

# Utilizing Satellite Data for Extreme Heat Surveillance Efforts

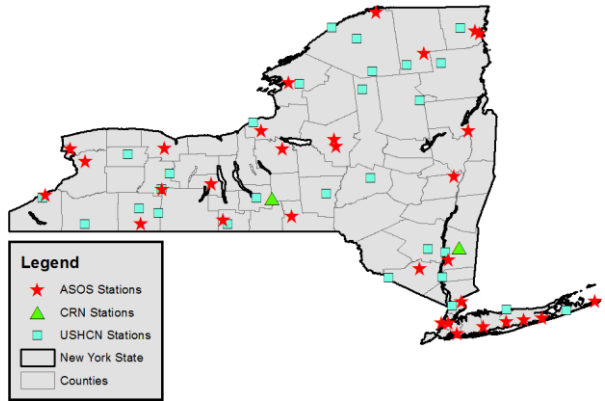
Tabassum Insaf – New York State Department of Health

# Outline

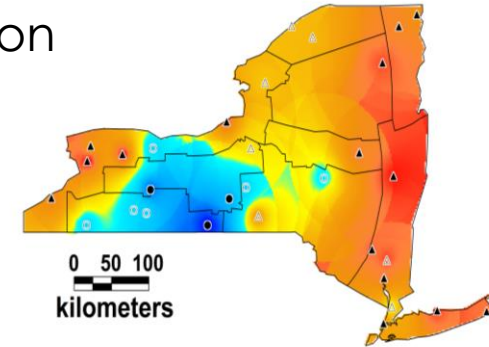
- Enhanced Exposure Assessment with Satellite Data
- Policy Relevant Public Health Research
- Outreach and Communication

# Enhanced Exposure Assessment with Satellite Data

Monitoring stations in New York State are sparse

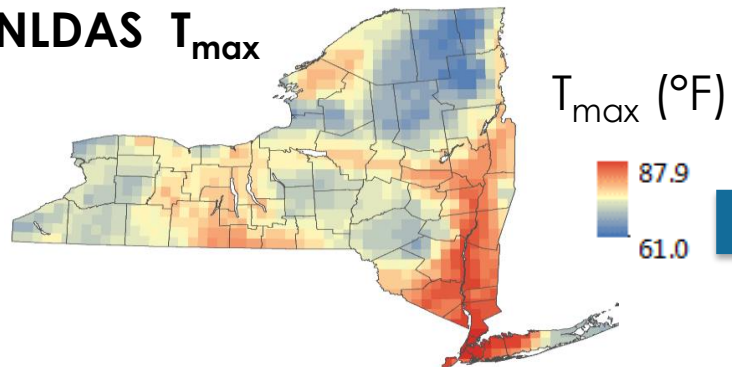


Spatial extrapolation from monitor data can result in misclassification



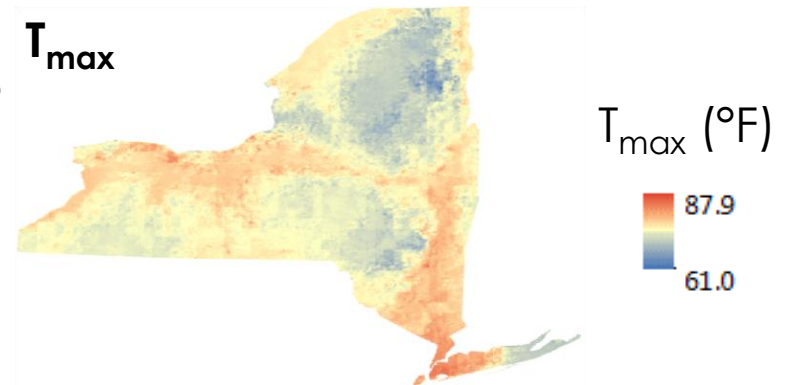
North American Land Data Assimilation System provides uniform exposure surface for health studies

**12 Km Native NLDAS  $T_{max}$   
July 21, 2010**



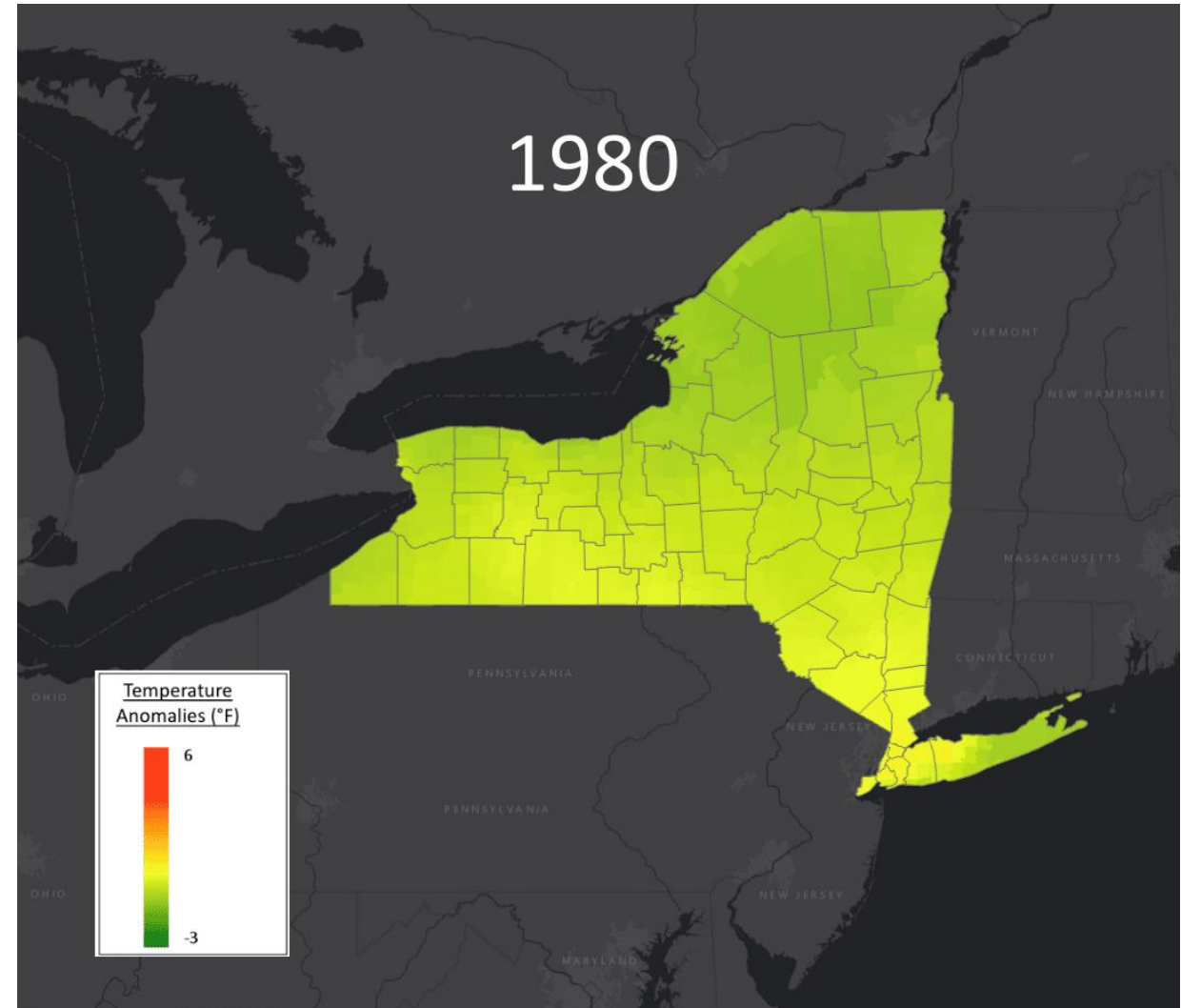
Downscaling to a 1KM using MODIS land surface temperature improves identification of local effects

**Downscaled  $T_{max}$   
July 20, 2009**



# Extreme Heat in New York State (NYS)

- Annual average temperatures have increased by over 2°F since 1970
- Over the next century, average summertime (June-August) temperatures in NYS are projected to increase between 3.6 to 10.8°F
- A 5°F increase in daily maximum summer temperature could double the risk of heat-related illnesses in New Yorkers



# Down-Scaling NLDAS Air Temperature to MODIS Scale

## Rationale

- NLDAS is a meteorological re-analysis providing hourly air temperature and other variables on a 1/8 degree (~12 km) CONUS grid for 1979-present
- The resolution is in fact coarser since NLDAS is interpolated from the 32 km North American Regional Reanalysis (NARR)
- At this resolution, small-scale features such as the Urban Heat Island and near-coastal temperature gradients are not captured



# Down-Scaling NLDAS Air Temperature to MODIS Scale

## Approach

- Use long-term means of MODIS Aqua LST (1:30 PM/AM local time) to capture the spatial pattern of daily max/min temperatures, and impose that spatial pattern onto NLDAS 12 km max/min air temperatures

The disaggregated daily Tmax or Tmin is given by:

$$T_{DIS} = T_{LR} + ZHR * \sigma_{LR}$$

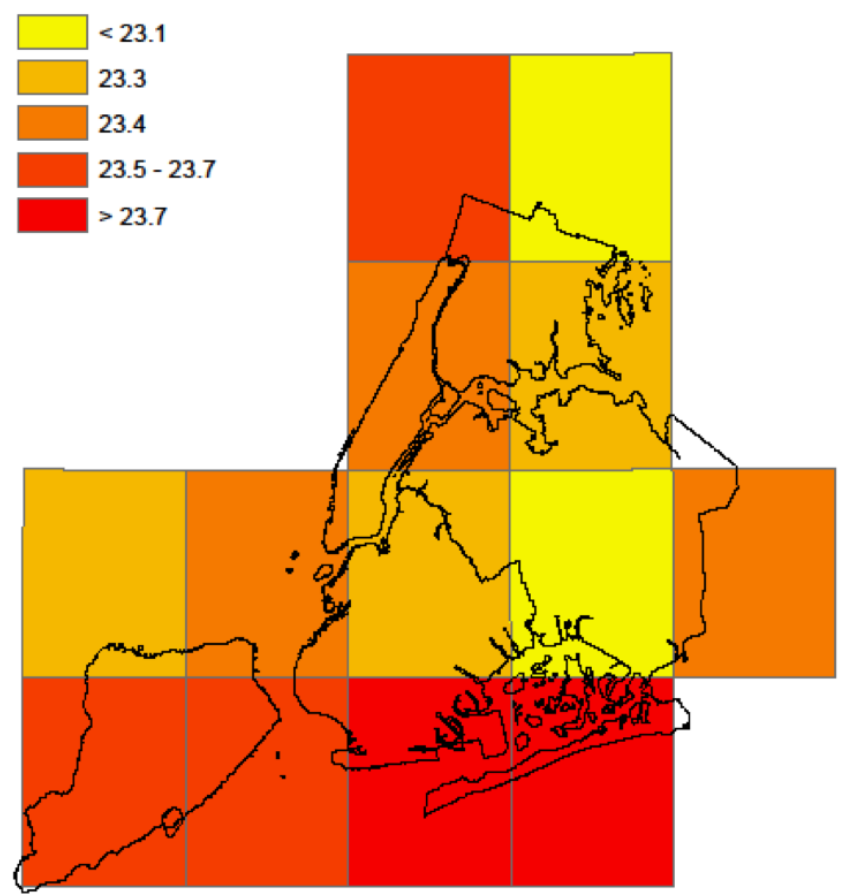
where ZHR is the standardized LST departure, given by:

$$ZHR = (THR - THR[\text{mean}]) / \sigma_{HR}$$

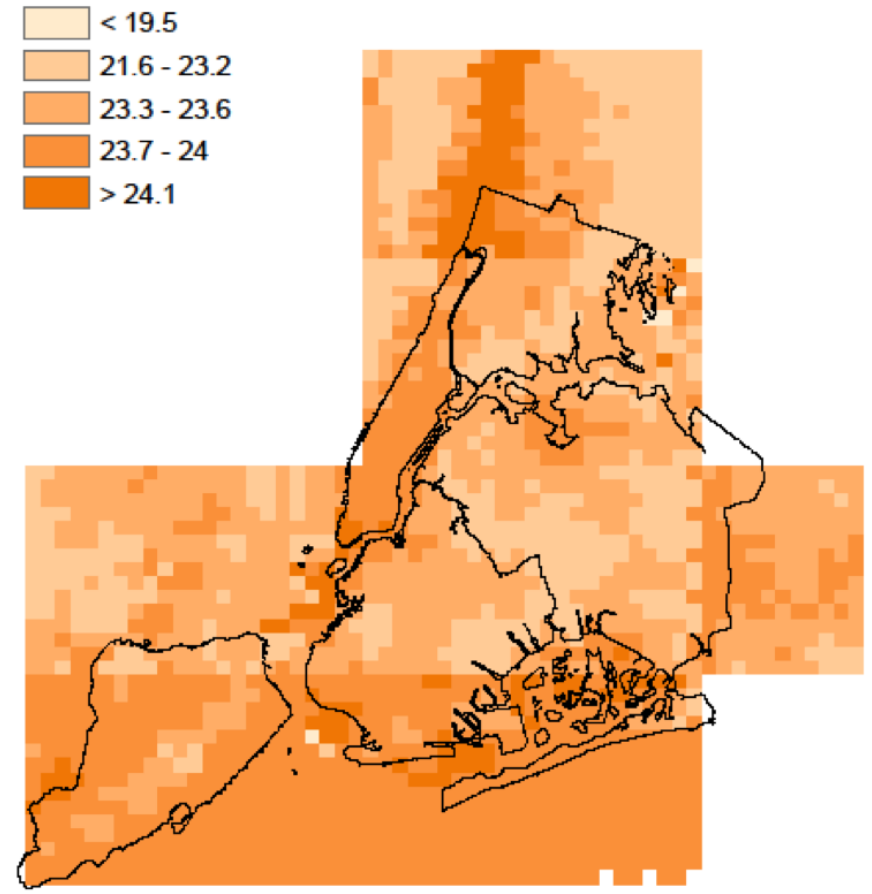
- THR = high-resolution (MODIS) LST, THR[mean] and  $\sigma_{HR}$  are the mean and standard deviation, respectively, of high-resolution (MODIS) LST over a spatial neighborhood, here set to one NLDAS grid cell (~12 km)

