

# Florida



State Findings from

## Confronting Climate Change in the Gulf Coast Region

Prospects for Sustaining  
Our Ecological Heritage

## Florida's Variable and Changing Climate

Florida is famous for its pleasant temperatures year-round—yet climate change may noticeably alter the character of the state's climate. Average state temperatures have varied substantially over the past century, with a warming trend since the late 1960s. Average winter rainfall has increased while summer averages have decreased, and extreme rainfall events have become more frequent.

Florida has a warm-temperate to subtropical climate with occasional winter freezes. It has a distinct summer wet-season and a winter dry-season.

Competing demands on limited water resources will increase freshwater management challenges with or without climate change.

Rainfall totals can vary widely from year to year—from as little as 33 inches to as much as 90 inches. Rainfall is brought by extratropical storms in the winter and thunderstorms

and tropical storms in the summer and fall, which can result in substantial flooding and other weather extremes. Tropical storms strike Florida on average every 1 to 2 years—the highest rate of any state along the Gulf or Atlantic coast. Hurricane frequency varies by decade and is strongly influenced by the El Niño–La Niña cycle.

Sea level along Florida's Gulf coast—from the Everglades to the Panhandle—has steadily risen, increasing by up to eight inches over the past 100 years. The number of miles of eroding beaches has been increasing as well.

## Future Climate Projections

It is possible to assess Florida's vulnerability to a rapidly changing climate, even though extracting state-specific information from global climate model projections entails significant uncertainty. Scientists use a variety of computer models and other scientific methods to project plausible climate futures as a basis for impact studies. 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 July heat index increases between 10–15°F; minimum winter temperatures could increase from less than 3° to about 10°F. The freeze line is likely to move north. Ocean water temperatures are also likely to warm.

- **Precipitation and runoff:** In South Florida, one climate model projects the area to get wetter; the other, drier. However, summer soil moisture—critically important to agriculture and forestry and a function of rainfall gains and evaporation losses—is projected to change little in the southern part of the state. On the other hand, rainfall over northern Florida is projected to decrease, with soil moisture projections varying.

- **Fire:** Forest and fire management and fire prevention are important in determining fire risk, outbreak, spread, and containment. However, moisture conditions are also critical determinants of fire risk. Projections differ between models

and by geographic area. Where and when dry conditions do increase, the risk of wildfires is likely to increase as well.

- **Sea-level rise:** Sea level will increase at a faster rate over the coming century. By 2100, ocean levels would 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. Even a relatively small vertical rise in sea level (inches to 1 foot) can move the shoreline inland by a substantial distance (several tens of feet) along low-lying, flat coastal areas.

- **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, however, 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 Sunshine State

### Freshwater Resources

Florida's current population of almost 16 million is projected to increase to more than 24 million by 2030. Thus, the state already faces a growing demand on freshwater resources for urban residential or industrial uses, irrigation, the prevention of saltwater intrusion in coastal aquifers, and for the maintenance of healthy aquatic ecosystems. Competing demands on limited water resources due to growth alone will increase freshwater management challenges with or without climate change. However, any change in rainfall, evaporation, groundwater recharge rates, and runoff patterns would affect ecosystems and all users of fresh water.

- 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. Restrictions on the water use and withdrawal from aquifers—already occurring periodically today—could become more common.

- 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.

- Higher water temperatures impact aquatic ecosystems by changing aquatic food webs and species communities. Higher water temperatures also reduce the amount of dissolved oxygen in the water, diminishing water quality, and in extreme cases, leading to fish kills.

- Where saltwater intrudes into coastal groundwater sources due to sea-level rise, freshwater resources could be further affected. Where saltwater intrudes into freshwater marshes, vegetation with low salt tolerance—such as the Sabal Palm—would be decimated.

## Agriculture

Florida's agricultural industry is among the most important in the nation. It ranks first in citrus production, second in the production of vegetables and horticultural products, and fourth in all crops. Global warming could bring substantial changes and challenges to this industry.

- Florida's citrus sales, topping \$1.6 billion in 1998 and accounting for about 60 percent of US citrus production, may decrease moderately with global warming over the 21st century.
- In areas where climate becomes drier in the future, the production of cotton, commercial fruits and vegetables, and sugarcane may decline without increased irrigation. (*Note:* The fertilization effect from elevated levels of CO<sub>2</sub> will increase productivity only with sufficient irrigation.)

