# Heat, Public Health & Climate Change

Mariana B. Alfonso Fragomeni, MEPD, Ph.D

Assistant Professor
Plant Science and Landscape Architecture

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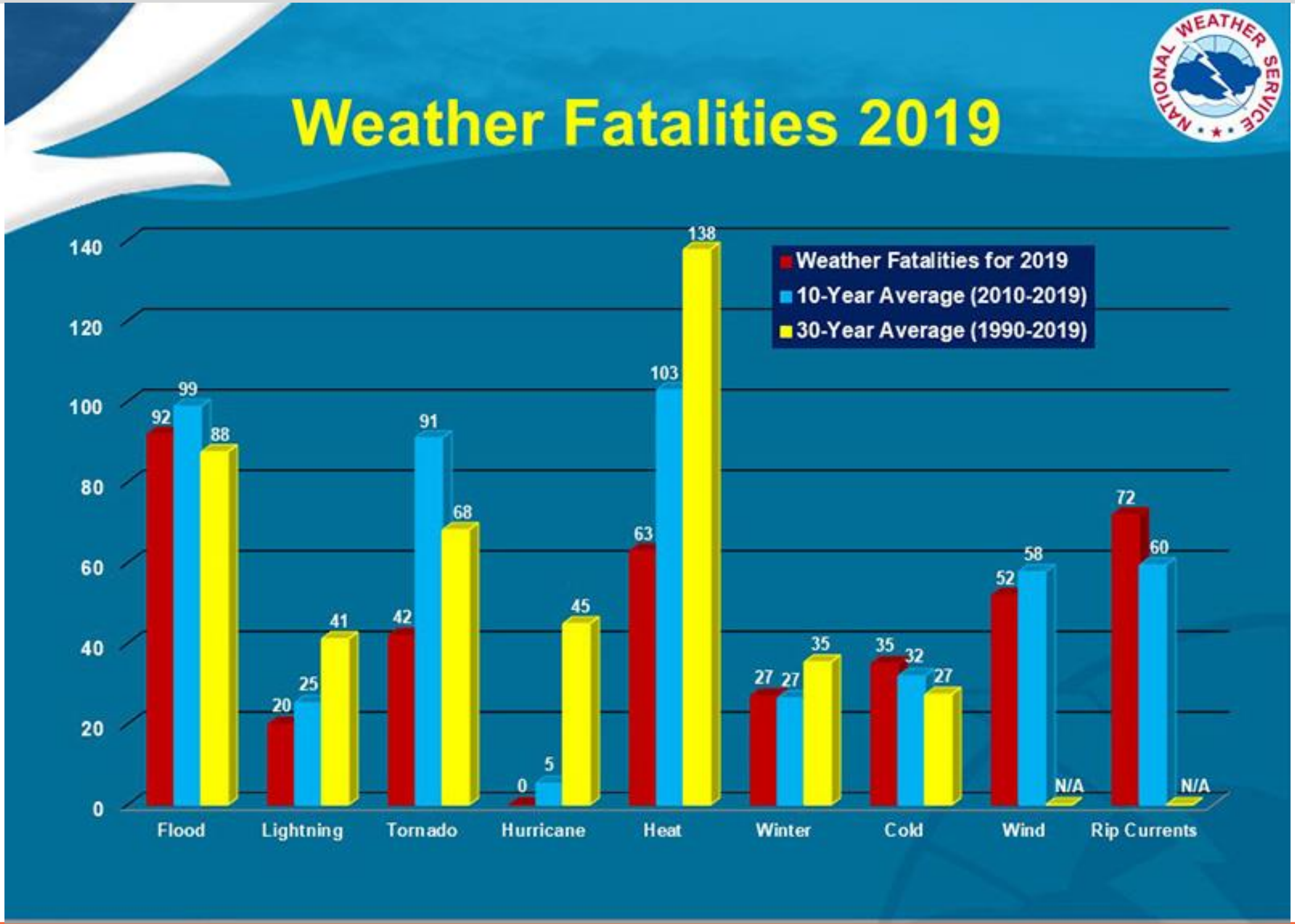
# Heat?

Heat is responsible for the highest number of weather-related fatalities in the United States in the last 30 years (NOAA 2019).



# Health Implications

Exposure can cause:

- Heat stress → body's inability to cool down properly.
  - Ranges:
    - Milder conditions → heat rash and heat cramps,
    - Most common type → heat exhaustion.
    - Most serious heat-related illness → heat stroke.


