

Carolinas Climate Connection

Carolinas Integrated Sciences & Assessments

Integrating Climate Science and Resource Management in the Carolinas

Focus on Climate & Public Health

Climate plays an important role in public health both directly and indirectly. The Carolinas have very diverse geographies and populations and are subject to a wide variety of climate conditions and extremes. Considering current impacts to public health in the aftermath of extreme events, such as hurricanes or heat waves, gives an indication of the necessity to improve our understanding of these connections in order to reduce risk, particularly among the most vulnerable populations. However, it is not only extreme events which impact public health. Other types of seasonal temperature and precipitation patterns can also affect public health through interactions with water and air quality or increasing exposure to water- or vector-borne disease.

Announcements

Carolinas Climate Resilience Conference



CISA, with support from a strong steering committee of regional partners, is pleased to host the Carolinas Climate Resilience Conference Monday, April 28 and Tuesday, April 29, 2014 at the Hilton Charlotte University Place.

The conference will promote on-the-ground climate resilience efforts by providing managers and regional experts with an opportunity to share lessons learned and discuss resources and tools for incorporating climate information into their work. The interactive sessions will contribute to the development of a climate information network for the Carolinas and provide a venue for practitioners, resource people, and researchers to share information about current activities, plans and opportunities for collaboration. Find more information at www.cisa.sc.edu/ccrc.

New Report: Climate of the Southeast United States

[Climate of the Southeast United States: Variability, Change, Impacts and Vulnerability](#) is the most comprehensive look to date at the effects of climate change on the southeastern United States. The report covers 11 southeastern states as well as Puerto Rico and the U.S. Virgin Islands. Part of a series of technical reports to the [3rd National Climate Assessment](#), scheduled to be released in Spring 2014, the report includes sectoral chapters which discuss the implications of projected future climate conditions on public health, transportation, the built environment, agriculture, forests, fisheries and aquaculture, water resources, and natural ecosystems.

A [PDF version](#) of the report is available on the CAKE website. Print copies can be ordered from [Island Press](#).

Upcoming Events

[Southeast Tidal Creeks Summit](#)
Wilmington, NC
December 16-17, 2-13

[NIDIS/USGS Real-Time Salinity Drought Index Workshop](#)
Charleston, SC
January 7, 2014

[Social Coast Forum 2014](#)
Charleston, SC
February 18-20, 2014

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UNIVERSITY OF
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Climate and Public Health in the Carolinas

The Carolinas have very diverse geographies and populations and are also subject to a wide range of climate conditions and weather extremes. Some of the geographic and demographic characteristics of the Carolinas increase our vulnerability to climate variability and change. These include:

