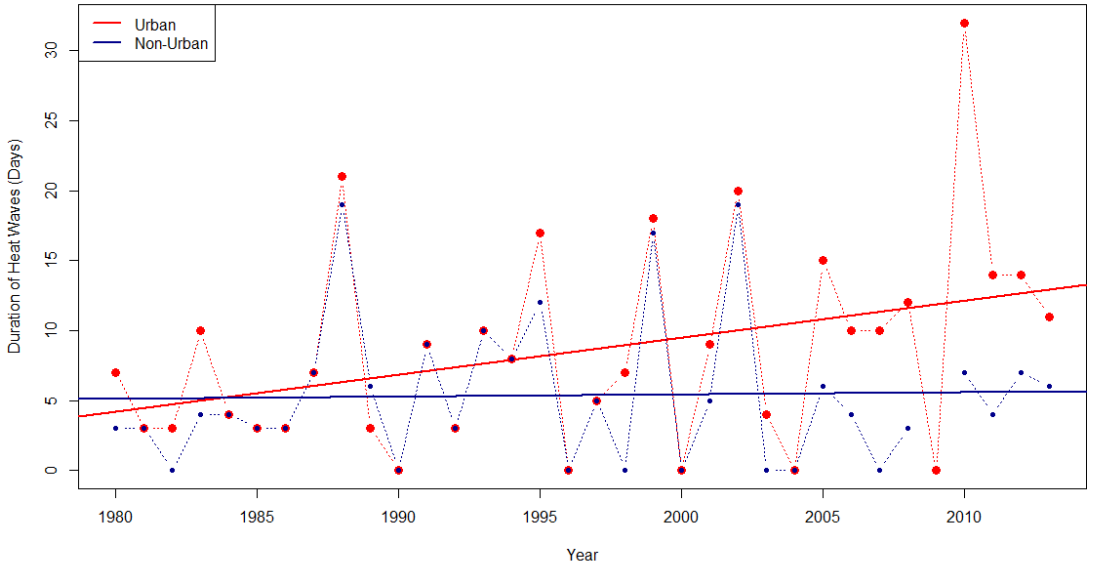
Calculate and Visualize Indicators

Urban Heat Wave Indicator

Duration of Heat Waves

- Heat wave is defined as 3 or more consecutive days where the average ambient temperature is above the 85th percentile threshold
- Cumulative sum of days per year classified as being part of a heat wave

