



Department
of Health

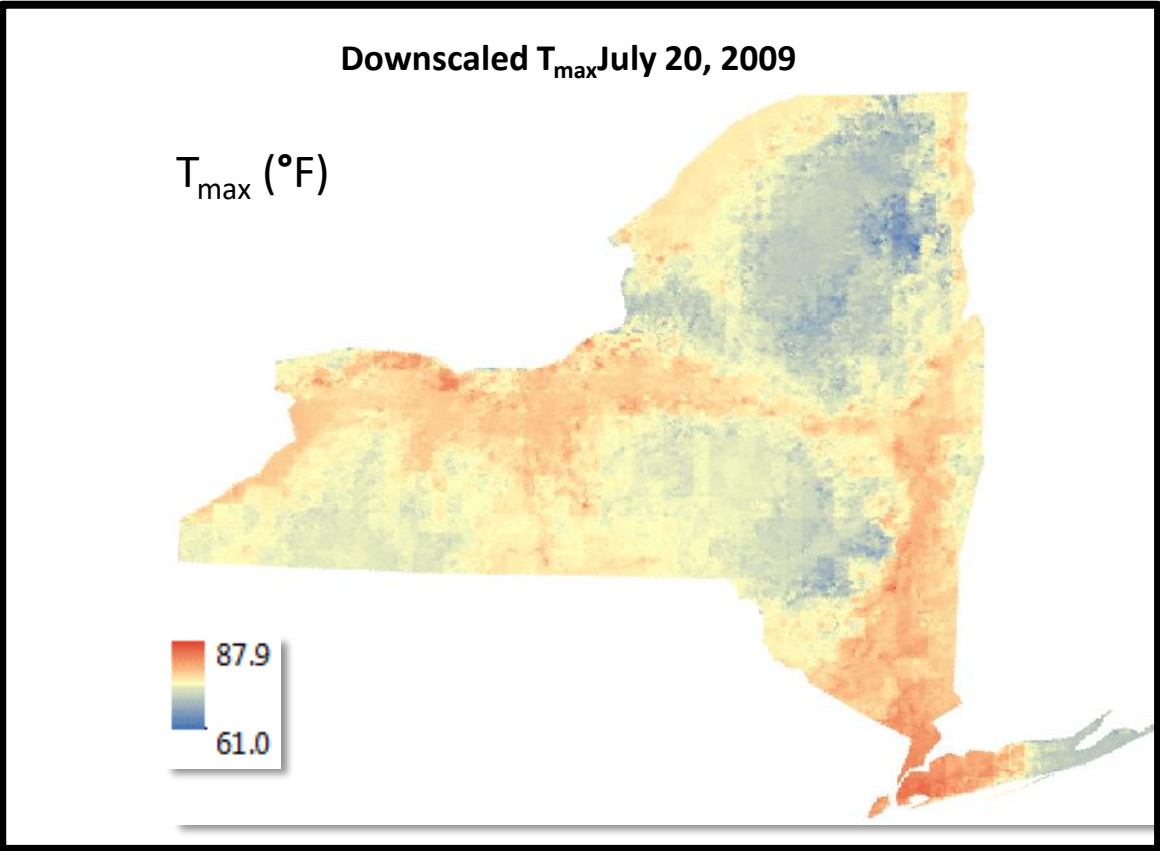
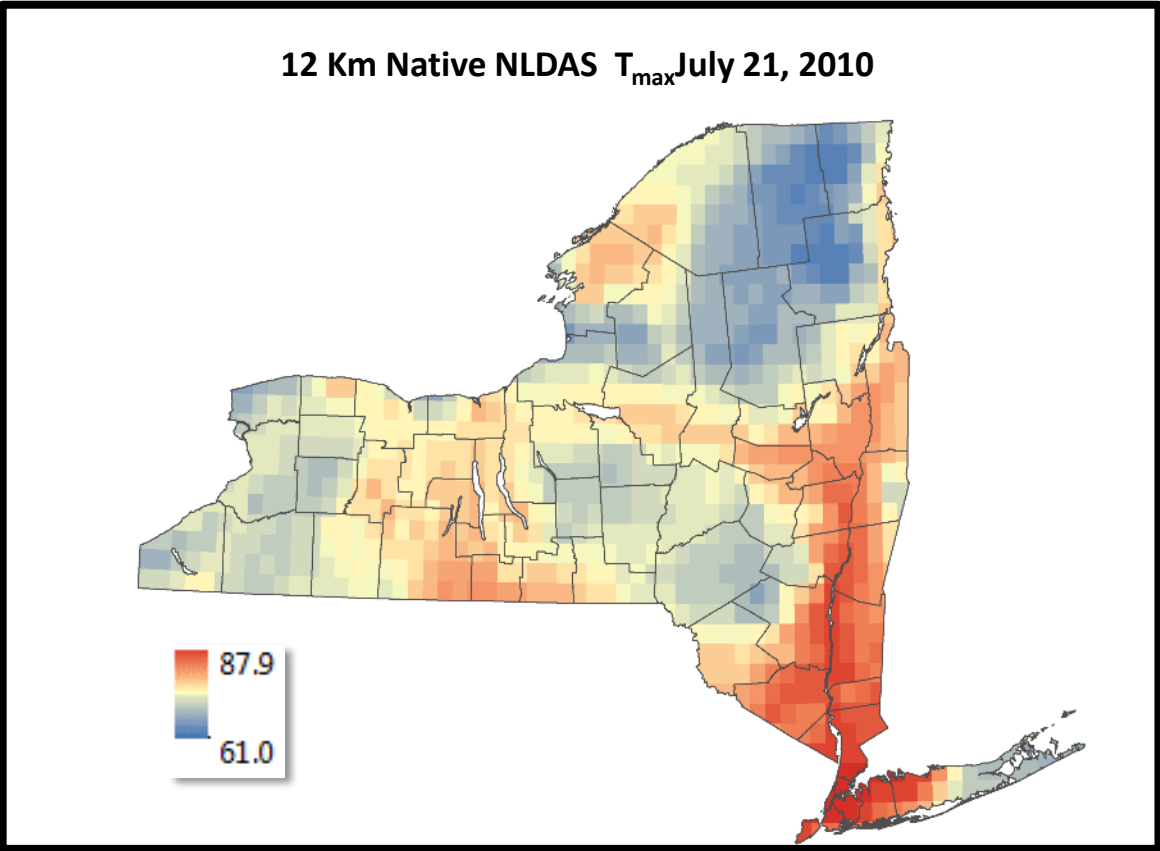


Utilizing Satellite Data in Climate Health Surveillance and Mitigation

Building Resilience Against Climate Effects



NLDAS Datasets for New York



Down-scaling NLDAS air temperature to MODIS scale

➤ Rationale:

- NLDAS is a meteorological re-analysis providing hourly air temperature and other variables on a $1/8^\circ$ (~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.
- 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 T_{\max} or T_{\min} is given by:

$$T_{\text{DIS}} = T_{\text{LR}} + Z_{\text{HR}} \cdot \sigma_{\text{LR}}$$

where Z_{HR} is the standardized LST departure, given by:

$$Z_{\text{HR}} = (T_{\text{HR}} - T_{\text{HR,mean}}) / \sigma_{\text{HR}}$$

and T_{HR} = high-resolution (MODIS) LST, and $T_{\text{HR,mean}}$ and σ_{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).

12km NLDAS Maximum Temperature Product

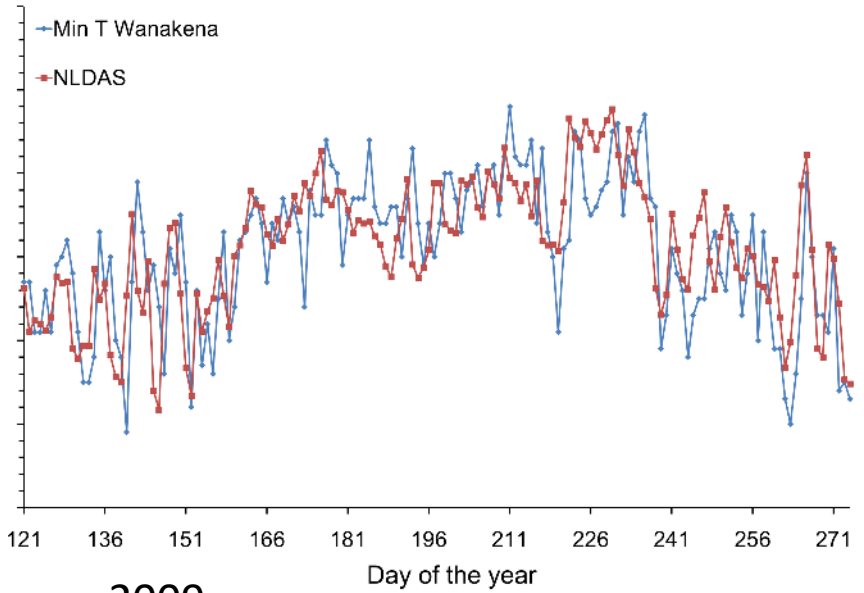
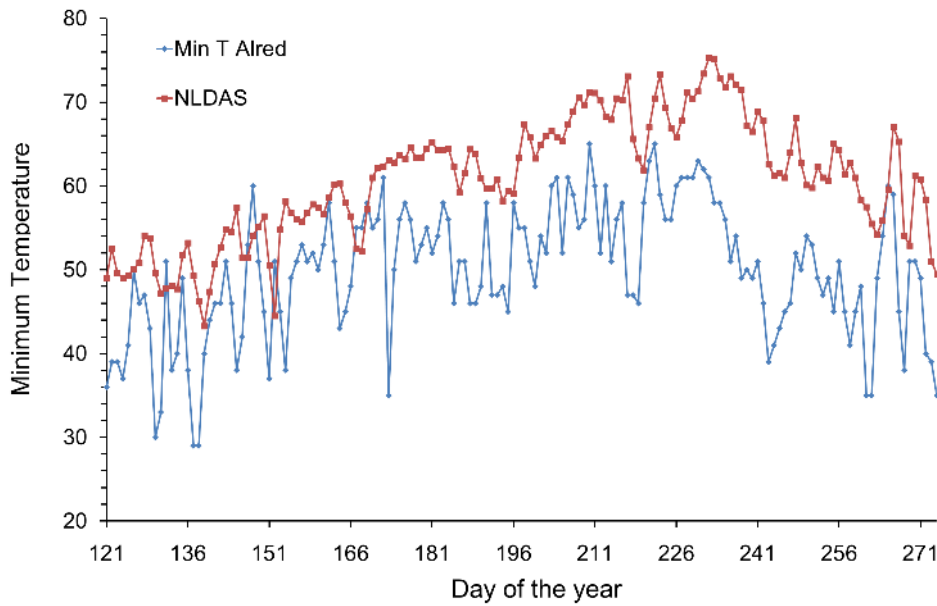
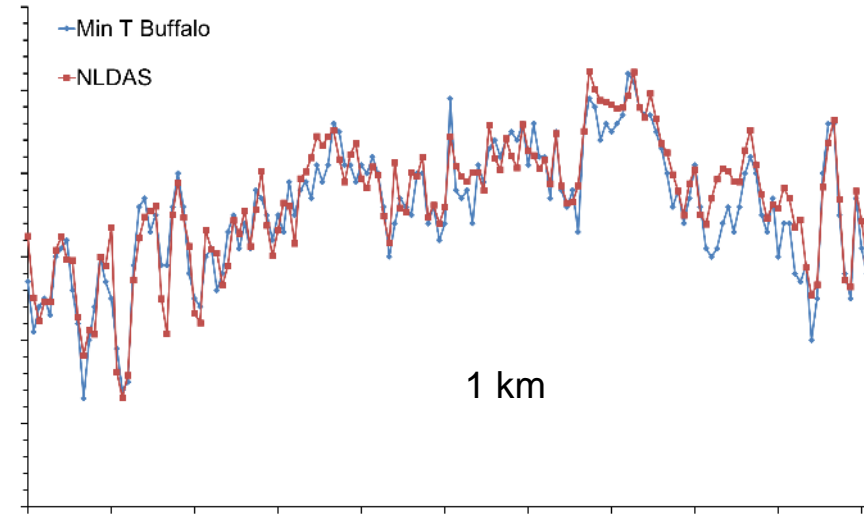
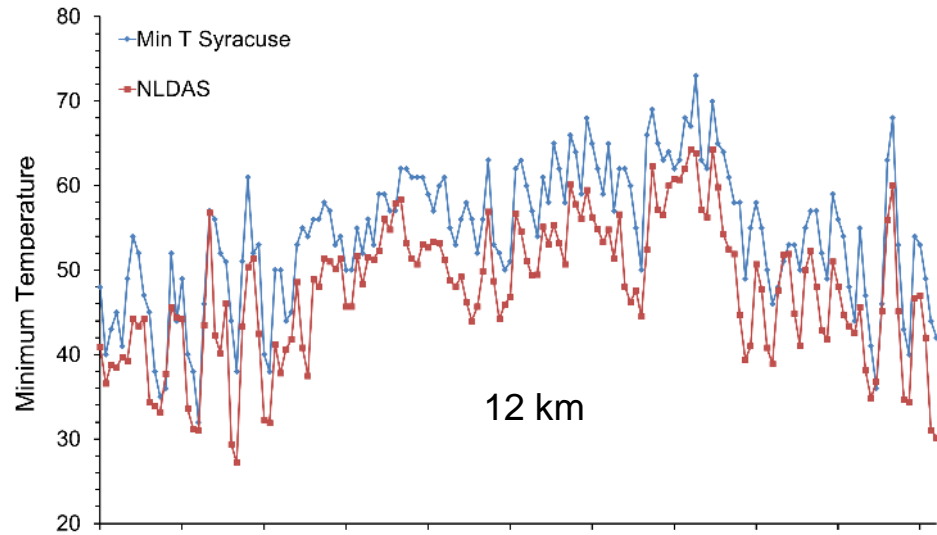
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Dansville	0.93	0.86	Hemlock	0.91	0.8	Binghampton	0.92	0.85
Indian Lake	0.92	0.85	Syracuse	0.89	0.8	Syracuse	0.92	0.84
Ithaca	0.92	0.85	Rochester	0.88	0.8	Rochester	0.92	0.84
Tupper	0.91	0.84	Oswego	0.88	0.8	Hemlock	0.91	0.83
Cooperstown	0.89	0.79	Albany	0.85	0.7	Oswego	0.90	0.81
Elmira	0.86	0.74	Lake Placid	0.85	0.7	Cooperstown	0.90	0.81
Norwich	0.85	0.73	Binghampton	0.84	0.7	Fredonia	0.89	0.80
Oswego	0.85	0.72	Fredonia	0.84	0.7	Lake Placid	0.88	0.77
Fredonia	0.85	0.72	Cooperstown	0.84	0.7	Albany	0.84	0.71
Dannemora	0.84	0.71	Poughkeepsie	0.75	0.6	Poughkeepsie	0.84	0.70
Canton	0.82	0.68	Batavia	0.74	0.6	Batavia	0.84	0.70
Mohonk Lake	0.80	0.65	Buffalo	0.74	0.6	Buffalo	0.82	0.67
Lake Placid	0.80	0.63	Indian Lake	0.73	0.5	Mohonk Lake	0.79	0.62
Hemlock	0.78	0.61	Ithaca	0.73	0.5	Angelica	0.79	0.62
Poughkeepsie	0.77	0.60	Ogdensburg	0.70	0.5	Watertown	0.78	0.61
NYC Park	0.76	0.59	Dannemora	0.69	0.5	NYC Park	0.77	0.59
Batavia	0.76	0.58	Stillwater	0.69	0.5	Ithaca	0.76	0.58
Dobbs Ferry	0.76	0.58	Mohonk Lake	0.66	0.4	Dannemora	0.76	0.58
WestPoint	0.75	0.56	Canton	0.66	0.4	Dobbs Ferry	0.74	0.55
Port Jarvis	0.75	0.56	Dansville	0.64	0.4	Wanakena	0.72	0.52
Albany	0.75	0.56	Dobbs Ferry	0.64	0.4	Tupper	0.71	0.50
Rochester	0.74	0.54	Port Jarvis	0.63	0.4	Indian Lake	0.71	0.50
Lawrenceville	0.73	0.53	Angelica	0.62	0.4	Ogdensburg	0.68	0.46
Binghampton	0.72	0.52	NYC Park	0.62	0.4	Elmira	0.65	0.42
Syracuse	0.72	0.51	Elmira	0.58	0.3	Norwich	0.64	0.41
Buffalo	0.66	0.44	Norwich	0.58	0.3	Port Jarvis	0.62	0.39
Angelica	0.62	0.39	Alred	0.57	0.3	Stillwater	0.62	0.38
Alred	<u>0.59</u>	0.35	Watertown	0.57	0.3	WestPoint	<u>0.58</u>	0.34
Avg.	0.79		Wanakena	0.56	0.3	Avg.	0.78	
			Tupper	0.52	0.3			
			WestPoint	<u>0.48</u>	0.2			
			Avg.	0.71				

