# Heat and Health Profile Report

Madison County

NEW YORK STATE | Department of Health

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This report was created by the New York State (NYS) Department of Health to supplement current efforts undertaken by NYS counties to mitigate the impacts of extreme heat. It is intended to help local public health leaders and emergency planners with developing targeted strategies and allocating resources. This report is also available at https://www.health.ny.gov/environmental/weather/profiles/.

For more information contact the NYS Environmental Public Health Tracking Program at epht@health.ny.gov

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# Madison County Heat-Health Vulnerability Assessment

## Introduction

**What is extreme heat and/or an extreme heat event?**

Extreme heat is defined as summertime temperatures that are substantially hotter and/or more humid than expected or typical for a specific region[1,2]. An extreme heat event (EHE) is an extended period of unusually hot weather conditions that can potentially be harmful to human health[3]. In comparison to other extreme weather hazards, EHEs occur less frequently but can have devastating consequences and can be underestimated as a public health hazard. Summertime temperatures in NYS have been increasing for past several decades[4,5] and are predicted to continue to increase along with more frequent and intense EHEs over the next century.

**How does extreme heat affect health in NYS?**

Exposure to extreme heat can have adverse effects on health, particularly in vulnerable populations[6,7]. Direct impacts of extreme heat on health include heat-related illness (heat cramps, heat exhaustion, or heat stroke) and even death. Exposure to extreme heat can also exacerbate pre-existing conditions like cardiovascular, respiratory and renal diseases.

Heat can disproportionately affect vulnerable populations including the elderly, young children, outdoor workers, socioeconomically disadvantaged populations and those living in socially and environmentally vulnerable regions[8]. Most heat-related deaths occur from long exposure to extreme heat with little or no air-conditioning[2].

Health impacts of heat can be avoided if timely measures are taken to reduce long periods of heat exposure. This can be achieved with the help of air-conditioning and/or cooling centers. This emphasizes the importance of identifying vulnerable populations, and taking steps to reduce heat impacts. Some examples of mitigating steps include having a heat-specific plan, alerting the community of an EHE, education, support services, and cooling centers. Since many heat-related illnesses can be prevented, communities can benefit by identifying their vulnerable populations and directing resources to help them adapt.

This report summarizes the impact of extreme heat on health in NYS with regards to four major factors- **exposure, sensitivity, vulnerability and adaptive capacity**[9,10]. The combination of these factors can affect an individual's ability to respond to and adapt/cope with the impacts of heat and extreme heat events.

# Exposure

## Temperature

Annual average temperatures across NYS have been steadily increasing over the last few decades. This trend includes an increase in the number of extremely hot summer days (above $90^0$F). July is consistently the hottest month in the region. Summer (June-August) daily maximum temperature in NYS ranged from $42.8^0$F to $93.7^0$F in 1979 and $46.9^0$F to $99.2^0$F in 2016. Variations and sudden spikes in temperature can affect health, especially among the elderly who may need time to adjust to the rising temperatures. The trend graph in **Figure 1a** shows the number of days each year with maximum temperature above $90^0$F in Madison County while **Figure 1b** displays the summer (June-August) maximum temperature anomalies between 1979 and 2016 in Madison County. **Figure 1c** shows the average monthly summer (June-August) maximum temperature between 1979 and 2016 in Madison County.

## Temperature Projections for Madison County

Over the next century, average summertime (June-August) temperatures in NYS are projected to increase between 3.6 to $10.8^0$F. Projected temperatures are based on Representative Concentration Pathways (RCP)[11]. RCPs are scenarios that describe different pathways of the total measure of greenhouse gas emissions from multiple sources for a hundred-year period (2000 to 2100). The scenarios are based on a range of possible climate policy outcomes with different assumptions about economic growth, energy consumption, population, land use and energy sources for the 21st century. Here, we compare two RCP scenarios: 1) RCP 4.5[11], an intermediate emission scenario in a future with relatively ambitious emissions reductions and stabilization after 2100, and 2) RCP 8.5[11], a high emission scenario representing a future with no policy changes to reduce emissions. **Figure 1d** displays temperature projections with the two scenarios in Madison County up to 2100. Both scenarios predict an increase in average temperatures, with a much greater increase under the high emission scenario in comparison to intermediate emission scenario.