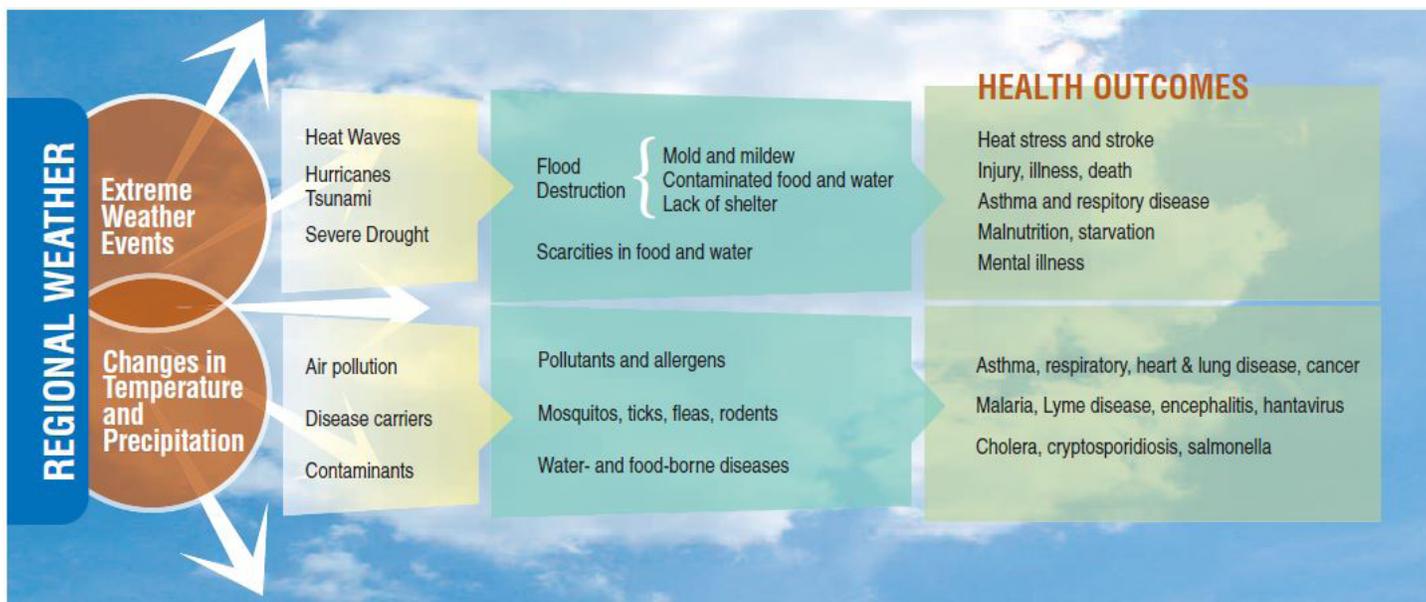
- Extensive coastlines, coastal populations and coastal assets
- High rates of urban sprawl and, therefore, significant threats caused by the urban heat island effect
- Significant reliance on mobile homes and substandard housing
- Ample trees and vegetation that can become projectiles during storms
- A high proportion of older populations and retirees
- A high proportion of poor and disadvantaged populations
- Rural populations that may not have ready access to health care facilities
- A high proportion of outdoor laborers
- High rates of chronic disease, including asthma and obesity

Other types of interacting stresses and risks amplify potential impacts such as:

- The condition of wastewater and water treatment facilities which may be poorly maintained, damaged, in need of repair or replacement, or constructed in vulnerable locations
- An energy grid that is vulnerable to power outages
- Physical infrastructure (ports, airports, power plants, transportation infrastructure, water infrastructure) located on the coast

When combined with climate extremes such as heat waves, hurricanes, or drought, these characteristics can make populations in the Carolinas highly vulnerable to health impacts. Understanding these vulnerabilities and interacting stressors can help in developing adaptation and preparedness plans in order to reduce risk and increase the resilience.

Climate Impacts on Public Health



Source: United States Global Change Research Program. Climate Change Impacts. 2009

Public Health Interactions with Water Quality and Availability

Climate Variables

Drought

- Drought poses both short-term, directly observable and measured effects as well as longer-term, indirect effects caused by the slow rise and chronic nature of drought that are not easy to anticipate or monitor.

Extreme Events

- Strong winds associated with hurricanes have the potential to impair water treatment or distribution infrastructure.

Sea Level Rise, Coastal Flooding

- Impacts to water quality and availability might occur through salinity intrusion into groundwater supplies or impacts to water infrastructure.

Vulnerable Populations

- Coastal communities
- Rural populations who rely on well water
- Recreational swimmers and fishermen

CISA Research

Vibrio Bacteria Exposure

CISA team members are conducting research to determine if levels of exposure to harmful *Vibrio* bacteria increase with increased water temperatures and salinity levels under future climate scenarios in the Winyah Bay estuary. Model projections show increased salinity levels over longer periods of time in the estuary, which creates optimum growth conditions for *Vibrio*. From a public health perspective, increases in *Vibrio* bacteria populations in these waters could lead to increased risk for swimmers and shellfish consumers.