# Improved Resolution Over New York City Using MODIS LST for Downscaling

NLDAS native resolution temperatures in deg. C

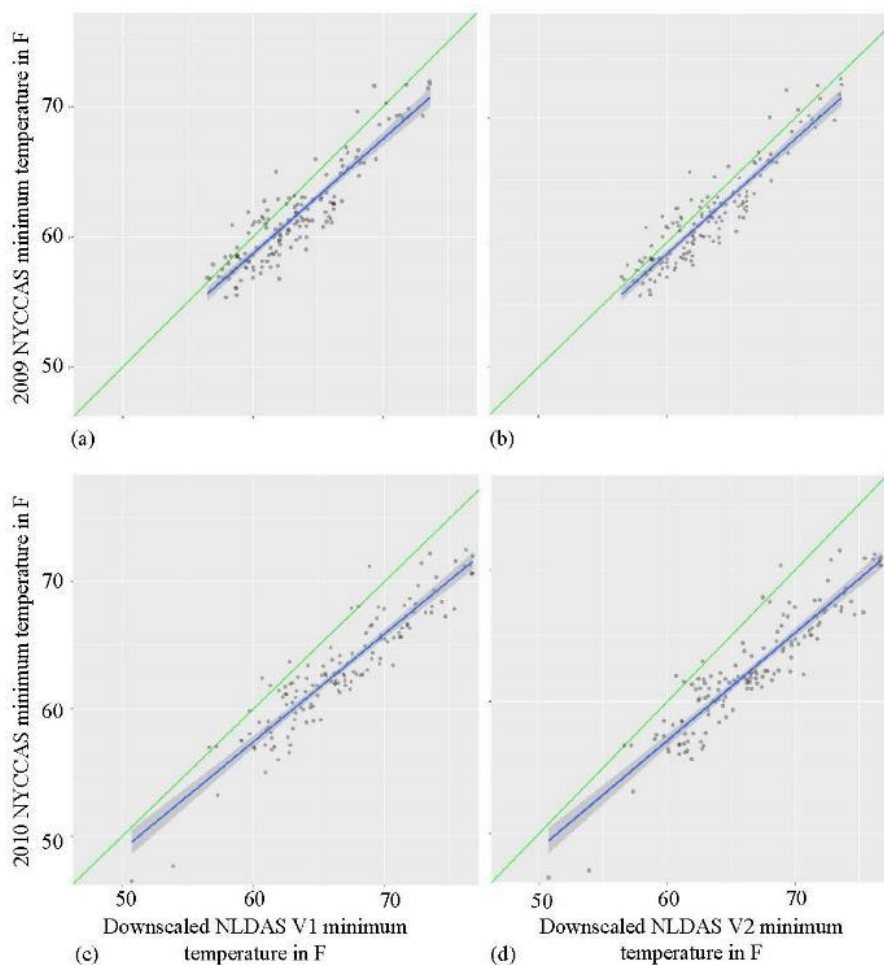


1-km downscaled NLDAS temperatures in deg. C



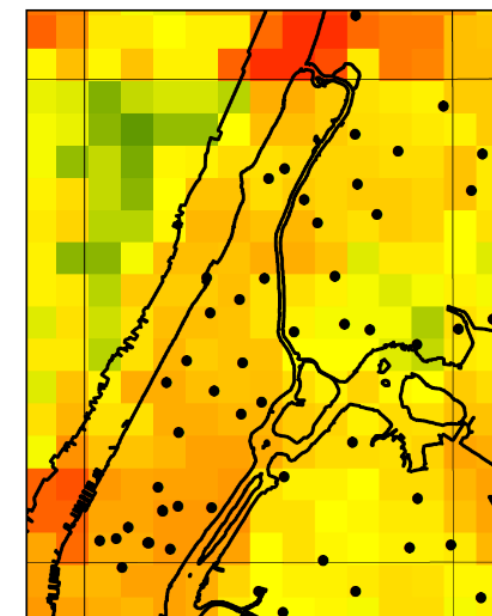
Eleizer H, Johnson S, Crosson, WL, Al-Hamdan MZ, Insaf TZ. Ground-truth of a 1 km downscaled NLDAS air temperature product using the New York City Community Air Survey. Journal of Applied Remote Sensing 13(2), 024516 (2019) <https://doi.org/10.1117/1.JRS.13.024516>

# New York City Validation



Scatterplots of (a) 2009 NYCCAS vs NLDAS down-scaled 1 km averaged values for the Version 1 model (3x3 kernel), and (b) the same for Version 2 (5x5 kernel)

Plots (c) and (d) are the same scatterplots for Versions 1 and 2 respectively for 2010. The blue line shows values fitted to a linear model; gray shading show the 95% confidence interval limits. The green line shows a 1:1 fit.



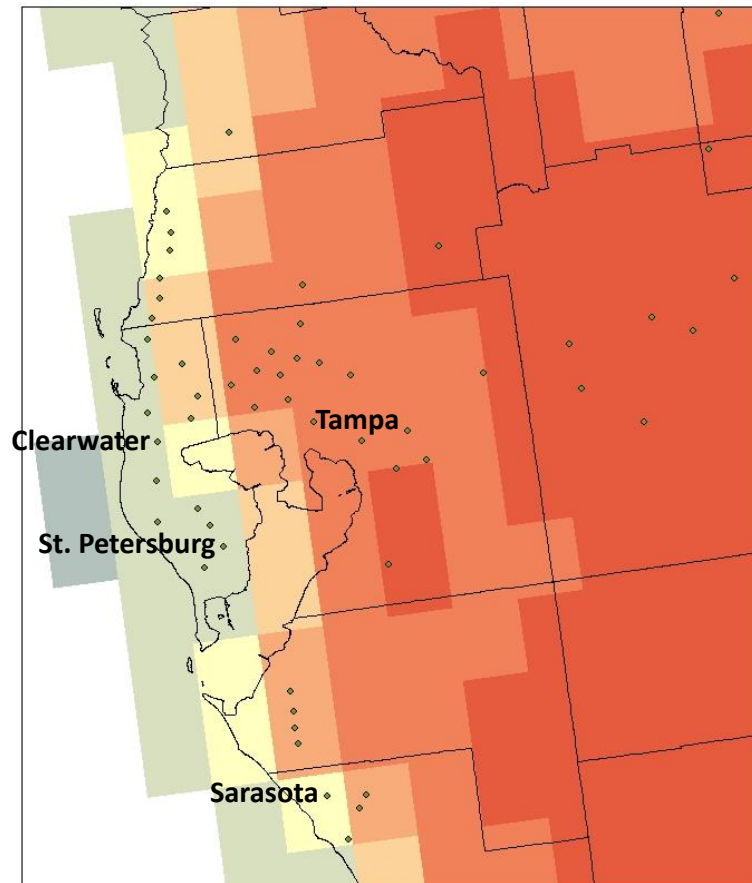
- Down-scaled 1 km grid
- High temperature
- Low temperature
- NYCCAS Ground Stations
- ~12 km NLDAS grid cell
- New York City boundaries

Eleizer H, Johnson S, Crosson, WL, Al-Hamdan MZ, Insaf TZ. Ground-truth of a 1 km downscaled NLDAS air temperature product using the New York City Community Air Survey. Journal of Applied Remote Sensing 13(2), 024516 (2019) <https://doi.org/10.1117/1.JRS.13.024516>



# Improved Resolution Over Florida's Tampa Bay Area Using MODIS LST for Downscaling

## Native NLDAS



## 1 km Downscaled Product

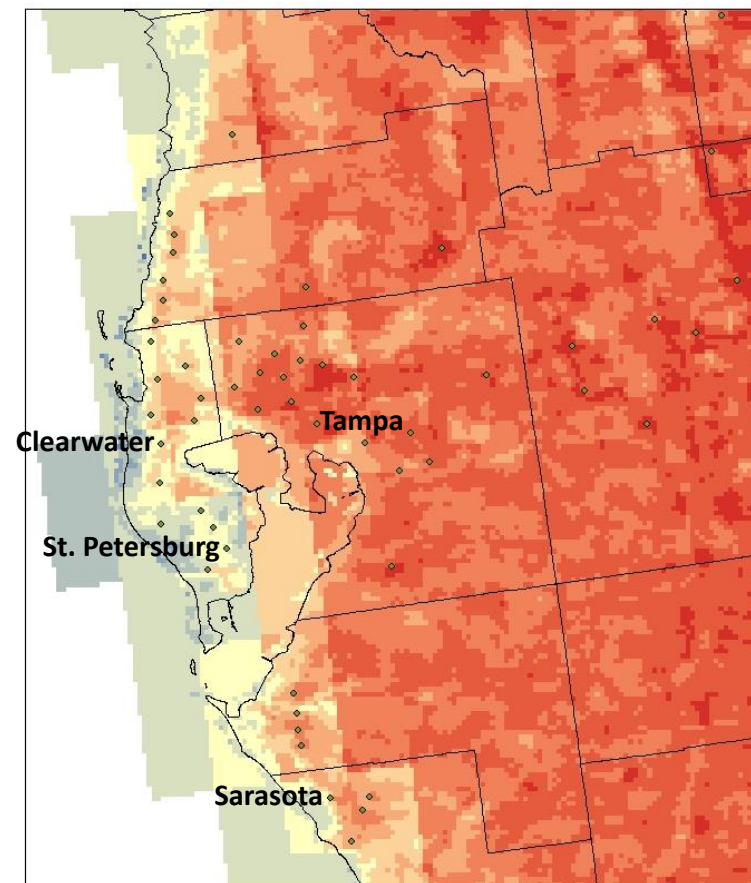
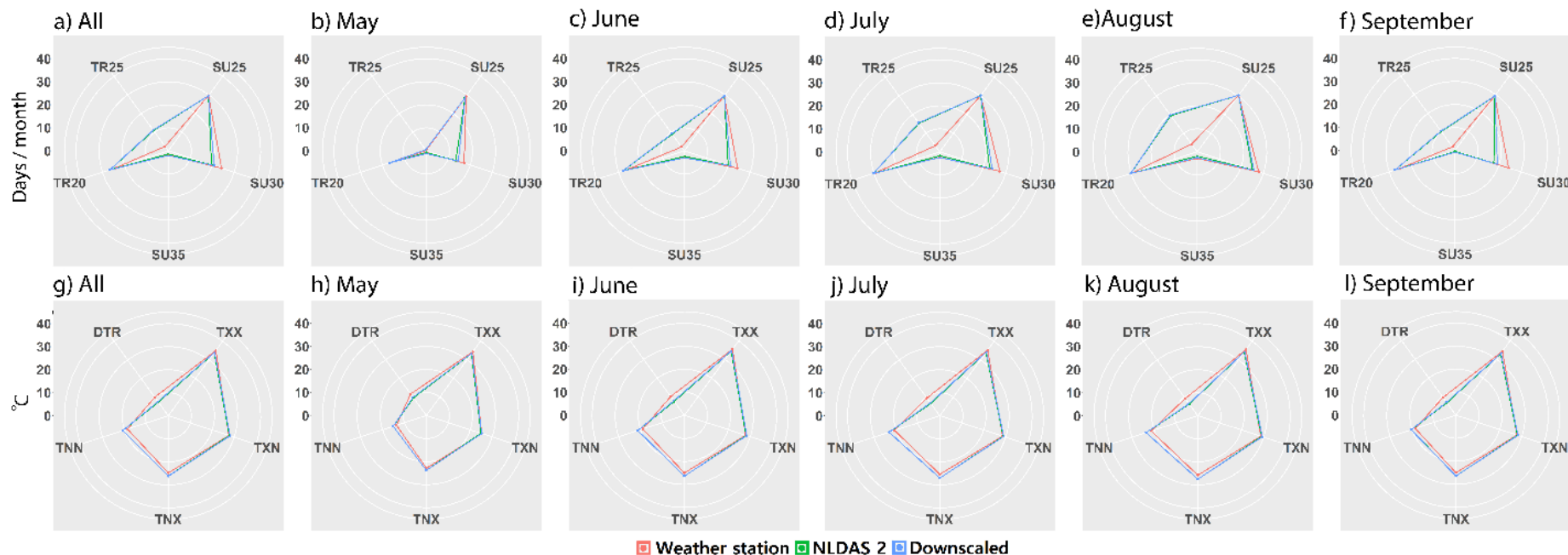


Image Credit: Bill Crosson : Universities Space Research Association

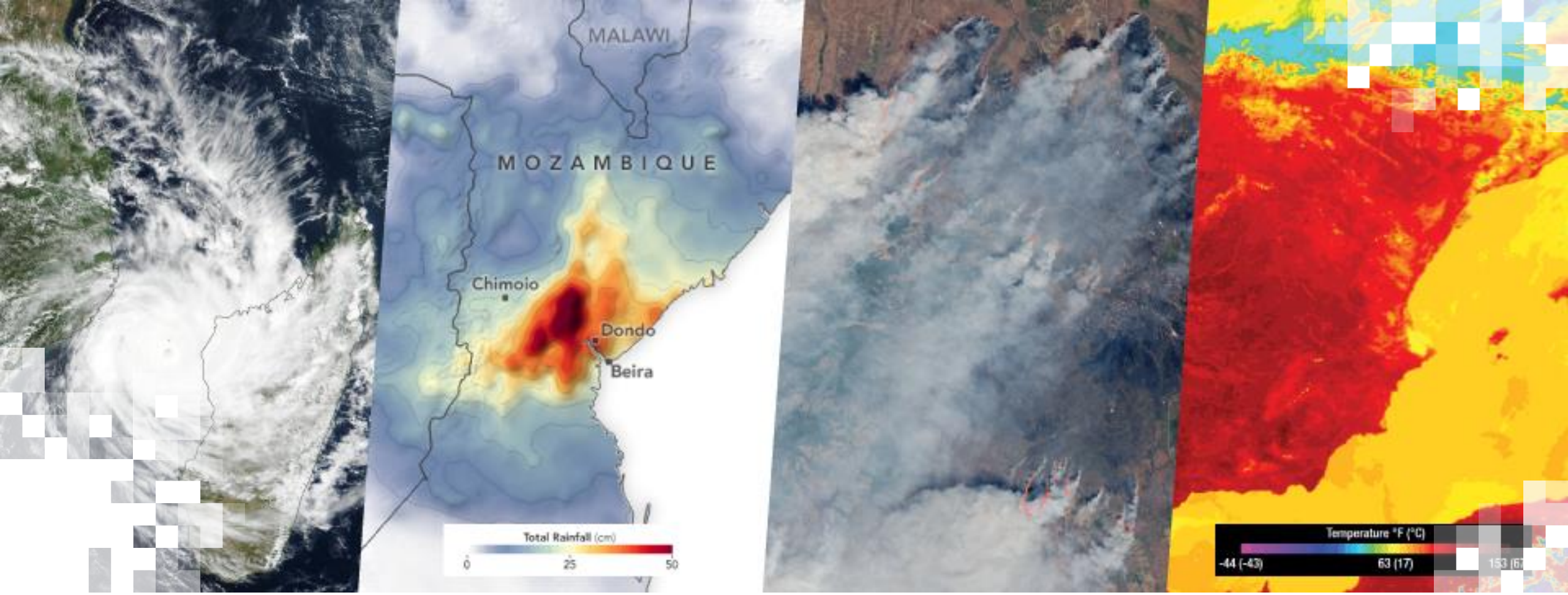
# Florida Validation

## Ten Indices to Compare Monthly Extremes



**SU25 (30, 35):** monthly count of days when maximum temperature > 25°C (30°C, 35°C); **TR20 (25):** monthly count of days when minimum temperature > 20°C (25°C); **TXX:** monthly maximum value of daily maximum air temperature; **TXN:** Monthly minimum value of daily maximum air temperature; **TNX:** Monthly maximum value of daily minimum air temperature; **TNN:** Monthly minimum value of daily minimum air temperature; **DTR:** Daily air temperature range; monthly mean difference (TX – TN).