Source: www.sciencecare.com

# Health Implications

**Vulnerable Population (Higher Risk):**

- Infants and children up to four years of age,
- Elderly citizens (65 years of age and older),
- People with preexisting conditions,
- Pregnant women
- People not acclimatized/ accustomed to heat
- Low-income population
- Homeless

# Local Health Implications

**Recent study by Vaidyanathan et al. 2019 indicates:**

- Residents of the Northeast have higher sensitivity to heat than in warmer parts of the country;
- Northeast heat index range corresponding with significant heat-attributable disease burden to be 85-95ºF. Heat alerts occur above 95ºF.
- Higher sensitivity factors include:
  - lower acclimatization to extreme heat, less awareness of heat risks, and fewer structural adaptations such as air conditioning.

# Connecticut – Past (Observations)

**Observed Temperature presented in the Connecticut Physical Climate Science Assessment report (Seth et al 2019):**

Records beginning in 1895 indicate:

- Average increase of +0.3°F per decade
- Extremes are increasing since 1980 → higher number of colder and warmer days.
- Increase in number of summer days: maximum temperatures above 77°F
- Decrease in number of frost days: minimum temperatures below 32°F

# Connecticut – Future (Projections)

**Projected Changes under a high CO2 scenario (Seth et al 2019):**

- Large temperature increases on average, for mid- and late-century → between +5ºF to +8ºF
- Greatest increases seen for summer months by mid-century (June-August) → +6ºF and fall by late-century (September-November) → +10ºF
- Number of Tropical Nights (above 68ºF):
  - Present → 10 days
  - Mid-century → 40 days
  - Late-century → 70 days

# Connecticut – Future (Projections) cont.

**Projected Changes under a high $CO_2$ scenario (Seth et al 2019):**

- Number of Warm spell days:
  - Present → 4/year
  - Mid-century → 48/year
  - Late-century → 100/year
- Number of Frost days (below 32$^{o}$F):
  - Present → 124 days
  - Mid-century → 85 days (decreased by 39 days)
  - Late-century → 60 days (decreased by 64 days)

# Connecticut – Projected population growth

**Connecticut's total population is projected to increase by 1.4% over the next 20 years (2020 – 2040).**

**Projected growth of vulnerable age groups:**

- Infants and children under 4 years of age → +5.4%
- Elderly citizens over 65 years of age → +9.2%

EPA (2017) estimates that overall the Northeast region could face an increase between 960 and 2,300 premature deaths due to heat per year as temperatures rise.

# Heat Vulnerability

**Physiology (Bodily response) + Behavior (+ Environmental conditions)**

Urban environments are linked to higher risk due to the effects of heat islands → warmer nights (Rosenthal 2016)

Certain populations in the state already have limited adaptive capacity

# Resilient Connecticut - Heat

## Question is:

**How can we better adapt the local environment to support adaption to heat?**

# Project Objectives

**Main Objective:** Identify areas vulnerable to heat and cold extreme climate conditions, with higher emphasis on heat due to indications of higher health risks.

1. Analyze land surface temperature data (LST), acquired from satellite images, to identify areas where heat islands are occurring.
2. Understand the linkages between LST changes and land use and land cover (LULC) changes, to interpret the relationship between thermal variation and urbanization.

**Project Boundary:** New Haven and Fairfield county areas, with potential for expansion to the entire state of Connecticut.

# Project Phases

## Phase 1:

- **Short-term analysis of LST →** focus on a 5-year timeframe to understand the current conditions for the studied region.
- **Work with CIRCA to incorporate an established methodology for framing heat vulnerability →** combined application of an index and vulnerability mapping to quantify and interpret thermal impacts

## Phase 2:

- **Long-term analysis of LST and LULC →** look at +20 years into the past to understand the relationship between LULC and LST changes to interpret the appearance and/or intensification of urban heat islands.

## Phase 3:

- **Heat vulnerability →** interpret how potential escalation of urban heat islands might impact human health and well-being.

# Phase 1- In Progress

## Prototype: City of New Haven

## Step 1: Identify the different land cover types (local climate zones)

### 1. Compact Mid-Rise:

***Definition:***

***Form:***
Tightly packed buildings of 3 to 9 stories tall. Separated by narrow streets. Sky view from street level significantly reduced. Heavy building materials (stone, brick, tile). Thick roof and walls. Landcover mostly paved. Few or no trees. Moderate to heavy traffic flow.

