OUR COASTAL FUTURE FORUM

Ocean Mineral and Energy Resources in a Changing Climate

COLLEGE of CHARLESTON 1770

Sea Grant
S.C. Sea Grant Consortium

The UNIVERSITY of OKLAHOMA

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The S.C. Sea Grant Consortium generates and provides science-based information to enhance the practical use and conservation of coastal and marine resources that foster a sustainable economy and environment for the state of South Carolina and its citizens. The Consortium provides mechanisms by which many interests can come together to identify, discuss, study, and share information about our coastal and ocean environment and its economic, environmental, and socio-economic importance to the state. We do this through partnerships, and we recognize that the value of working with partners from all sectors is critical to our success.

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Front Cover: Surf during the storm. *Lee Bundrick, S.C. Sea Grant Consortium (August 2018)*
Back Cover: Sunset near Sullivan's Island. *Lee Bundrick, S.C. Sea Grant Consortium (May 2017)*

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About Our Coastal Future Forum

The Our Coastal Future Forum is one part of a research project to determine the feasibility of using a process of deliberative democracy in coastal resources decision-making, particularly when it comes to issues associated with climate change and increasing population. Our objectives are to:

- Assess the effectiveness of small group engagement of residents, local and state natural resource decision-makers, civic and non-governmental organization leaders, county and municipal staff and officials, and business leaders in deliberating on current issues in coastal planning and management.
- Prioritize issues and tasks associated with climate resilience, including biodiversity, living marine resources, environmental health, and mineral and energy resources in an inclusive process.

The outcomes of the forum will be shared with residents, community leaders, and natural resource decision-makers through a report, the project website, and presentations at local conferences. We hope that our forum participants will learn more about planning for the coastal future of our residents, visitors, and natural resources, and that they will share what they learn with their neighbors and friends.

Topics for Discussion

The great challenges to society's management of natural resources in coastal South Carolina include increasing population and changing weather and climate. Over the course of the forum we will be discussing four topics important to the people who live here. Since changes in weather and climate impact each area, this booklet begins with an overview of our changing weather and climate and the potential impacts. Then there is a section about our ocean mineral and energy resources.

After each section, you will find links to scientific resources that inform each discussion, additional resources, and steps others have considered to solve problems. We hope you will bring all of your ideas to the forum for discussion.

Introduction

South Carolina's coast is one of the state's most valuable assets. The coastal plain is divided into five watersheds – Pee Dee, Santee, Edisto, Salkehatchie, and Savannah. Through each of these watersheds, rivers mighty and meandering bring nutrients and sediments from the state's interior, some stretching to the mountains. Rain falling in each watershed finds its way through creeks, into the rivers, and eventually to our coastal cities and towns.

Our Changing Coast

Our coast is made up of a complex natural network of uplands, rivers, wetlands, beaches, creeks, and barrier islands. The network supports a diverse range of ecosystem types and coastal and marine species. It also serves as the natural resource foundation for the needs of our growing coastal population.

Our coastal areas are often divided into three regions: The "Grand Strand," which includes Horry and Georgetown counties; the Berkeley-Charleston-Dorchester county region, which includes the Charleston metropolitan area and rural communities; and the "Lowcountry," which includes Colleton, Beaufort, and Jasper counties. Each of these are growing in population and development. People are increasingly drawn to the South Carolina coast and enjoy the often-pleasant climate and overall high quality of life while taking advantage of the opportunities provided by the state's natural and cultural resources. More than 28 percent of the state's 4.83 million residents live in the eight coastal counties. From 1970 to 2010, the population of the eight coastal South Carolina counties increased by 130 percent, third highest among the 31 coastal and Great Lakes states nationwide. The coastal S.C. population, which was 530,260 in 1970, is expected to top 2 million by 2025 (S.C. Sea Grant Consortium Strategic Plan FY2018-FY2021). In addition, more than 20 million tourists visit coastal South Carolina each year. Indeed, during this decade, Charleston, S.C. has been identified multiple times by *Condé Nast Traveler* as the number one tourist destination in the United States, and in 2015, number one in the world.

"In the spring our rivers fill up with migrating fish moving into fresh-water rivers and creeks to lay their eggs according to the primal urges of heredity. The shad surrender egg sacs that gourmet restaurants prize as one of the great delicacies of the sea, and huge cobia provide steaks for the grills of lowcountry people. Men and women throw their cast-nets with gestures of infinite beauty, and they can fill their freezers with shrimp for a half season on a good night. The osprey dive for mullet in golf-course lagoons and chase bald eagles away from their nests."