Note: Bold is ASOS station

1km Downscaled Maximum Temperature Product

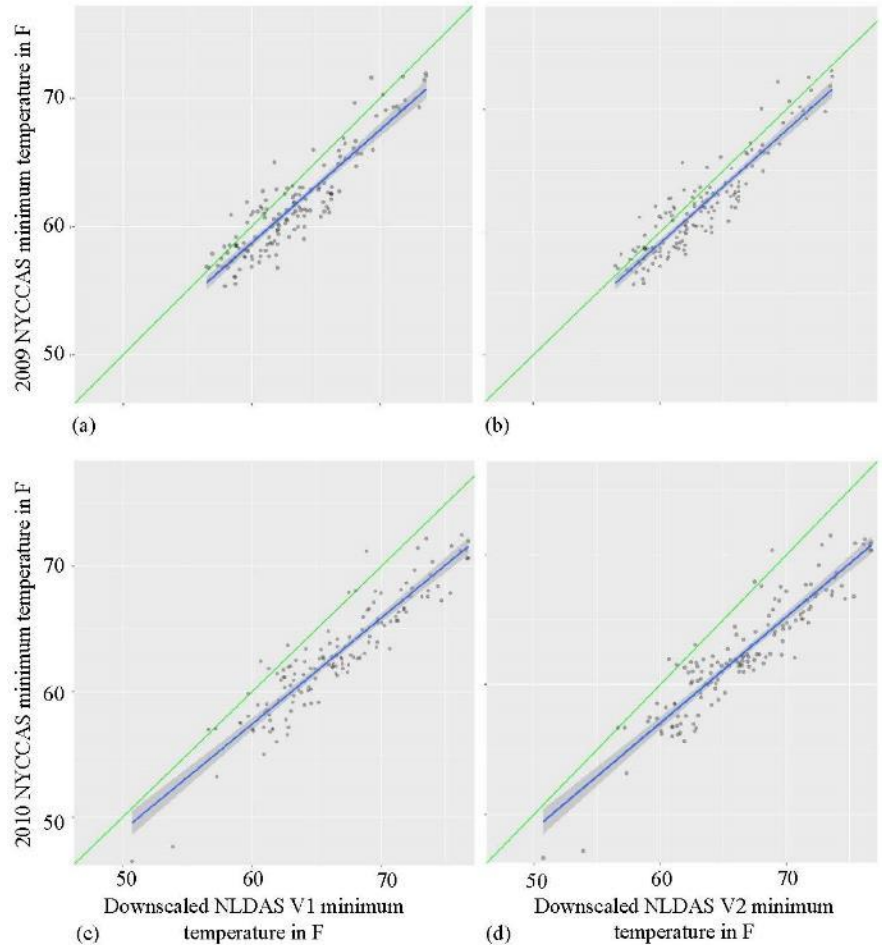
2006			2009			2010		
Station	r	r ²	Station	r	r ²	Name	r	r ²
Rochester	0.97	0.93	Syracuse	0.94	0.89	Albany	0.96	0.93
Albany	0.95	0.91	Rochester	0.94	0.89	Syracuse	0.96	0.92
Syracuse	0.95	0.91	NYC Park	0.93	0.87	Binghampton	0.96	0.92
NYC Park	0.95	0.90	Buffalo	0.93	0.86	Buffalo	0.96	0.92
Dobbs Ferry	0.94	0.89	Binghampton	0.92	0.85	NYC Park	0.95	0.91
Poughkeepsie	0.94	0.88	Albany	0.92	0.84	Rochester	0.95	0.91
Hemlock	0.94	0.88	Poughkeepsie	0.91	0.84	Cooperstown	0.94	0.89
Oswego	0.94	0.88	Hemlock	0.91	0.82	Poughkeepsie	0.94	0.89
Angelica	0.93	0.86	Batavia	0.90	0.81	Batavia	0.94	0.88
Buffalo	0.93	0.86	Oswego	0.89	0.79	Hemlock	0.92	0.84
Lawrenceville	0.92	0.86	Alred	0.89	0.79	Fredonia	0.91	0.83
Port Jarvis	0.92	0.84	Dobbs Ferry	0.88	0.77	Lake Placid	0.90	0.82
Lake Placid	0.92	0.84	Dannemora	0.87	0.76	Oswego	0.90	0.81
Alred	0.91	0.82	Angelica	0.87	0.75	Dobbs Ferry	0.89	0.80
Fredonia	0.91	0.82	Lake Placid	0.86	0.74	Dannemora	0.88	0.78
Batavia	0.90	0.81	Cooperstown	0.86	0.74	Mohonk Lake	0.87	0.76
Dannemora	0.90	0.81	Fredonia	0.86	0.74	Angelica	0.86	0.75
Mohonk Lake	0.89	0.80	Mohonk Lake	0.83	0.69	Watertown	0.75	0.57
Cooperstown	0.82	0.67	Port Jarvis	0.82	0.67	Indian Lake	0.75	0.57
WestPoint	0.82	0.67	Watertown	0.76	0.57	Wanakena	0.74	0.55
Dansville	0.80	0.65	Indian Lake	0.74	0.55	Ogdensburg	0.73	0.53
Ithaca	0.80	0.64	Canton	0.73	0.54	Tupper	0.72	0.51
Elmira	0.80	0.64	Ogdensburg	0.73	0.53	WestPoint	0.71	0.51
Indian Lake	0.79	0.63	Tupper	0.73	0.53	Norwich	0.71	0.50
Norwich	0.79	0.62	Ithaca	0.71	0.51	Ithaca	0.71	0.50
Tupper	0.74	0.55	Stillwater	0.67	0.45	Port Jarvis	0.70	0.50
Canton	<u>0.73</u>	0.53	Norwich	0.67	0.45	Elmira	0.68	0.46
Avg.	0.88		Elmira	0.67	0.45	Stillwater	<u>0.64</u>	0.41
			Dansville	0.64	0.41	Avg.	0.84	
			WestPoint	0.64	0.41			
			Wanakena	<u>0.57</u>	0.33			
			Avg.	0.81				