***Function:***
Residential (multi-unit housing, multi-story tenement). Commercial (office buildings, hotels, retail shops). Industrial (warehouses and factories)

***Location:***
Core (old city, old town: inner city, central business district)

### 8. Dense Trees:

***Definition:***

***Form:***
Heavily wooded landscape of deciduous and/or evergreen trees. Land cover mostly pervious.

### 9. Low Plants:

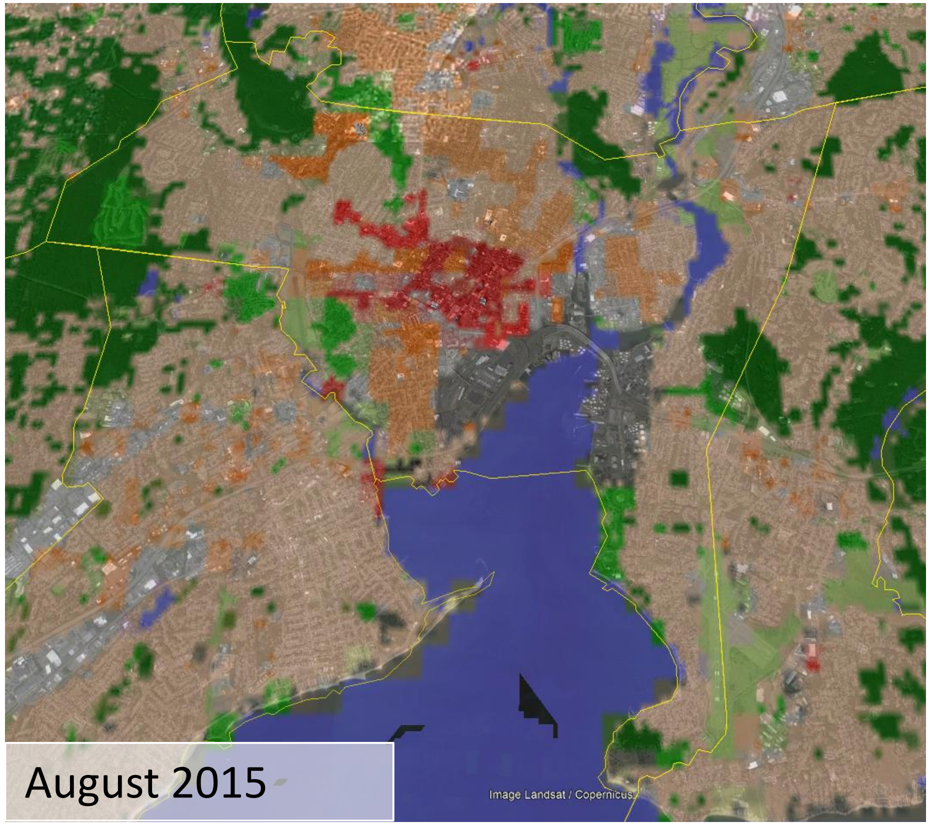
***Definition:***

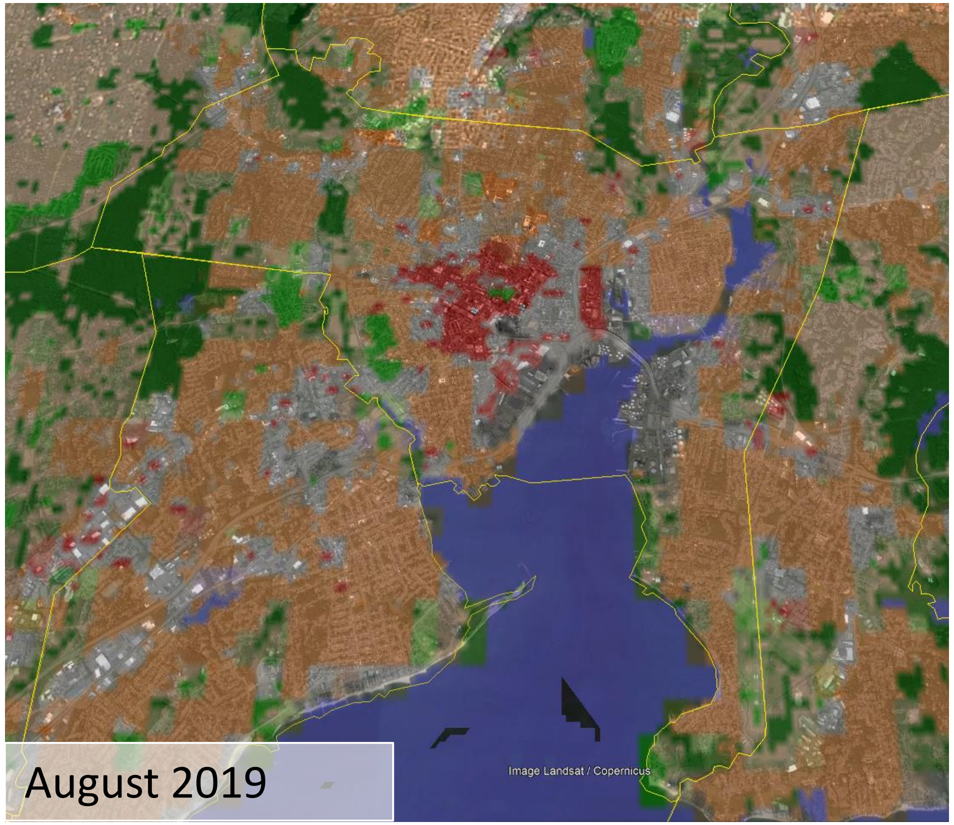
***Form:***
Featureless landscape of grass or herbaceous plants/crops/wetlands. Few or no trees.