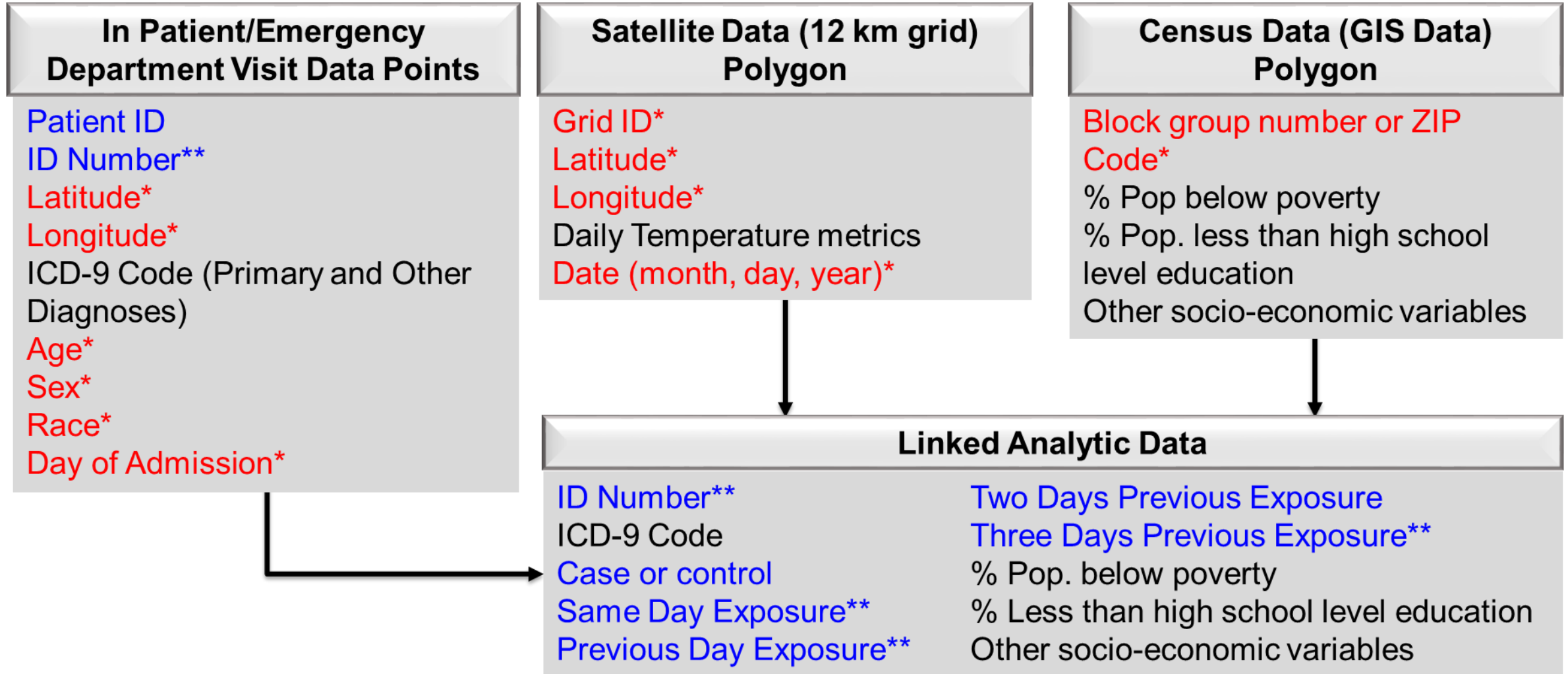
Image Credit: JiHoon Jung Florida State University



Policy Relevant Public Health Research



# Schema for Linkage of Analytic Datasets



# Risk of Hospitalizations/Emergency Department Visits in NYS 2008-2012

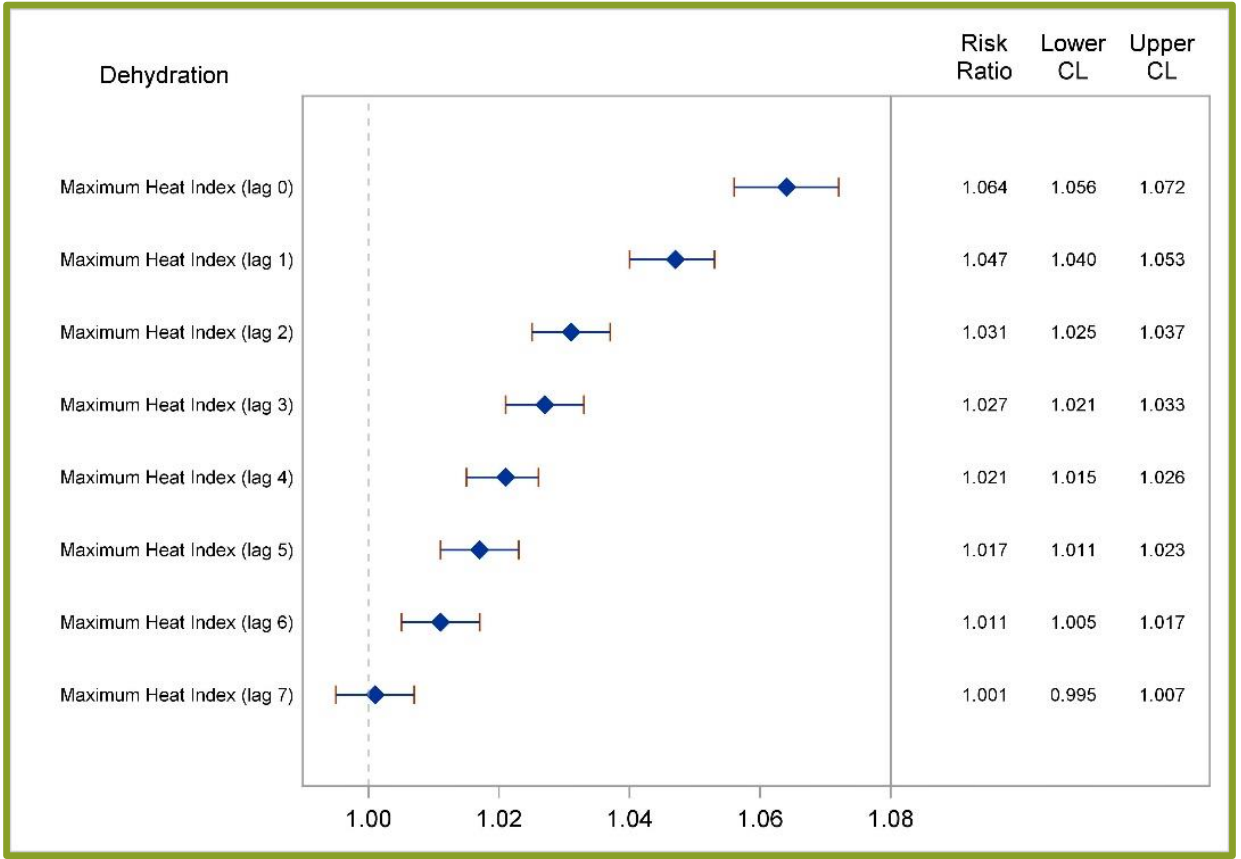
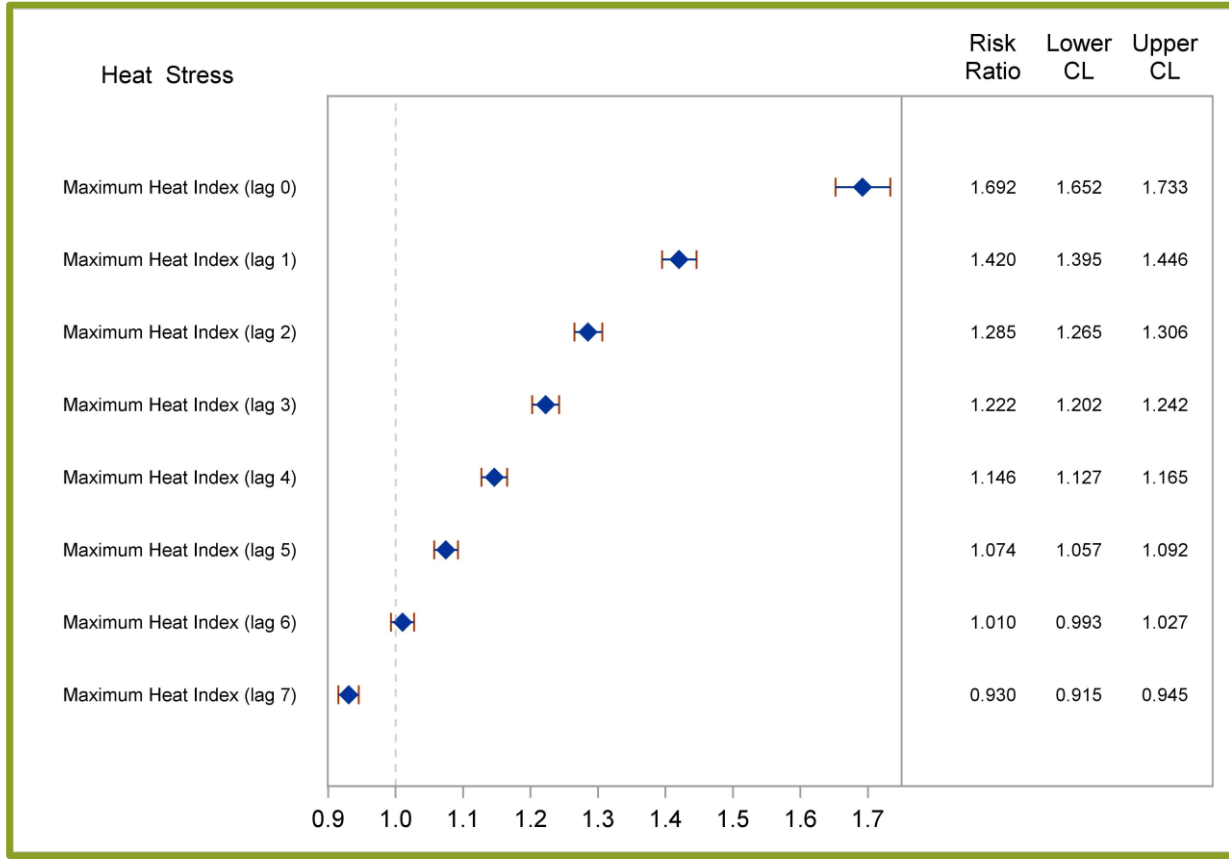
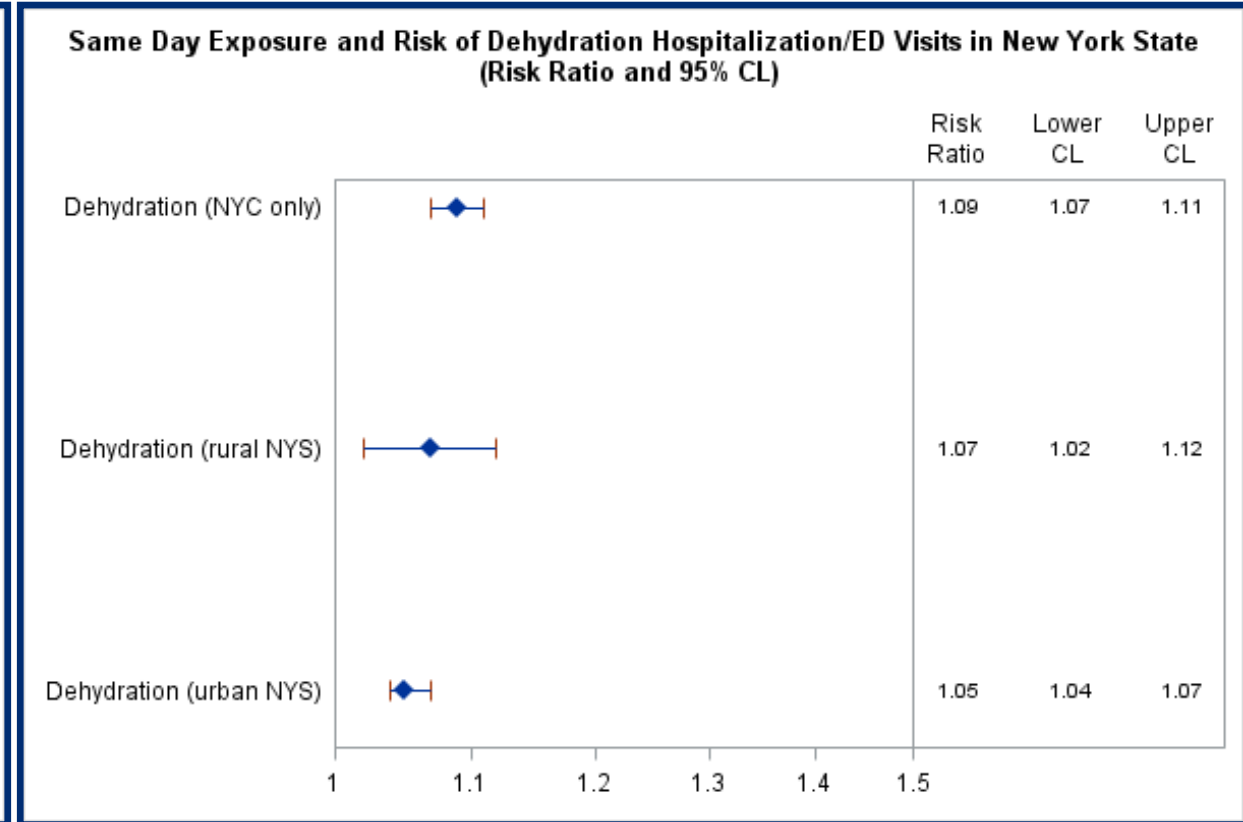
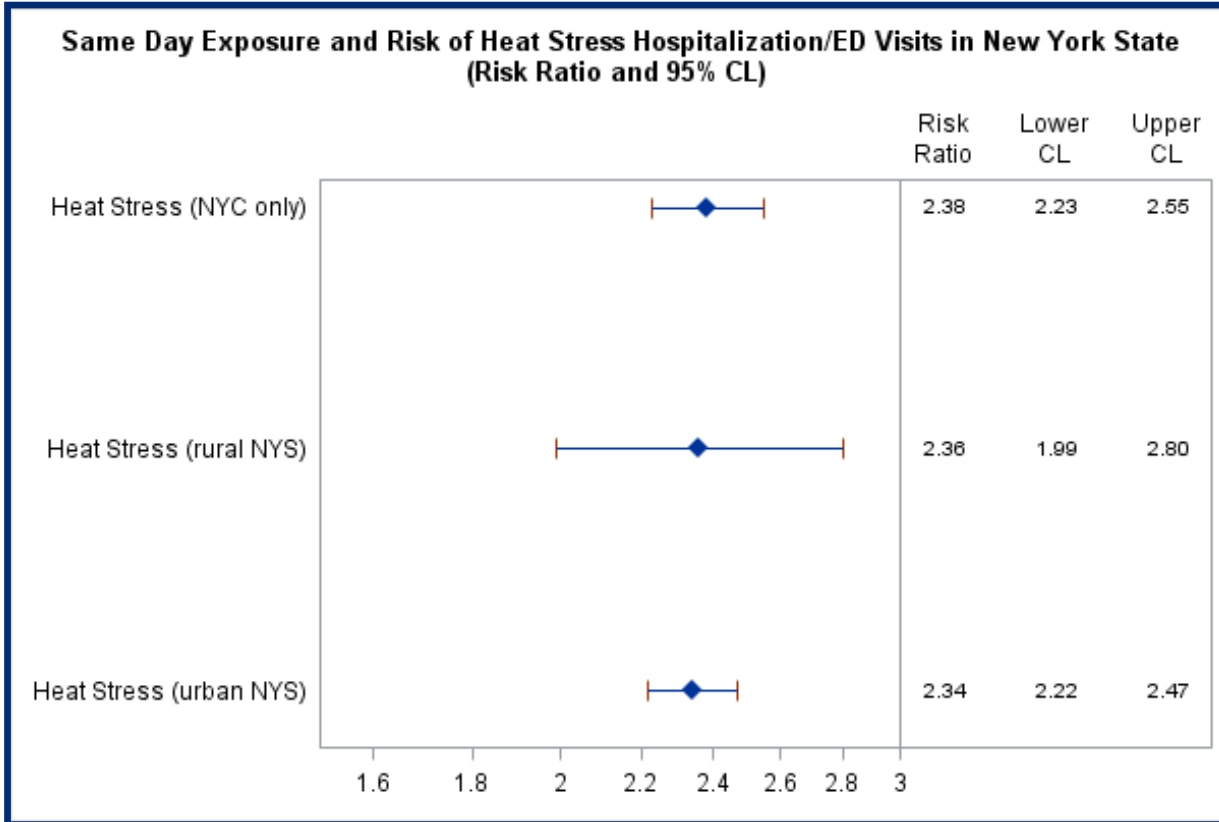