2009

New York City Validation



Down-scaled 1 km grid

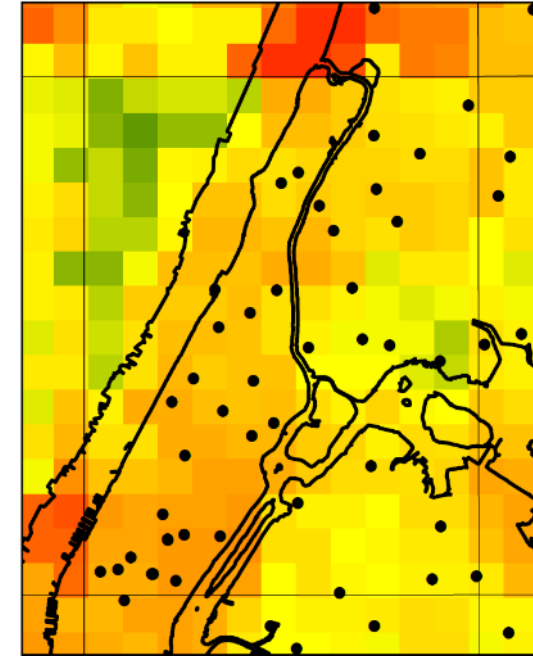
High temperature

Low temperature

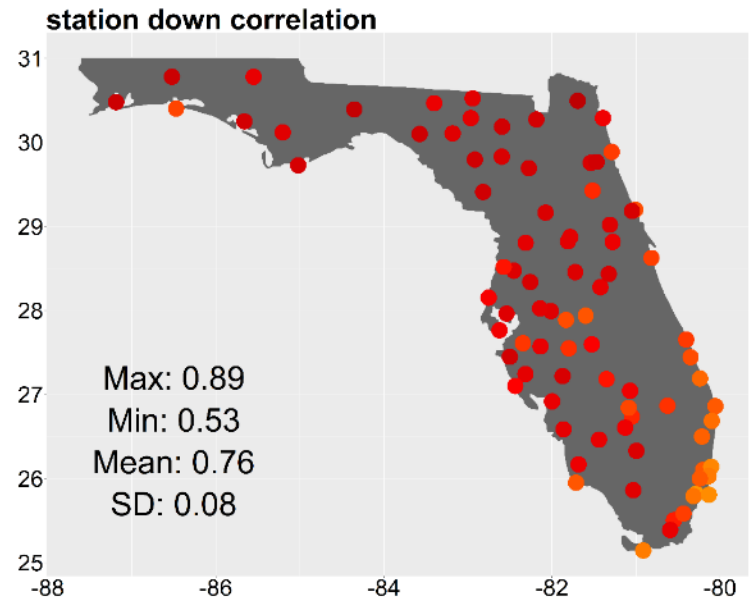
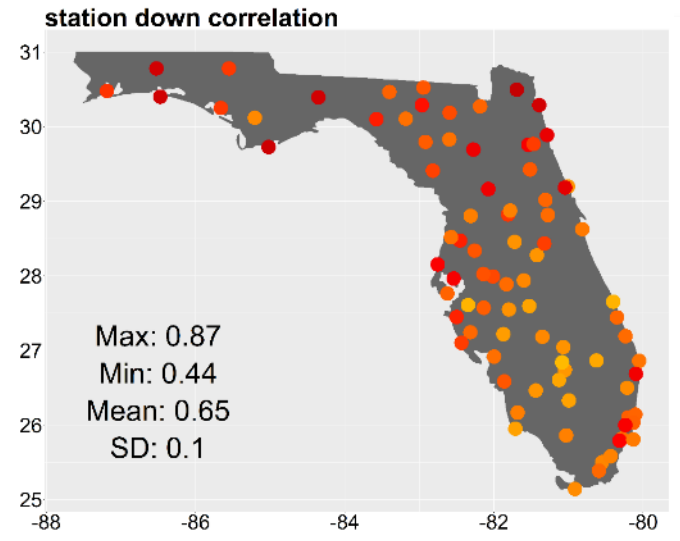
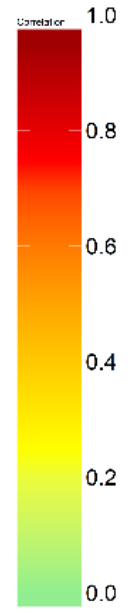
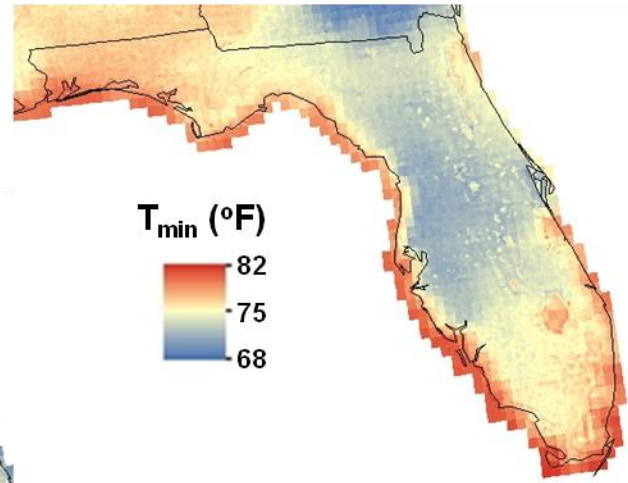
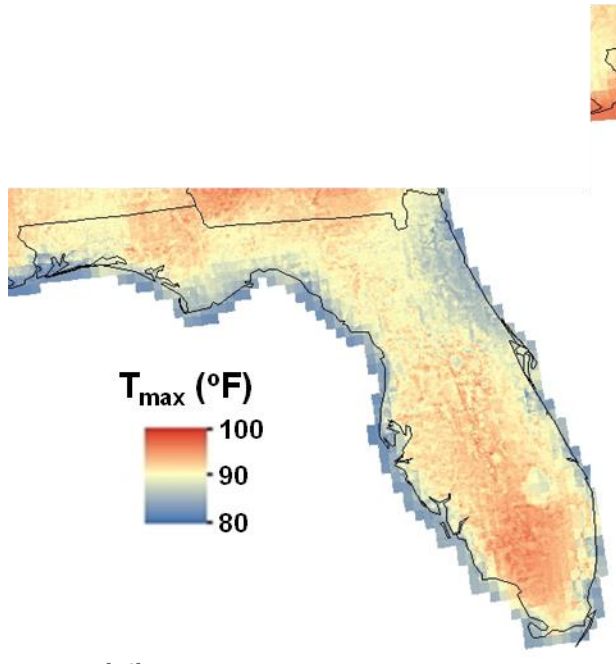
• NYCCAS Ground Stations

~12 km NLDAS grid cell

New York City boundaries



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.

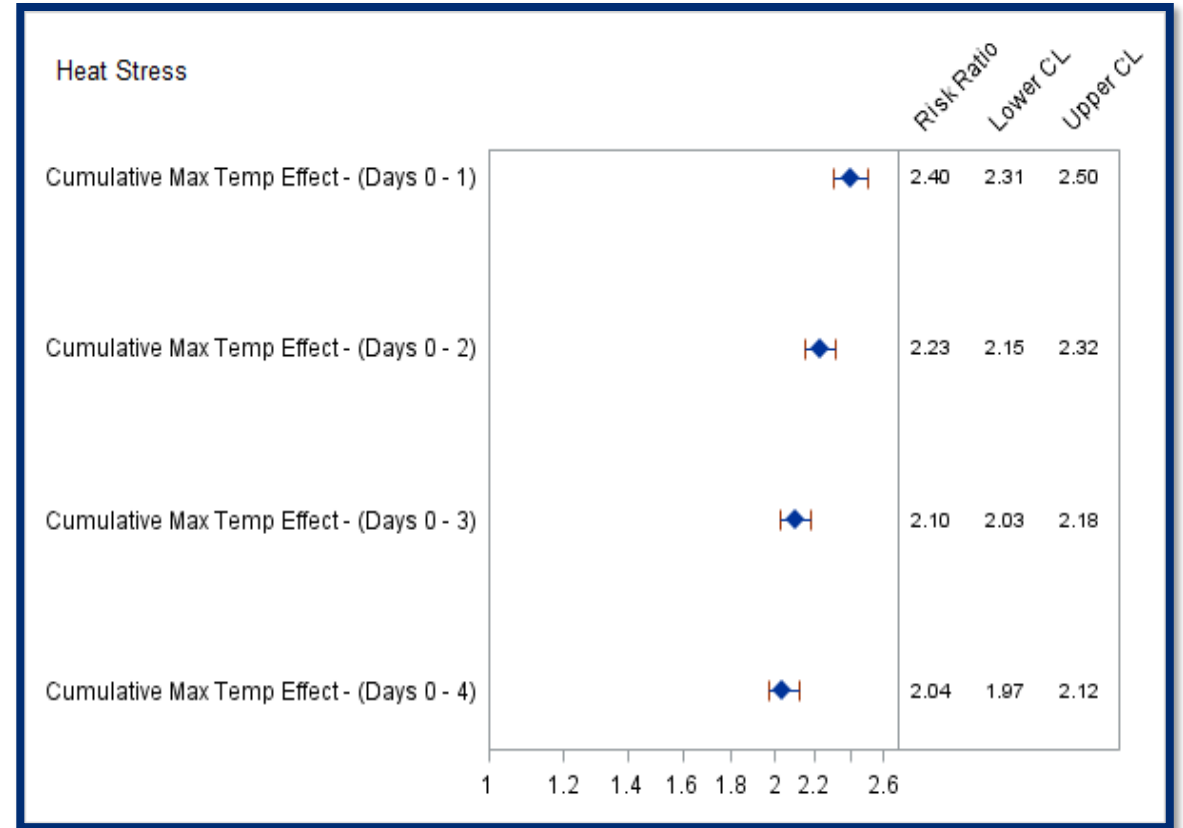
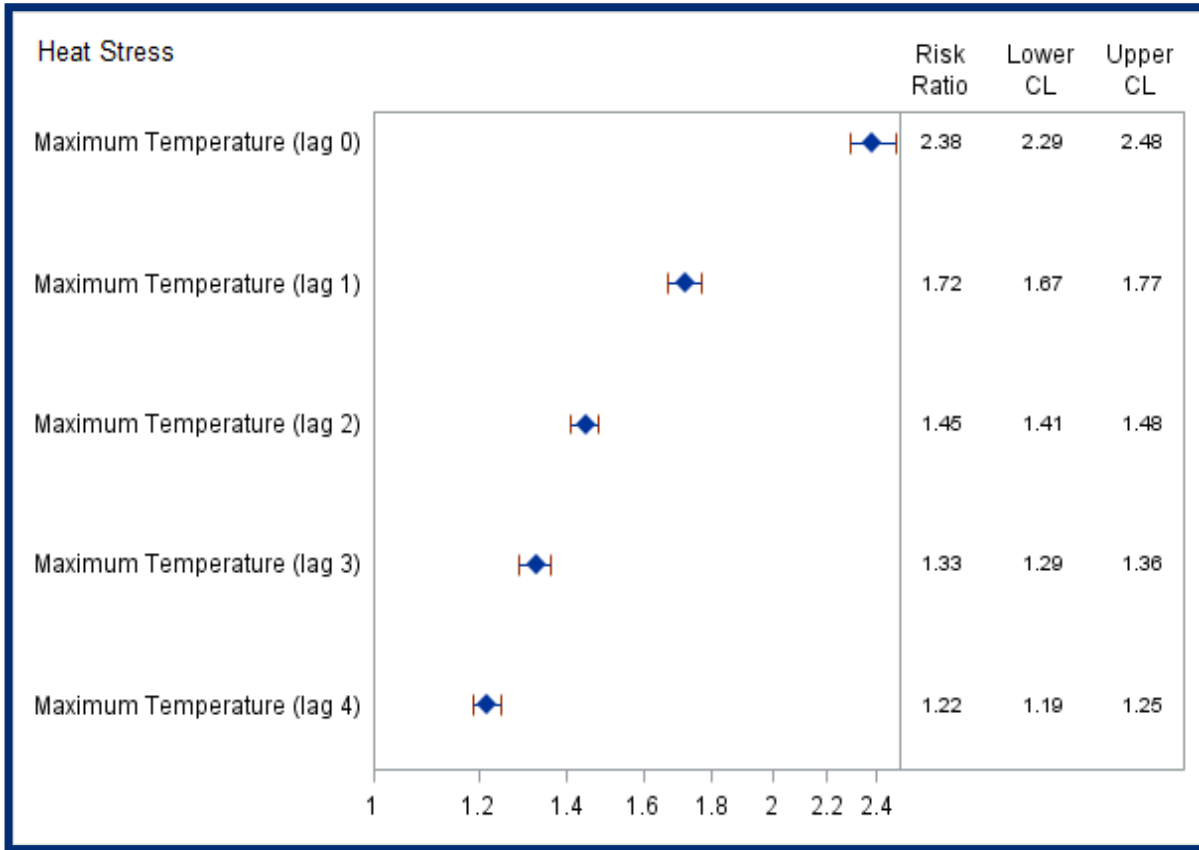


Health- Analysis

Case-Crossover Design

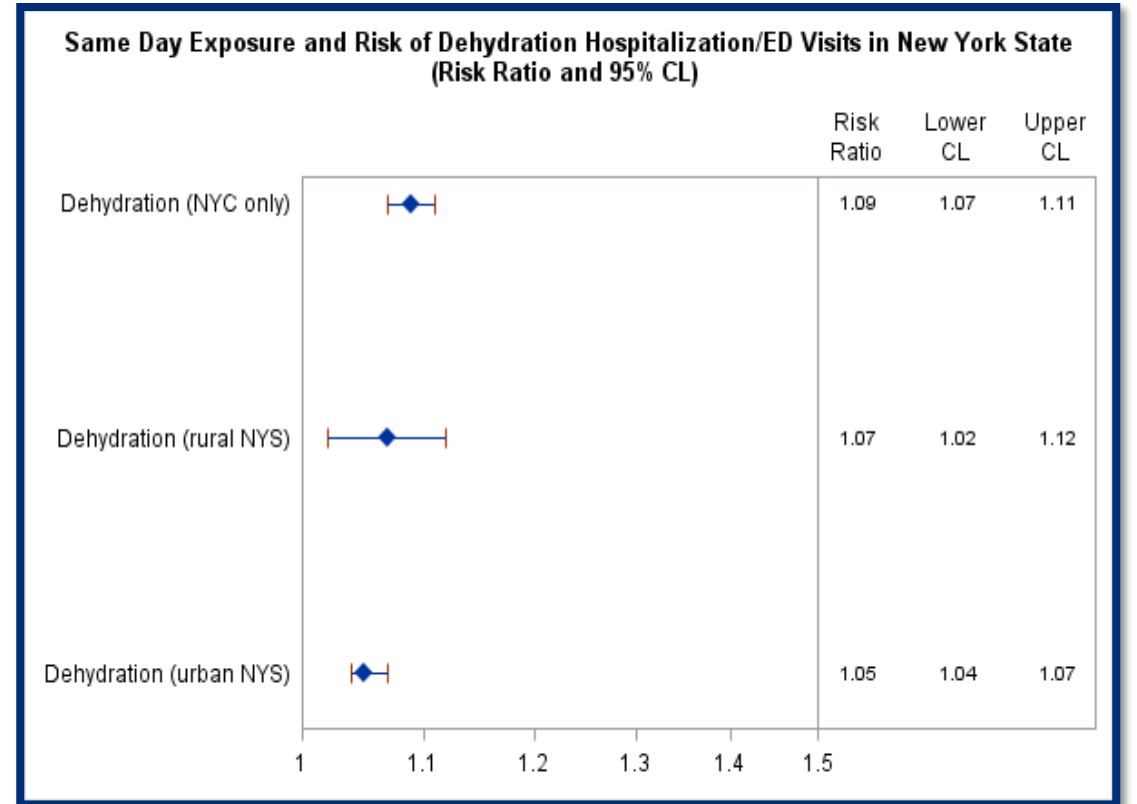
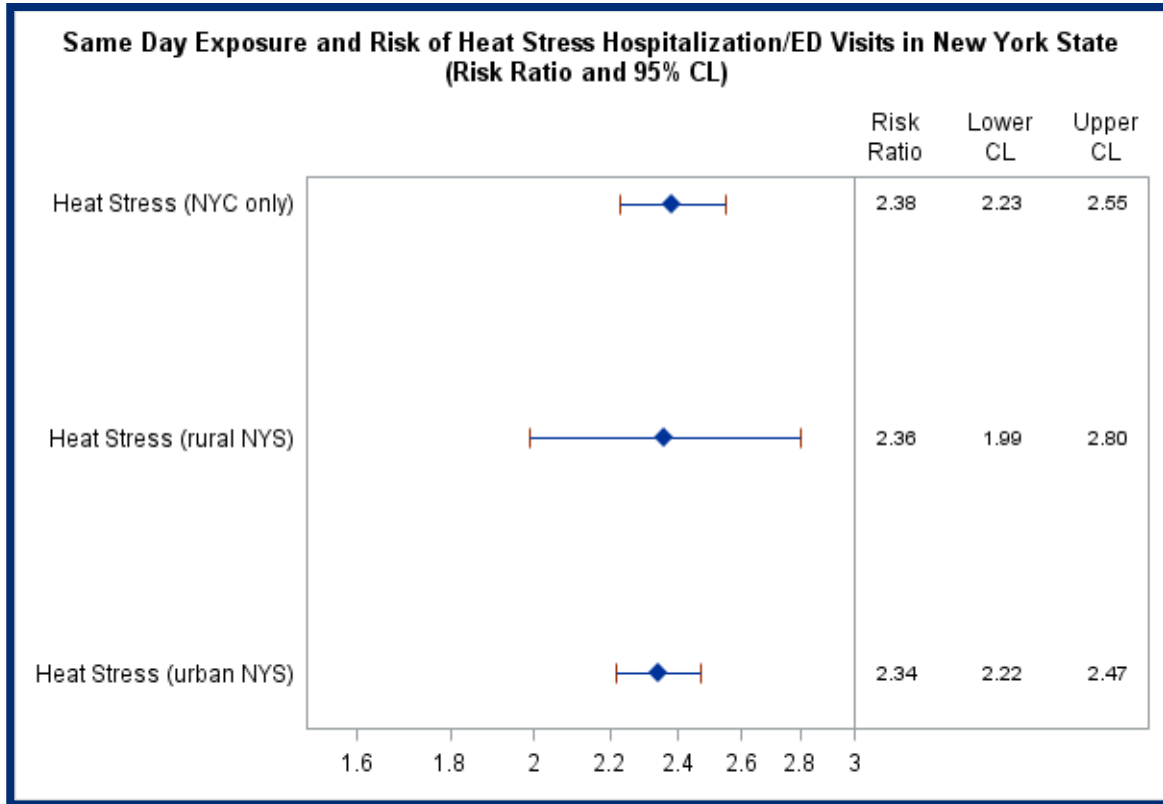
- Outcomes:
 - May through September hospital admissions & ED visits 2008 – 2012 (SPARCS)
 - Heat Stress, Dehydration, Acute Kidney Failure, Cardiovascular Diseases
- Exposure:
 - Daily maximum temperature (Tmax) & Daily maximum heat index
- Stratum Window: 28 days
- Exposure lags: 1 – 4 days
- Cumulative exposure: 1 – 4 days