- Pat Conroy, Forward in "State of the Heart: South Carolina Writers on the Places They Love," 2013.

Population growth and increasing tourism are placing greater pressure on the state's natural resources and coastal infrastructure, especially at the ever-widening margins of our urbanized areas. Where we put people and how we accommodate their needs for critical infrastructure, transportation, jobs, and quality of life are questions facing decision-makers along the South Carolina coast and inland, and indeed across the whole southeastern U.S.

Natural Resources and the Economy

The economy of coastal South Carolina is also changing. Although it represents a decreasing portion of the state's economy, the commercial fishing industry (fish, oysters, clams, shrimp, and crabs) remains an important component of our local waterfronts, coastal economies, and way of life. South Carolina's shellfish aquaculture industry consists of established clam growers

and new oyster farmers, a sector that doubled its number of businesses in 2016. Recreational fishing and boating make an ever-larger contribution to the state's economy. According to S.C. Department of Natural Resources (SCDNR), the annual impact of marine recreational fishing in the state exceeds $590 million. As of June 30, 2015, more than 2,964,343 individual saltwater stamps/licenses have been sold to recreational anglers since the state began issuing licenses in 1992. In addition, tourism is now a $19 billion industry, with the eight coastal counties accounting for approximately 60 percent of that total and supporting more than 62,000 jobs. The Port of Charleston is one of the busiest and fastest growing container ports on the East and Gulf coasts. Other expanding sectors include manufacturing (Boeing, Daimler, Volvo), tech (Blackbaud), pharmaceutical development and manufacturing, and health care, especially for the growing retirement communities. Although some of these may depend on raw resources shipped into our state, the people who work in these industries depend on our natural resources for clean air, clean water, and commercial and recreational opportunities.

How do we accommodate new residents and visitors who come and go? And how do we do so while maintaining the environmental, cultural, and historical resource qualities that we enjoy and that continue to draw people here? How do we continue to adapt to sea level rise and a warming climate so that our communities remain strong and resilient now and into the future?

These are some of the reasons we are hosting the Our Coastal Future Forum. During this event, we want to have a thoughtful discussion on natural resources topics to provide decision-makers with the perspectives of our communities. We wish to identify priority areas and actions that will support the well-being of our residents and visitors alike through protection of the natural resources on which we all depend.

Southernmost groin on Folly Beach. *Lee Bundrick, S.C. Sea Grant Consortium (Aug. 2017)*

Our Coastal Weather and Climate

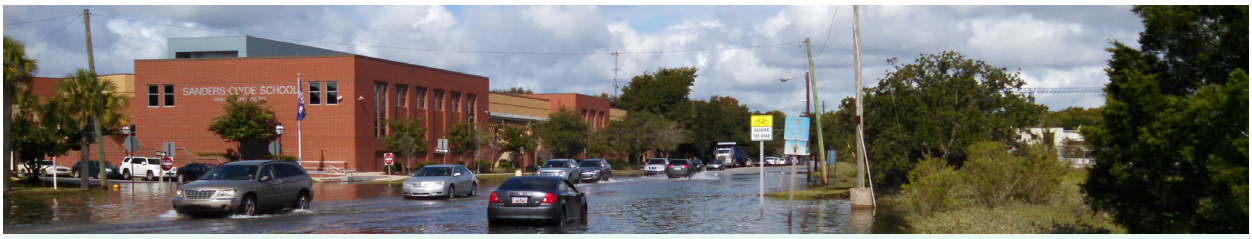

Figure 1.1 "Blue Sky" tidal flooding during King Tide. *Elizabeth Fly, S.C. Sea Grant Consortium (2014)*

Changing Weather and Climate: Impacts in South Carolina

Have you noticed the changes in our weather patterns? We seem to have longer dry periods, and the rain all seems to come at once. Flowers are blooming earlier, and we have home-grown tomatoes at Christmas. The television local morning news regularly warns us to expect road closures due to extreme high tides (**Figure 1.1**). These are weather impacts of our changing climate. The term climate refers to long-term patterns that impact short-term weather events such as heavy rains, record high temperatures, and droughts.