Image Credit: Adeyeye T, Insaf TZ\*\*, Al-Hamdan M, Nayak S, Stuart N, Dirienzo S, Crossson W. Estimating policy relevant health effects of ambient heat exposures using spatially contiguous remote sensing reanalysis data –Environmental Health 2019 18:35 <https://doi.org/10.1186/s12940-019-0467-5>





# New York City (NYC), rural & urban New York State (NYS)



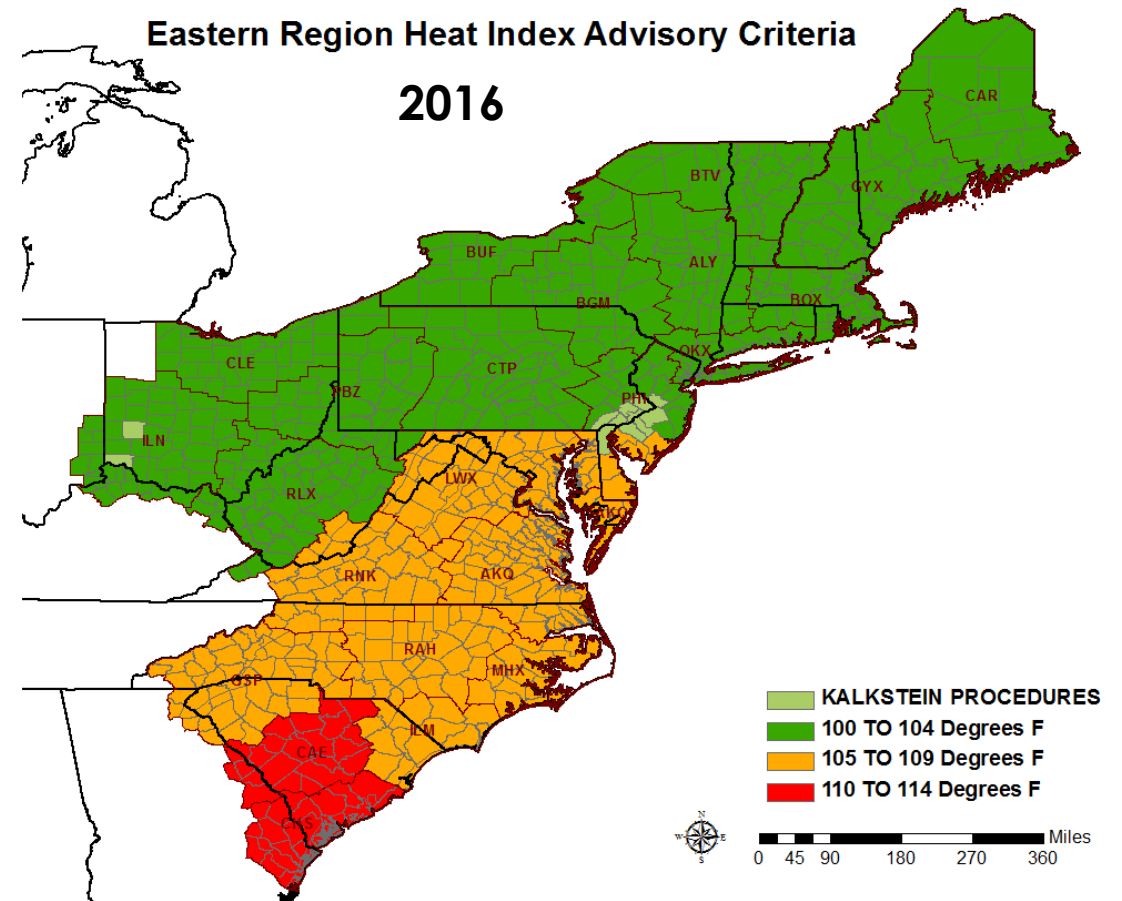
For every 5F change in temperature; Adjusted for ozone & PM2.5. Adeyeye T, Insaf TZ\*\*, Al-Hamdan M, Nayak S, Stuart N, Dirienzo S, Crossson W. Estimating policy relevant health effects of ambient heat exposures using spatially contiguous remote sensing reanalysis data –Environmental Health 2019 18:35 <https://doi.org/10.1186/s12940-019-0467-5>



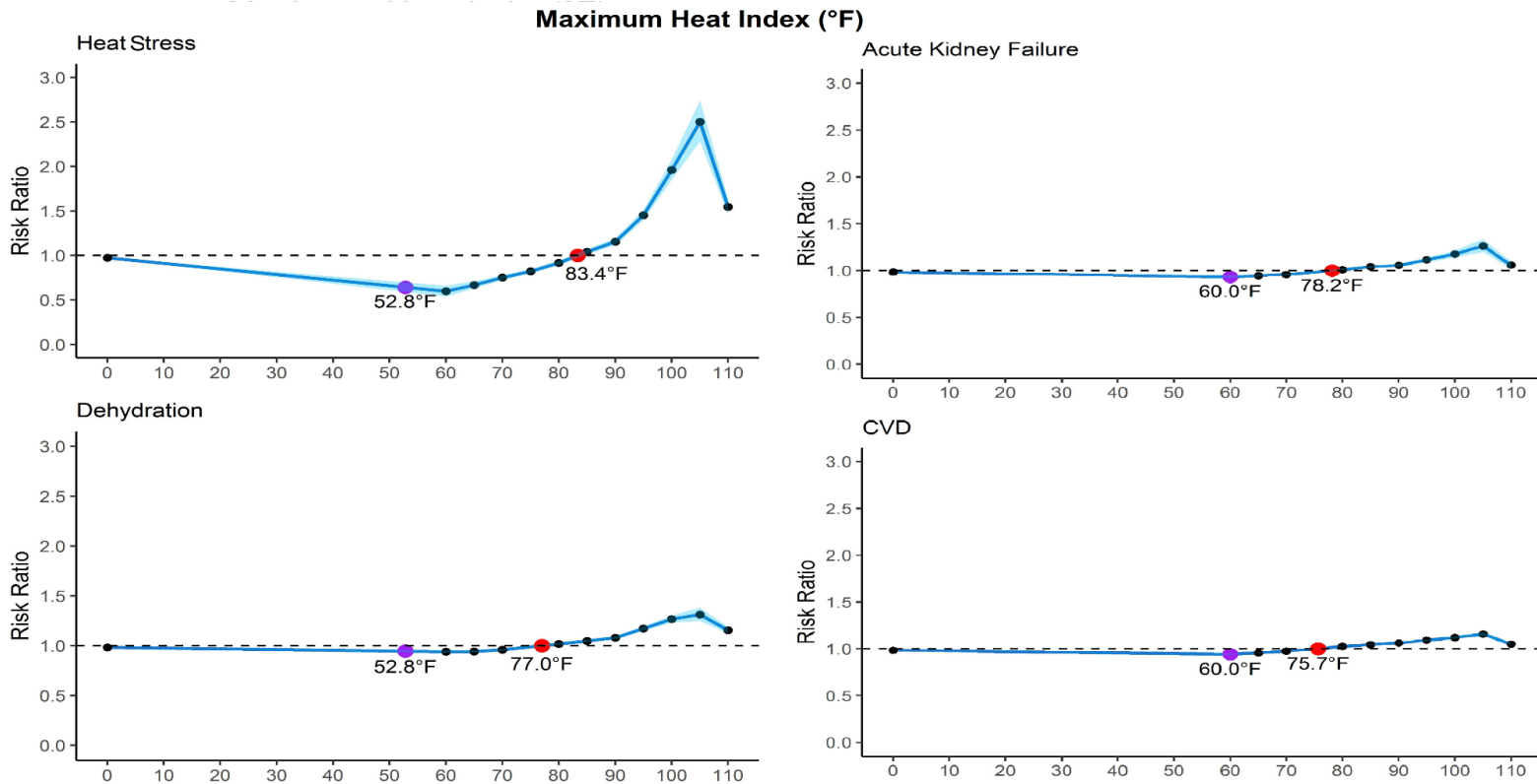
# National Weather Service Heat Advisory

- Regional NWS forecast offices issue excessive heat alerts (advisories, watches, and warnings) based on the maximum heat index forecasts over 24–72 hours
- Current temperature thresholds for heat advisories and warnings in upstate NYS were established over 20 years ago and were not based on heat-health associations
- The NLDAS reanalysis dataset provides the opportunity to conduct heat-health analysis for all regions of NYS and reassess the criteria for heat advisories, so they are more relevant to temperatures experienced in NYS during the summer