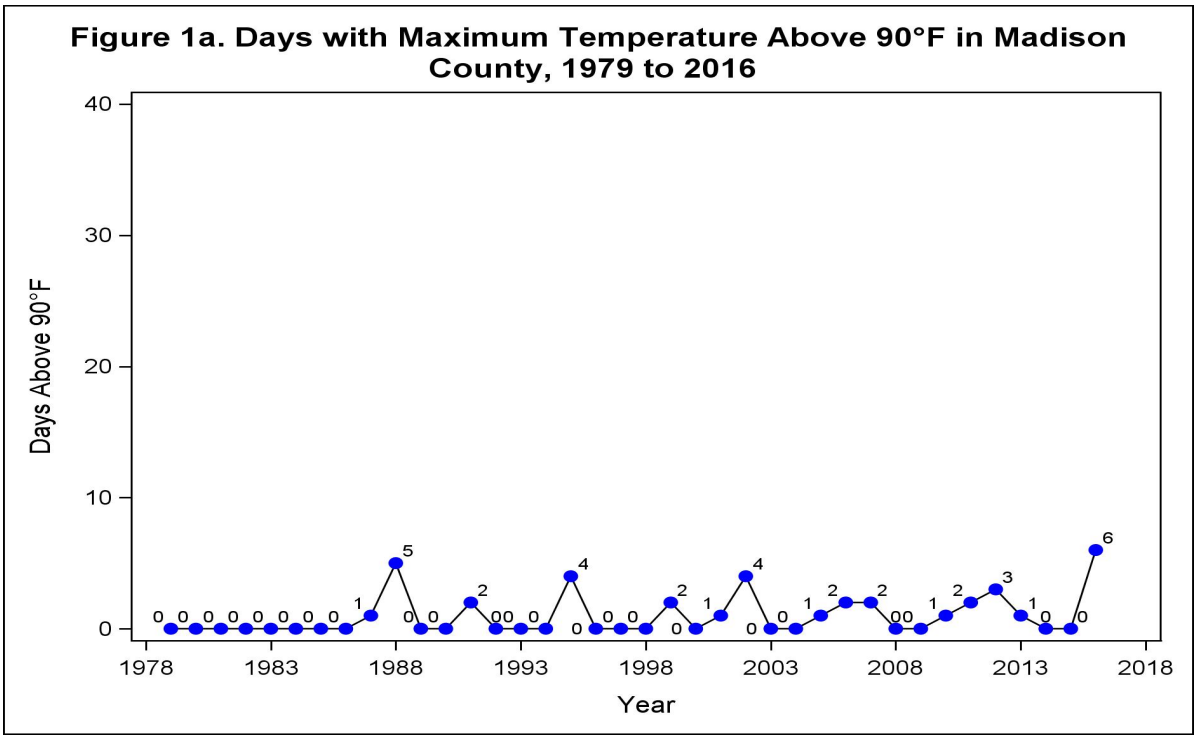
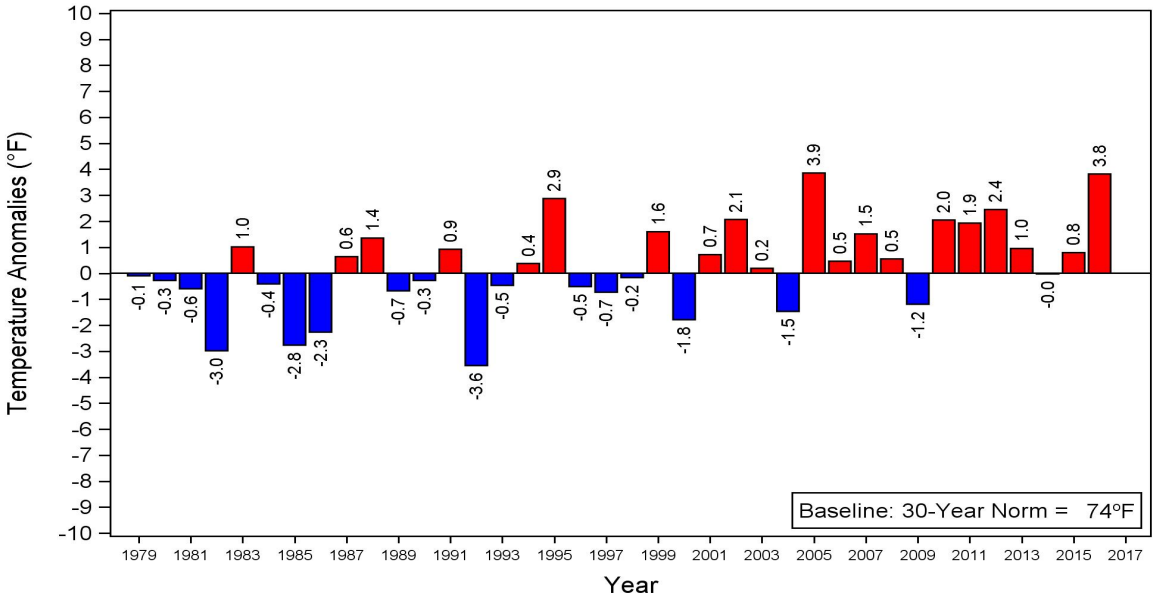
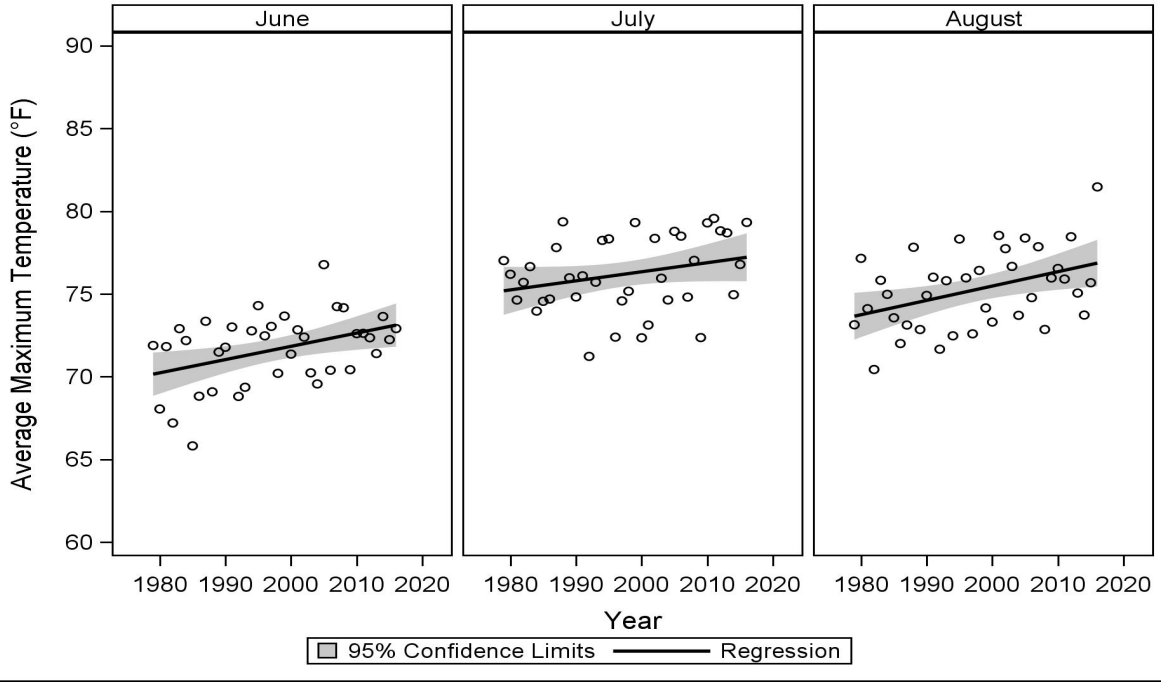


