Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

backgrounder

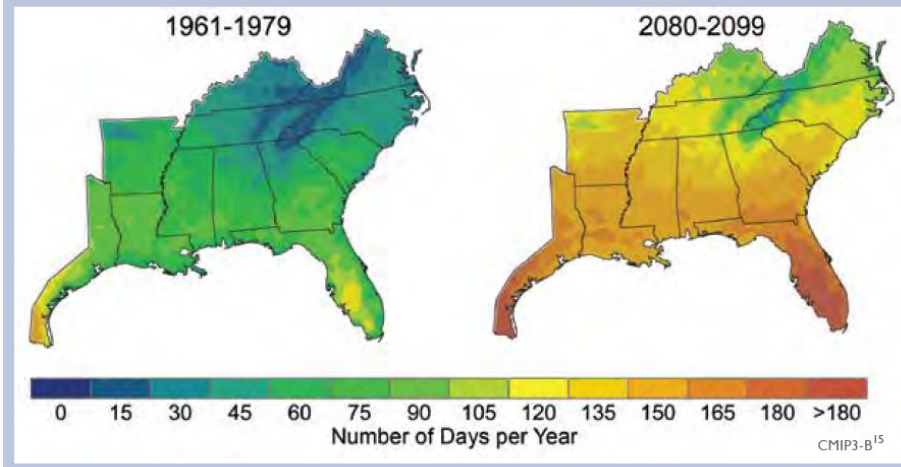
All information in this summary is entirely based on "Global Climate Change Impacts in the United States" (USGCRP, 2009). To enhance clarity, slight modifications were made that maintain the intended meaning of the report.

Southeast

Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, Gulf Region of Texas

Under a lower emissions scenario, average temperatures in the region are projected to rise by about 4.5°F by the 2080s, while a higher emissions scenario yields about 9°F of average warming (with about a 10.5°F increase in summer, and a much higher heat index). Since 1970, annual average temperature in the Southeast has risen about 2°F, with the greatest seasonal increase in temperature occurring during the winter months. The number of freezing days in the Southeast has declined by four to seven days per year for most of the region since the mid-1970s.

AIR AND WATER TEMPERATURE



The number of days per year with peak temperature over 90°F is expected to rise significantly, especially under a higher emissions scenario† as shown in the map above. By the end of the century, projections indicate that North Florida will have more than 165 days (nearly six months) per year over 90°F, up from roughly 60 days in the 1960s and 1970s. The increase in very hot days will have consequences for human health, drought, and wildfires.

Projected increases in air and water temperatures will cause heat-related stresses for people, plants, and animals. The warming projected for the Southeast during the next 50 to 100 years will likely create heat-related stress for people, agricultural crops, livestock, trees, wildlife, transportation and other infrastructure,. Projected increase in maximum and minimum temperatures pose the greatest risks. Examples of potential impacts include:

- Increased illness and death due to greater summer heat stress, unless effective adaptation measures are implemented.
- Decline in forest growth and agricultural crop production due to the combined effects of thermal stress and declining soil moisture.
- Increased buckling of pavement and railways.
- Decline in dissolved oxygen in stream, lakes, and shallow aquatic habitats leading to fish kills and loss of aquatic species diversity.
- Decline in production of rangeland livestock. Significant impacts on beef cattle occur at continuous temperatures in the 90 to 100°F range, increasing in danger as the humidity level increases. Poultry and swine are primarily raised in indoor operations, so warming increases energy requirements.
- The Occupational Health and Safety Administration states that concern for heat stress for moderate to heavy work begins at about 80ºF as measured by an index that combines temperature, wind, humidity,

and direct sunlight. For dry climates, such as Phoenix and Denver, National Weather Service Heat Indices above 90ºF might allow work to proceed, while higher humidity areas such as New Orleans or Miami should consider 80 to 85ºF as an initial level for work restrictions.

- A reduction in very cold days is likely to reduce the loss of human life due to cold-related stress, while heat stress and related deaths in the summer months are likely to increase. The reduction in cold-related deaths is not expected to offset the increase in heat-related deaths.
- Other effects of the projected increases in temperature include more frequent outbreaks of shellfish-borne diseases in coastal waters, altered distribution of native plants and animals, local loss of many threatened and endangered species, displacement of native species by invasive species, and more frequent and intense wildfires.