# Phase 1- In Progress

## Prototype: City of New Haven

## Step 2: Classification Mapping → approximately 4 revisions thus far



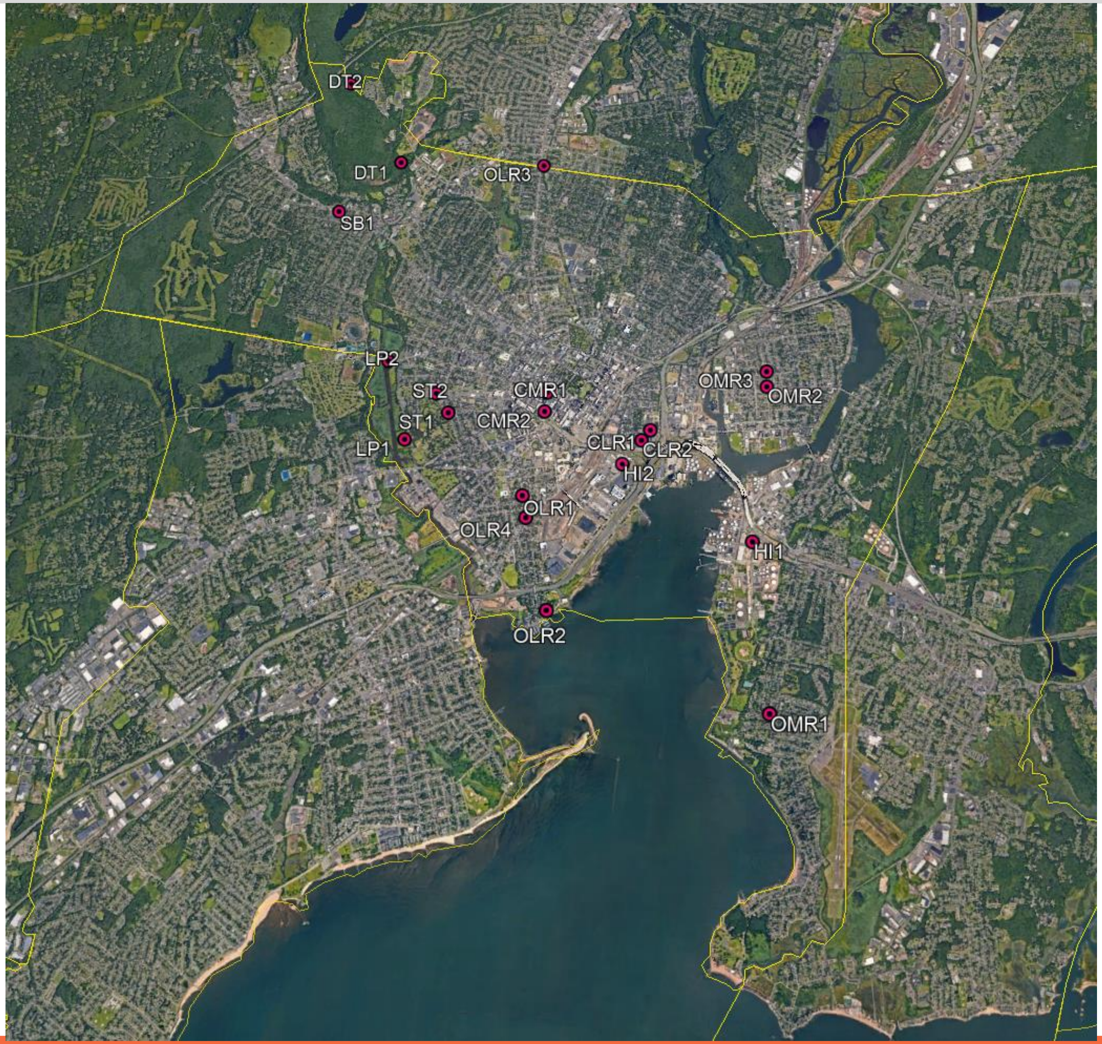
# Phase 1- In Progress

**Prototype: City of New Haven**

**Step 3: Heat Sensor Deployment**

Started in Aug

Measurements will end in Oct 2020



# Next Steps

1. **Phase 1 - Land Surface Temperature Change analysis → ends by the end of the month**
2. **Phase 2 - +20 year analysis of the relationship between land cover changes and temperature changes**

Landsat 5 Surface Reflectance (Tier 1) images (approximately 264 images) 1990-2012 and Landsat 8 Surface Reflectance (Tier 1) images (approximately 117 images) 2013-2016.