## Forestry

Florida's managed shortleaf and loblolly pine tree forests contributed about \$7.0 billion in production value to the state economy in 1997.

- Increased fire frequency in drier conditions would require significant adaptations in forest and fire management (species selection, density of tree stands, fertilization, rotation length). Extreme, long-lasting droughts would seriously damage forests in the long-term; these same droughts would also increase the risk of wild fires.
- The combined effects of climatic changes and fire management practices will determine the magnitude of future wildfire problems. In recent years, thousands of wild fires engulfing hundreds of thousands of acres of land, destroyed

timber, homes and businesses illustrate the risks and potential losses from wild fires.

- Warmer, wetter conditions would increase the risk of forestry pests—such as Southern pine bark beetle—and frequent disturbance from fires and storms would favor the spread of invasive species—such as mellaleuca and casuarina over native species.
- Savannas and grasslands would expand at the expense of forests, particularly in northern Florida, if the drier climate scenario were to play out. As temperatures rise, the capacity of trees to absorb and store carbon diminishes.

Sea-level rise will increase storm surges, even if hurricanes and tropical storms do not become more intense.

## Coastal Development and Infrastructure

Most of the shoreline has been rapidly developed as residential, recreational and tourism sites over the last 40 years. Other areas—such as the international seaport in Tampa Bay—have long been critically important industrial locations and transportation hubs. As development in coastal areas has increased, so has societal vulnerability to coastal hazards.

- Sea-level rise will increase the rate of beach erosion—an already significant threat to homes, roads, industrial facilities, and other infrastructure along the shoreline.
- 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.

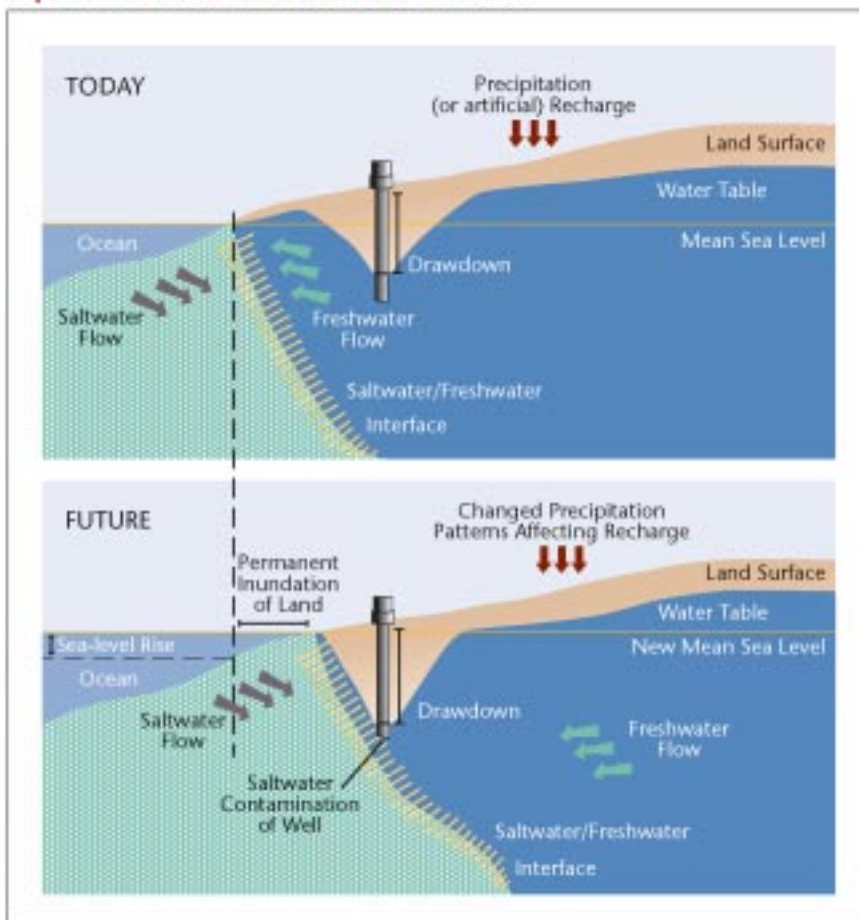
- Coastal ecosystems—such as estuaries, mangroves, and seagrass beds—and managed land for agriculture, forestry, and tourism—will experience the combined impacts of human pressures and higher temperatures, accelerated sea-level rise, changing rainfall patterns, and accompanying changes in the frequency and intensity of wild fires. If ecosystems cannot adapt or migrate to more suitable habitat, the diversity of species and habitats is likely to diminish.