Health Risks

- Temperature and precipitation frequency and intensity effect water quality which can lead to incidence of waterborne disease.
- During drought, concentrations of contaminants in surface waters can increase when there is no rainfall. Stagnation of surface waters due to reduced flows also occurs during periods of little to no rainfall.
- Water temperatures are likely to rise in lakes and reservoirs during drought which can lead to reduced oxygen levels. Lower oxygen levels impact both water quality and aquatic life.
- Periods of drought limit recharge of groundwater supplies which may lead to saltwater intrusion into aquifers or the need to drill deeper wells to access clean drinking water.
- Drought may lead to decreased water supplies for irrigation or unclean water supplies that are not suitable to be used for irrigation
- Decreased freshwater flows from upstream can impact the health of shellfish and freshwater fish, which might be consumed by humans.
- The first heavy rains after a drought (also referred to as 'drought busters') can lead to higher levels of pollutants in waterways from runoff that has accumulated on surfaces such as roadways and parking lots.
- Harmful algal blooms (HABs) are caused by nutrient loading and can be of particular concern in developed neighborhoods with stormwater retention ponds. HABs can cause illness through exposure to toxins by consumption of contaminated seafood or through recreational use of contaminated water bodies.
- During hurricanes and tropical storms, storm surge can lead to infiltration of saltwater into wastewater treatment infrastructure.
- Food safety and supply issues are also a concern when weather events lead to impacts to water quality and supply.



Harmful Algal Blooms, such as the one shown here, can cause illness through direct exposure or from eating contaminated seafood. Photo credit: UNC-W

Public Health and Heat

Climate Variables

- Days with extremely high temperatures
- Heat waves
- Drought

Vulnerable Populations

- Urban and poor communities
- Outdoor laborers and agricultural workers
- Children and the Elderly
- Athletes

CISA Research

Assessing Heat Vulnerability

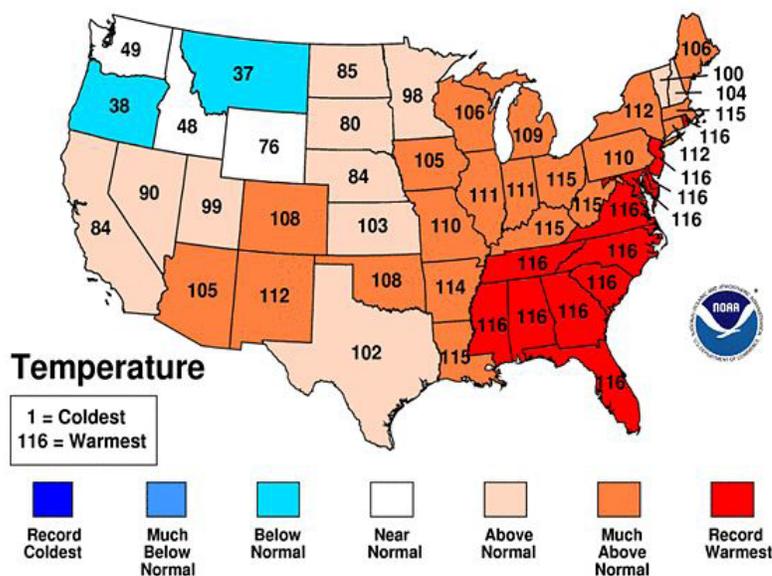
CISA researchers at the [Southeast Regional Climate Center](#) are investigating heat stress vulnerability and assessing methods to improve existing warning systems. They have developed a tool called the Climate-Public Health Toolbox to support these efforts. The toolbox integrates data from the [North Carolina Disease Event Tracking and Epidemiologic Collection Tool](#) (NC DETECT), a database for emergency department admittances in hospitals throughout the state, with historical weather conditions such as temperatures and precipitation. The tool allows users to select combinations of demographic information, geographic scope, and climate variables to help in determining relationships between climate conditions, emergency department admittance, and different populations in the state.

Health Risks

- Heat is the #1 weather-related cause of death in the US.
- Public health concerns range from mild heat rashes to deadly heat strokes.
- Excessive heat can cause aggravation of chronic diseases such as cardiovascular and respiratory disease.
- Building materials and impervious surfaces such as roadways absorb heat during the day which is slowly released during the night. This leads to warmer nighttime temperatures in urban areas compared to surrounding rural areas. This is known as the urban heat island effect and further contributes to the risk of heat-related illnesses in urban areas.
- Drought conditions can exacerbate the effects of high temperatures during summer months. For example, sunnier days are associated with higher ground-level ozone concentrations.
- Because of persistently observed high temperatures such as those that occur during the summer months in the Carolinas, public health preparedness plans should not only focus on extreme heat events, but also the effects of continuous heat exposure.