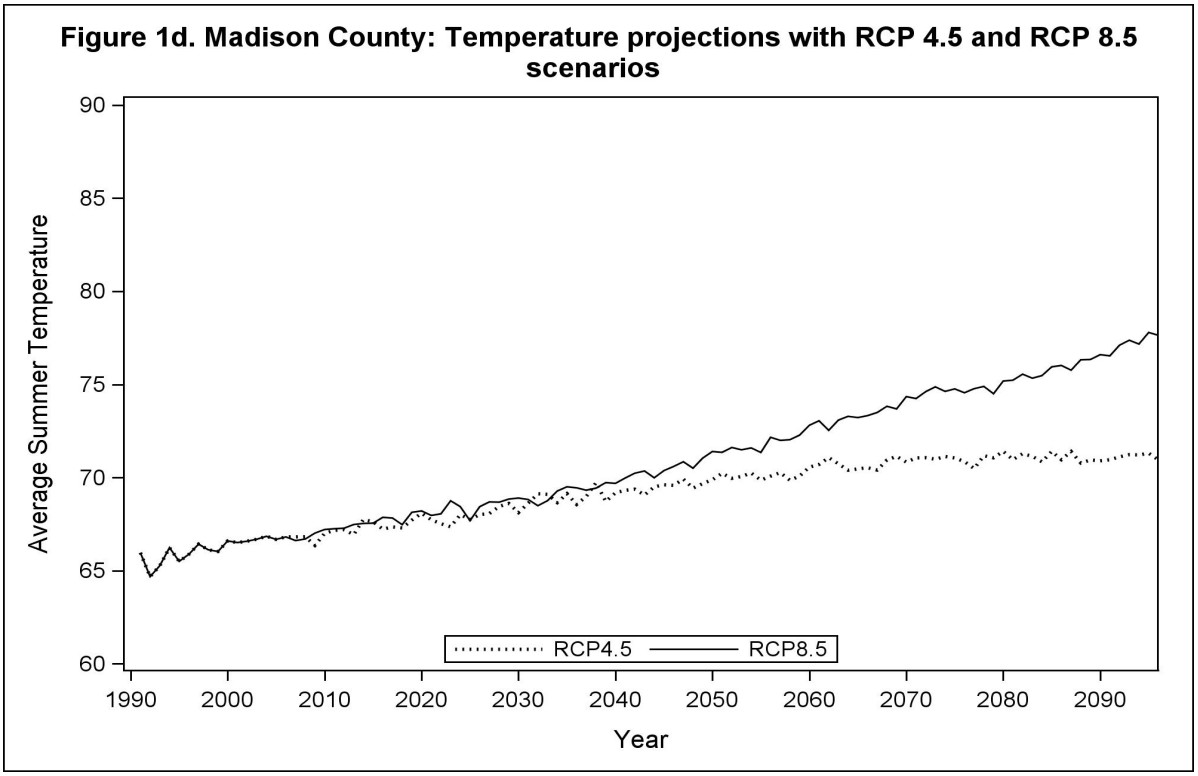
**Figure 1b. Summer Temperature Anomalies in Madison County, 1979 to 2016**




A temperature anomaly is a departure from a reference value or long-term average. Reference value used is a 30-year norm (1980 - 2010). A positive anomaly indicates that the observed temperature was warmer than the reference value, while a negative anomaly indicates that the observed temperature was cooler than the reference value

**Figure 1c. Madison County: Monthly Averages of Daily Maximum Temperature, 1979 - 2016**






## Sensitivity

The effect of heat on health can depend on an individual's overall health. The presence of existing health conditions predisposes a person to the effects of extreme heat by causing or worsening health conditions.

### Heat Related Illness

The spectrum of heat-related illness includes heat edema, heat stroke, heat cramps, heat stress, and dehydration. Heat related illness, although largely preventable, occurs during hot days or extreme heat events when the body is unable to dissipate heat by natural mechanisms. High humidity, direct sun exposure, and dehydration caused by excessive loss of fluid or salt via sweating can result in heat related illness[12, 13]. These conditions can also be exacerbated in situations that require intense physical exertions such as outdoor sports and physical labor. **Figure 2a** shows heat related illness hospital and ED visit rates across Madison County from 2008 to 2016.

### Renal Illness

High temperatures can affect the body's fluid balance, which can exacerbate renal and urinary disorders [14] including acute renal failure, chronic kidney disease, urinary tract infections, renal and urinary tract calculi, nephritis and nephrosis and other kidney, ureter, and lower urinary tract disorders. **Figure 2b** shows acute kidney disease related hospital and ED visit rates across Madison County between 2008 and 2016 during warm weather months.

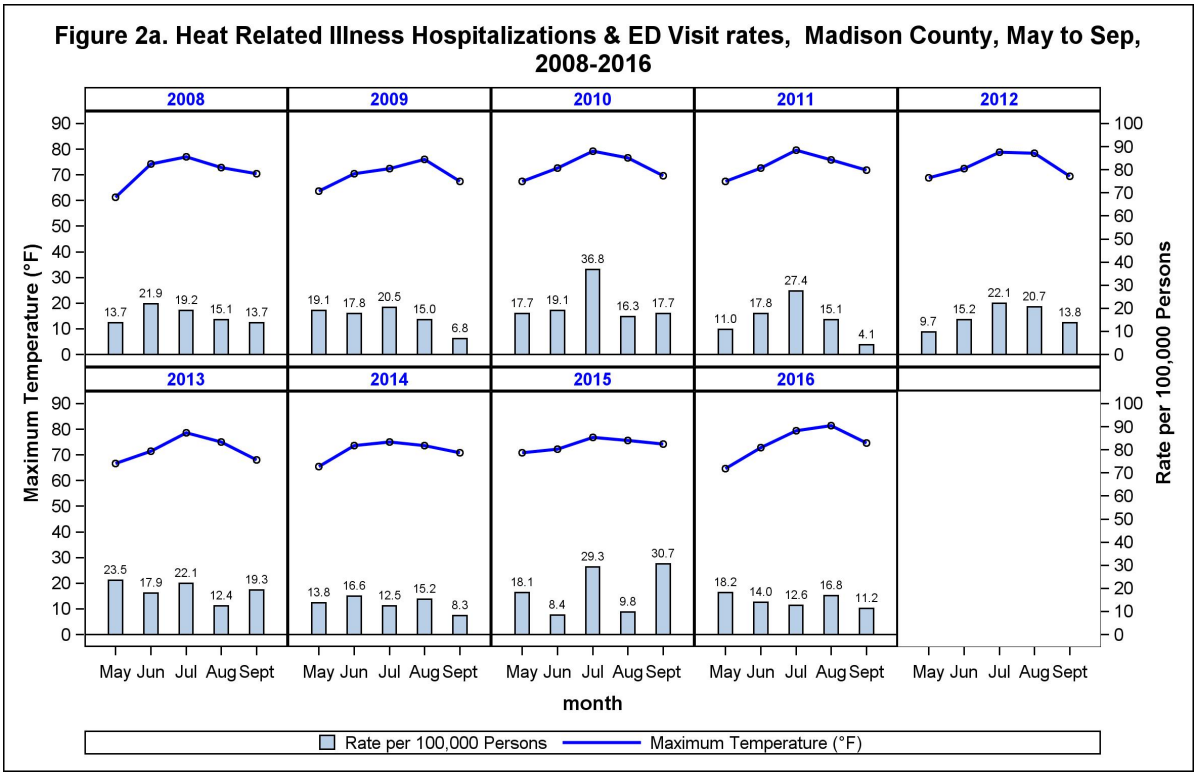


Figure 2a. Heat Related Illness Hospitalizations & ED Visit rates, Madison County, May to Sep, 2008-2016
2008
2009
2010
2011
2012
2013
2014
2015
2016
Maximum Temperature (°F)
Rate per 100,000 Persons
May Jun Jul Aug Sept
month
Rate per 100,000 Persons
Maximum Temperature (°F)