## Tourism and Recreation

Florida's coastline is the jewel of the state's number one industry—tourism—which, in 1999, generated \$46.7 billion for the state. Beaches, along with the coral reefs off the Florida Keys, and the rich habitats of the Panhandle region, contribute to the state's attractiveness.

- Coral reefs—a key attraction—will experience increasing pressures from the combined impacts of recreational use; overfishing; coastal pollution; and warming coastal waters.
- Rising sea levels will increase coastal erosion, leading to beach loss where sediment supplies are low, and to increased risk of damages from hurricanes and other coastal storms. The maintenance of

## Aquifer Drawdown and Saltwater Intrusion





beaches through nourishment will likely be required more often as faster sea-level rise speeds coastal erosion.

- Coastal wetland loss due to faster sea-level rise combined with a limited ability of wetlands to migrate inland due to development could reduce the habitats of waterfowl and other wildlife essential to hunting and recreational fishing.

### Human Health

**H**ealth concerns related to global warming result from the complex interaction of a number of human and environmental factors. Heat, air and water quality, seafood safety and storm-related risks are of great concern for all residents and visitors, particularly Florida's large elderly population.

- The July heat index is projected to increase most in the southern United States. Metropolitan areas—such as Orlando and Tampa-St. Petersburg—are particularly vulnerable to more frequent heat waves. Prolonged, severe heat could increase the number of heat-related illnesses and deaths, especially of people who are unable to protect themselves from the heat or whose health is already compromised.

- Higher temperatures will also lead to increased production of ground-level ozone, which when combined with higher concentration of air pollutants and higher pollen counts, could seriously compromise air quality.

- Contamination of surface water bodies and groundwater resources from septic tanks (already contributing about 210 million gallons of waste every day) increases the risk of bacterial and viral infections. This risk increases with extreme rainfall and runoff events and higher water temperatures.

- Nearshore waters could also be affected by viral and bacterial contamination (as seen in recent years in Tampa Bay), negatively impacting the seafood and recreation industries.

- Warmer coastal waters, especially in combination with nutrient pollution, can also increase the intensity, duration, and extent of blooms of harmful algae and cyanobacteria

(formerly known as blue-green algae). Red tides—while considered a natural phenomenon and not dependent on pollution—are already a chronic problem along Florida's Gulf Coast and thrive in warmer waters. Algal blooms damage habitat and shellfish nurseries and can be toxic to both marine organisms and humans.

### Fisheries

**I**n the bays and estuaries behind the barrier islands fresh and saltwater combine to create the environment shrimp and oysters need to thrive. Changes in the salinity, water temperature, and the extent of estuarine wetlands critically affect this habitat and the fisheries that depend on it.

- If freshwater flow into bays—such as Tampa Bay and Florida Bay—permanently declines, then higher salt concentrations and less frequent flushing will result in lower water quality overall. Salt tolerance of some species may be exceeded, causing changes in the food web and possibly a reduction in fish and shellfish growth and landings.

- Aquaculture, ranked third in the nation, producing food fish, baitfish, ornamental fish, shrimp, and oysters, is particularly sensitive to adequate amounts of freshwater and increases in salinity.

### Unique Habitats

**M**any natural habitats in Florida harbor threatened or endangered species—such as the Everglades snail kite or Cape Sable seaside sparrow in South Florida or the coral reefs off the Florida Keys. Habitat losses due to continued human development, combined with climate change impacts, will likely increase the threats to these species and habitats.

- The environment of the globally unique Everglades—while seriously impacted by human activities originating outside its boundaries—is currently being restored in a multi-billion dollar effort. The restoration plan does not account for global warming. The greatest impacts from climate change include potential reductions in water availability, accelerated sea-level rise, invasive species, and potentially more frequent disturbances such as wild fires.

- The Panhandle and Big Bend region is likely to experience increased rates of coastal erosion and saltwater intrusion into freshwater marshes. Reductions in freshwater flow to estuaries such as Apalachicola Bay would reduce the economically important fisheries. If climate-related disturbances increase, invasive species—such as blue tilapia, Brazilian pepper, water hyacinth and others—are likely to spread and become dominant at the expense of native species.



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). Experts from Florida included Henry Gholz (University of Florida), Mark Harwell (University of Miami), and Joan Rose (University of South Florida-Tampa).

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