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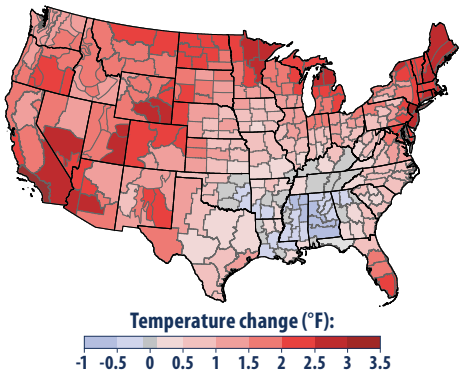
What Climate Change *Means for* North Carolina

North Carolina's climate is changing. Most of the state has warmed one-half to one degree (F) in the last century, and the sea is rising about one inch every decade. Higher water levels are eroding beaches, submerging low lands, exacerbating coastal flooding, and increasing the salinity of estuaries and aquifers. The southeastern United States has warmed less than most of the nation. But in the coming decades, the region's changing climate is likely to reduce crop yields, harm livestock, increase the number of unpleasantly hot days, and increase the risk of heat stroke and other heat-related illnesses.

Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat-trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet about one degree during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others.

Greenhouse gases are also changing the world's oceans and ice cover. Carbon dioxide reacts with water to form carbonic acid, so the oceans are becoming more acidic. The surface of the ocean has warmed about one degree during the last 80 years. Warming is causing snow to melt earlier in spring, and mountain glaciers are retreating. Even the great ice sheets on Greenland and Antarctica are shrinking. Thus the sea is rising at an increasing rate.



Rising temperatures in the last century. North Carolina has warmed less than most of the United States. Source: U.S. EPA, Climate Change Indicators in the United States.

Rising Seas and Retreating Shores

As the oceans warm, seawater expands and raises sea level. Melting ice adds more water to the ocean, further raising sea level. Along much of the Atlantic Coast, including parts of North Carolina, the land surface is sinking, so the observed rate of sea level rise relative to the land is greater than the global average rise. Sea level is likely to rise one to four feet in the next century along the coast of North Carolina.

As sea level rises, the lowest dry lands are submerged and become either tidal wetland or open water. Most existing wetlands can create their own land and keep pace with a slowly rising sea. But if sea level rises three feet in the next century, most of the wetlands on the Albemarle-Pamlico peninsula are likely to be submerged by the higher water level.

Beaches also erode as sea level rises. A higher water level makes it more likely that storm waters will wash over a barrier island or open new inlets. The United States Geological Survey estimates that the lightly developed Outer Banks between Nags Head and Ocracoke could be broken up by new inlets or lost to erosion if sea level rises two feet by the year 2100. Eroding shores will threaten most coastal towns unless people take measures to halt the erosion.

Beach houses in Nags Head are vulnerable to severe storms, flooding, and coastal erosion. © James G Titus; used by permission.

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Coastal Ecosystems

As sea level rises, salt water can mix farther upstream and farther inland in aquifers and wetlands. Increasing salinity can kill some types of trees found in swamps. Salt water also reacts with some wetland soils, which causes the surface of the wetlands to sink below the water, adding to the loss of wetlands.

Trees killed by increasing salinity near Camden Point. © James G. Titus; used by permission.

Many species of birds and fish in North Carolina depend on coastal wetlands threatened by rising sea level. Blue crabs, shrimp, and southern flounder use marshes for both feeding and evading larger predators. Larger fish such as sea trout and red drum also feed in these marshes. Many types of birds feed on fish in the marsh, including egrets and herons. Wetlands along the Alligator River are the principal habitat in the wild for the endangered red wolf. Pocosin swamps provide refuge for black bears and bobcats, and they help to maintain water quality in the nearby sounds.

Storms, Homes, and Infrastructure

Tropical storms and hurricanes have become more intense during the past 20 years. Although warming oceans provide these storms with more potential energy, scientists are not sure whether the recent intensification reflects a long-term trend. Nevertheless, hurricane wind speeds and rainfall rates are likely to increase as the climate continues to warm.

Water covering front yards near Swan Quarter. © James G. Titus; used by permission.

Whether or not storms become more intense, coastal homes and infrastructure will flood more often as sea level rises, because storm surges will become higher as well. Rising sea level is likely to increase flood insurance rates, while more frequent storms could increase the deductible for wind damage in homeowner insurance policies. Many cities, roads, railways, ports, airports, oil and gas facilities, and water supplies in the Southeast are vulnerable to the impacts of storms and sea level rise. People may move from vulnerable coastal communities and stress the infrastructure of the communities that receive them.

Increased rainfall may further exacerbate flooding in some coastal areas. Since 1958, the amount of precipitation during heavy rainstorms has increased by 27 percent in the Southeast, and the trend toward increasingly heavy rainstorms is likely to continue.

Agriculture

Changing the climate will have both harmful and beneficial effects on farming. During the next few decades, hotter summers are likely to reduce yields of corn. But higher concentrations of atmospheric carbon dioxide increase crop yields, and that fertilizing effect is likely to offset the harmful effects of heat on cotton, soybeans, wheat, and peanuts—if enough water is available. More severe droughts however, could cause crop failures. Higher temperatures are also likely to reduce livestock productivity, because heat stress disrupts the animals' metabolism.

Energy

Seventy years from now, temperatures are likely to rise above 95°F approximately 20 to 40 days per year in most of the state, compared with about 10 days per year today. Greater use of air-conditioning will increase electricity consumption.

Human Health

Hot days can be unhealthy—even dangerous. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. High air temperatures can cause heat stroke and dehydration and affect people's cardiovascular and nervous systems. Warmer air can also increase the formation of ground-level ozone, a key component of smog. Ozone has a variety of health effects, aggravates lung diseases such as asthma, and increases the risk of premature death from heart or lung disease, so EPA and the North Carolina Division of Air Quality have been working to reduce ozone concentrations. As the climate changes, continued progress toward clean air will become more difficult.

The sources of information about climate and the impacts of climate change in this publication are: the national climate assessments by the U.S. Global Change Research Program, synthesis and assessment products by the U.S. Climate Change Science Program, assessment reports by the Intergovernmental Panel on Climate Change, and EPA's *Climate Change Indicators in the United States*. Mention of a particular season, location, species, or any other aspect of an impact does not imply anything about the likelihood or importance of aspects that are not mentioned. For more information about climate change science, impacts, responses, and what you can do, visit EPA's Climate Change website at www.epa.gov/climatechange.

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