

# Alabama



State Findings from

## Confronting Climate Change in the Gulf Coast Region

Prospects for Sustaining  
Our Ecological Heritage

## Alabama's Variable and Changing Climate

Alabama's climate has always been variable and sometimes extreme—and climate change may intensify this historical pattern. Average state temperatures have varied substantially over the past century, with a warming trend since the late 1960s. Average rainfall has changed only a little, with summers becoming slightly drier and winters slightly wetter, and extreme rainfall events have become more frequent.

Alabama has a warm-temperate and humid climate; annual rainfall totals range from 40–70 inches with little seasonal pattern. Rainfall is brought by thunderstorms and tropical storms in the summer, and by extratropical storms in the winter. Occasionally, especially during hurricanes, Alabama experiences substantial flooding. Tropical storms strike the Alabama coast once every 9–10 years on average, but hurricane frequency varies by decade and is strongly influenced by the El Niño–La Niña cycle. Sea level along Alabama's Gulf coast—from Dauphin Island to Gulf Shores—has risen by as much as 8 inches over the past 100 years.

## Future Climate Projections for Alabama

It is possible to assess Alabama's vulnerability to a rapidly changing climate, even though extracting state-specific information from global climate model projections entails significant uncertainty. Therefore, scientists use a variety of models and other scientific methods to project plausible climate futures as a basis for impact studies. For the US Southeast,

Rainfall is likely to decrease in the immediate coastal regions of Alabama and sea level will increase at a faster rate over the 21st century.

the climate projections from the best available climate models agree on temperature and sea-level increases, but differ on changes in precipitation in some parts of the region. Because future trends in rainfall and runoff are critical to human and ecological well-being in the Gulf Coast region, the most prudent approach is to assess the potential impacts of both the drier and wetter scenario. The following climate projections are

derived from models produced by the Canadian Climate Centre and the U.K.'s Hadley Centre.

- **Temperature:** Maximum summer temperatures could increase by 3–7°F—with rises in the July heat index of 10–25°F; minimum winter temperatures could increase by less than 3° to about 10°F. The freeze line is likely to move north.

- **Precipitation and runoff:** Rainfall is likely to decrease in the immediate coastal regions of Alabama. In upland areas, one model projects wetter conditions, the other, drier. These differences are also reflected in projected soil moisture changes, which are critically important to agriculture and forestry and are a function of rainfall gains and evaporation losses. In coastal Alabama, models project significant summer soil moisture decreases, and project either decreases or increases in north-

ern Alabama. Where drought conditions increase, the risk of wildfires also increases.

- **Sea-level rise:** Sea level will increase at a faster rate over the 21st century. By 2100, ocean levels could be 15 inches higher than today, based on a continued average subsidence rate of 2 inches per century and a mid-range sea-level rise scenario.

- **Tropical storms:** Hurricane intensity (maximum wind speeds, rainfall totals) could increase slightly with global warming, although changes in future hurricane frequency are uncertain. Even if storm frequencies and intensities remain constant, the damages from coastal flooding and erosion will increase as sea level rises.

## Potential Impacts from Global Warming on the Environment, Human Health, and the Economy of the Yellowhammer State

### Human Health

Health concerns related to global warming result from a complex set of interactions among human and environmental factors. Extreme heat, air and water quality, seafood safety, and storm-related risks are of great concern for all residents and visitors, but particularly for the elderly population.

- The greatest increase in the July heat index is projected for the southern United States. Alabama—especially Birmingham, Montgomery, Mobile, and other large urban areas—is particularly vulnerable to more heat waves. As a result, Alabama is likely to see an increase in the number of heat-related illnesses and deaths, especially among the elderly, the very young, those whose health is already compromised, and the very poor, who are unable to protect themselves from the heat.

- Higher temperatures also lead to increased production of ground-level ozone and smog, exacerbating asthma and other respiratory diseases and making it even harder for urban areas like Birmingham and surrounding counties, which are currently in noncompliance with federal air quality standards, to meet acceptable air quality.