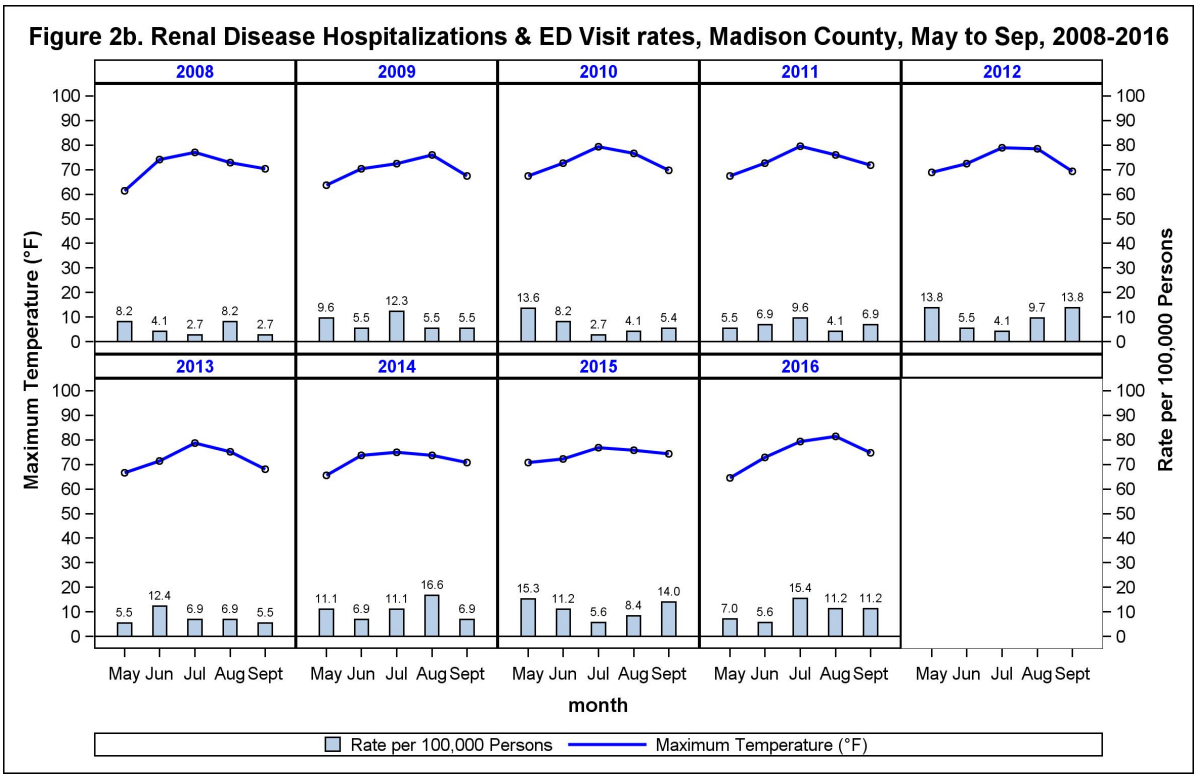
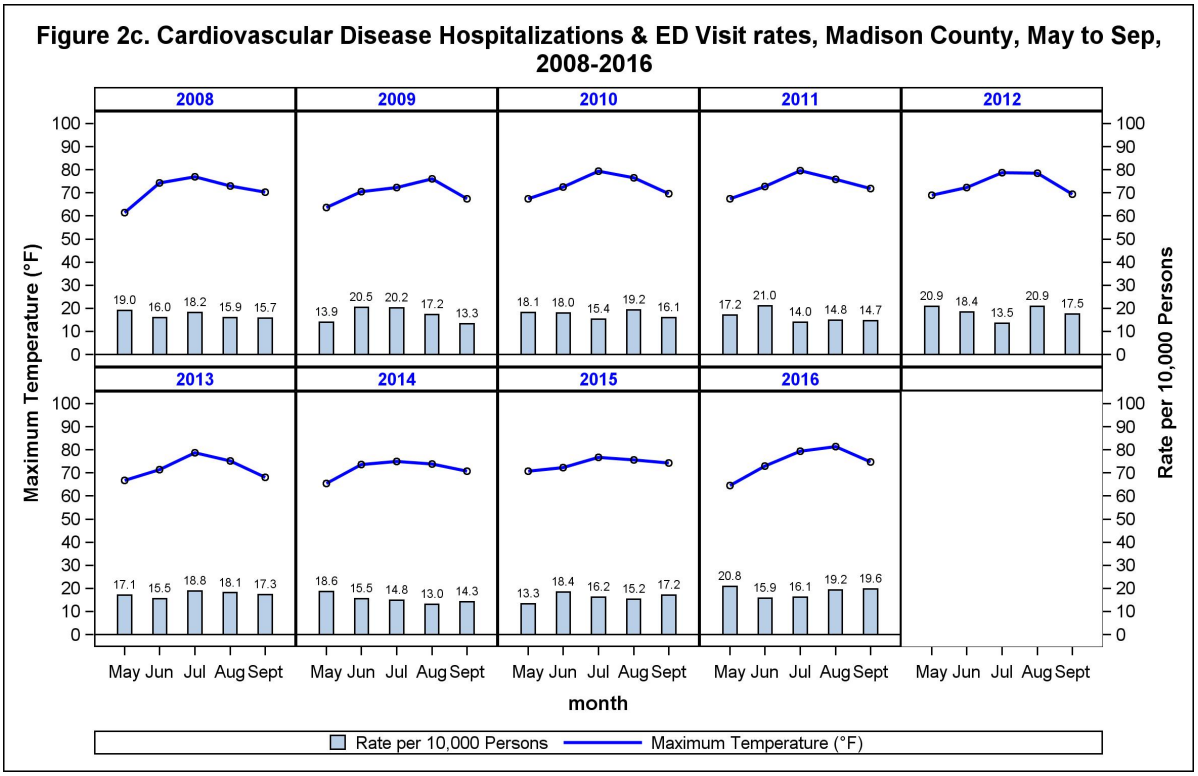


Figure 2b. Renal Disease Hospitalizations & ED Visit rates, Madison County, May to Sep, 2008-2016
2008
2009
2010
2011
2012
2013
2014
2015
2016
Maximum Temperature (°F)
Rate per 100,000 Persons
May Jun Jul Aug Sept
month
Rate per 100,000 Persons
Maximum Temperature (°F)




## Cardiovascular Illness

Prolonged exposure to extreme temperatures can worsen chronic conditions such as cardiovascular diseases (CVD)[15,16] including myocardial infarction, congestive heart failure[17] and coronary thrombosis[18]. **Figure 2c** shows the cardiovascular disease hospital and ED visit rates across Madison County between 2008 and 2016 during warm weather months.