Image Credit: NWS offices, Albany

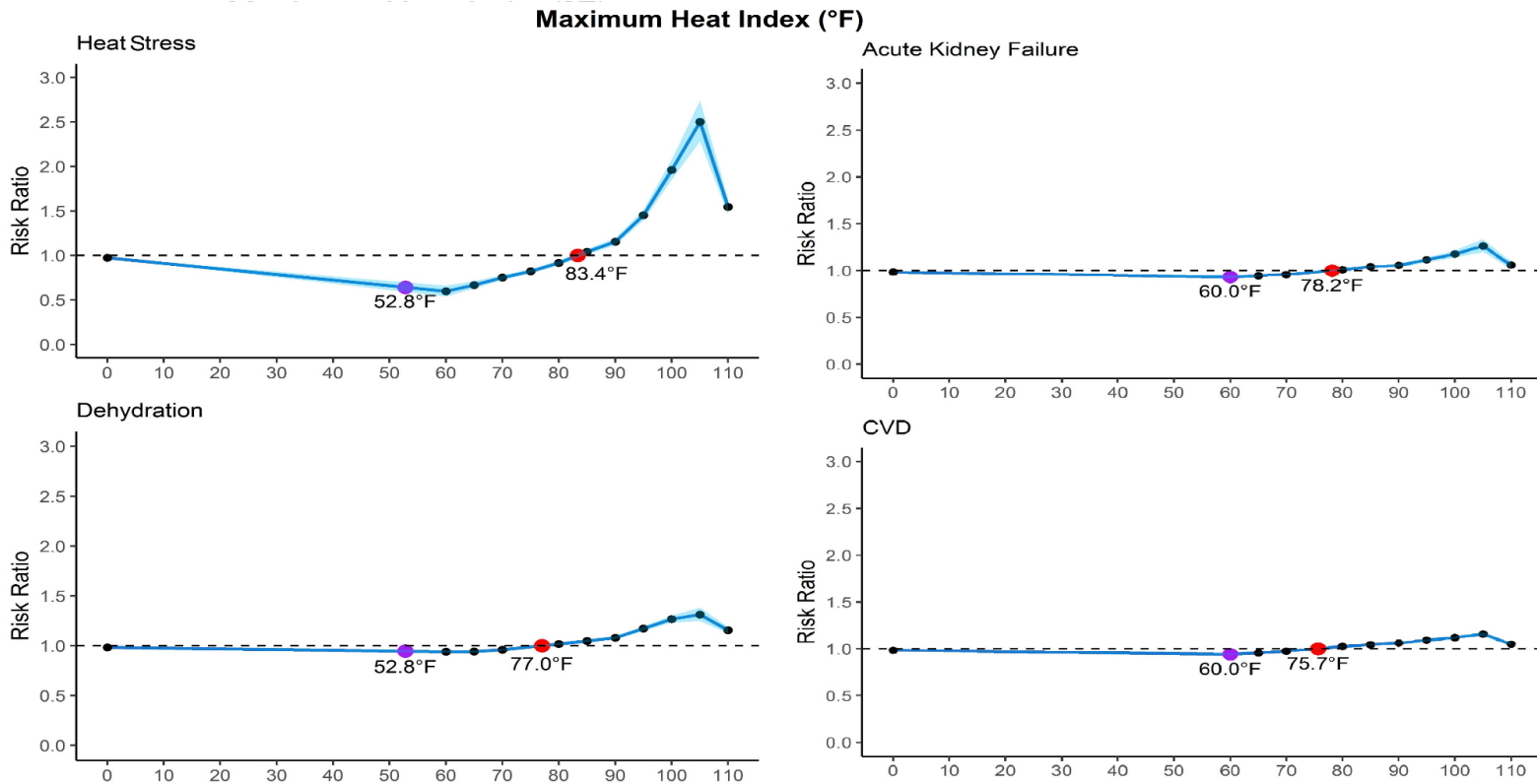


# Threshold Analysis



- The excess risk temperature (ERT) was defined as the lowest temperature at which the lower bound of the 95% confidence interval of relative risk of a particular health outcome was greater than 1.
- For heat stress, the ERT was defined at 83.8 °F while the ERTs were between 75.2–78.8 °F for all other health outcomes.

# Threshold Analysis



- At the pre-existing NWS threshold of 100 °F, the risk ratio for heat stress was 3.727 while the risk ratio for other health outcomes ranged from 1.727 for dehydration, 1.534 for AKF and 1.412 for CVD
- In contrast, at a reduced heat advisory criterion of 95 °F, the risk ratio for heat stress is 1.927 and ranges from 1.436 for dehydration, 1.329 for AKF and 1.290 for CVD

# National Weather Service Heat Advisory

- Recognizing that the Excessive Heat Warning / Heat Advisory criteria should be based on regional climate variability and the effect of excessive heat on the local population, the NWS encourages regional offices to work with health departments and develop criteria based on scientific evidence derived from local data
- We recommended that a conservative heat advisory threshold of 35 °C (95 °F) be considered for the general public

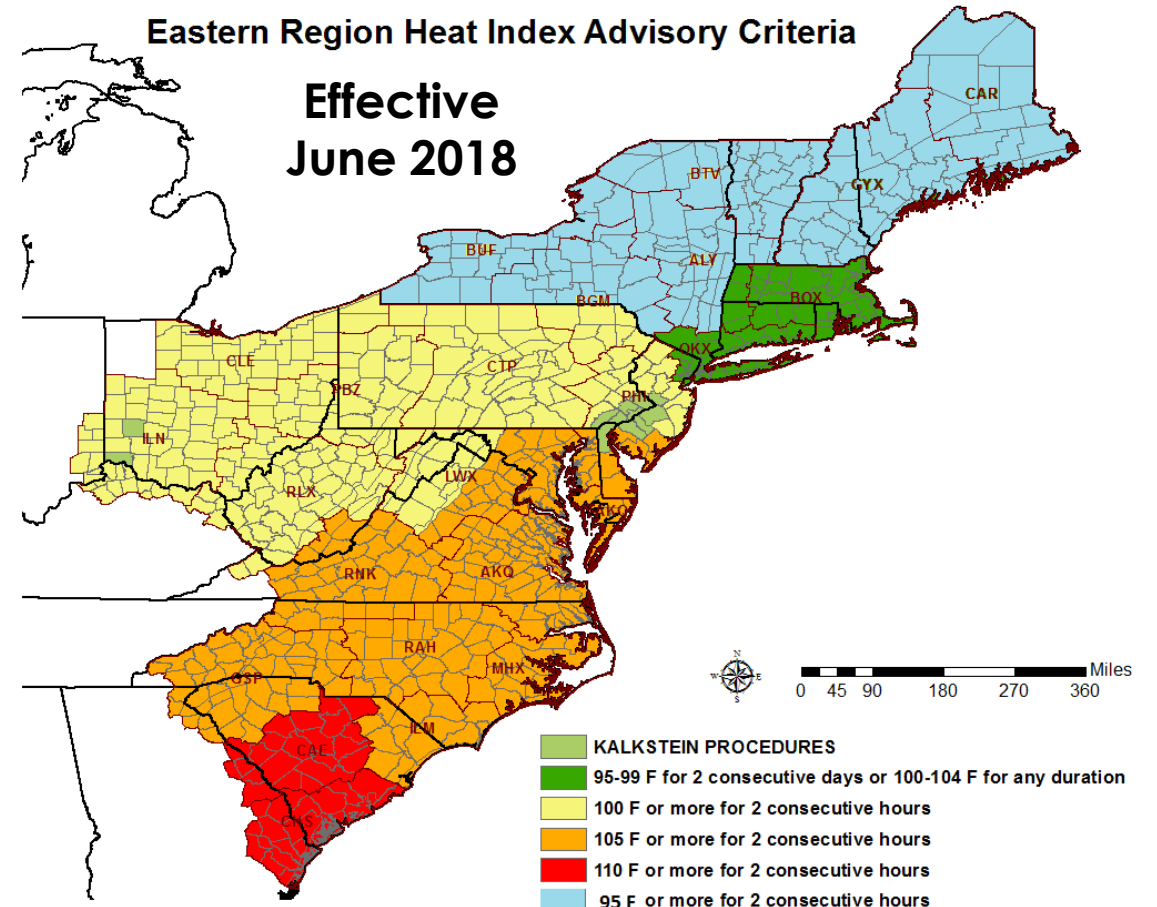


Image Credit: NWS offices, Albany





# National Weather Service Heat Advisory

- This would capture a high proportion of heat events likely to result in significant morbidity, while avoiding warning fatigue if frequent advisories were issued at lower temperatures
- Based on research findings and recommendations, four NWS offices (Albany, NY; Binghamton, NY; Buffalo, NY; and Burlington, VT) changed their heat advisory criteria for New York, effective on or about June 1st, 2018 to 35 °C (95 °F) or more for two consecutive hours

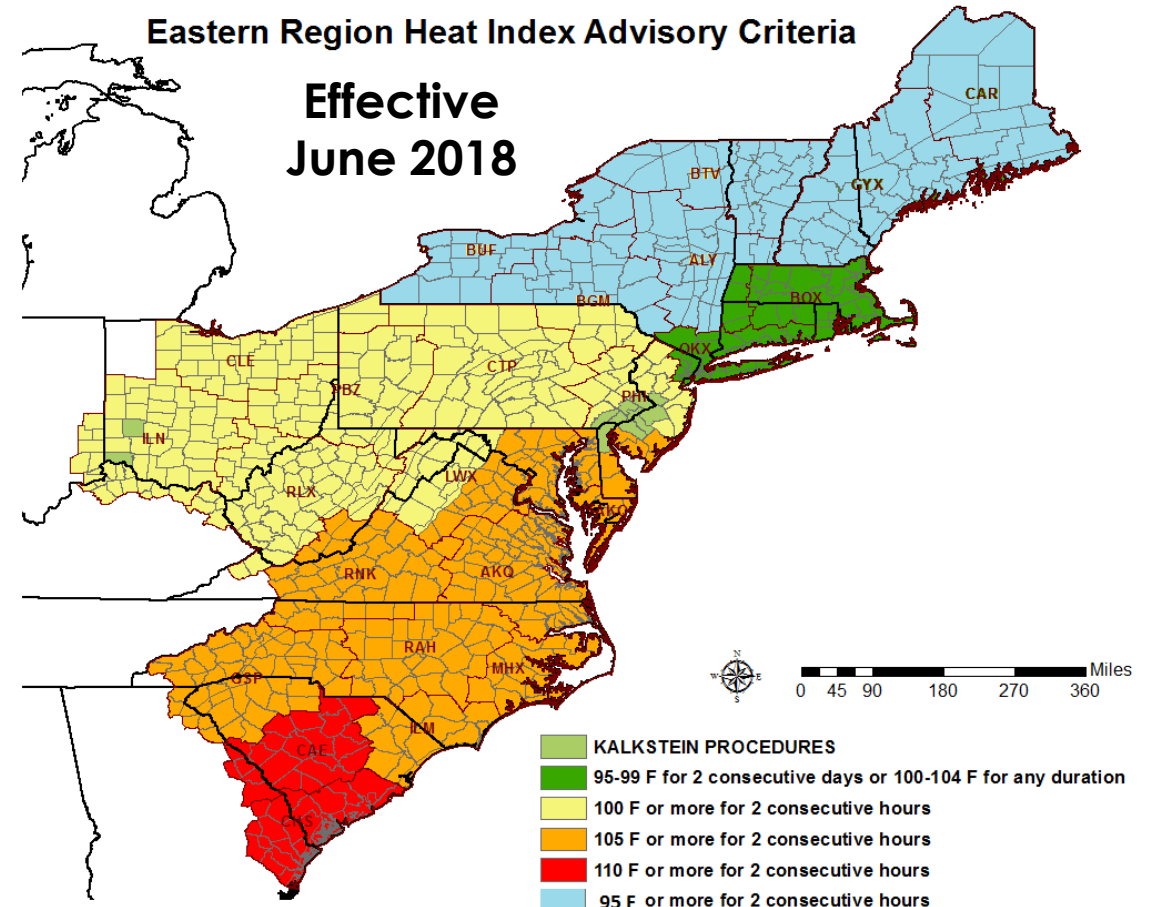
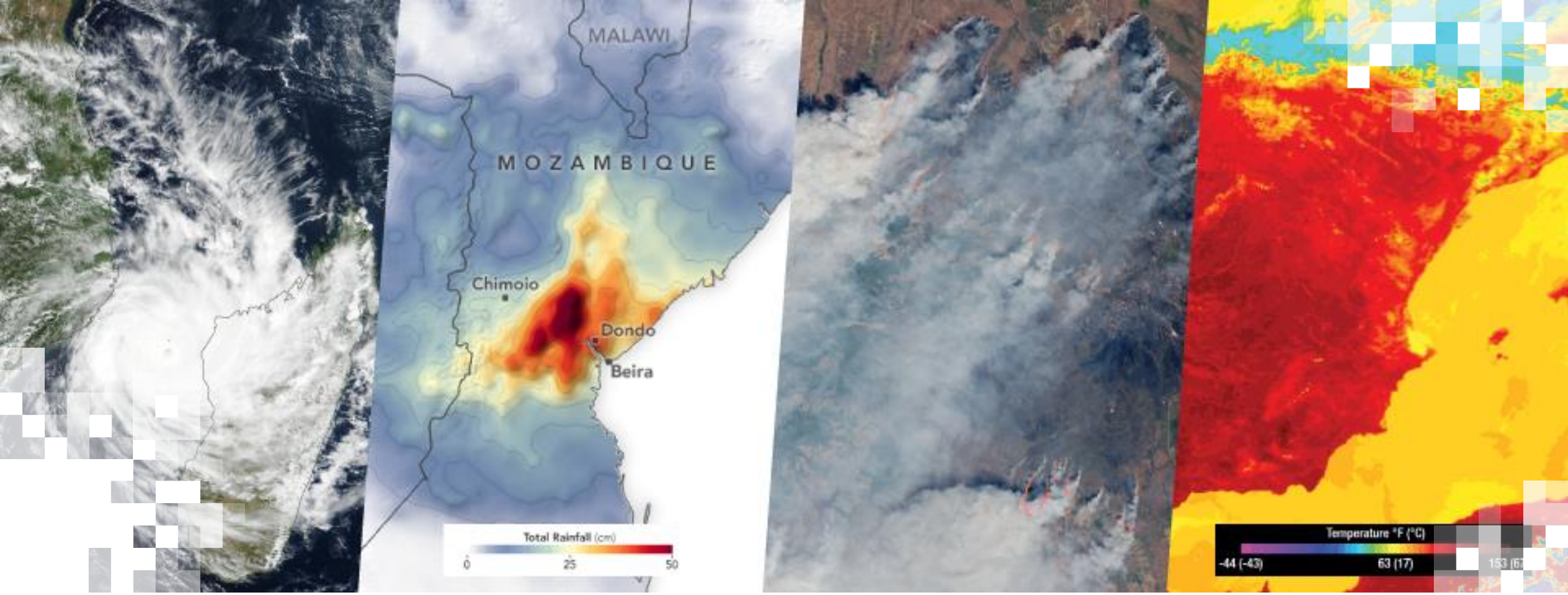


Image Credit: NWS offices, Albany





## Outreach and Communication

# New York State Heat & Health Infographic

<https://www.health.ny.gov/publications/6636.pdf>

## Heat and Health in New York State

New Yorkers are at risk of heat-related illness because summer temperatures are warming and our bodies are not used to long periods of extreme heat. County Heat and Health Profiles help identify populations and neighborhoods at highest risk. Learn more about extreme heat and what can be done to help people keep cool during the hottest days of the year.