- The risk of water-borne illnesses can increase with warmer temperatures and extreme rainfall and runoff. The incidence of gastrointestinal diseases, respiratory diseases, and skin, ear, and eye infections, however, is determined only in combination with human factors, such as the effectiveness of water and sewage treatment and the responsiveness of the public health system. Thus, climate-related health risks will place greater demands on public health resources.

- Vulnerability to climate change and water-related health risks is particularly severe in areas where water supply and quality, waste disposal systems, and power supplies for heating and cooling are already substandard.

- Microorganisms associated with diseases in coastal waters, such as toxic algae, red-tide dinoflagellates, *Vibrio vulnificus* (a pathogen contaminating shellfish), and others, can damage habitat and shellfish nurseries and be toxic to both marine species and humans.

## Forestry and Agriculture

Alabama's managed shortleaf and loblolly pine tree forests contribute \$12.9 billion to the state economy each year.

- Wetter climate conditions would increase productivity of hardwoods at the expense of softwoods, but would also increase the risk of forest pests such as Southern pine bark beetle.
- If the drier climate scenario were to play out, savannas and grasslands would expand at the expense of forests, particularly further inland from the Gulf Coast.
- Increased fire frequency under drier conditions would require significant adaptations in forest and fire management (species selection, stand density, fertilization, rotation length). Extreme, long-lasting droughts would seriously damage forests in the long-term.
- With CO<sub>2</sub> fertilization, tree growth increases if water is not limited. As temperature increases further, however, the capacity of trees to absorb and store carbon diminishes.
- In the immediate coastal zone, where the climate is projected to become drier, the production of cotton, soybeans, sorghum, hay, and vegetables may decline without increased irrigation. (*Note:* The fertilization effect from elevated

levels of CO<sub>2</sub> will increase productivity only if sufficient water is available for irrigation.)

- If and where climate becomes wetter, the risk of agricultural pests will increase.

### Freshwater Resources

Alabama's current population of almost 4.5 million is projected to increase to about 5.2 million in 2025. The state's freshwater resources will be increasingly tapped for residential, industrial, irrigation and

other uses. Competing demands on limited water resources will increase freshwater management challenges with or without climate change. However, any change in rainfall,



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evaporation, groundwater recharge rates, and runoff patterns would affect ecosystems and all freshwater users.

- Greater freshwater losses because of increased temperatures and evaporation will magnify the water resource challenges of the future if rainfall stays at current levels. Where rainfall amounts decline, especially during critical times of the growing season, drought and widespread freshwater shortages could increase.
- More extreme rainfall events, a trend already detected, create their own challenges: extreme runoff can produce overload on the sewage systems with resulting septic contamination of surface and coastal waters, and negative consequences for health and the fishing industry.
- Where saltwater intrudes into coastal groundwater sources due to sea-level rise, freshwater resources would be further affected. Baldwin and Mobile counties, for example, are already experiencing higher salinity in wells. Where saltwater intrudes into freshwater marshes, vegetation with low salt tolerance would be decimated.
- One of largest freshwater users in the state is thermoelectric power generation. Reduced stream flow and higher water temperatures would cause problems for power production and cooling systems and create significant ecological problems downstream as temperature tolerance of fish and water quality requirements for aquatic organisms are no longer met.

### Biodiversity and Land Conservation

Threats from human development and global warming could undermine Alabama's efforts to protect its natural heritage in public trust. This is particularly important in light of Alabama's extraordinary biodiversity in coastal and especially inland ecosystems. The state—while only ranked 25th in land area among all US states—is fifth in terms of biodiversity, and second only to Hawaii in terms of species lost to extinction.

- The coastal region stretching from the Florida panhandle to Mobile Bay is one of the richest areas in the United States in terms of biodiversity—harboring threatened or endangered species such as the Alabama canebrake pitcher plant, the red-cockaded woodpecker, or the Alabama beach mouse. Habitat losses due to continued human development combined with climate change impacts could increase the threats to these species.

Higher temperatures lead to increased production of ground-level ozone and smog, exacerbating respiratory diseases and making it harder for urban areas to meet acceptable air quality standards.