Heat Stress (Lag Effects)



ψ For every 5F change in temperature
Adjusted for ozone & PM2.5

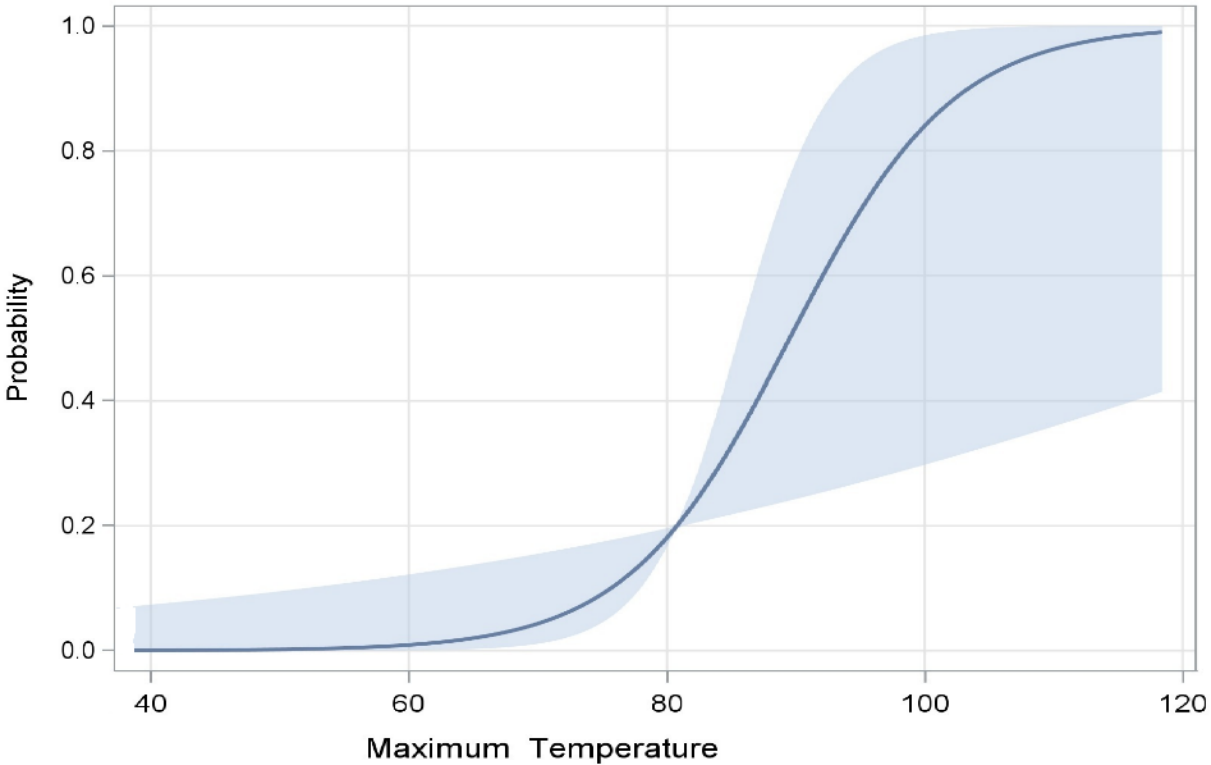
NYC, rural NYS & urban NYS



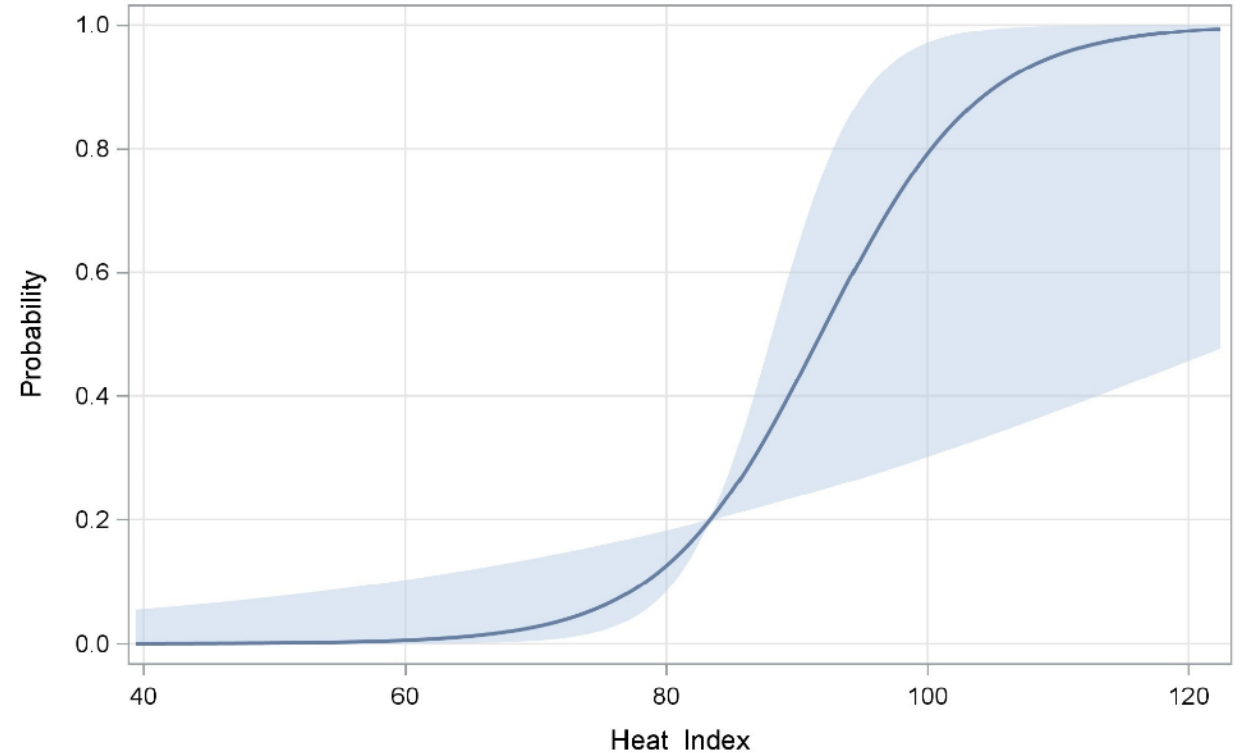
ψ For every 5F change in temperature
Adjusted for ozone & PM2.5