Hospitalizations and ED visits across NYS during the months May to September showed that hot days and sustained high temperatures (heat waves) can have a direct impact on health outcomes like heat stress, dehydration and renal diseases and a delayed (lagged) effect with cardiovascular diseases. Temperatures were highest during the months of July or August and increased risk of illness was observed with various health conditions during these months. The impact of heat on health can also be influenced by community level sociodemographic and environmental factors that contribute to heat vulnerability as described in the next section.

More information on heat-health associations in NYS can be found in a recently published article (https://ehjournal.biomedcentral.com/articles/10.1186/s12940-019-0467-5) by the NYS Department of Health[19].

# Vulnerability

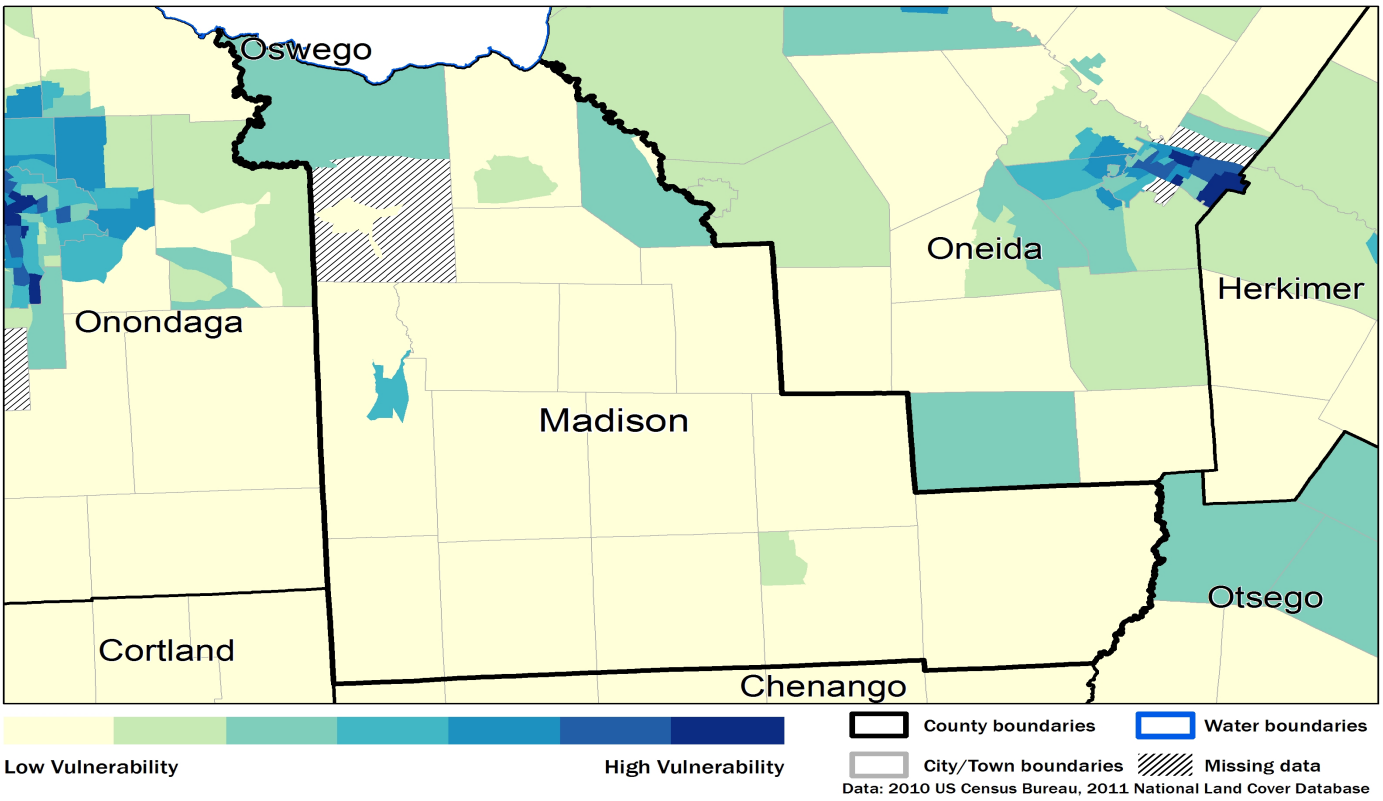
Heat vulnerability can be influenced by individual characteristics (such as underlying health, socio-demographics, etc.) as well as certain aspects of the community where one lives (environment, community demographics). These community level sociodemographic and land use indicators can help to identify areas with populations that may be more vulnerable to the effects of heat, which may help planning and implementing local adaptations and interventions. The NYSDOH developed a Heat Vulnerability index (HVI) combining these indicators to help identify heat vulnerable areas in NYS[8].