Statewide Ranks June-August 2010

National Climatic Data Center/NESDIS/NOAA



The map above shows that 2010 was the warmest summer on record in the Carolinas and for much of the Southeast. Despite the summer of 2012 ranking as a much cooler summer, Columbia, SC set a new maximum temperature record of 113°F on June 29, 2012. The maximum recorded temperature in North Carolina was 110°F on August 21, 1983 in Fayetteville, NC.

Public Health and Extreme Weather Events

Climate Variables

- Hurricanes/Tropical Storms
- Tornadoes
- Severe Thunderstorms

Vulnerable Populations

- Coastal communities
- Those with limited access to suitable shelter (mobile homes/ manufactured houses)
- Low income communities
- Migrant and seasonal farm workers who might have language barriers, limited access to emergency updates, news sources, or transportation, and who might have little to no insurance. (Burke et al. 2012)

CISA Research

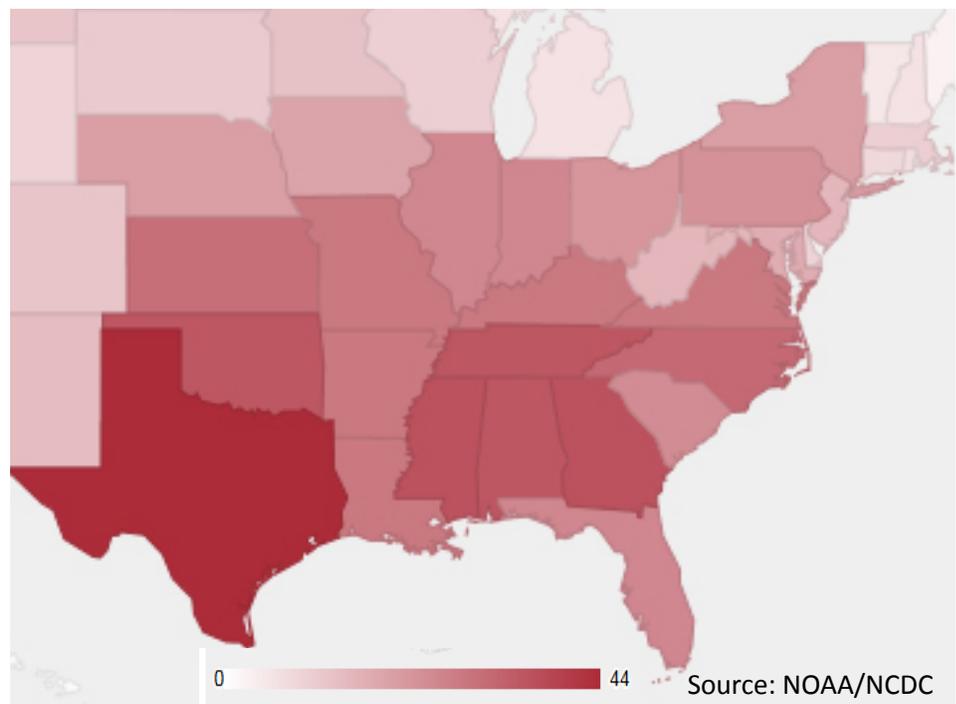
Tropical Cyclone Fatalities

Researchers at the Southeast Regional Climate Center are studying tropical cyclone (TC) related fatalities from 1970 to 2011. Unlike previous studies (i.e. Rappaport 2000, 2013), this study includes deaths both directly and indirectly related to the TC. Indirect deaths include deaths caused by power outages, health issues, or during evacuation, clean up, or storm preparation. Direct deaths include deaths caused by the direct forces of the TC (i.e. high wind, tornado, flash flood, storm surge, etc.). Overall, over 1800 deaths were recorded during this period. Most of these deaths are directly related to the storm, typically caused by inland flash flooding events or high wind events. In this study, deaths are also related to TC attributes such as size, speed of movement and intensity. The results illustrate that more deaths are found in fast moving TC, large TCs or high intensity TCs. With respect to storm track, most deaths are found within 50 km of the right side track.