Heat Stress – *Threshold Analysis*

Predicted Probabilities for Heat Stress
With 95% Confidence Limits



Predicted Probabilities for Heat Stress
With 95% Confidence Limits

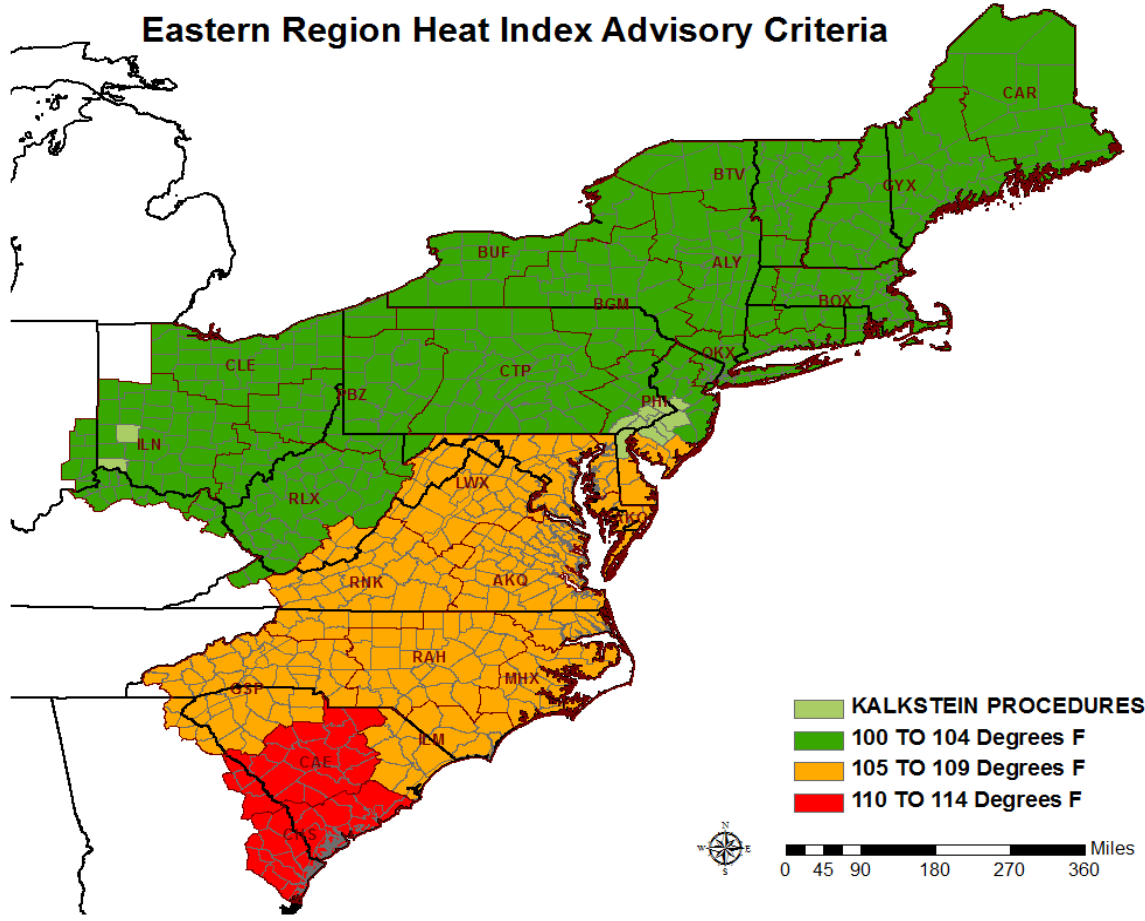




NATIONAL WEATHER SERVICE

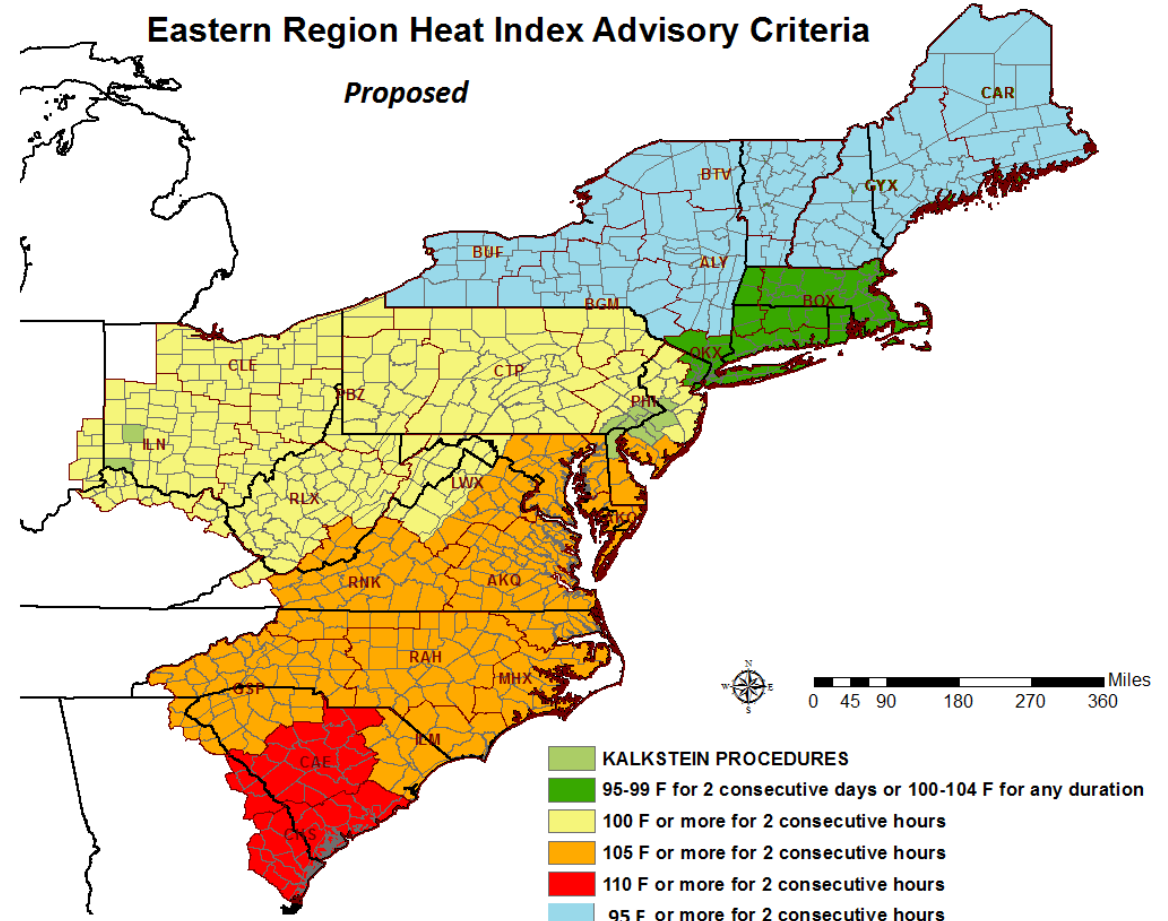
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Eastern Region Heat Index Advisory Criteria

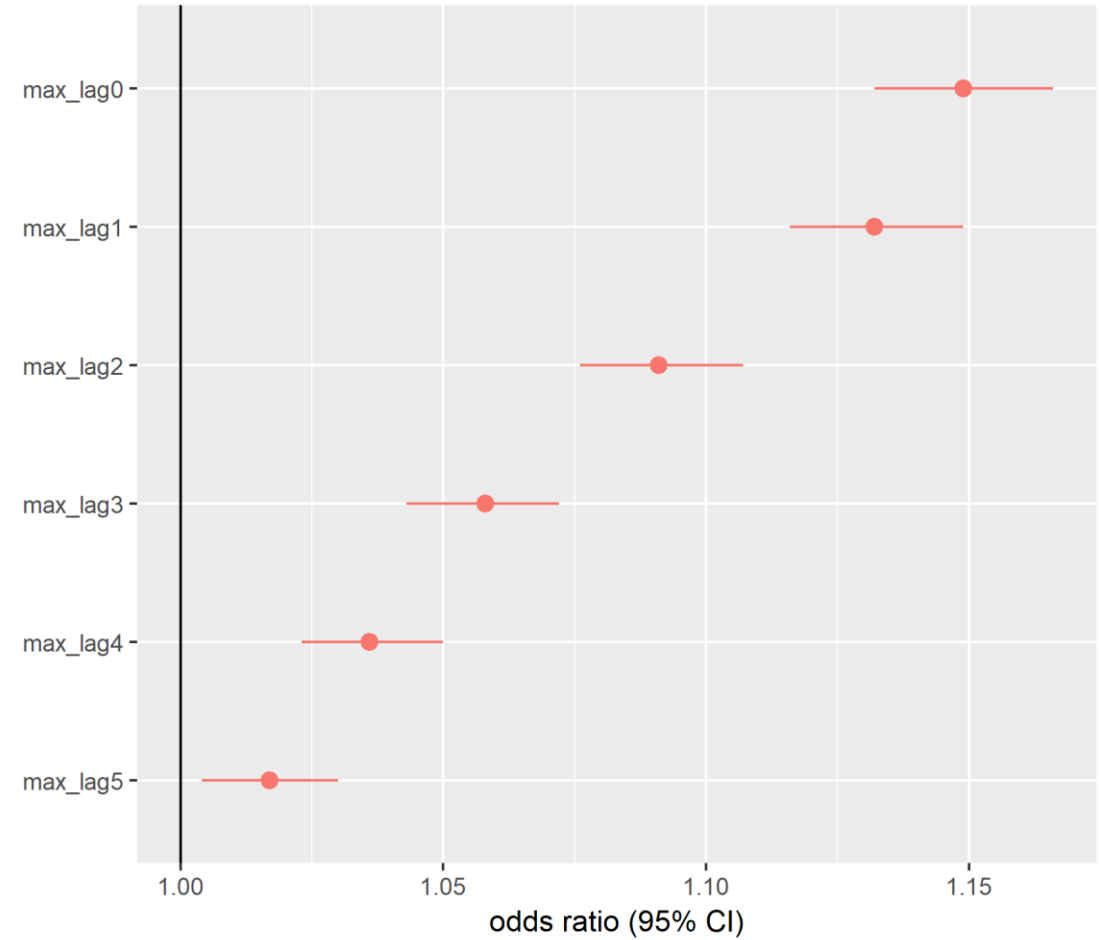
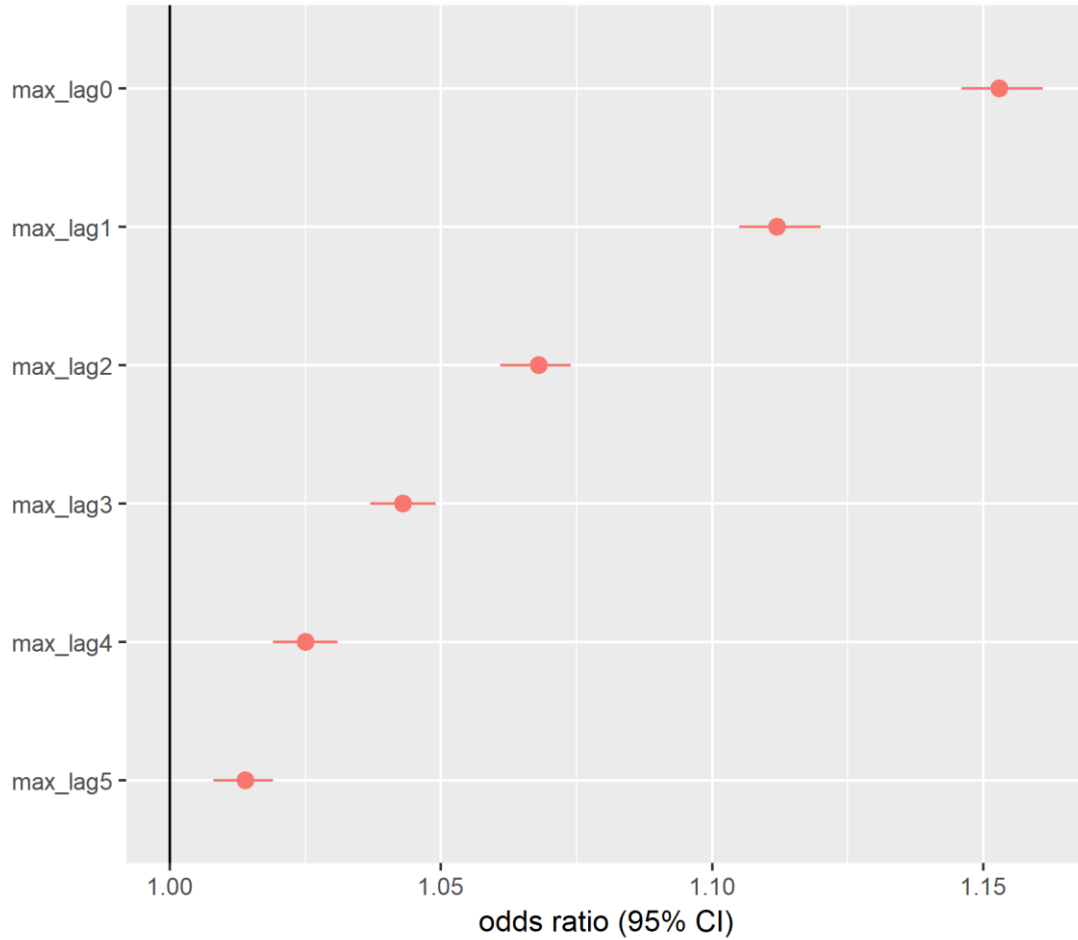


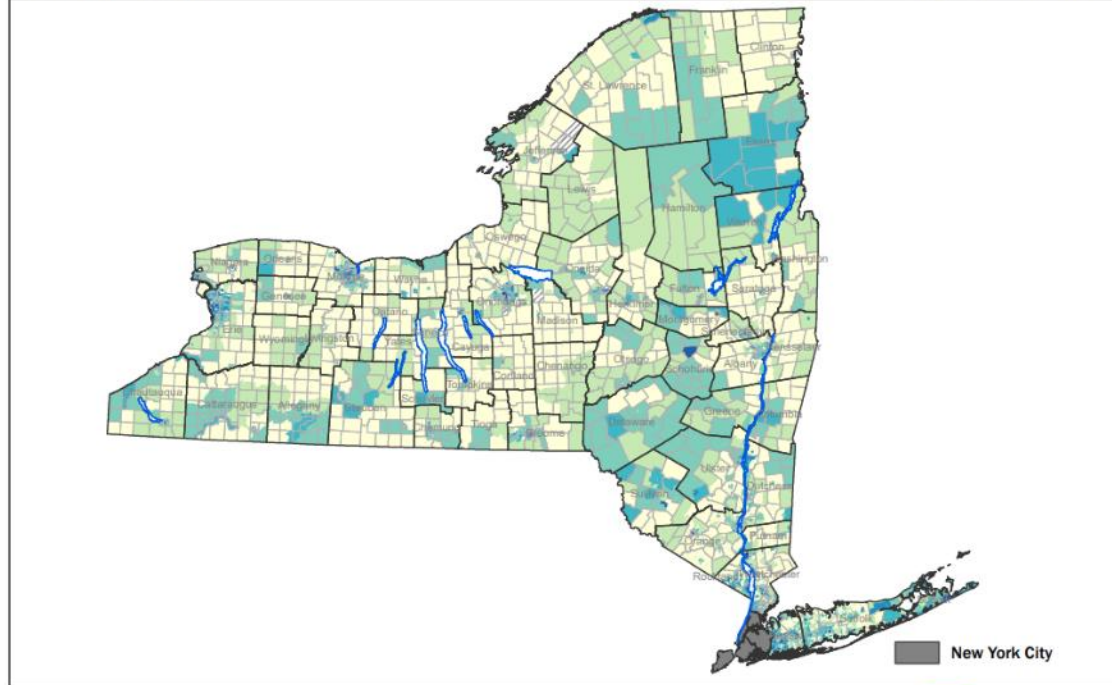
Eastern Region Heat Index Advisory Criteria

Proposed



Florida Heat-related (left: ED, right: HSP)





Heat Vulnerability	Vulnerability Category	Heat Vulnerability Factors (Variables)
	Language Vulnerability	Percent population that is Hispanic Percent population that is foreign born Percent population who speak English 'less than very well'
	Socio-economic Vulnerability	Percentage population with income below poverty level Percentage population that is Black Percentage population (18–64 years) that has a disability Percentage population (18–64 years) that are unemployed
	Environmental/Urban Vulnerability	Percentage houses built before 1980 Density of housing units per square mile Percentage land with highly developed areas Percentage land that consists of open undeveloped areas
	Elderly Isolation and Vulnerability	Percentage population 65 years of age and over Percentage population 65 years of age and over and living alone