**Heat Vulnerability Index (HVI):**

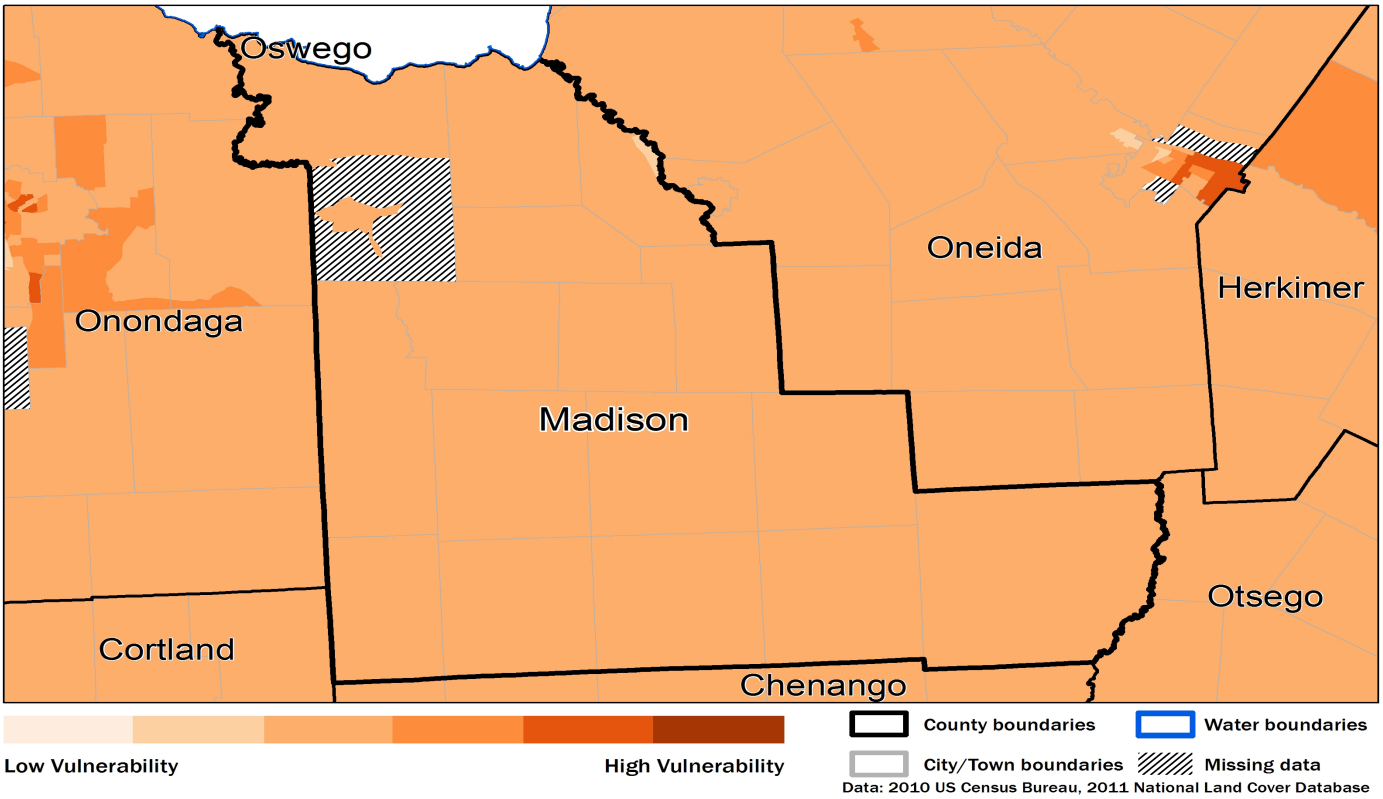
Thirteen environmental and sociodemographic factors that could influence the impact of heat on health were first grouped into four categories to represent different aspects of heat vulnerability. The four heat-vulnerability categories include 1) language vulnerability; 2) socioeconomic vulnerability; 3) environmental and urban vulnerability; and 4) elderly isolation and elderly vulnerability. **Figure 3a** displays the overall county HVI identifying the most heat vulnerable areas in NYS. **Figure 3b-e** display the four heat vulnerability categories. The heat-vulnerability categories together estimated the overall HVI for each census tract.

The HVI can assist in the deployment of scarce resources based on characteristics of the vulnerable populations in that community. The HVI can also inform long term heat-mitigation planning efforts in the community. For example, the HVI can help local agencies make decisions on targeted risk communication and alert messages, or setting up cooling centers and transportation to and from cooling centers. More information on the HVI and printable state and county-specific maps are available at https://www.health.ny.gov/environmental/weather/vulnerability_index/index.htm.

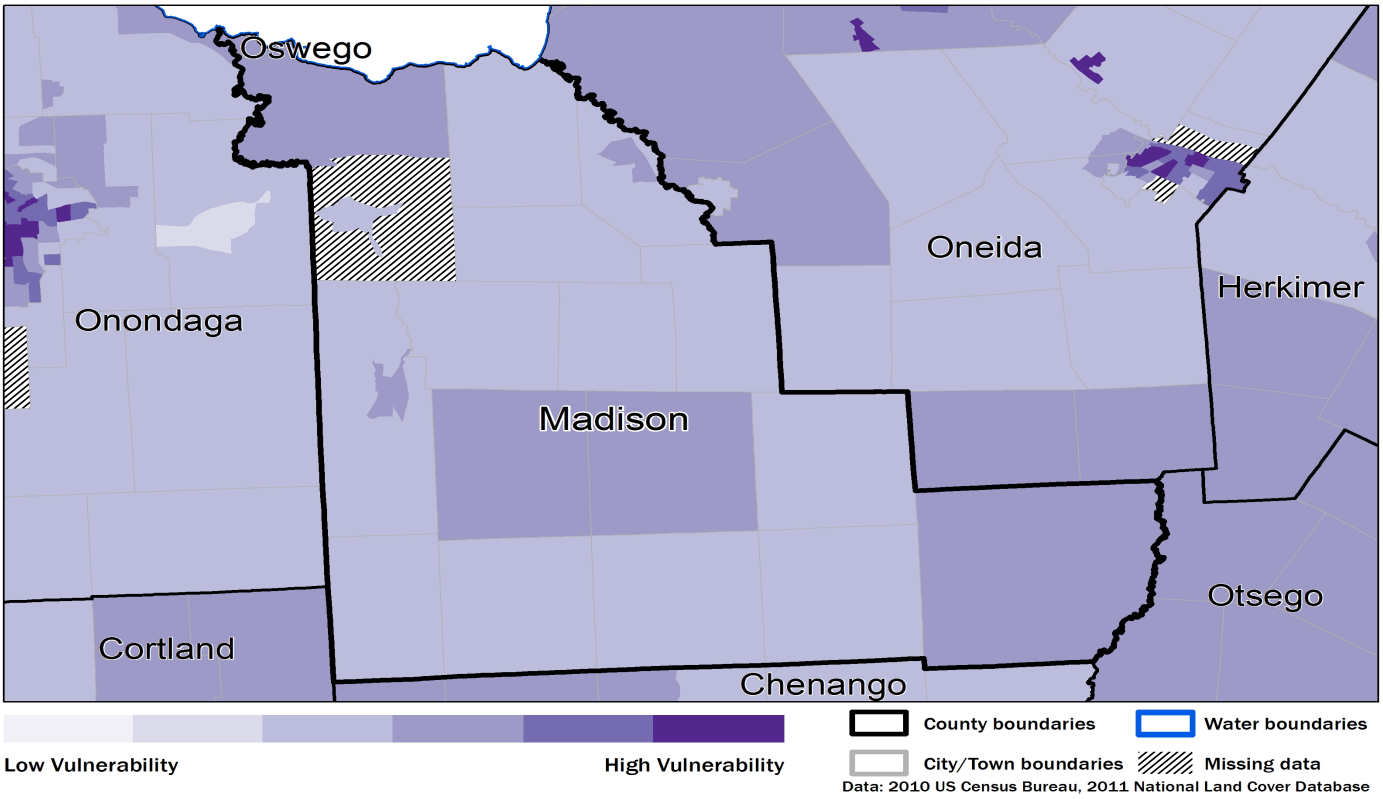
**Figure 3a. Heat Vulnerability Index Madison County**