### WHAT WE KNOW

Heat Exposure	Health Sensitivity	Community Vulnerability
Heat waves or extreme heat events are extended periods of high temperatures and can be harmful to health. Summer temperatures have been increasing across NYS and are expected to continue rising.	The risk of heat stress, dehydration, kidney illness, cardiovascular illness, and death increases for up to 4 days after a heat wave. Children, older adults, and those with preexisting conditions or participating in outdoor activities are at higher risk.	The community and its environment influence heat-related illness. Urban areas or communities with large populations, limited English proficiency, low income, and limited access to air conditioning are at higher risk.

### WHAT WE LEARNED

A 5° F change in temperature can double a New Yorker's risk of heat-related illness.

#### Rising Temperatures in New York State, 1981-2016

In the past decade average summer temperatures have risen by 1-2° F in most areas in the state.

Year Range	Average Temperature (°F)
1981-1985	77.3
1986-1990	76.8
1991-1995	78.6
1996-2000	77.3
2001-2005	77.4
2006-2010	78.6
2011-2016	81.2

#### Days with Max Temperature Above 95° F in New York State, 1981-2016

The number of days with maximum temperatures above 95° F in New York State has been increasing, putting New Yorkers at higher risk of heat-related illness.

Year Range	Number of Days
1981-1985	1
1986-1990	0
1991-1995	14
1996-2000	4
2001-2005	6
2006-2010	15
2011-2016	37

## WHAT TO DO ABOUT IT

Take steps to prevent heat-related illness

Know the risks and signs of heat-related illness.  
[www.health.ny.gov/extremeheat](http://www.health.ny.gov/extremeheat)

Check your local weather so you can be prepared.  
[www.weather.gov](http://www.weather.gov)

Find a place to get cool.  
[www.health.ny.gov/environmental/weather/cooling](http://www.health.ny.gov/environmental/weather/cooling)

Get involved in community planning.  
[www.climatesmart.ny.gov/](http://www.climatesmart.ny.gov/)



View your County's Heat and Health Profile at [www.health.ny.gov/ExtremeHeat](http://www.health.ny.gov/ExtremeHeat)



Department of Health

6636

Funded by the National Aeronautics and Space Administration's Research Opportunities in Space and Earth Sciences NASA ROSES- NNH13ZDA001N-Health

3/2019





# County Heat and Health Profiles

<https://www.health.ny.gov/environmental/weather/profiles/>

The screenshot shows the 'County Heat and Health Profile Reports' page on the New York State Department of Health website. The page features a navigation menu with 'Services', 'News', 'Government', and 'Local' options. The main content area is titled 'County Heat and Health Profile Reports' and includes a summary of the reports, a 'How to Use' section, and four detailed panels: 'Exposure: Heat', 'Sensitivity: Health', 'Vulnerability: Community', and 'Adaptive Capacity: What to Do'. Each panel contains a figure and explanatory text. The 'Exposure: Heat' panel includes a bar chart titled 'Rising Temperatures in New York State, 1981-2016'. The 'Sensitivity: Health' panel includes a bar chart showing hospitalization and emergency room visits. The 'Vulnerability: Community' panel includes a map of New York State. The 'Adaptive Capacity: What to Do' panel includes a map of New York City. The page also includes a sidebar with 'Heat and Health Profiles' and 'Related Links' sections.

**Department of Health** | Individuals/Families | Providers/Professionals | Health Facilities | Search

**Heat and Health Profiles** | You are Here: Home Page > Climate & Health Data & Research > County Heat and Health Profile Reports

## County Heat and Health Profile Reports

New Yorkers are at risk of heat-related illness because summer temperatures are warming and our bodies are not used to long periods of extreme heat. [County Heat and Health Profiles](#) help identify populations and neighborhoods at highest risk. The reports describe county temperature trends, summarize heat-related health effects, identify areas with populations at highest vulnerability to heat, and list some available adaptation resources. The County Heat and Health Profiles can help communities prepare for and prevent heat-related illness.

[County Heat and Health Profiles](#) | [NYS Heat and Health Infographic](#) | [NYC's Climate and Health Profile](#)

### How to Use County Heat and Health Profile Reports?

Local health departments, county emergency planning offices and local governments can use this information to support efforts towards mitigating the impacts of extreme heat. The county profiles provide a picture of temperature trends and future projections, heat-related health effects, population and environmental vulnerability to heat and availability of adaptation resources for each county, excluding New York City.

#### Exposure: Heat

**Rising Temperatures in New York State, 1981-2016**  
In the past decade average summer temperatures have risen by 5.2°F in most areas in the state.

Overall, temperatures and heat events across the state are expected to rise throughout the century.

Each county report summarize summertime temperature trends from 1979-2016. Graphs display number of days with maximum temperature of 90°F or more, increases over historical summertime average temperatures, and trends of monthly average temperatures from 1979 to 2016. Future temperature projections are also provided.

#### Sensitivity: Health

Exposure to high temperatures can cause heat-related illness and death and some people are more vulnerable.

Each county report summarizes rates of hospitalization and emergency room visits for heat-related health outcomes along with monthly average temperatures. Higher rates of heat related illness, cardiovascular diseases and renal diseases are observed as monthly temperatures rise.

#### Vulnerability: Community

A community's demographic makeup and environmental characteristics influence how heat impacts health.

Each county reports groups heat vulnerability factors into four categories: language vulnerability, socio-economic vulnerability, environmental and urban vulnerability, and older adult isolation and vulnerability. Together they estimate the county's overall [Heat Vulnerability Index](#). Identifying these community-level vulnerabilities to heat can help allocate adaptation resources more efficiently.

#### Adaptive Capacity: What to Do

Heat-related illness and deaths can be avoided by spending time in air conditioning.

Each county report highlights the importance of spending a few hours in a cool or air-conditioned place to reduce the impact of heat on health. Learn more about [New York State Cooling Assistance](#). In the absence of air-conditioning at home or work, cooling centers in the community are a valuable resource for cooling down during a heat wave. The profile contains links to information about [places to get cool in each county](#).

Questions or comments: [epht@health.ny.gov](mailto:epht@health.ny.gov) | Revised: March 2019

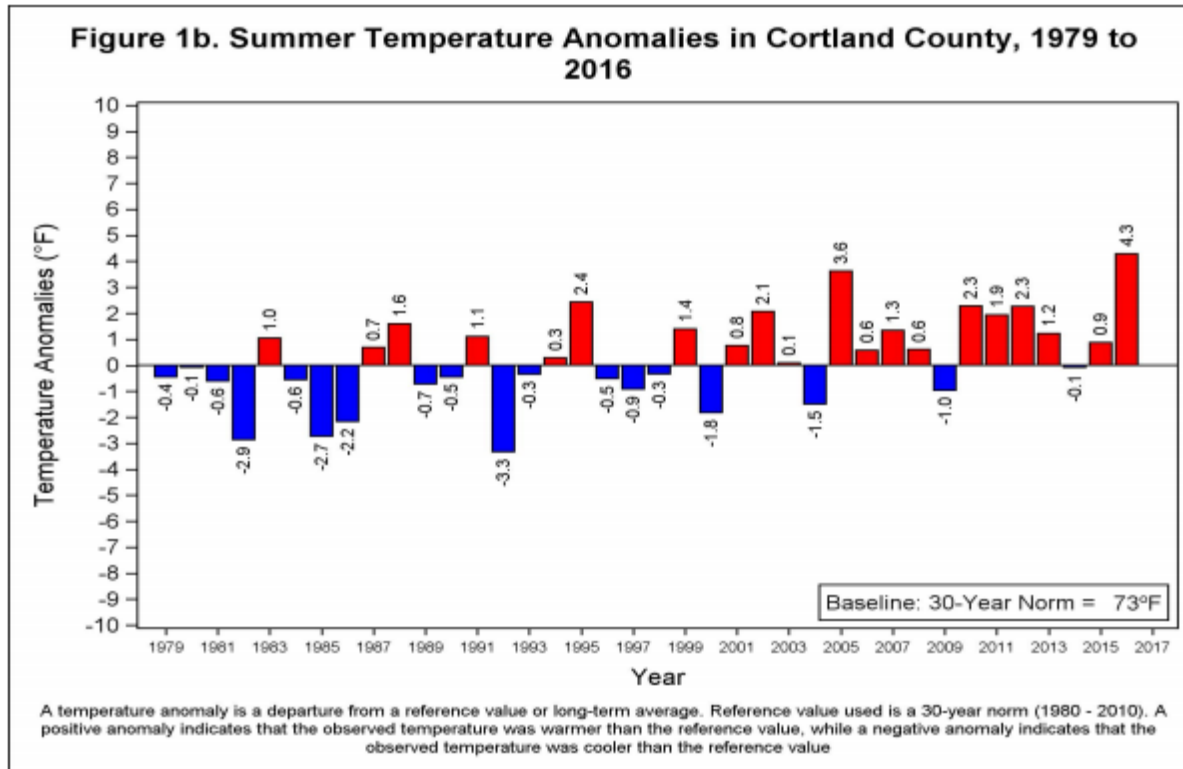
**Department of Health**

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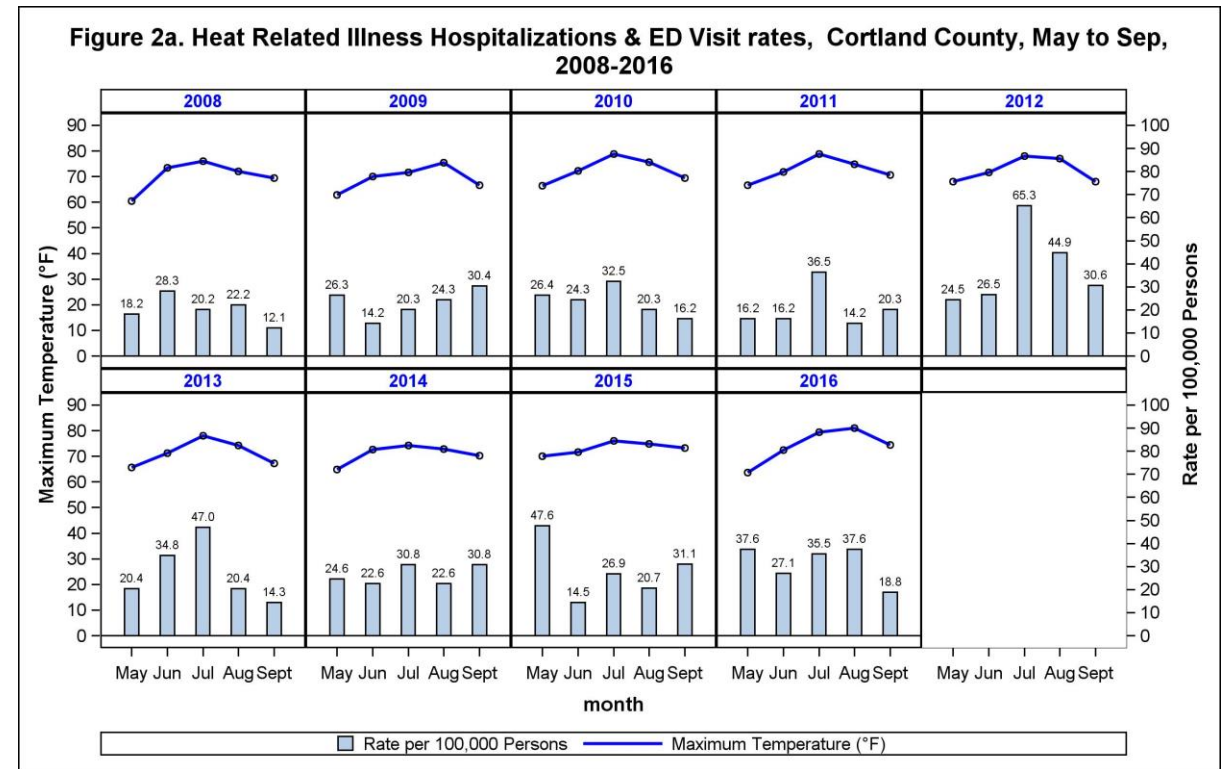


# County Heat and Health Profiles

## Exposure: Heat



## Sensitivity: Health



Satellite data allows NYS DOH to provide climate reports for each county in NYS



# EPHT Portal

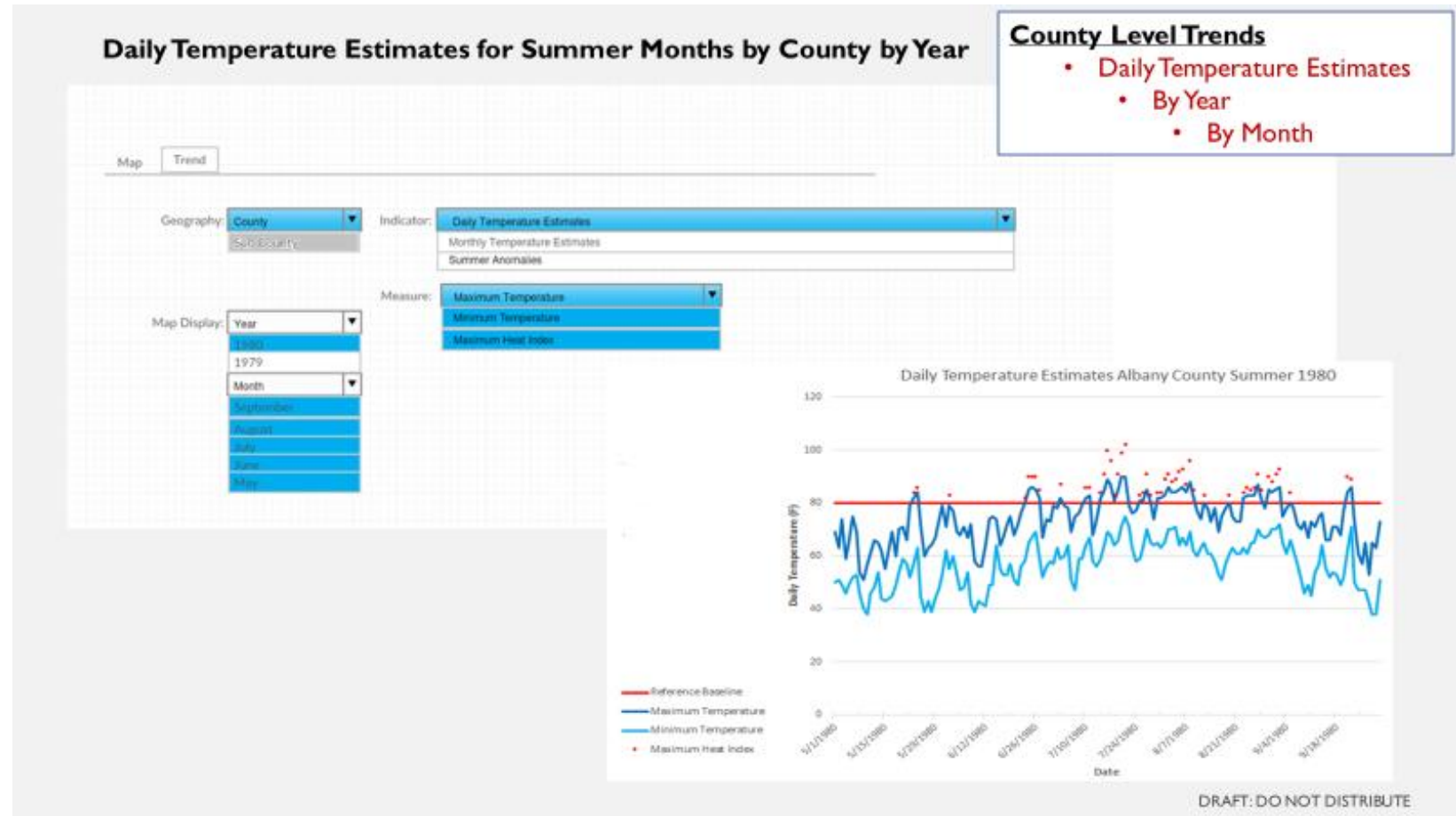
[https://www.health.ny.gov/environmental/public\\_health\\_tracking/](https://www.health.ny.gov/environmental/public_health_tracking/)