COASTAL RISKS

Sea-level rise and the likely increase in hurricane intensity and associated storm surge are among the most serious consequences of climate change. An increase in average sea level of up to 2 feet by the end of this century under high emissions scenario and the likelihood of increased hurricane intensity and associated storm surge are likely to be among the most costly consequences of climate change for this region. Relative sea-level rise in parts of the Gulf Coast region (Louisiana and East Texas) is projected to be as high as 2 to 4 feet by 2050 to 2100, due to the combination of global sea-level rise caused by warming oceans and melting ice and local land sinking. As sea level rises, coastal shorelines suffer increased erosion and retreat. Wetlands will likely be inundated and eroded away, and low-lying areas including cities could be inundated more frequently—some permanently—by the advancing sea. Current buildings and infrastructure were not designed to withstand the intensity of the projected storm surge, which could cause catastrophic damage.
Since most large U.S. cities are on coasts, rivers, or both, climate change will likely lead to increased potential flood damage. The largest impacts are expected when sea-level rise, heavy runoff, high tides, and storms coincide. Cities such as New Orleans and Miami are particularly at risk. Remnants of hurricanes moving inland also threaten cities of the Appalachian Mountains, which are vulnerable if hurricane frequency or intensity increases.

As temperature increases and rainfall patterns change, soil moisture and runoff to the coast are likely to be more variable. The salinity of estuaries, coastal wetlands, and tidal rivers is likely to increase in the southeastern coastal zone, thereby altering coastal ecosystems and displacing them farther inland if no barriers exist. More frequent storm surge flooding and permanent inundation of coastal ecosystems and communities is likely in some low-lying areas, particularly along the central Gulf Coast where the land surface is sinking. Rapid acceleration in the rate of increase in sea-level rise could threaten a large portion of the Southeast coastal zone. The likelihood of a catastrophic increase in the rate of sea-level rise is dependent upon ice sheet response to warming, which is the subject of much scientific uncertainty. Such rapid rise in sea level is likely to result in the crossing of thresholds, resulting in the destruction of barrier islands and wetlands.

Major hurricanes also pose a severe risk to people, personal property, and public infrastructure in the Southeast, and this risk is likely to be exacerbated. Strong hurricanes have severe impact both at the coastal margin where they make landfall, causing storm surge, severe beach erosion, wind-related casualties, and during inland flooding. Recent examples of societal vulnerability to severe hurricanes include Katrina and Rita in 2005, which were responsible for the loss of more than 1,800 lives and the net loss of 217 square miles of low-lying coastal marshes and barrier islands in southern Louisiana.

A two foot rise in global seal level — within the range of recent estimates by the end of this century — would likely result in a relative sea-level rise of 2.9 feet at Hampton Road, VA. and 3.5 feet at Galveston, TX.

WATER RESOURCES

Decreased water availability is very -likely to impact the region's economy as well as its natural systems. Decreased water availability due to increased temperature and longer periods of time between rainfall events, coupled with an increase in societal demand is very likely to affect many sectors of the
Southeast's economy. The magnitude of the projected changes in extremes is expected to be greater than changes in averages, and hence detectable sooner.

The amount and timing of water available to natural systems also is affected by climate change, as well as by human response strategies such as increasing storage capacity (dams) and increasing acreage of irrigated cropland. Many locations in the United States are already undergoing water stress. Georgia, Alabama, and Florida are in a dispute over water for drinking, recreation, farming, environmental purposes, and hydropower in the Apalachicola–Chattahoochee–Flint River system. In Atlanta and Athens, Georgia, 2007 was the second driest year on record. Among the numerous effects of the

rainfall shortage were restrictions on water use in some cities and low water levels in area lakes. The 2007 water shortage in the Atlanta region created serious conflicts between three states, the U.S. Army Corps of Engineers (which operates the dam at Lake Lanier), and the U.S. Fish and Wildlife Service, which is charged with protecting endangered species.