A total of approximately 381 images for 20 years.

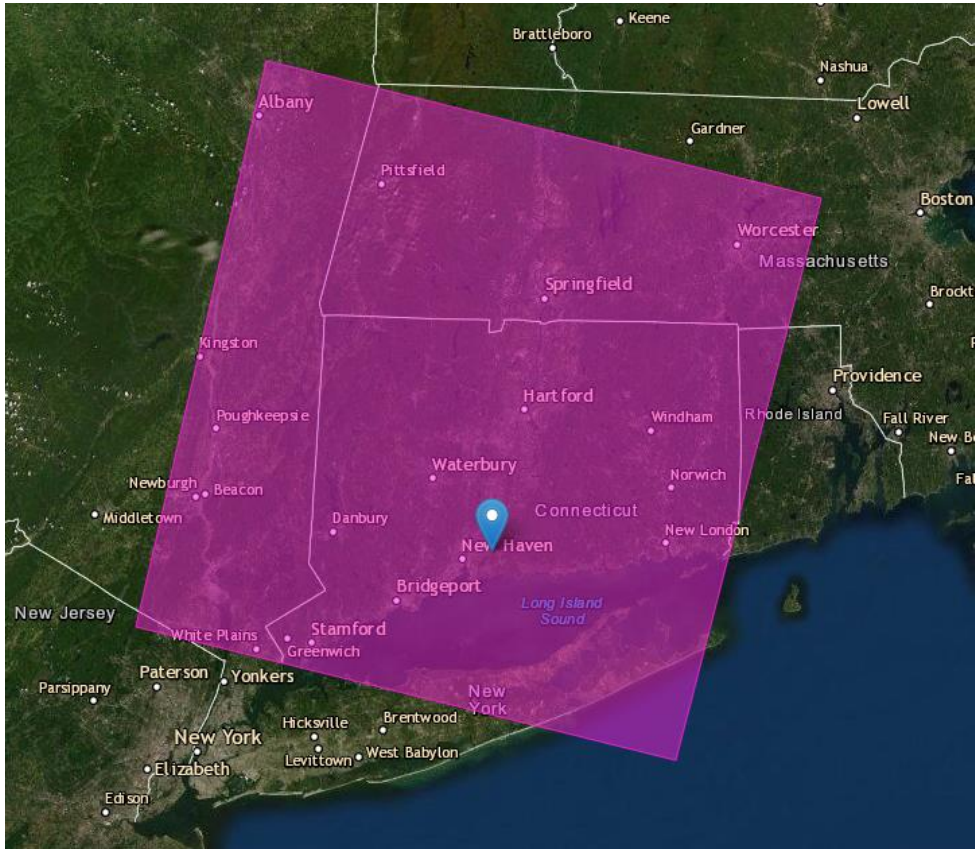



Image footprint for Landsat 5 and Landsat 8 flyovers encompassing Fairfield and New Haven Counties, Connecticut. (Source: USGS Earth Explorer).

# Final Thoughts

The project intends to demonstrate an increase in surface temperatures during the +20-year studied period and link it to the loss of specific forested and other vegetated land cover types.

1. Data created needs to support local decision-making and promote adaptation
2. Heat response planning needs to go beyond communication
3. We need to understand the environmental drivers that exacerbate heat so we can support adaptive measures at the city scale

# Questions?