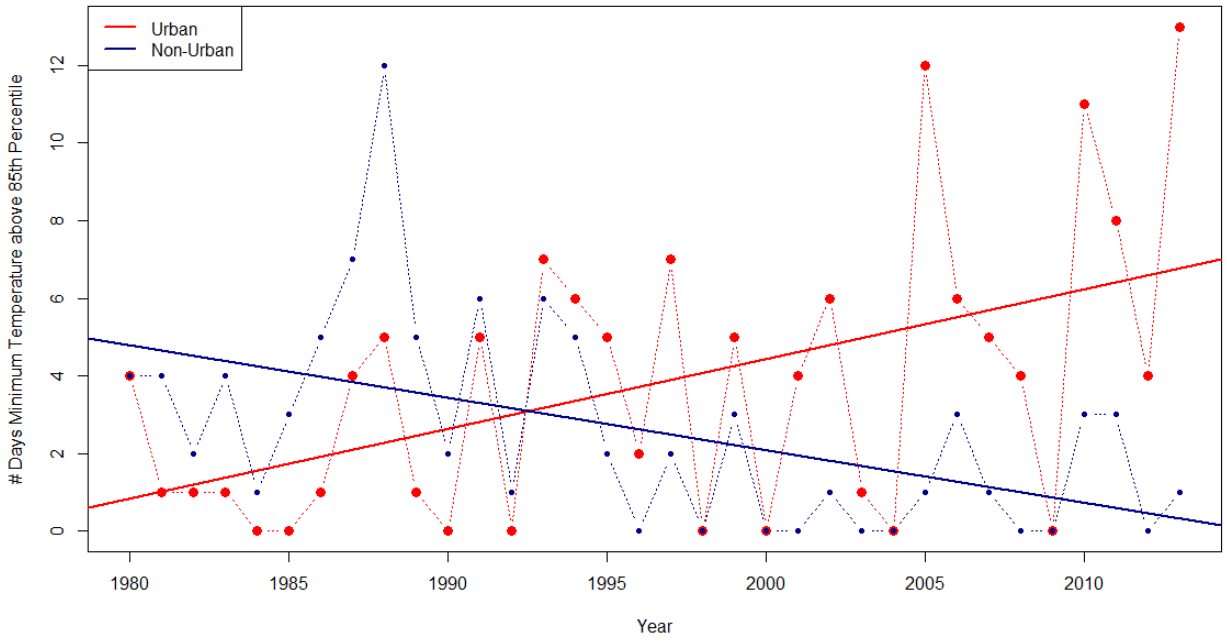




Urban Heat Wave Indicator

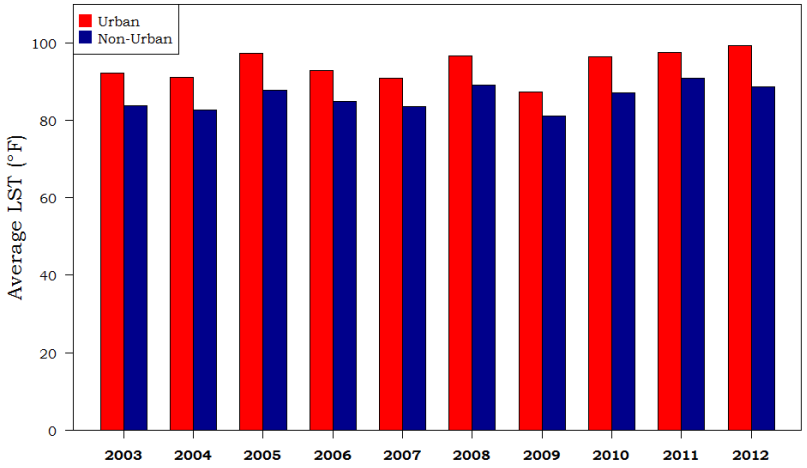
Minimum Temperature Threshold

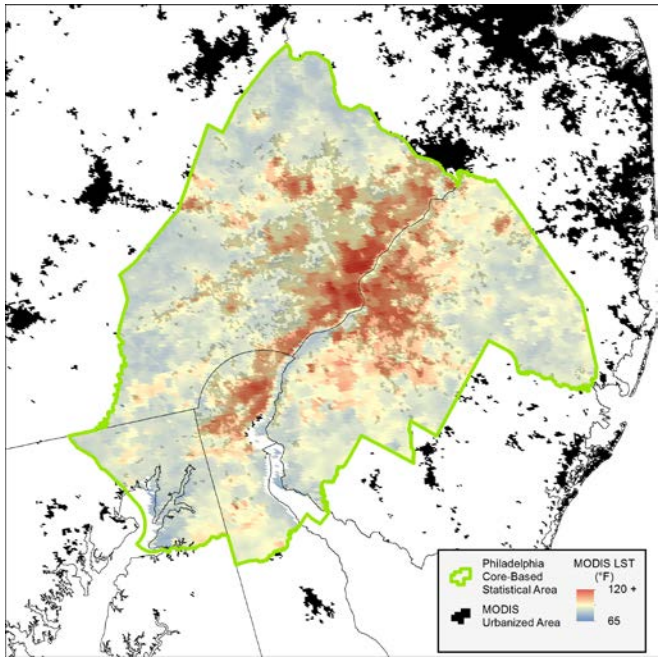
- Number of days per year where the average minimum ambient temperature is greater than the 85th percentile threshold for minimum temperature



Urban Heat Island Indicator

- Calculate the average LST difference between urban and non-urban areas (unit: °F)
- *Possible additional indicator:*
  - Estimate the area and/or population affected by the UHI
    - Calculate how much of the urban area has temperatures that are in excess of the average non-urban temperatures (unit: mi^2). How many people are affected by the increased temperatures?