Randall Haddock, Cahaba River Society

- Much of Alabama's biodiversity is centered in the Calhoun and Cahaba River watersheds and includes some of the highest numbers of fish and amphibians in the US. Cahaba River has the world's largest remaining stand of the imperiled shoals lily, locally known as the Cahaba Lily. Moreover, half of Alabama's aquatic species are considered endangered or threatened, and nearly 100 plant species are deemed globally rare. With many of these species bound to moist habitats and thus critically dependent on sufficient fresh water, any declines in local precipitation and runoff would be detrimental to Alabama's biodiversity.

- If climate-related disturbances, such as fires and storms, increase, invasive species, including blue tilapia, Brazilian pepper, water hyacinth and others, are likely to spread and become dominant at the expense of the great biodiversity of the state's native species.

### Fisheries

In the sounds, bays and estuaries behind the small number of barrier islands separating the Alabama mainland from the Gulf of Mexico, fresh and salt water combine to create the environment that shrimp and oysters need to live and flourish. The state's aquaculture industry—fifth in the nation

in producing food fish, baitfish, shrimp, and oysters—is particularly sensitive to adequate amounts of fresh water and increases in salinity.

- If freshwater flow into Mississippi Sound, or Mobile and Perdido Bay permanently declines, then higher salt concentrations, less nutrient input, and less frequent flushing would result in lower water quality overall. Salt tolerance of some species in marshes, mangroves, and seagrass beds may be exceeded, causing changes in the food web

and possibly a reduction in fish growth and fishery yields.

- Mobile Bay already experiences periods during which oxygen is significantly reduced in coastal waters—a condition called hypoxia and locally known as 'jubilee.' Should runoff into the Bay increase with climate change, the size or frequency of this naturally occurring nutrient influx and stratification of Bay waters—with heavier saltwater beneath and lighter fresh water on top—could increase. The resulting "dead zone" would affect Alabama's fisheries, especially shrimp, whose yield typically declines during hypoxia events.

Threats from human development and global warming could undermine Alabama's efforts to protect its natural heritage and the state's extraordinary biodiversity.



Robert Twilley

- If wetlands can migrate inland as sea level continues to rise, the yield of estuarine-dependent fisheries, such as shrimp, will increase or decrease depending on the size and quality of the new habitat over time.

### Coastal Development and Infrastructure

Over recent decades, most of the shoreline has been rapidly developed for residences, recreation, and tourism. Other areas, such as Mobile Bay and the seaport of Mobile, have long been important industrial sites and transportation hubs. As development and economic activity in coastal areas has increased, so has societal vulnerability to coastal hazards.

- Sea-level rise will increase the rates of erosion—an already significant threat to homes, roads, harbor installations, and other infrastructure along the shorefront. As erosion proceeds, communities and built infrastructure, such as on Dauphin Island, become more vulnerable to the impacts of severe storms.

- Sea-level rise will also increase storm surges, even if hurricanes and tropical storms do not become more intense. Thus, greater economic losses from storms and higher repair and maintenance costs (e.g., for port and industrial facilities or beach replenishment) must be expected in the future.

- Coastal ecosystems, such as estuaries, salt marshes and seagrass beds, and managed land for agriculture and tourism will experience the combined impacts of human pressures and higher temperatures, accelerated sea-level rise, and changing rainfall patterns. Unless ecosystems can adapt or migrate to more suitable habitat, the diversity of species and habitats in the coastal zone are likely to diminish.



This fact sheet is based on the findings of *Confronting Climate Change in the Gulf Coast Region*, a report published in October 2001 by the Union of Concerned Scientists and the Ecological Society of America. The report was written by 10 regional experts under the leadership of Robert Twilley (University of Louisiana-Lafayette). The Alabama expert is Dr. Robert Wetzel, formerly from the University of Alabama-Tuscaloosa, now at the University of North Carolina-Chapel Hill.

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The full report is available from UCS at [www.ucsusa.org](http://www.ucsusa.org) or call (617) 547-5552.