Global Warming

Overall our world is warming. This is determined by measuring changes in air and sea temperatures, humidity, and glacier, snow, and ice cover (**Figure 1.2**). Viewing these measures over time, it is clear our global climate is warming, affecting many of our local weather patterns.

The chart at the bottom right (**Figure 1.3**) uses zero as the baseline average of global surface temperatures between 1880 and 2016. Each year is different. However, despite variability year to year, we see an overall trend from temperatures below the baseline before the 1940s to well above it by the 1990s. In fact, we see record high years in 1998, 2005, 2010, 2014, and 2015, with 2016 being the warmest year on record.

Ocean temperatures are also rising. The graph on the next page (**Figure 1.4**) shows the change in sea surface temperatures from a baseline average between years 1971-2000. The trend is increasing globally. The temperatures have been consistently higher during the last 30 years than any other time since reliable records began being kept in 1880.

Changes in Sea Level

The heat from the atmosphere is absorbed by the oceans. When water heats up, the molecules get bigger. This is called thermal expansion, and it is one cause for sea level rise. Additionally, the heat causes glaciers and ice on land to melt, adding more water to the ocean. The changing temperatures also interfere with the hydrological cycle, the pattern of water movement from land to atmosphere and back again, and, in many cases, cause a change in rain patterns (**Figure 1.5**).

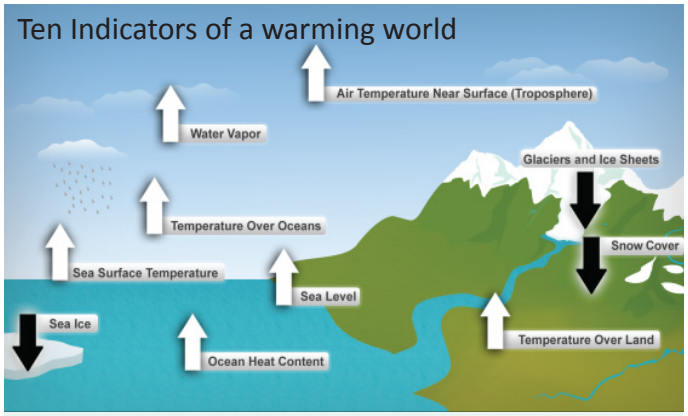

Figure 1.2 Indicators of Global Warming. *National Oceanic and Atmospheric Administration (NOAA) National Climate Data Center (NCDC). Based on data updated from Kennedy et al. 2010*

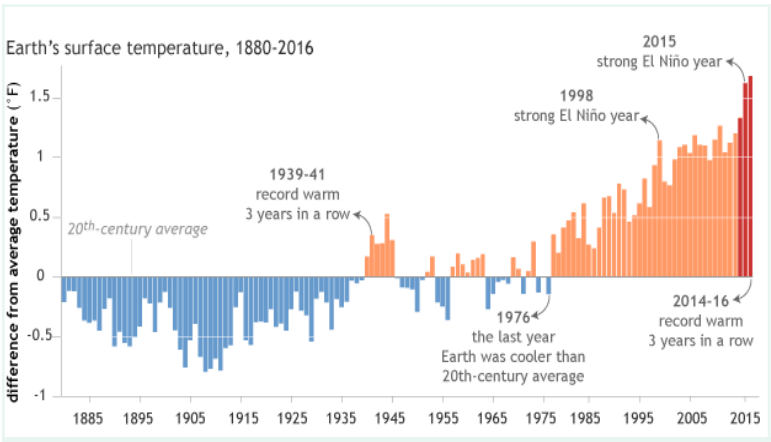

Figure 1.3 Difference in Earth's surface temperature over time. *NOAA NCDC Climate at a Glance (September 2017)*

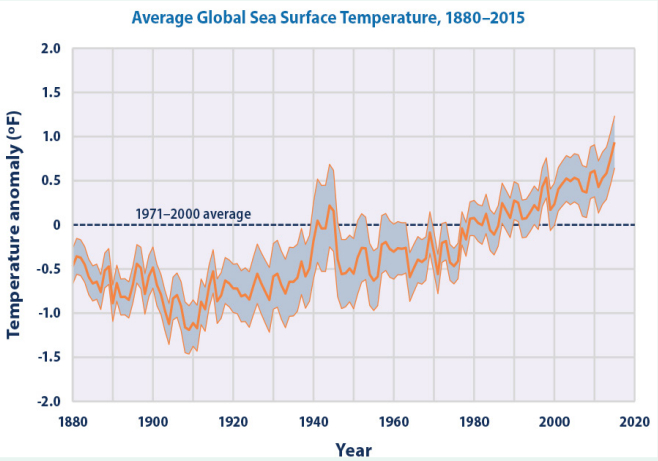

Figure 1.4 Global sea surface average temperature anomalies from 1880 to 2020. *NOAA (2016)*