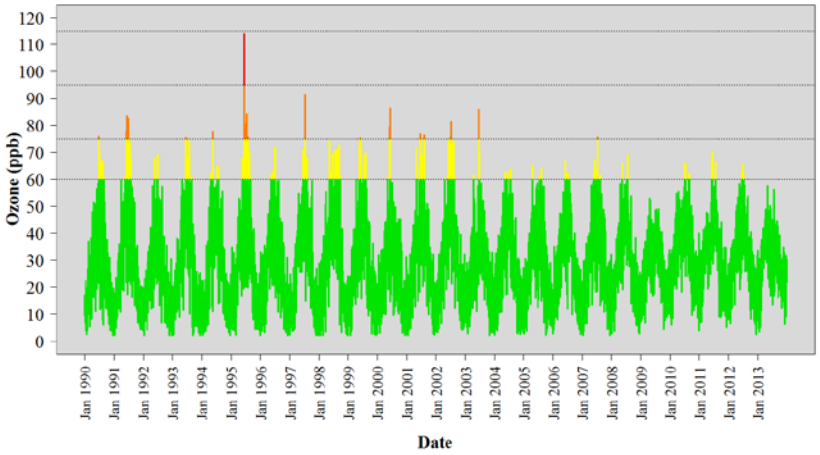


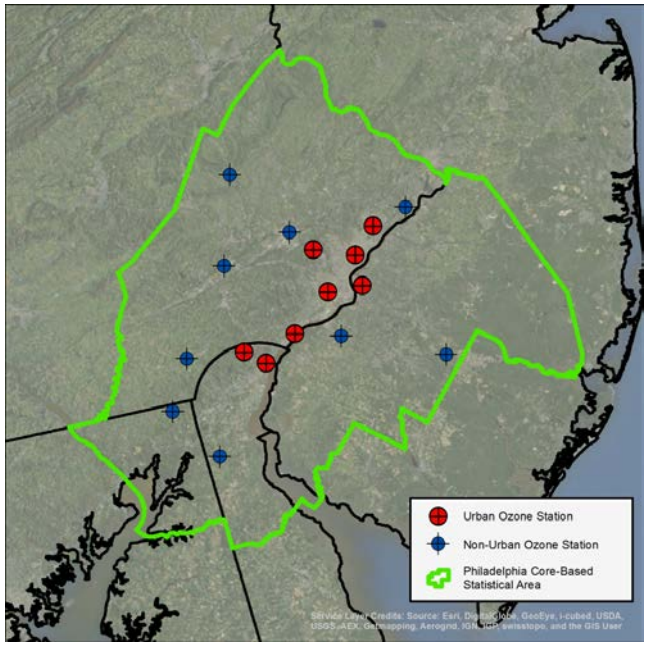
Notes: Results presented are for July 20 – 27
Map shown is 2011

Air Quality Indicator

Methodology

- During heat events, calculate the average daily maximum 8-hr ozone concentration for stations within the metro area. How does it compare to times not during heat events?
- Could also be looked at in terms of AQI
  - # of days of orange/red AQIs