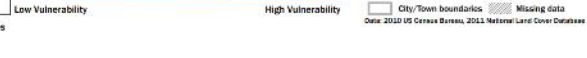
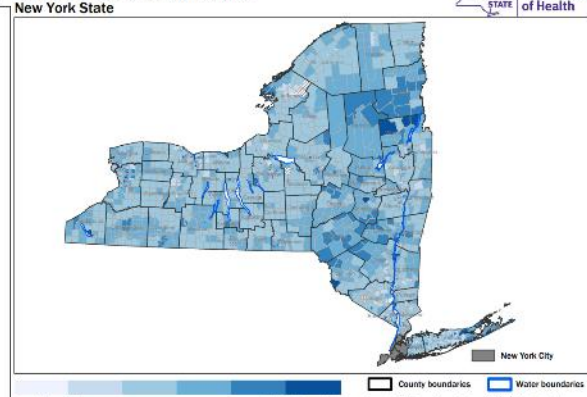
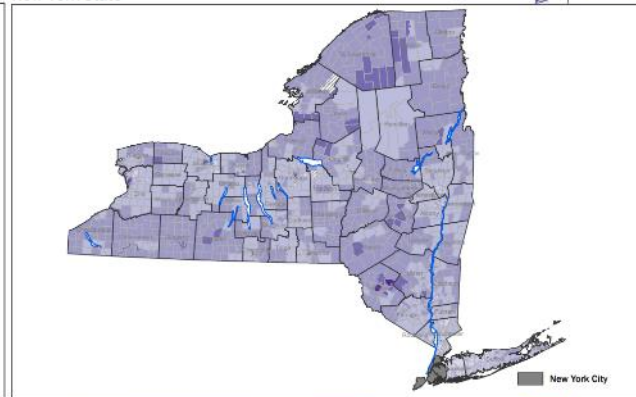
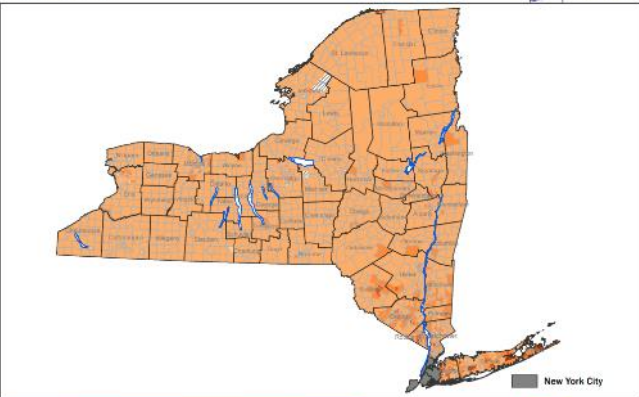
https://www.health.ny.gov/environmental/weather/vulnerability_index/index.htm

Language Vulnerability
New York State

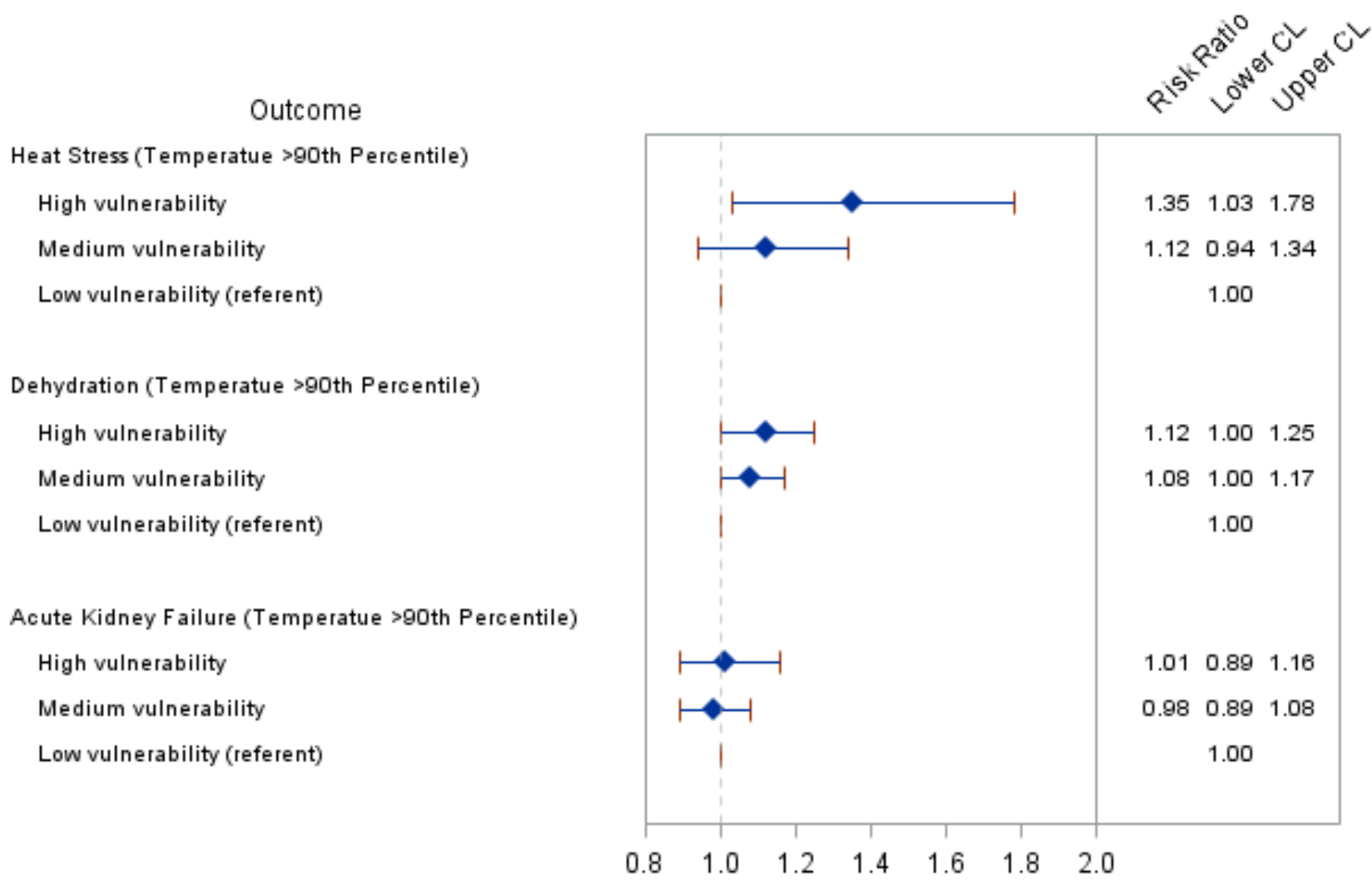
Socio-Economic Vulnerability
New York State

Environmental/Urban Vulnerability
New York State

Elderly Isolation/Elderly Vulnerability
New York State



Evaluation of Risk of Hospitalization/ED Visit by Heat Vulnerability Index



NYS EPHT/ CDC EPHT

DATA DISSEMINATION AND INDICATORS

*Relative Thresholds calculated based on the temperature distribution of the NLDAS grids within the entire county, by month, over the 1980-2010 baseline period.

County Level Maps

- Number of Extreme Heat Days
 - By Year
 - By Month

Relative Threshold Days Above 90th Percentile Maximum Temperature July 1980

Temperature ▾

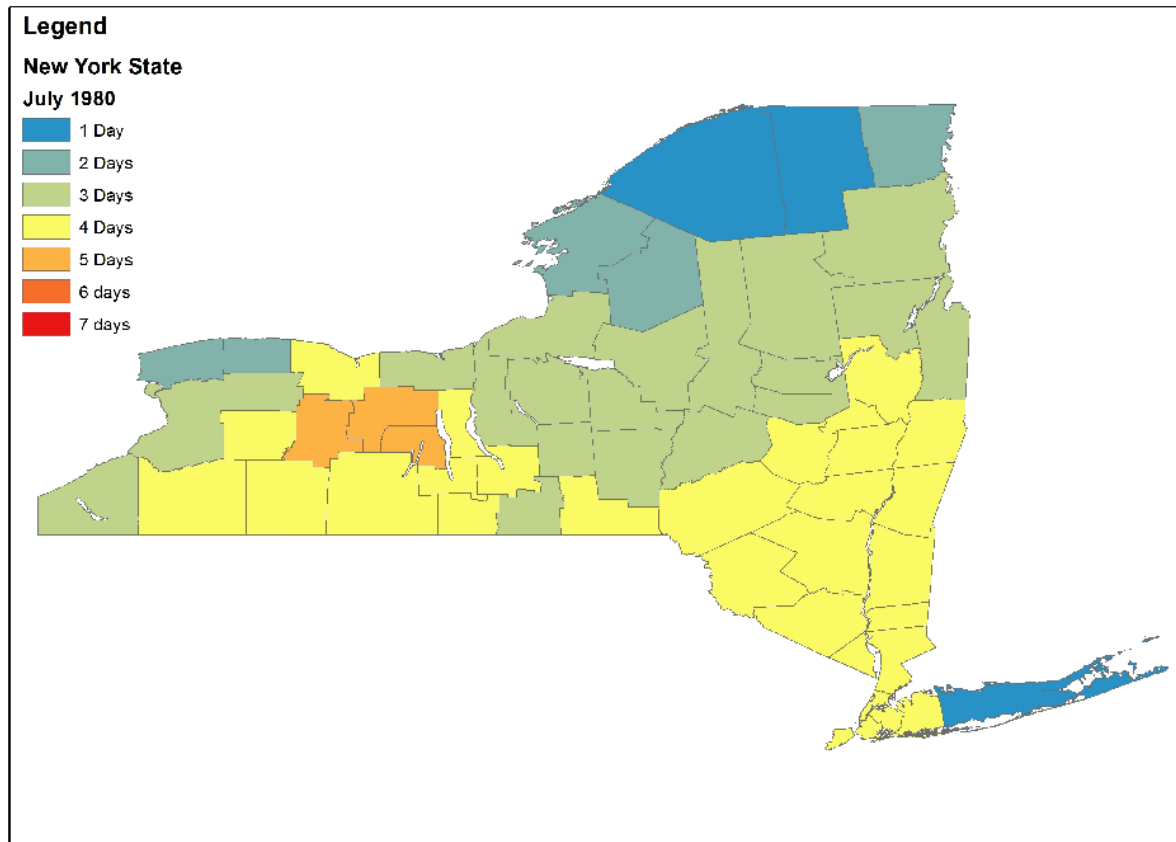
Relative Threshold 90th % ▾

Maximum Temperature ▾

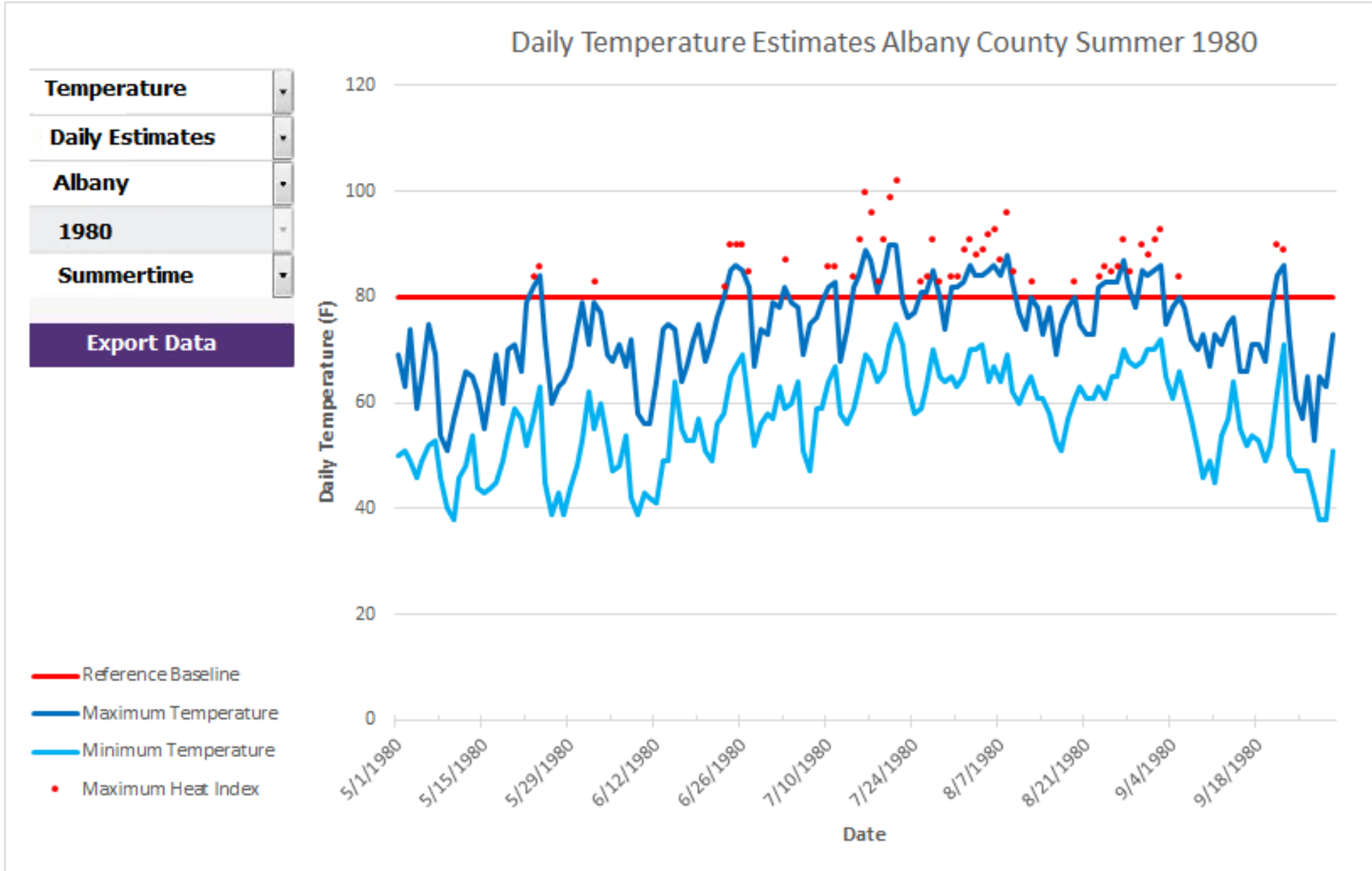
1980 ▾

July ▾

Export Data



- Absolute Threshold: 90 degrees F
 - Daily Maximum Temperature
 - Daily Maximum Heat Index
- Absolute Threshold: 95 degrees F
 - Daily Maximum Temperature
 - Daily Maximum Heat Index
- Absolute Threshold: 100 degrees F
 - Daily Maximum Temperature
 - Daily Maximum Heat Index
- **Relative Threshold*: 90th percentile**
 - **Daily Maximum Temperature**
 - Daily Maximum Heat Index
- Relative Threshold*: 95th percentile
 - Daily Maximum Temperature
 - Daily Maximum Heat Index
- Relative Threshold*: 99th percentile
 - Daily Maximum Temperature
 - Daily Maximum Heat Index