These challenges will likely grow as the region improves planning to cope with climate change by manipulating water resources, streamflow further increasing risks to biological diversity. Increasing evaporation and plant water loss rates alter the balance of runoff and groundwater recharge, which is likely to lead to salt water intrusion into shallow aquifers in many parts of the Southeast. During droughts, recharge of groundwater will likely decline as the temperature and spacing between rainfall events increases. Responding by increasing groundwater pumping further depletes aquifers and likely increases strain on surface water resources.

THREATS TO ENERGY INFRASTRUCTURE IN THE SOUTHEAST

A significant fraction of America's energy infrastructure is located near the coasts, from power plants, to oil refineries, to facilities that receive oil and gas deliveries. Rising sea levels are likely to lead to direct losses, such as equipment damage from flooding or erosion, and indirect effects, such as the costs of raising vulnerable assets to higher levels or building new facilities farther inland, increasing transportation costs. The U.S. East Coast and Gulf Coast have been identified as particularly vulnerable to sea-level rise because the land is relatively flat and also sinking in many places.

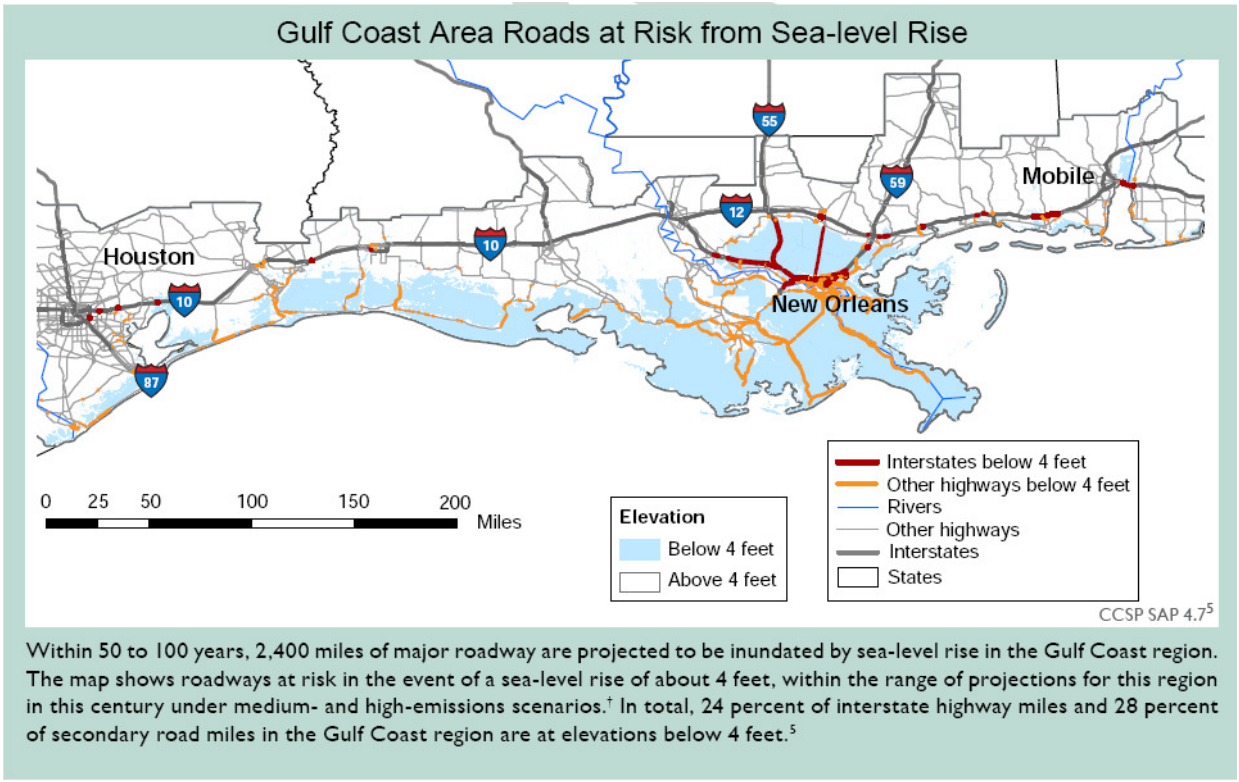
The Gulf Coast is home to nearly 30 percent of the nation's crude oil production and approximately 20 percent of its natural gas production. One-third of the national refining and processing capacity lies on coastal plains adjacent to the Gulf of Mexico.

