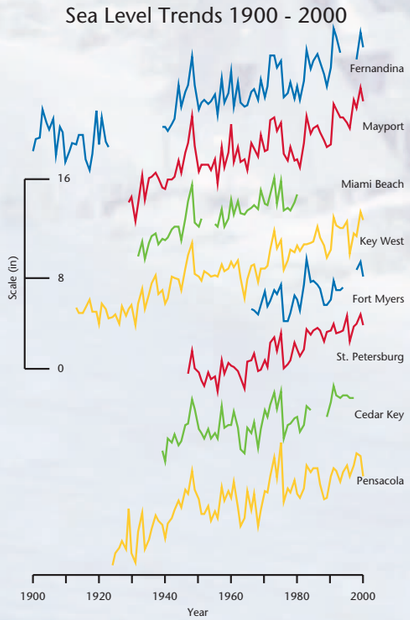
Global Warming and The Coast

Carbon dioxide and other gases in the atmosphere transmit sunlight to the Earth's surface but retain heat that would otherwise escape into space. This mechanism is called the "greenhouse effect" because it is somewhat like the way that the glass in a greenhouse traps heat.

The atmosphere's greenhouse effect keeps the Earth 60˚ Fahrenheit warmer than it would be otherwise. But human activities, such as burning oil, coal, and natural gas in everything from power plants to cars and boats, are increasing the concentration of greenhouse gases. As a result, the Earth has warmed almost 1˚ Fahrenheit in the last century.

Warmer temperatures increase the intensity of storms. Higher temperatures also raise the sea level by expanding ocean water and melting mountain glaciers. Rising sea level erodes beaches, increases flooding, threatens coastal



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For More Information

- See the U.S. Environmental Protection Agency's Global Warming Site at **www.epa.gov/globalwarming**.
- For specific information about sea level rise, see **www.epa.gov/globalwarming/sealevelrise**.
- Contact the Florida Coastal Management Program at 850-922-5438, or Florida Sea Grant (Miami-Dade County) at 305-361-4017 or visit **www.dca.state.fl.us/ffcm/**.
- For information on flood insurance, call 800-480-2520 and ask for a booklet titled "Answers to Questions About the National Flood Insurance Program."
- Miami-Dade County Department of Environmental Resources Management: **www.co.miami-dade.fl.us/derm/globalwarming**.

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Background photo: Cape Romano, 1995, Provided by Florida Department of Environmental Protection

Background photo: South Florida, Provided by OAR/National Undersea Research Program

Saving Florida's VANISHING Shores

Front Cover: The effect of sand replenishment on the beach in Bal Harbor, 1998. Provided by Miami-Dade County.

Are Florida's Beaches Disappearing?

Most beaches along the Atlantic and Gulf Coasts of the United States are eroding a few feet per year. In Florida, beach erosion has been attributed partially to the construction and maintenance of inlets, but rising sea level is the primary reason that most shores erode. Rising global temperatures and gradually sinking land contribute to the higher water levels. Along the Florida shore, the sea level is rising 1 inch every 11-14 years. Approximately 328 miles of sandy beaches are eroding enough to threaten existing developments and recreation areas. That's about 40 percent of Florida beaches.

In some other coastal states, homeowners are removing their oceanfront houses along eroding shores. The beach survives, but the building is lost. Along bay shores in most states, owners often protect their homes from erosion by replacing the natural beach with wooden walls (bulkheads) or piles of rock (revetments). The property survives, but the beach is lost. A few states have implemented "rolling easements," which protect private property rights but also ensure that beaches are not replaced with bulkheads and revetments.

In Florida, people want to keep the beach and their homes, so you may see dump trucks releasing sand and bulldozers spreading it to rebuild a beach, or a dredge pumping sand from the sea floor through a pipe to the beach, or homeowners putting up fencing and planting grasses to hold the dunes. Without these activities, communities will lose beaches, shorefront homes, condominiums, hotels, and other buildings.

Cape St. George, October 10, 1995,
Provided by Florida Department of Environmental Protection

Why Care About Erosion?

Much of the Florida shore is developed. As the sea rises, the beach is squeezed between the sea and the first row of buildings. Along ocean shores, this means less room for vacationers and local residents to sunbathe, play volleyball, or build sandcastles. Likewise, there is less room for sandpipers, terns, sea turtles, and other wildlife that feed and breed in the sandy habitat.

Along the coast of Florida, sea level has risen 7 to 9 inches in the last century. Rising global temperatures contributed 1 to 4 inches to sea level in the last century, but they could raise the sea another 1 to 3 feet in the next century, in addition to the rise caused by other factors. A 1-foot rise would erode most Florida beaches 100-200 feet unless measures were taken to hold back the sea. A 3-foot rise would require the state to spend $4 to 8 billion just to replace the sand that would be lost to beach erosion.

