

NORTH CAROLINA

ASSESSING THE COSTS OF CLIMATE CHANGE

CLIMATE TRENDS IN NORTH CAROLINA

During the last century, the average temperature in North Carolina rose by 1.2° F, and precipitation increased by 5 percent in many parts of the state.¹ Although temperature and rainfall variations occur within the state, overall the last decade was warmer and wetter than the previous four decades. The maximum summer temperature has risen near the coast, and minimum temperatures have risen for all seasons throughout the state. During the past 50 years, precipitation increased during the fall and spring, but decreased during the summer.²

During the next century, climate models predict that temperatures could increase by 4.1° F (considered a conservative estimate) for the southeastern United States.³ Increases in frequency and duration of extreme hot days during the summer also have been predicted for North Carolina.⁴ Precipitation could increase by 15 percent in winter and spring and by a greater amount in summer. Despite the projected precipitation increase, droughts may become more frequent as higher temperatures accelerate evaporation.

Climate change also could accelerate the trend of global sea-level rise. The latest Intergovernmental Panel on Climate Change report estimates a 7- to 23-inch worldwide rise in sea level during the next century.⁵ Rising sea levels could be particularly disastrous to coastal North Carolina because its shoreline is already sinking at 7 inches per century, so the projected increase will worsen erosion and land loss.⁶ In fact, the National Assessment of Coastal Vulnerability to Sea-Level Rise, undertaken by the U.S. Geological Survey, found that more than half the state's shoreline is at very high risk to sea-level rise.⁷ Climate change could further add to this risk by increasing the intensity and frequency of hurricanes. Fueled by warmer ocean temperatures, hurricane activity in the Atlantic may intensify; the strength, duration and frequency of hurricanes are predicted to increase due to climate change.^{8,9}

ECONOMIC IMPACTS¹⁰

Coastal Impacts

Sea-level rise due to climate change could have a major economic effect on North Carolina tourism, recreation and real estate. Many variables—such as regional coastal slopes, shoreline erosion rates and the shape of the coastline—determine a particular area's vulnerability to rising sea levels. Figure 1 shows the vulnerability of the North Carolina coastline to higher sea levels. The coastal areas shaded

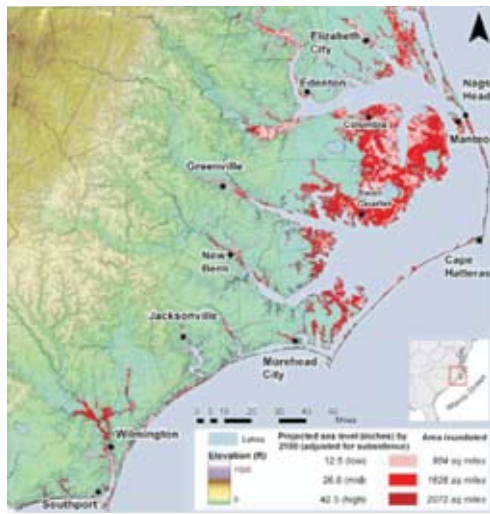
OVERVIEW

In the coming decades, a changing climate is expected to increase economic impacts on North Carolina and the nation. The most recent climate modeling predicts warmer temperatures, higher sea levels and more precipitation for North Carolina, and that these changes may be more pronounced if global emissions of greenhouse gases are not reduced. Climate change threatens state coastal infrastructure, agricultural productivity and drinking water supplies. Since the state economy is directly linked to those of neighboring states and regions, policymakers may wish to consider both state and regional policies to address climate change.



in dark red are at highest risk to sea level rise; the lighter shades indicate the land area at risk from higher sea levels. More than half of the state's coast falls in the high or very high-risk categories.

Figure 1. Map of Coastal North Carolina and Sea Level¹¹



Source: Poulter and Halpin, 2008.

The rising seas threaten valuable property along the coast. In North Carolina, South Carolina and Georgia, the value of insured coastal property increased by 88 percent— \$62 billion—between 1988 and 1993.¹² It is estimated that an 18 inch rise in sea level by 2080 would result in a total loss in value of more than \$2.8 billion for residential and nonresidential property in four North Carolina coastal counties— New Hanover, Dare, Cataret and Bertie (see Table 1).¹³ Increased real and perceived dangers of coastline loss and flooding also affect the cost for insurance coverage in coastal communities.¹⁴

Table 1. Estimates of Lost Coastal Property Value, 2080, 18-inch Sea Level Rise Scenario in Four North Carolina Counties

County	Residential Property Value Loss	Nonresidential Property Value Loss
New Hanover	\$99 million	\$35 million
Dare	\$988 million	\$1.42 billion
Cataret	\$100 million	\$183 million
Bertie	\$5.45 million	\$3.8 million

Source: Bin et al., 2007, converted to 2007 dollars.

North Carolina also is at high risk due to hurricane activity.

It ranks fourth in the nation for number of recorded hurricane strikes; 50 hurricanes made landfall on its coastline between 1851-2006.¹⁵ Hurricane Isabel, which

hit North Carolina in 2003, caused nearly \$200 million in insured property losses.¹⁶ With climate change predicted to increase hurricane activity and intensity, North Carolina and neighboring states could see increased losses.