Health Risks

- Short-term, direct injuries or death caused by extreme events are the more obvious impacts, such as injury from structural collapse or incidents of drowning in flood waters.
- Extreme weather events can also lead to long-term illness such as behavioral and mental health issues. These issues might stem from interruptions to regular health care service or may be caused by geographic displacement as a result of total destruction of homes and communities.
- Injuries can become more severe for those who have limited access to emergency health care either because they live in rural areas where health care facilities are not easily accessible or because of damage or destruction to health care or transportation infrastructure during the event.
- During evacuations before or after extreme events, medical services can also be overloaded in the areas outside of the disaster impact zone.
- Damage to water treatment or delivery infrastructure can lead to a lack of potable water for disaster-affected communities.
- Food safety and supply issues can also arise following these types of extreme events.

Billion-Dollar Weather/Climate Disasters, 1980-2012



The map above shows that between 1980 and 2012, there were 31 billion-dollar weather/climate events in North Carolina and 24 events in South Carolina. These costs translate to public health effects through impacts to food and water supplies, destruction of health care facilities, destruction of homes and other related health care services.

Public Health and Air Quality

Climate Variables

- Drought conditions often lead to wildfire which impacts air quality in surrounding areas.
- Pollen distribution and timing is effected by temperature and precipitation in a region.
- Higher temperatures can contribute to higher ozone levels.

Vulnerable Populations

- Outdoor laborers and agricultural workers
- Athletes
- Children and the elderly
- Those within proximity of wildfire sites and associated smoke
- Individuals with existing respiratory conditions

CISA Research

Climate Change Impacts of Air Pollution on Morbidity in Vulnerable Populations

CISA researchers at the University of North Carolina at Chapel Hill are working to understand how climate change may impact ground-level ozone in Mecklenburg County, NC, particularly with respect to the children and the elderly. The research looks at current associations between ozone levels and respiratory and cardiovascular morbidity in order to better understand how those relationships might change under future climatic conditions.

[Learn more...](#)

Health Risks

Degraded air quality can both cause respiratory disease and exacerbate those with current respiratory conditions. Air quality conditions which can lead to these health impacts include:

- Increased levels of ozone on warm, sunny days.
- Increased demand for air conditioning on very hot days also contributes to degraded air quality through fossil fuel combustion during electricity production.
- Pollen and mold spores released during different growing seasons throughout the year.
- Fine particulate matter (PM2.5) from mobile combustion, among other sources, that remains airborne during dry or stagnant conditions.
- Smoke exposure during and in the days following a wildfire as the smoke disperses into surrounding areas.

Specific conditions associated with degraded air quality for continuous periods of time include decreased lung function, cardiovascular diseases, chronic bronchitis and asthma, among other respiratory illnesses.

The photo below shows burned peat soils in the Pocosin Lakes National Wildlife Refuge. Peat soils in coastal regions of the Carolinas pose a particular threat to air quality during wildfire due to their high levels of organic matter and low oxygen levels. This combination leads to slow burning wildfires with more smoke that can lead to extended periods of exposures to degraded air quality for those living in areas surrounding the wildfire. Photo Credit: Ed Christopher

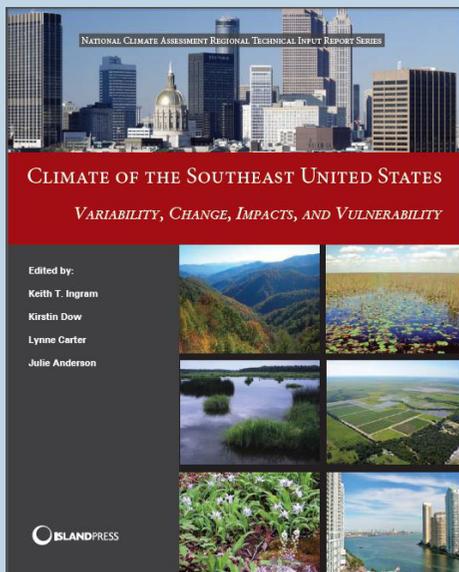


Public Health and Climate Change

Climate of the Southeast United States: Variability, Change, Impacts & Vulnerability

Below are some of the highlights from the Public Health and Climate Change Chapter in the recently released Southeast Climate report.