Several thousand offshore drilling platforms, dozens of refineries, and thousands of miles of pipelines are vulnerable to damage and disruption due to sea-level rise and the high winds and storm surge associated with hurricanes and other tropical storms. Hurricane Ivan in 2004 destroyed seven platforms in the Gulf of Mexico, significantly damaged 24 platforms, and damaged 102 pipelines. Hurricanes Katrina and Rita in 2005 destroyed more than 100 platforms and damaged 558 pipelines. For example, Chevron's $250 million "Typhoon" platform was damaged beyond repair. Plans are being made to sink its remains to the seafloor. Hurricanes Katrina and Rita halted all oil and gas production from the Gulf, disrupted nearly 20 percent of the nation's refinery capacity, and closed many oil and gas pipelines.

Port Fourchon, Louisiana, supports 75 percent of deepwater oil and gas production in the Gulf of Mexico, and its role in supporting oil production in the region is increasing. The Louisiana Offshore Oil Port, located about 20 miles offshore, links daily imports of 1 million barrels of oil and production of 300,000 barrels in the Gulf of Mexico to 50 percent of national refining capacity. One road, Louisiana Highway 1, connects Port Fourchon with the nation. It transports machinery, supplies, and workers and is the evacuation route for onshore and offshore workers. Responding to threats of storm surge and flooding, related in part to concerns about climate change, Louisiana is currently upgrading Highway 1, including elevating it above the 500-year flood level and building a higher bridge over Bayou LaFourche and the Boudreaux Canal.

Florida's energy infrastructure is particularly vulnerable to sea-level rise and storm impacts. Most of the petroleum products consumed in Florida are delivered by barge to three ports, two on the east coast and one on the west coast. The interdependencies of natural gas distribution, transportation fuel distribution and delivery, and electrical generation and distribution were found to be major issues in Florida's recovery from recent major hurricanes.

THREATS TO TRANSPORTATION INFRASTRUCTURE IN THE SOUTHEAST



Within 50 to 100 years, 2,400 miles of major roadway are projected to be inundated by sea-level rise in the Gulf Coast region. The map shows roadways at risk in the event of a sea-level rise of about 4 feet, within the range of projections for this region in this century under medium- and high-emissions scenarios.† In total, 24 percent of interstate highway miles and 28 percent of secondary road miles in the Gulf Coast region are at elevations below 4 feet.[5]

Sea-level rise could potentially affect commercial transportation activity valued in the hundreds of billions of dollars annually through inundation of area roads, railroads, airports, seaports, and pipelines. Existing vulnerable infrastructure in the area shown on the map are built on land at or below 4 feet in elevation, a level within the range of projections for relative sea-level rise in this region in this century, include 27 percent of the major roads, 9 percent of the rail lines, and 72 percent of the ports.

Gulf Coast gateways are major centers of economic activity. Six of the nation's top 10 freight gateways (measured by the value of shipments) will likely be threatened by sea-level rise. Seven of the 10 largest ports (by tons of traffic) are located on the Gulf Coast. Roughly two-thirds of all U.S. oil imports are transported through this region.

An estimated 60,000 miles of coastal highway are already exposed to periodic flooding from coastal storms and high waves. Since the Gulf Coast region's transportation network is interdependent and relies on minor roads and other low-lying infrastructure, the risks of service disruptions due to sea-level rise are likely to be even greater. Combined with the high population density near the coasts, the potential exposure of transportation infrastructure to flooding is immense. Population swells in these areas during the summer months because beaches are very important tourist destinations. In the Gulf Coast area alone, an estimated 2,400 miles of major roadway and 246 miles of freight rail lines are at risk of permanent flooding within 50 to 100 years as global warming and land subsidence (sinking) combine to produce an anticipated relative sea-level rise in the range of 4 feet. Some of these highways currently serve as evacuation routes during hurricanes and other coastal storms, and these routes could become seriously compromised in the future.