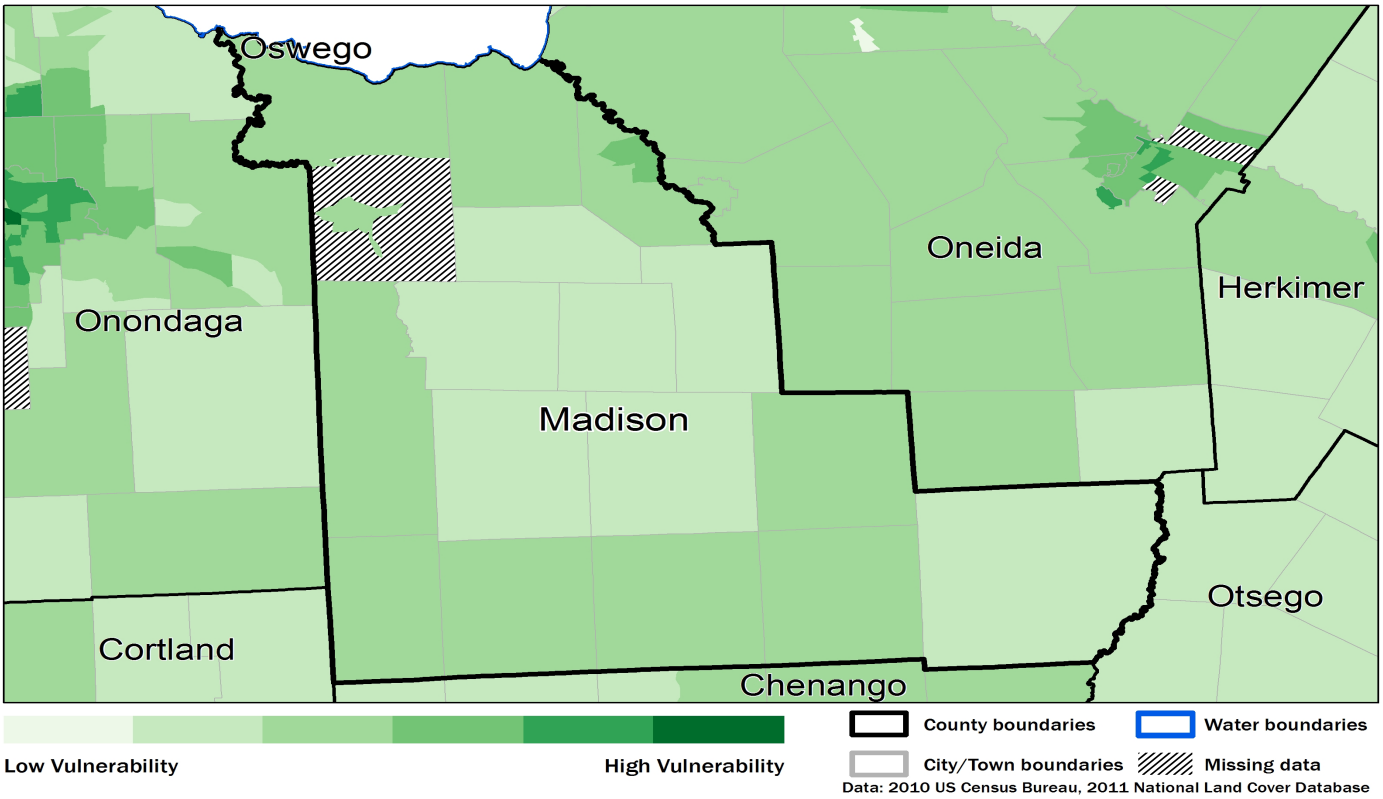
## Figure 3b. Language Vulnerability Madison County