Key Biscayne, Courtesy of Greater Miami Convention and Visitors Bureau

Storms Will Do More Damage

Since 1886, Florida has been hit by 150 hurricanes and more than 250 tropical storms. More than 60 percent of Florida's population lives within 10 miles of the coast, in the areas most susceptible to hurricane damage.

Hurricanes and other tropical storms can temporarily raise the sea 5 to 10 feet—or more. Higher sea level brings higher floods, which might block evacuation routes unless roads are elevated. Narrowing beaches could enable storm waves to reach oceanfront buildings, roads, and boardwalks. Increased rainfall from global warming would further intensify flooding, and the higher water levels in the canals would slow the rate at which low-lying areas drain.

The Federal Emergency Management Agency estimates that a 1-foot rise in the sea level would increase flood insurance premiums by 35 to 60 percent. Hotels and landlords generally will pass these costs on to visitors.

What About the Everglades?

The Everglades already are stressed by water diversions, invading species of plants and animals, and natural droughts, floods, and storms. Sea level rise adds to these pressures, by enabling salt water to advance inland, which can kill sawgrass in the Everglades and cypress trees in freshwater swamps.

Florida's beaches, small islands, marshes, mangroves, and cypress swamps provide habitat for species such as key deer, manatees, storks, snail kites, sea turtles, panthers, alligators, and crocodiles. Sea level rise could threaten many of these ecosystems.

Beaches and wetlands are being squeezed between the advancing sea and coastal development.

Indian River Shores, 1995, Provided by Florida Coastal Management Program

What Is Florida Doing?

- The state dedicates $30 million per year for beach replenishment.
- The state's Coastal Construction Control Line program protects beaches and dunes from construction that could weaken, damage, or destroy the integrity of beach and dune systems.
- Florida's Long-Term Redevelopment Program helps communities plan for and complete projects that will reduce their vulnerability to catastrophic storms.
- The State of Florida, Miami-Dade County, and the South Florida Water Management District are working with the U.S. Army Corps of Engineers and other federal agencies to reduce saltwater intrusion into the Everglades.
- Broward, Miami-Dade, Hillsborough, Orange, and Sarasota counties participate in the Cities for Climate Protection Campaign to reduce their emissions of greenhouse gases.
- More than 150 Florida companies participate in voluntary programs to reduce greenhouse gas emissions. For example, five Florida electric utilities have set targets for carbon dioxide emissions reductions.
- Florida's Local Mitigation Strategy program supports efforts by communities to develop their own hazard-reduction strategies.

Background photo: Miami Beach, Courtesy of Greater Miami Convention and Visitors Bureau

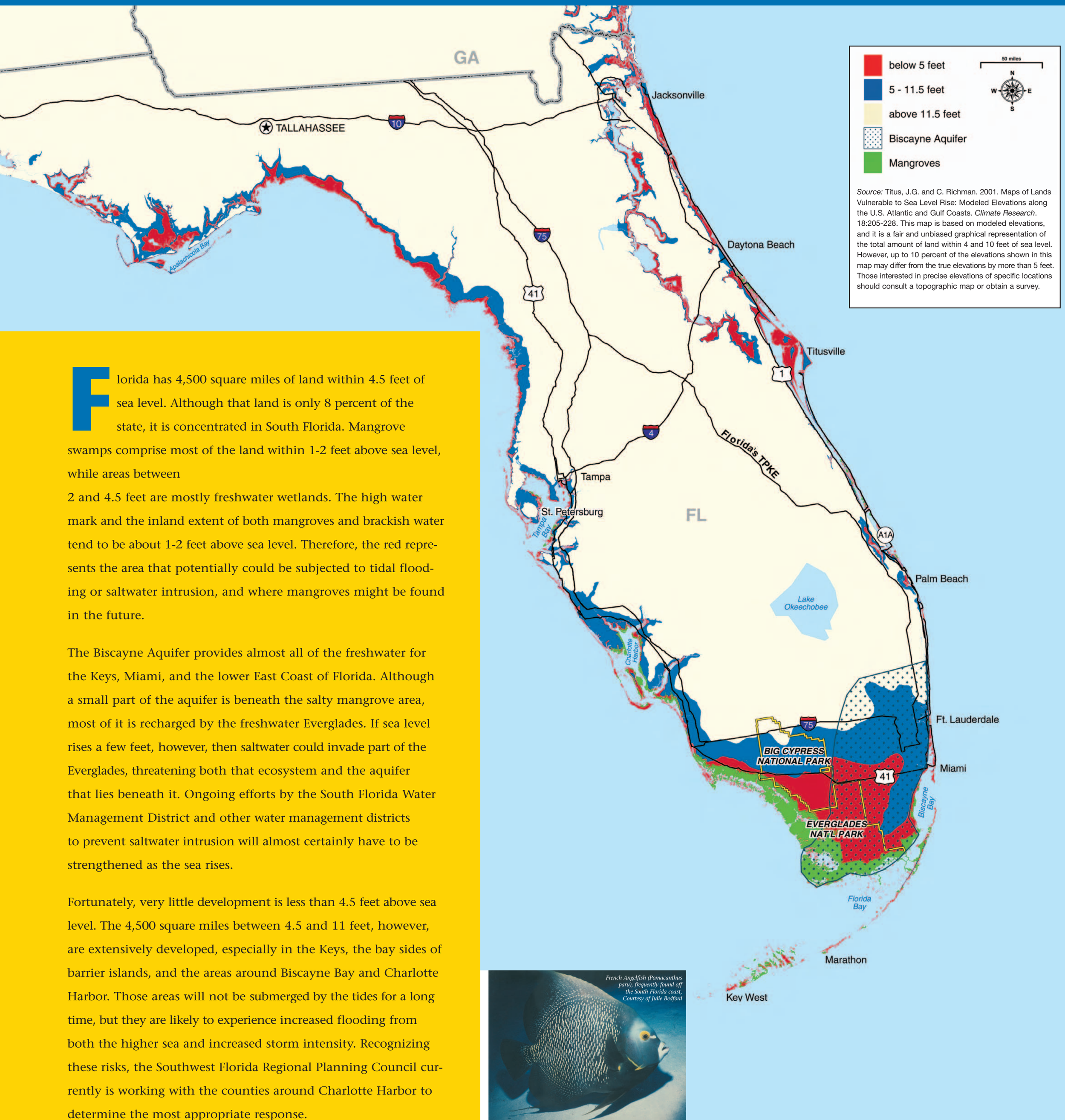
What Can You Do?