Urban Socioeconomic and Hotspot Indicator

Methodology

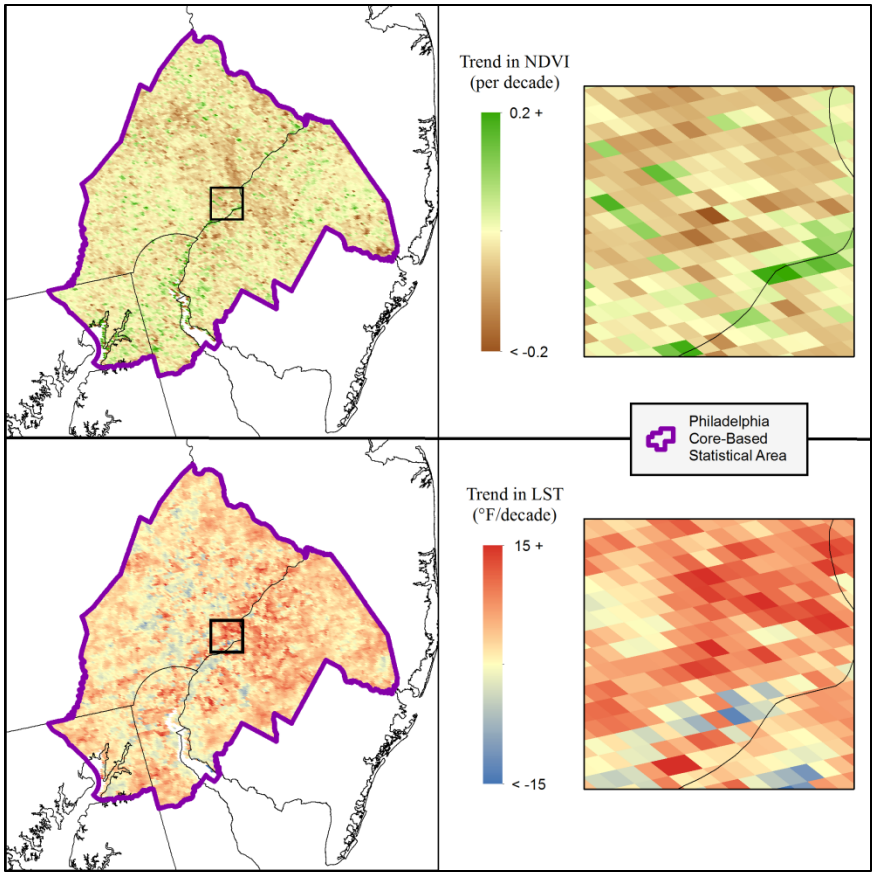
- Develop an indicator that combines the socioeconomic factors with NDVI observations to estimate how 'vulnerable' a census block group population is to extreme heat.
  - e.g.:
    - Median Income / Poverty Level
    - Education *(% HS/College Graduate)*
    - Age *(% young children, % elderly)*
  - Review existing studies to determine best algorithm for calculating vulnerability index in urban areas.
- How does the distribution of vulnerability relate to areas often affected by UHI?

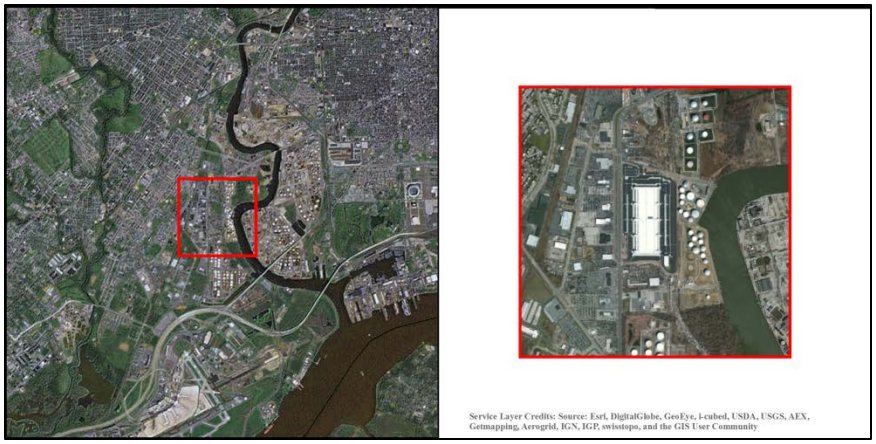
Urban Adaptation Effectiveness Indicator

Methodology

- Calculate local trends in NDVI and LST with respect to time
- Work with advisory group to identify completed, ongoing and proposed programs/plans/policies that could potentially affect impacts due to extreme heat
  - *E.g. Greening, storm water management, social improvements, etc.*
- Compare NDVI and LST with periods prior to program implementation
    - Have efforts increased greenness?
    - Quantify the changes in LST

Urban Adaptation Effectiveness Indicator Data





Urban Adaptation Effectiveness Indicator

Implications

- Provides a quantitative measure of the positive effects of programs implemented.
- Allows for the creation of metrics and visuals that city organizations can use to present to management and decision-makers
- Can be used to extrapolate estimated effects of program expansion or reduction
- Also allows decision-makers to see effects of development and increases in impervious surfaces

NEXT STEPS

Next Steps

- Finalize calculations and visualizations of indicators for the Philadelphia region
- Quarterly calls with the AG to ensure that the indicators are relevant to Philadelphia and other urban areas more broadly throughout the revision and calculation process
- Apply methodology to second pilot city
- Assess national scale-up and NCA relevance
- Identify areas for study expansion and future work