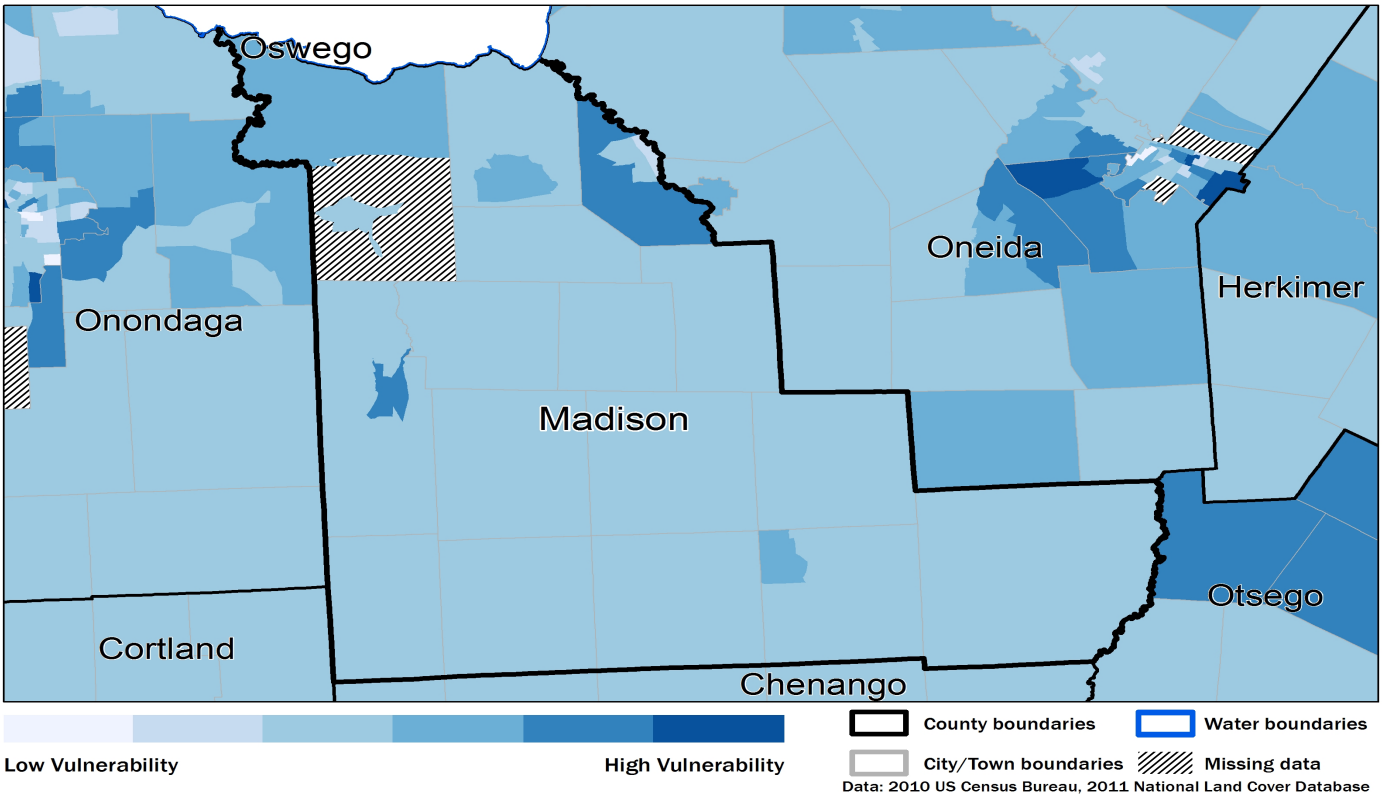

## Figure 3c. Socio-Economic Vulnerability Madison County



## Figure 3d. Environmental/Urban Vulnerability Madison County




## Figure 3e. Elderly Isolation/Elderly Vulnerability Madison County



## Adaptive Capacity and Adaptation Resources

### Cooling Centers

Access to air conditioning at work or home for a few hours a day during an extreme heat event can significantly reduce the effect of heat on health[20, 21]. But since this may not be always possible, the availability of places to get cool in the community can play an important role in heat-adaptation. Cooling centers are usually set up by local agencies and could be indoors in air-conditioned facilities or outdoors in parks or recreation areas that are open to the public. The NYSDOH works with local health departments and county emergency management offices to gather information on cooling center locations in the 57 NYS counties (excluding NYC). The addresses and contact information of cooling centers are updated annually and provided to the public at https://www.health.ny.gov/environmental/weather/cooling/. County and local agencies can contact us at epht@health.ny.gov to update cooling centers in their jurisdictions. An interactive mapping application is now available on the Environmental Public Health Tracker so the public can find the closest cooling centers to an address in NYS. Users can also obtain contact information, operating hours, driving directions and public transportation information on the application.

### Extreme Heat Outreach Materials

The NYSDOH has developed outreach and educational material to inform the public about the impacts of heat on health. Relevant information on signs and symptoms of heat related illness and preventive measures can be explored at https://www.health.ny.gov/environmental/emergency/weather/hot/. The NYSDOH has also created an infographic that provides a snapshot of heat and health in NYS (https://www.health.ny.gov/publications/6636.pdf/). Local health departments and emergency management offices are encouraged to utilize and disseminate these resources.

### Climate Smart Communities

Climate Smart Communities (CSC) is a network of New York communities engaged in reducing greenhouse gas emissions and improving climate resilience. The CSC Program is sponsored by six state agencies, including the NYS Department of Health, who provide resources to local governments to support climate action at the community level. The program is structured around ten CSC pledge elements that provide a comprehensive approach to climate change mitigation and adaptation, including actions that local governments can take to reduce vulnerability to extreme heat events. Learn more about the resources available via the CSC Program at http://www.dec.ny.gov/energy/76483.html.

### National Weather Service (NWS)

The NWS uses a multi-tiered heat warning system to increase public awareness and promote a proper response to the impending hazardous weather event. Effective on or about June 1, 2018, the NWS lowered the heat advisory criteria for NYS. More information can be found at https://www.weather.gov/media/car/DSS/NEWHeatThresholds.pdf and in the recently published article describing the heat-health analysis that helped inform the NWS decision to lower regional thresholds [19]. Details on the NWS heat resources can be found on the NWS 'Heat Safety Tips and Resources' at https://www.weather.gov/safety/heat/.

### Other Heat-Adaptation Measures

Long-term planning efforts, including green or cool roofs and increasing trees and vegetation, can help keep buildings and the surrounding areas cool especially in urban areas which may experience the heat island effect. Cool pavements are another means of reducing the heat island effect. These pavements can be used in urban roads and parking lots as they are modified to reflect more solar energy, and enhance water evaporation, thereby keeping the pavement cooler than conventional pavements[22].

## Data Sources

- Statewide Planning and Research Cooperative System (SPARCS): Daily summer hospitalizations and ED visits (May - September) between 2008 and 2016 in New York State were acquired from SPARCS. The SPARCS database is created and maintained by the New York State Department of Health (NYS DOH) and consists of inpatient (hospitalizations) and outpatient (Emergency department, outpatient and ambulatory surgery) visits among NYS residents.More information at https://www.health.ny.gov/statistics/sparcs/
- US Census Bureau: Census data was used to develop the Heat Vulnerability Index. Census tract data was obtained from the 2010 US Census Bureau Summary File 1 which contains data compiled from the questions asked of all people and about every housing unit. Data can be downloaded at https://www.census.gov/
- National Land Cover Database (NLCD): NLCD data was used to develop the Heat Vulnerability Index. NLCD provides nation-wide data on land cover, impervious surface and tree canopy cover at 30-m spatial resolution. Data is available at https://www.mrlc.gov/data
- North American Land Data Assimilation System (NLDAS): Temperature indicators including daily maximum air temperature were computed across grid cells using model-derived data of NLDAS, available at approximately 12 km by 12 km grid. The grid-level daily temperature data were averaged for summer months and mapped for each county. More information at https://climatedataguide.ucar.edu/climate-data/nldas-north-american-land-data-assimilation-system
- Downscaled CMIP5 Climate and Hydrology Projections: provides monthly average of surface air temperature at the 1/8th degree grid (approximately 12 km by 12 km) from 1950-2099 with coverage of NLDAS domain (contiguous US plus portion of southern Canada and northern Mexico). Data is archived at https://gdo-dcp.ucllnl.org/downscaled_cmip_projections/

### NASA temperature data for downloading

- Census tract level estimates for Average Temperature by month will be available on the sub-county Environmental Public Health Tracking portal (in development). Daily census tract level data can be made available on request. For more information, contact the NYS Environmental Public Health Tracking Program at epht@health.ny.gov

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