- Higher ocean temperatures will contribute to outbreaks of harmful algal blooms and food-borne illnesses from marine toxins in shellfish, such as *Vibrio*.
- Higher air temperatures will worsen heat waves and increase levels of harmful pollutants such as ozone.
- Changes in seasonal trends, such as warmer winters or earlier springs, may lead to changes in the onset or intensity of the spring pollen season.
- Potential changes in rainfall intensity and patterns may lead to heavier rainfall events that could cause direct injury (flash floods) or other related health effects (pollutant contamination of surface water during a drought buster event).
- Sea level rise may impact human health through increasing storm surges and disruptions to infrastructure or ecosystems.
- Water quality and quantity may be impacted through variations in rainfall patterns outside of the levels of historical natural variability.
- The potential for an increase in extreme weather events in the region will increase the need to plan for relief efforts and make sure that communities are prepared for potential impacts.



Public Health & Climate Change Summit: Focusing North Carolina Forward

By: Chris Furhmann

CISA researchers from the North Carolina Triangle region participated in a two-day workshop on climate change and public health sponsored by the [Research Triangle Environmental Health Collaborative](#) October 29-30, 2013. The workshop brought together individuals from federal, state, and local governments, academia, and industry to discuss the research, policy, and communication gaps involving climate change and public health in North Carolina. The workshop began with plenary talks that provided overviews of observed and projected changes in climate across North Carolina, the major health implications of climate change, how to communicate and frame climate change as a human issue, and the different federal programs that support research efforts on health and climate change.

Workshop attendees participated in small work group discussions focused on the health effects, climate drivers, and research and policy gaps specific to urban, rural, and coastal communities in North Carolina. During this process, several cross-cutting and overlapping themes emerged, (**see table below**). Workshop participants were also tasked to make recommendations for policy and other decision makers on how to address the public health implications of climate change across the state.

Access the workshop presentations and initial recommendations from the three work groups [here](#).

<i>Cross-cutting Recommendations</i>
<ul style="list-style-type: none"> • Research to understand different heat stress thresholds for vulnerable populations in different regions of North Carolina
<ul style="list-style-type: none"> • Research and policies focused on water quality, availability, and watershed management - issues surrounding runoff from agricultural operations, stormwater, hazardous wastes, and drought
<ul style="list-style-type: none"> • Mapping of vulnerable populations for mental health services and other emergency health services and vulnerable facilities
<ul style="list-style-type: none"> • Training of health professionals on climate change impacts
<ul style="list-style-type: none"> • Outreach and education to the public and relevant agencies/policy-makers on climate change issues, public health impacts and recommendations
<ul style="list-style-type: none"> • Need for better disease surveillance systems
<ul style="list-style-type: none"> • Options for responding to population in and out migration, return and relocation

Public Health and Climate - References & Resources

Climate-Ready NC

The [Climate-Ready NC](#) program is part of the [Climate-Ready States & Cities Initiative](#) sponsored by the [Centers for Disease Control and Prevention's Climate and Health program](#). 16 states and 2 cities are part of the program, which is designed to help health departments 'investigate, prepare for, and respond to' the potential public health impacts caused by changes to our climate. Led by Lauren Thie (NC Division of Public Health Epidemiologist and CISA Advisory Committee member), the program brings together experts and available resources in order to improve understanding of potential changes to the state's climate, predict and monitor health effects, identify populations and regions that may be most vulnerable to these effects, and develop programs to protect the public's health. The [strategic plan](#) for this effort outlines specific objectives to achieve these goals. The outline of these objectives is below. Read the full plan on the [program website](#).