Temperature

Anomalies

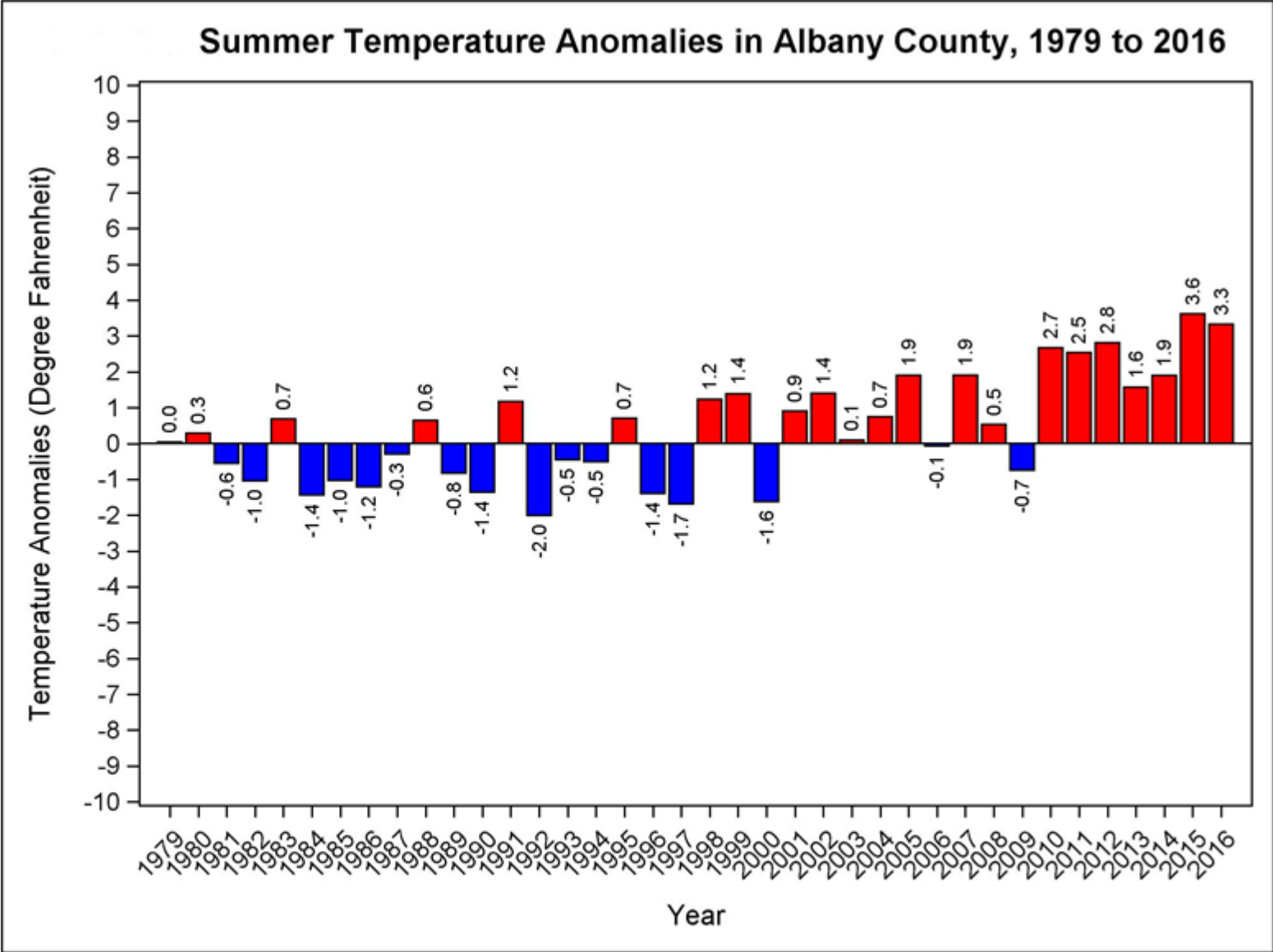
Albany

Summer

Yearly

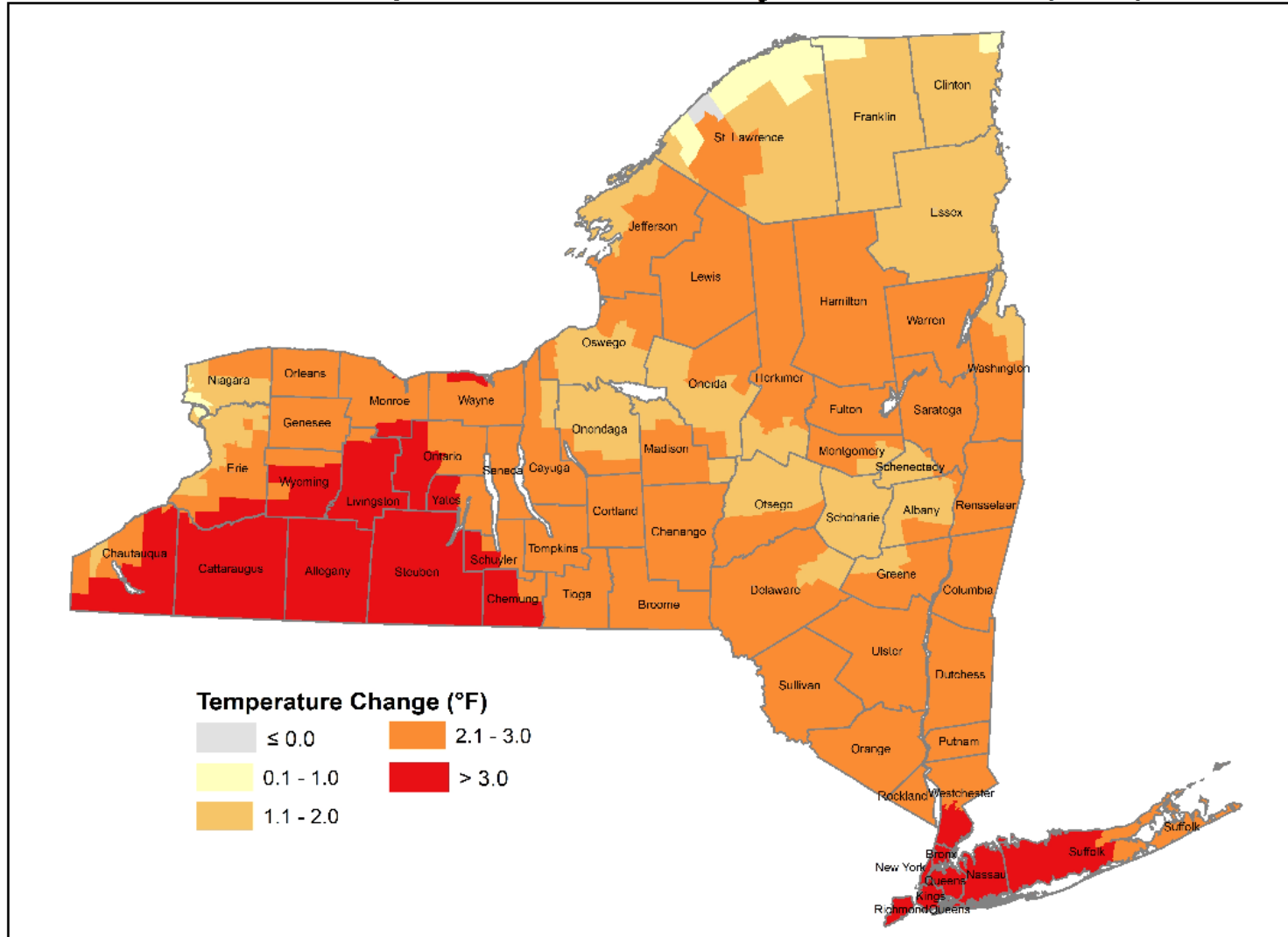
Export Data

*Temperature anomalies were calculated based on the deviation of the average summer temperature in each county from the 30-year baseline/norm (1980 – 2010) for each county (0 represents the 30 year norm for each county)



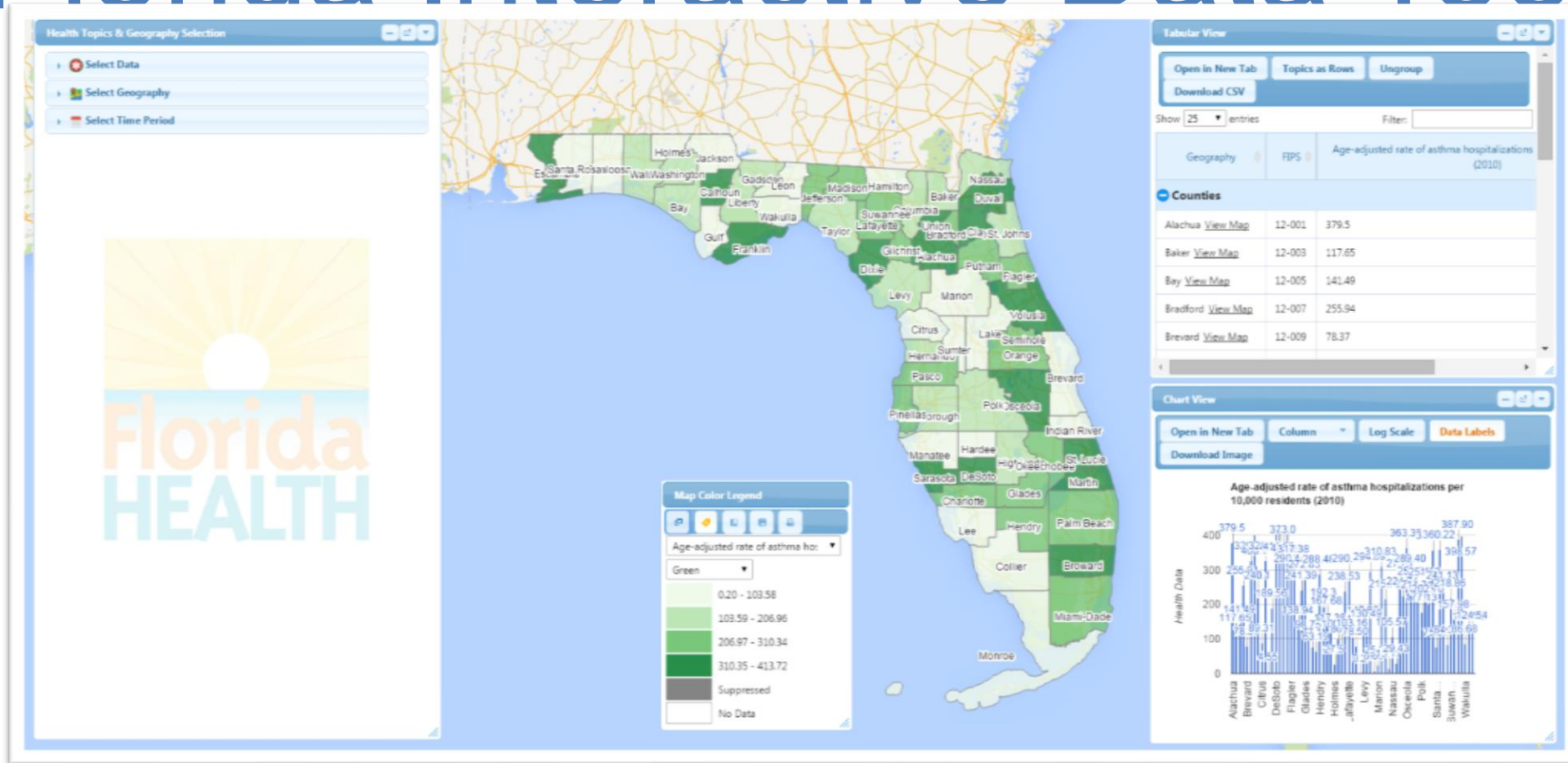
Temperature ▾
 Maximum Temperature ▾
 2010 ▾
 Summer ▾
 Anomalies ▾
 Export Data

Summer Temperature Anomalies by Census Tracts (2010)



***Temperature anomalies were calculated based on the deviation of the average summer temperature in each census tract from the 30-year baseline/norm (1980 – 2010) for each census tract (0 represents the 30 year norm for each census tract)**

Florida Interactive Data Tool



ZIP Code Level Heat Data (ED Visits)

Health Topics & Geography Selection

- Select Data
- Select Geography
 - States
 - Counties
 - Zip Codes
 - Orange
 - Select Zip
 - Add All
 - Remove All
 - Add All Florida Zip Codes
 - Zoom to
 - Show Combined
- Addresses
- Select Time Period

Zip	Remove?
32808	Remove
32703	Remove
32822	Remove

Chart View

Open in New Tab | Column | Log Scale

Data Labels | Download Image

Number of Heat-related emergency department visits during summer months

Effective October 1, 2015, hospital record data transitioned to a new coding system called the International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM). Differences between counts and rates in years prior to 2015 compared with 2015 and subsequent years could be a result of this coding change and not an actual difference in the number of events.