- New York's Environmental Public Health Tracking (EPHT) Program focuses on tracking environmental and health patterns and trends
- Environmental Public Health Tracking is a national program led by the Centers for Disease Control and Prevention (CDC)
- It is intended to improve access to environmental health information and support research, programs and policies that may help protect our communities

The screenshot shows the New York State Department of Health website for the Environmental Public Health Tracking program. At the top, there is a navigation bar with links for Services, News, Government, and Local, along with a Translate button. Below this is a purple header with 'Department of Health' and sub-sections for Individuals/Families, Providers/Professionals, Health Facilities, and Search. A breadcrumb trail indicates the current location: Home Page > Health and Safety in the Home Workplace and Outdoors > Environmental Public Health Tracking. The main heading is 'Environmental Public Health Tracking' with a New York State logo. A descriptive paragraph states that the program focuses on tracking environmental and health patterns and trends, and is a national program led by the CDC. Below the text are navigation tabs for About Tracking, Tracking Data, Tracking Resources, Tracking Projects, and Timely Topics. The 'Tracking Data' section is active, displaying a grid of 15 environmental health topics, each with a representative image and a label: Air Pollution, Asthma, Birth Defects, Birth Outcomes, Cancer, Carbon Monoxide, Childhood Lead, COPD, Drinking Water, Heat Stress, Heart Attacks, Occupational Health, and Radon.

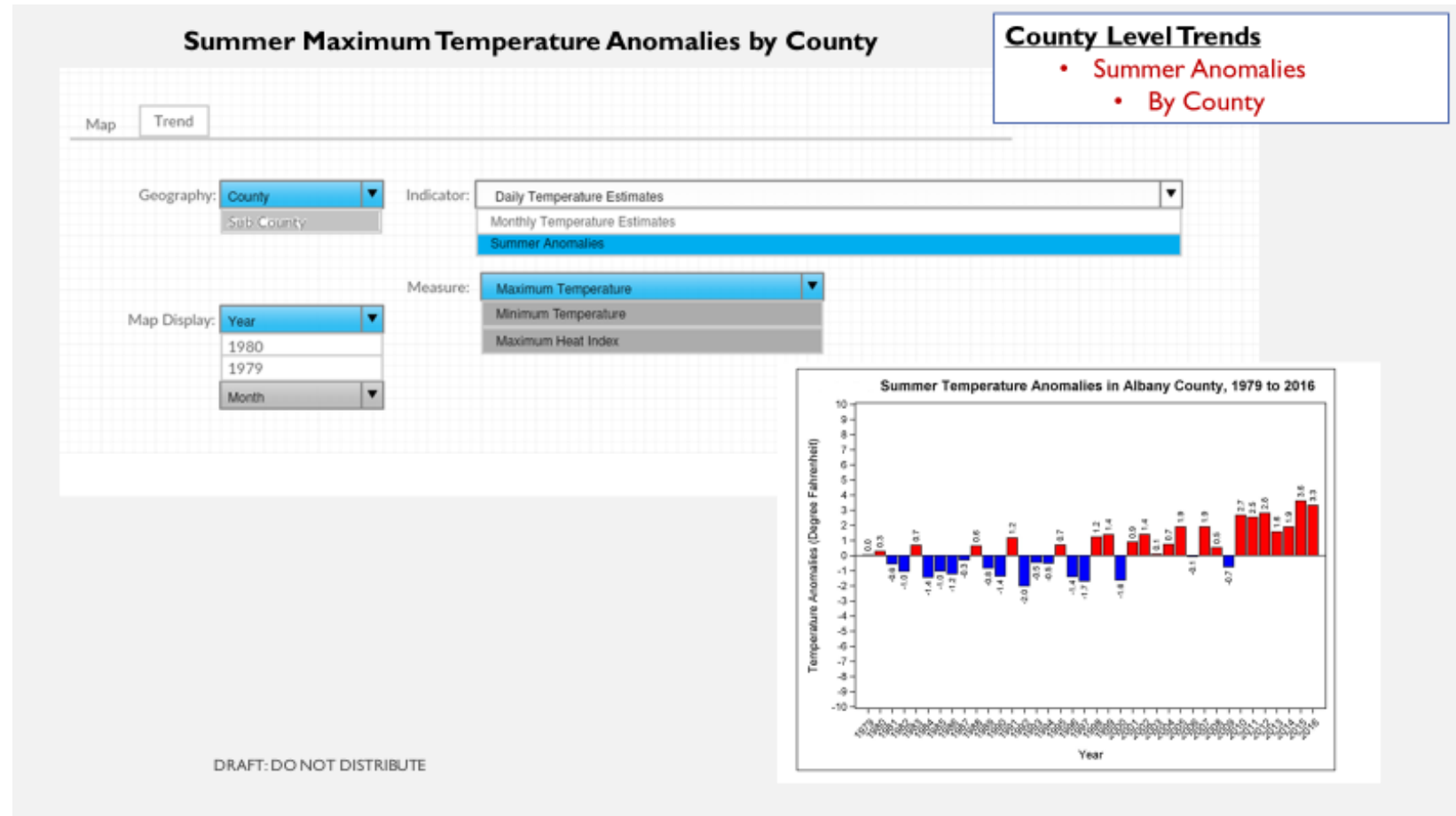
# EPHT Subcounty Portal

- Currently under development
- Satellite/Reanalysis data allows development of region specific climate indicators
- Indicators include:
  - Daily Temperature Estimates (by month and year)-derived from 12 km NLDAS



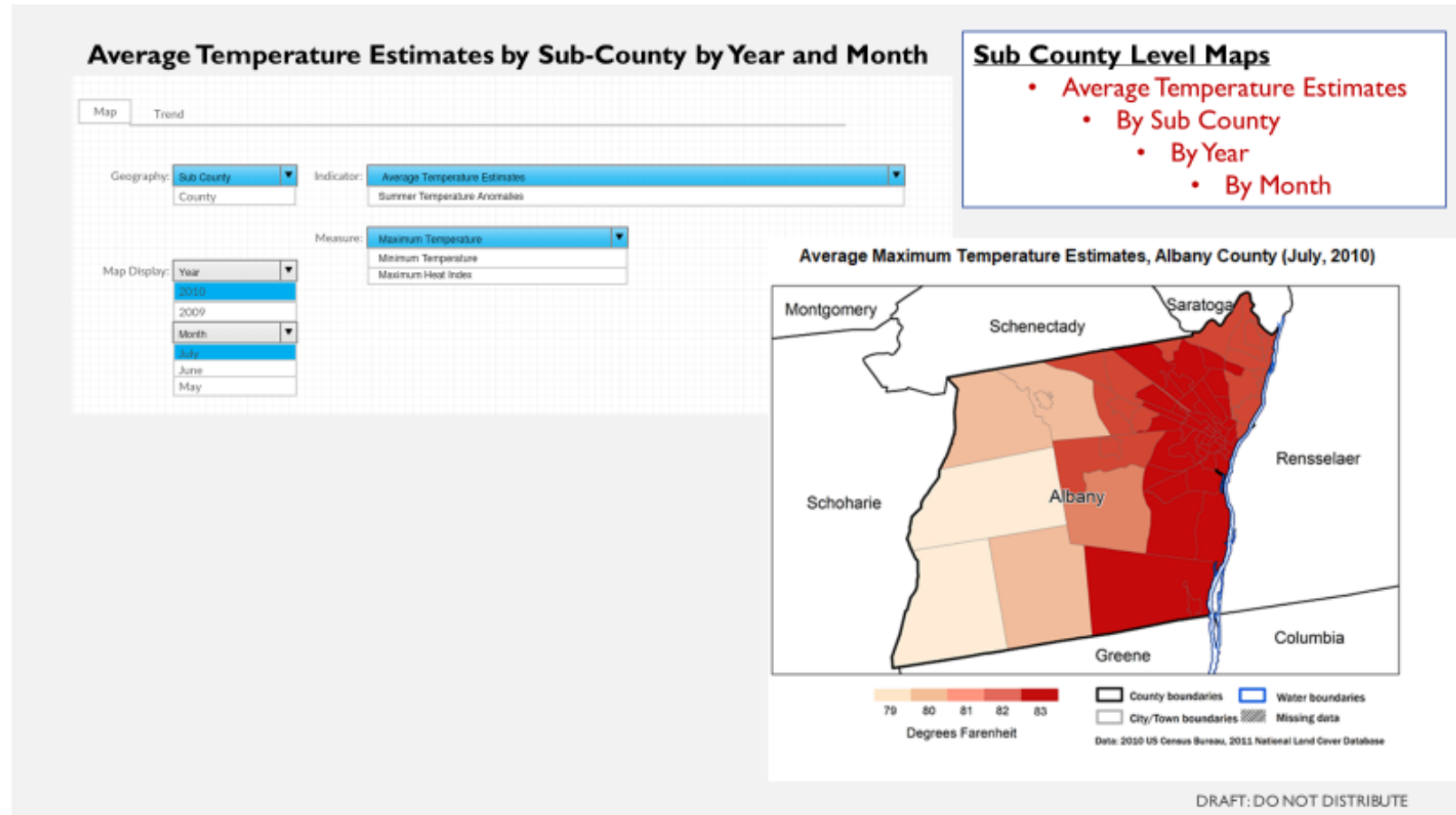
# EPHT Subcounty Portal

- Currently under development
- Indicators include:
  - Summer Anomalies (May through September)-derived from county level estimates of 12 km NLDAS



# EPHT Subcounty Portal

- Currently under development
- Indicators include:
  - Average Temperature (by month and year)
  - census tract estimates derived from 12 km NLDAS



# Apply for Heating and Cooling Assistance (HEAP)

Need help paying your energy bill? Low-income New Yorkers can apply for heating and cooling assistance under the Home Energy Assistance Program, or HEAP.



**Apply for HEAP**

**Vendor Information**

You may be eligible for a Cooling Assistance HEAP benefit if:

- Your household's gross monthly income is at or below the current income guidelines for your household size as posted in the following table, or
- You receive Supplemental Nutrition Assistance Program (SNAP) benefits, or
- You receive Temporary Assistance (TA), or
- You receive Code A Supplemental Security Income (SSI Living Alone), and
- You and your household members are United States Citizens or qualified aliens, and
- Includes an individual with a documented medical condition that is exacerbated by heat, and
- You received a Regular benefit greater than \$21 in the current program year, and
- You currently do not have a working air conditioner or the air conditioner you have is five years old or older, and
- You did not receive a HEAP funded air conditioner within the past ten years.

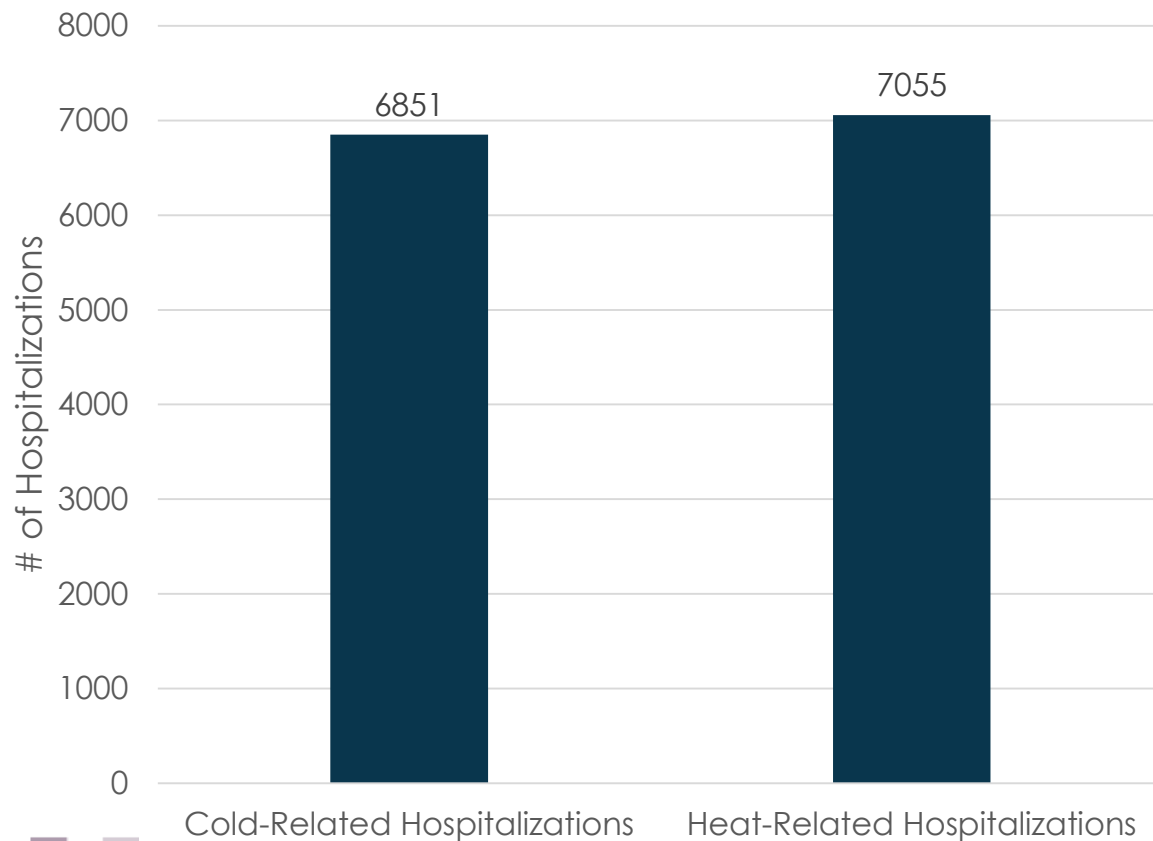
Your household eligibility requirements include filing an application with your local department of social services, providing all necessary documentation, and the household must reside in an eligible living situation.