- Use mass transit, carpool with friends, or ride a bike whenever possible.
- Haul in sand or plant vegetation to hold back the sea rather than building a seawall, if you own a shorefront home threatened by erosion.
- Enjoy the sea breeze, listen to the waves, and turn off the air conditioner.
- Consider replacing your car with one that gets more miles per gallon.
- Avoid walking on sand dunes and destroying their ability to protect the shorelines from storms and erosion.
- Look for the ENERGY STAR® label identifying energy-efficient models, when it's time to replace an appliance.
- Talk to your insurance agent about federal flood insurance, if your home is at risk. *Homeowners insurance does not cover flood damages.*
- Buy products that feature reusable, recyclable, or reduced packaging to save the energy required to manufacture new containers.
- If you choose to live in a high-risk area, build your home behind a dune and make sure that the structure is designed to withstand a severe hurricane.

Big Pine Key, Provided by Monroe County Tourist Development Council

Save our VANISHING shores.

South Florida's Vulnerability to Sea Level Rise



Source: Titus, J.G. and C. Richman. 2001. Maps of Lands Vulnerable to Sea Level Rise: Modeled Elevations along the U.S. Atlantic and Gulf Coasts. *Climate Research*. 18:205-228. This map is based on modeled elevations, and it is a fair and unbiased graphical representation of the total amount of land within 4 and 10 feet of sea level. However, up to 10 percent of the elevations shown in this map may differ from the true elevations by more than 5 feet. Those interested in precise elevations of specific locations should consult a topographic map or obtain a survey.

Florida has 4,500 square miles of land within 4.5 feet of sea level. Although that land is only 8 percent of the state, it is concentrated in South Florida. Mangrove swamps comprise most of the land within 1-2 feet above sea level, while areas between
2 and 4.5 feet are mostly freshwater wetlands. The high water mark and the inland extent of both mangroves and brackish water tend to be about 1-2 feet above sea level. Therefore, the red represents the area that potentially could be subjected to tidal flooding or saltwater intrusion, and where mangroves might be found in the future.

The Biscayne Aquifer provides almost all of the freshwater for the Keys, Miami, and the lower East Coast of Florida. Although a small part of the aquifer is beneath the salty mangrove area, most of it is recharged by the freshwater Everglades. If sea level rises a few feet, however, then saltwater could invade part of the Everglades, threatening both that ecosystem and the aquifer that lies beneath it. Ongoing efforts by the South Florida Water Management District and other water management districts to prevent saltwater intrusion will almost certainly have to be strengthened as the sea rises.

Fortunately, very little development is less than 4.5 feet above sea level. The 4,500 square miles between 4.5 and 11 feet, however, are extensively developed, especially in the Keys, the bay sides of barrier islands, and the areas around Biscayne Bay and Charlotte Harbor. Those areas will not be submerged by the tides for a long time, but they are likely to experience increased flooding from both the higher sea and increased storm intensity. Recognizing these risks, the Southwest Florida Regional Planning Council currently is working with the counties around Charlotte Harbor to determine the most appropriate response.

French Angelfish (Pomacanthus paru), frequently found off the South Florida coast, Courtesy of Julie Bedford