Tabular View

Open in New Tab | Topics as Rows | Ungroup | Download CSV

Blank values or * indicate either suppressed values or no data is available

Show 25 entries | Filter:

Geography	FIPS	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Zip Code Regions													
All Selected Zip Codes View Map	All Selected Zip Codes	40	28	29	31	33	43	40	32	36	42	42	63
32808 View Map	32808	22	11	15	14	16	13	16		15	12	12	16
32822 View Map	32822						14	11			17	15	25
32703 View Map	32703	14	11	10		11	16	13	16	19	13	15	22

Showing 1 to 4 of 4 entries | Previous | 1 | Next

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Climate, Weather & Health



OUTREACH EFFORTS

Public Affairs Group, CEH-Outreach and Education, NYS EPHT,
NYS CRSCI, NYSERDA



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

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.

Health Sensitivity

The risk of heat stress, dehydration, renal 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.

Community Vulnerability

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)
1981-1989	77.5
1990-1999	76.8
2000-2009	77.3
2010-2016	77.4
2017-2018	78.6
2019-2020	78.5
2021-2022	79.7
2023-2024	79.2
2025-2026	81.2
2027-2028	80.2

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	Days Above 95°F
1981-1983	1
1984-1986	0
1987-1989	10
1990-1992	15
1993-1995	20
1996-1998	25
1999-2001	30
2002-2004	35
2005-2007	40
2008-2010	45
2011-2013	50
2014-2016	55

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

Check your local weather so you can be prepared.
www.weather.gov

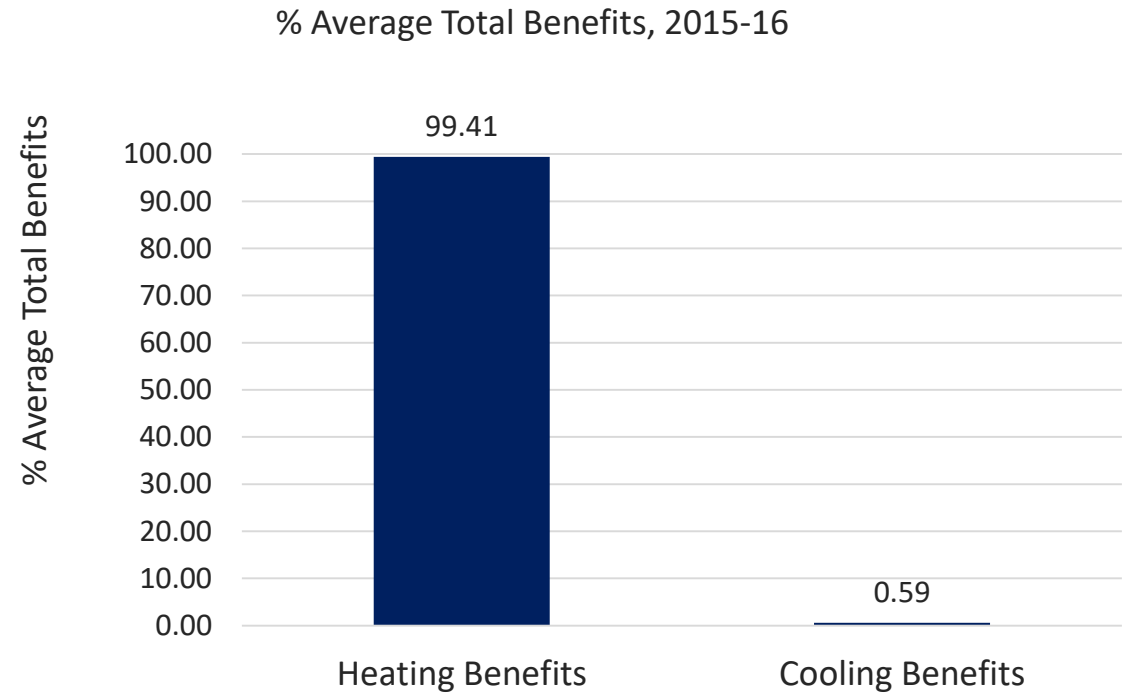
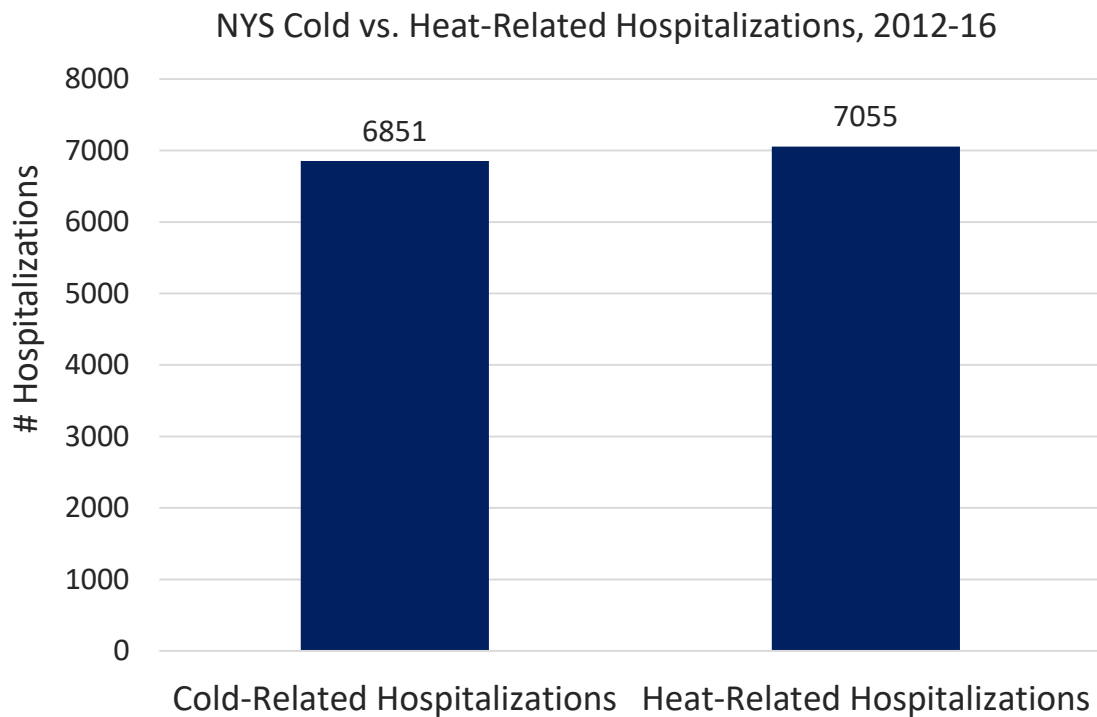
Find a place to get cool.
www.health.ny.gov/environmental/weather/cooling

Get involved in community planning.
www.climatesmart.ny.gov/

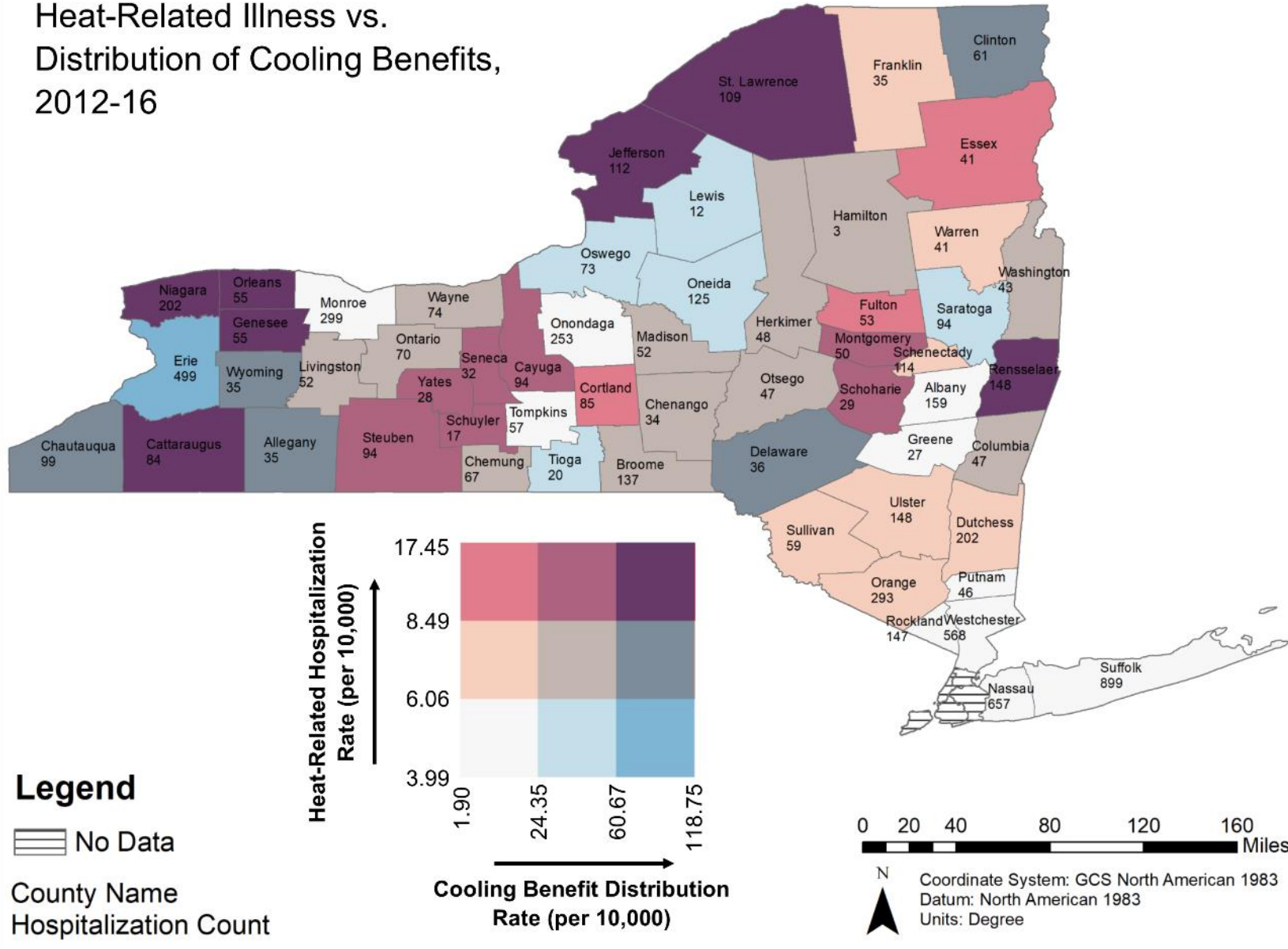


Office of Temporary and Disability Assistance- Home Energy Assistance Program

Distribution of HEAP Benefits and Illness



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



Past and Upcoming

PRESENTATIONS AND TRAINING



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2017 Conference on the Environment

November 17-18, 2017 | Kingston, NY



Preparing for Extreme Heat in New York State

Manuscripts(In review/planned):

- **Ground-truth of a 1 km downscaled NLDAS air temperature product using the New York City Community Air Survey”** Under 2nd review at the Journal of Applied Meteorology and Climatology
- **Estimating policy relevant health effects of ambient heat exposures using spatially contiguous remote sensing reanalysis data** – Under review at Environmental Health
- **Downscaling NLDAS Air Temperature Using MODIS Land Surface Temperatures-** Being readied for submission at Remote Sensing

Manuscripts (planned)

- NYS Downscaling Validation manuscript
- NYS Vulnerability manuscript
- Florida Validation manuscript
- Florida Health manuscript

Thank You

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