The tourism industry could be affected by higher sea levels and more intense hurricane activity, both of which erode beaches; more threatening weather also reduces tourist interest in beach trips. It is estimated that, by 2080, an 18-inch increase in sea level would cost the state tourism industry up to \$10.6 billion in today's dollars.¹⁷

One proposed method to protect coastal infrastructure from rising sea levels is to build a coastal seawall or bulkhead. Officials commonly estimate the cost of such a structure at approximately \$1,190 per linear foot.¹⁸ Building a seawall along North Carolina's 301-mile coast could cost the state \$1.89 billion.¹⁹

Agriculture

North Carolina's agriculture sector also could be affected by climate change. Droughts, an increase in severe weather and higher temperatures could severely affect the farming, livestock and forestry industries. An AEI-Brookings Joint Center for Regulatory Studies report estimates a 22.6 percent climate-change induced loss in agricultural profits for the state.²⁰ North Carolina ranks second nationwide for hog production; nearly \$2 billion was generated in cash receipts in 2006.^{21, 22} Heat stress can reduce animals' ability to gain weight and reproduce, and temperature increases influence availability of forage areas. Research shows that a 9° F increase in temperature reduces livestock yield in animal and dairy operations by about 10 percent in the Appalachian region.²³ Since poultry and eggs comprise 36 percent (nearly \$4 billion) of total farm sales, higher temperatures could contribute to significant losses.

The projected increase in severe weather caused by climate change also could threaten the agricultural sector. In the 10-year period between 1996 and 2006, 14 tropical storms and hurricanes caused agricultural damages totaling \$2.4 billion in North Carolina.²⁴

More severe tropical storms and hurricanes also could affect North Carolina's forests and forestry-related industries. Hurricane Fran, a 1996 Category 3 storm, damaged approximately 8.3 million acres of state forest land at total estimated cost of \$1.7 billion. For every increase in storm category level, forest damages have been found to rise by approximately \$500 million.²⁵ Furniture and related manufacturing industries that rely on the forestry sector are an integral part of North Carolina's economy, contributing \$3.1 billion in 2005.²⁶ Climate change could affect the forestry sector by



undermining important economic engines, such as construction and manufacturing.

Public Health

Higher temperatures caused by climate change could diminish air quality in North Carolina and increase health care costs. Higher temperatures contribute to the formation of ground-level ozone and smog, which can worsen asthma and other respiratory conditions. The American Lung Association ranked the Charlotte-Gastonia-Salisbury metropolitan area among the top 20 most ozone polluted cities in the United States.²⁷ Asthma already is a serious public health issue in North Carolina, costing the state and its residents \$631 million in 2003. Higher pollution levels caused by rising temperatures could increase social and economic costs due to higher levels of hospitalization and treatment for those with asthma and other respiratory diseases.²⁸

Water Resources

Climate change could create water shortages due to coastal flooding and saltwater contamination of the freshwater supply, and also could increase the likelihood of water shortages due to higher temperatures and increased evaporation. More than half the state's population depends on ground water for drinking, and about 98 percent of all public supply systems rely on ground water.²⁹ Water use restrictions during the 2007 drought affected 53 percent of public water systems and a total population of about 5 million.³⁰

Increased drought severity and the probability of heavy precipitation could increase runoff and flooding, since drier soils do not absorb water so readily. More runoff and flooding can wash pesticides, fertilizers or other pollutants into water resources, creating higher levels of contamination and increasing water treatment costs.³¹

Sports and Recreational Activities

The North Carolina ski industry and related businesses generated approximately \$120 million in revenue and employed more than 100,000 people during the winter of 2002-2003.³² Climate models have consistently predicted a decrease in total number of skiing days during the next century.³³

Wildlife-associated recreation, another popular activity in North Carolina, supports approximately 55,500 workers. In 2006, 3.4 million people spent nearly \$2.7 billion on this activity.³⁴ Climate change could alter habitat, affecting both wildlife populations and related industries.

CONCLUSION

North Carolina is likely to face large challenges in adapting to climate change along its coastline, since this is where the most significant economic and ecological effects are likely to occur. Protecting coastal developments and natural habitats—which will face increased risk of erosion from higher water levels and more intense storms—will be a leading concern. Since some sea level rise and climate change is likely regardless of efforts to reduce greenhouse gases (the long life of excess greenhouse gases already in the atmosphere make a certain degree of warming inevitable), it may be prudent to make adaptations to coastline development and habitat protection plans. Planners also may wish to improve flood response plans and adjust coastal development patterns to reduce community exposure to coastal flooding, erosion and storms.

An improved assessment of the effects of local climate change on freshwater supplies for drinking and agricultural uses will help plan for potential water resource changes. Since flooding is likely to be more intense when it occurs, planners and policymakers may wish to create assessments of those areas most likely to be affected so that flood response plans can be modified and mitigation measures can be taken.



MISSING INFORMATION AND DATA GAPS

Much more information is needed, including:

- More detailed analysis of crop yields and productivity value due to counteracting effects of increasing temperature and decreasing water availability.
- Detailed analysis of effects on transportation infrastructure.
- More information on effects of climate change on state energy demand and use.
- Full economic effects of climate change on state ecosystems in coastal and mountain regions.
- Vulnerability of urban infrastructure (buildings, electric grid, sewage and water pipes) to climate change.

NOTES

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