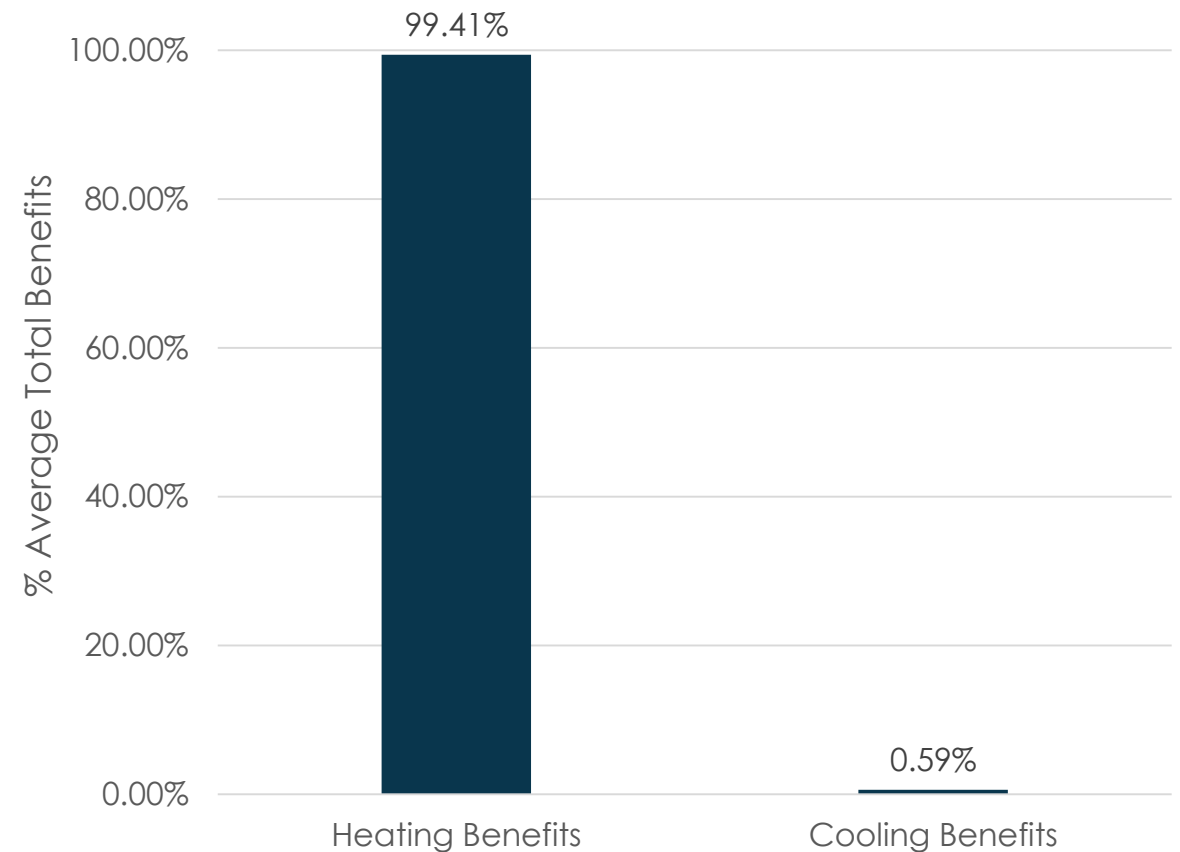
# Office of Temporary Disability Assistance – Home Energy Assistance Program

## Distribution of HEAP Benefits and Illness

NYS Cold vs. Heat-Related Hospitalizations, 2012-2016

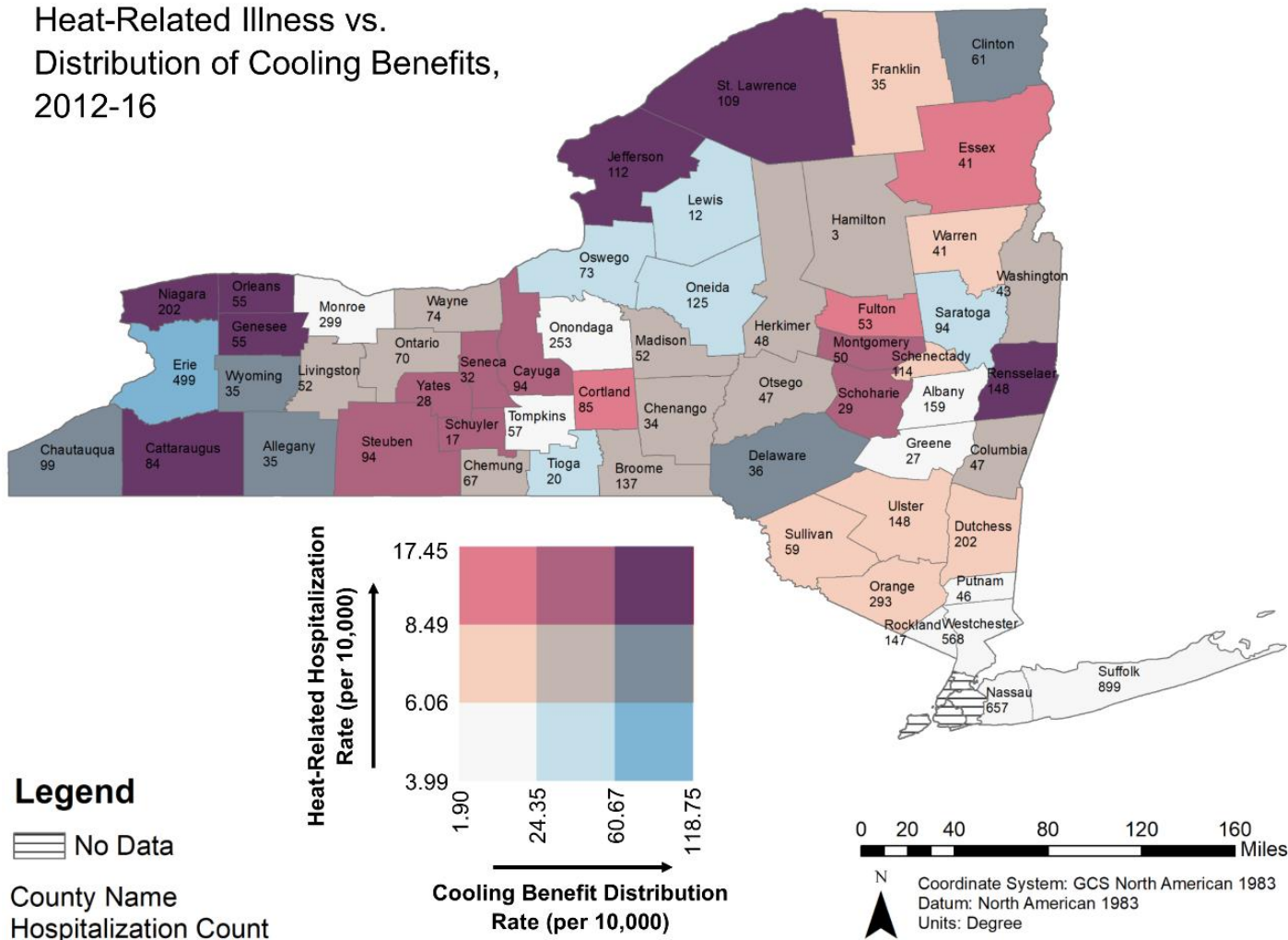


% Average Total Benefits, 2015-2016



# Heat-Related Illness vs. Distribution of Cooling Benefits

Heat-Related Illness vs.  
Distribution of Cooling Benefits,  
2012-16

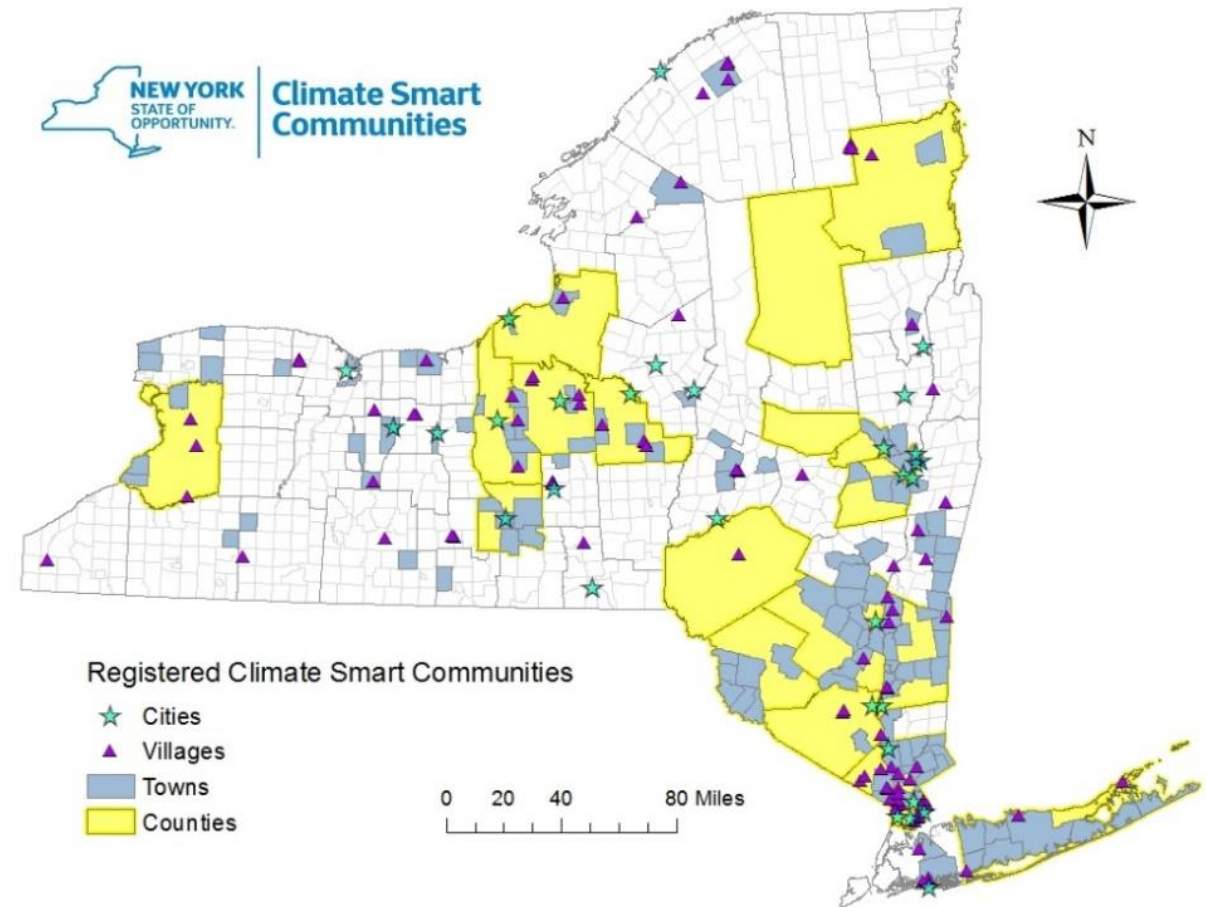


An additional **\$3.5 million** was allocated to the cooling budget after analysis of funding trends and projected utilization

# Climate Smart Communities

<https://climatesmart.ny.gov/>

- Climate Smart Communities (CSC) is a New York State program that helps local governments take action to reduce greenhouse gas emissions and adapt to a changing climate. Benefits include leadership recognition, free technical assistance, and access to grants.
- Satellite data can be used to estimate local climate trends, health benefits of climate change mitigation and assess local areas of high vulnerabilities



# Avenues for Outreach

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June 22, 2018  
**NASA Helps New Yorkers Cope with Summer Swelter**

Just ahead of the start of astronomical summer on June 21, New York State officially lowered the heat advisory threshold for alerting citizens statewide of the health impacts of upcoming heat waves due in part to NASA-supported research and satellite data.



NASA  
**ARSET**  
 Applied Remote Sensing Training

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Advanced Webinar: Methods in Using NASA Remote Sensing for Health Applications

**New York State Lowers the Heat Advisory Threshold**  
 HEAT  
 JUN 26, 2018



**PUBLIC HEALTH 3.0**  
 Innovating & Transforming  
 Public Health Partnership Conference  
 NYSPPH 69th Annual Meeting  
 NYSACHO 2019 Annual Meeting  
**May 1-3 | Greek Peak Mountain Resort | Cortland, NY**

**NYSACC**  
 NEW YORK STATE ASSOCIATION OF CONSERVATION COMMISSIONS  
**2017 Conference on the Environment**  
 November 17-18, 2017 | Kingston, NY



**APHA 2017**  
 ANNUAL MEETING & EXPO  
 ATLANTA | NOV. 4-8



**2019 Northeast Epidemiology Conference**





Draft version

# Climate Change and Health in New York State

Focus: Extreme Heat and Human Health





Department of Health



# Thank You

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