EPA-Climate Impacts on Human Health



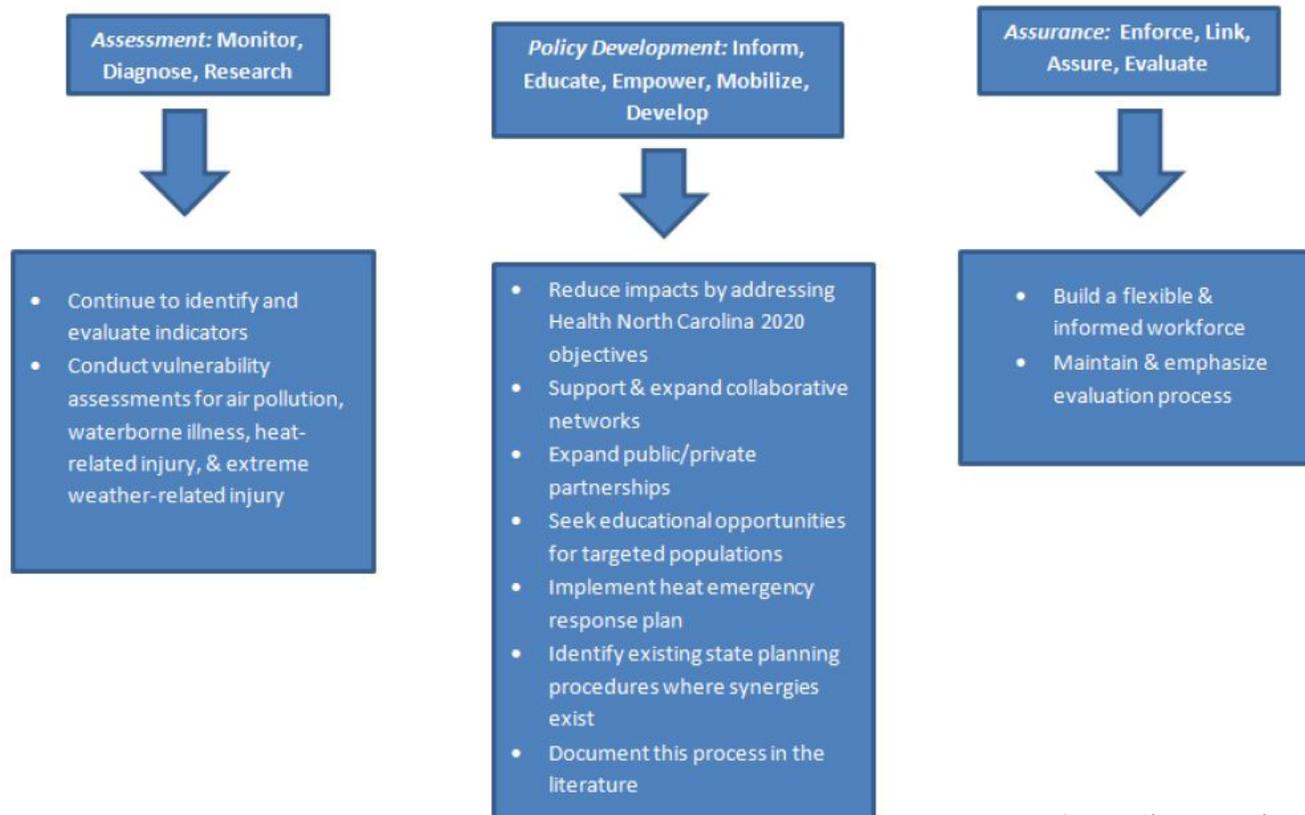
The EPA's webpage on [Climate Impacts on Human Health](#) provides a wealth of information and resources about the implications of climate variability and change on human health. Information can be searched by different climate variables as well as by vulnerable populations such as children and the elderly.

Southeast Regional Climate Center

The Southeast Regional Climate Center's '[Climate and Health](#)' webpage includes information from previous climate and health workshops as well as numerous additional resources on various topics related to climate and public health in the Southeast.



Climate-Ready NC Strategic Plan Objectives



Source: [Climate-Ready, NC](#)