Increased storm intensity might lead to increased service disruption and infrastructure damage: More than half of the area's major highways (64 percent of interstates, 57 percent of arterials), almost half of the rail miles, 29 airports, and virtually all of the ports, are below 23 feet in elevation and subject to flooding and damage due to hurricane storm surge. These factors merit consideration in today's transportation decisions and planning processes.

Impacts on harbor infrastructure from wave damage and storm surges are projected to increase.
Improved planning requires harbor and port facilities to accommodate higher tides and storm surges and reduced clearance under some waterway bridges for boat traffic. Changes in the navigability of channels are expected; some will become more accessible (and farther inland) because of deeper waters, while others will be restricted because of changes in sedimentation rates and sandbar locations. In some areas, waterway systems will become part of open water as barrier

islands disappear. Some channels are likely to have to be dredged more frequently as has been done across large open-water bodies in Texas.

More frequent interruptions in air service and airport closures can be expected. Airport facilities including terminals, navigational equipment, perimeter fencing, and signs are likely to sustain increased wind damage. Airports are frequently located in low-lying areas and can be expected to flood with more intense storms. Eight airports in the Gulf Coast region of Louisiana and Texas are located in historical 100-year flood plains; the 100-year flood events will likely be more frequent in the future creating the likelihood of serious costs and disruption

THREATS TO AGRICULTURE IN THE SOUTHEAST

Weeds benefit more than cash crops from higher temperatures and carbon dioxide levels. One concern with continued warming is the northward expansion of invasive weeds. Southern farmers currently lose more of their crops to weeds than do northern farmers. For example, southern farmers lose 64 percent of the soybean crop to weeds, while northern farmers lose 22 percent. Some extremely aggressive weeds plaguing the South (such as kudzu) have historically been confined to areas where winter temperatures do not drop below specific thresholds. As temperatures continue to rise, these weeds are expected to continue to expand their ranges northward into important agricultural areas. Kudzu currently has invaded 2.5 million acres of the Southeast and is a carrier of the fungal disease soybean rust, which represents a major and expanding threat to U.S. soybean production.

Controlling weeds currently costs the United States more than $11 billion a year, with the majority spent on herbicides; so both herbicide use and costs are likely to increase as temperatures and carbon dioxide levels rise. At the same time, the most widely used herbicide in the United States, glyphosate (RoundUp®), loses its efficacy on weeds grown at carbon dioxide levels that are projected to occur in the coming decades. Higher concentrations of the chemical and more frequent spraying thus will likely be needed, increasing economic and environmental costs associated with chemical use.

THREATS TO NATIVE ECOSYSTEMS

Large declines in trout populations also are projected to occur around the United States. Over half of the wild trout populations are likely to disappear from the southern Appalachian Mountains because of the effects of warming stream temperatures. Projected losses of trout habitat for some warmer states, such as North Carolina and Virginia, are up to 90 percent.

The United States has extensive coral reef ecosystems in the Caribbean, Atlantic, and Pacific oceans. In 2005, the Caribbean Basin experienced unprecedented water temperatures that resulted in dramatic coral bleaching with some sites in the U.S. Virgin Islands seeing 90 percent of the coral bleached. Some corals began to recover when water temperatures decreased, but later that year disease appeared, striking the previously bleached and weakened coral. To date, 50 percent of the corals in Virgin Islands National Park have died from the bleaching and disease events. In the Florida Keys, summer 2005 bleaching also was followed by disease in September.

Rising temperature is not the only stress coral reefs face. As the carbon dioxide concentration in the air increases, more carbon dioxide is absorbed into the world's oceans, leading to their acidification. This makes less calcium carbonate available for corals and other sea life to build their skeletons and shells. If carbon dioxide concentrations continue to rise and the resulting acidification proceeds, eventually, corals and other ocean life that rely on calcium carbonate could not be able to build these skeletons and shells at all.