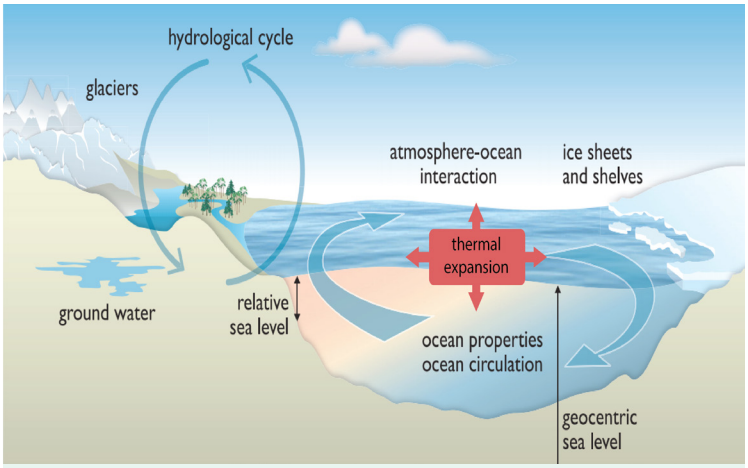

Figure 1.5 How the Ocean Water Cycle is Changing. *National Climate Assessment with added content (2014)*

So What Does This Mean for the South Carolina Coast?

Air temperatures in South Carolina are increasing. Temperatures here have increased about a half a degree (0.5 degree F) since 1900. The number of record high temperatures is also increasing. For instance, in Columbia, 10 days exceeded 100 degrees in 2015 and 16 days exceeded 100 degrees in 2016. For comparison, the average number of days above 100 degrees between 1953 and 1983 was only slightly more than two. There are also increases in night-time temperatures and fewer days below freezing since the 1990s, which have an impact on agricultural and native plants. With higher temperatures, there is also an increased risk of health issues for vulnerable populations, such as the young and the elderly.

Sea level rise increases the erosion along our coast and flooding in our streets. Many factors control how sea level rises locally, including land sinking or rising, sea level change, topography, and wind patterns. For those reasons, the amount of sea level rise has varied even along South Carolina's coast (**Figure 1.6**).

However, in the future the rate is expected to increase. The projection, shown in **Figure 1.7**, shows sea level is expected to rise 1 to 4 feet by 2100. The differences in projections are largely due to the rate of CO_2 increase (the greenhouse gas that acts as a warm blanket around earth) and the amount of ice melting on land, lakes, and sea. As we better understand how much ice is melting and how quickly the world reduces greenhouse gases, the gap in projections should go down.

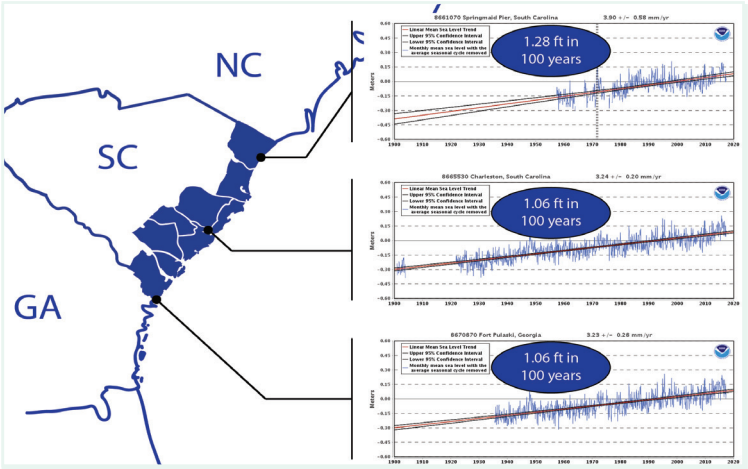

Figure 1.6 Sea level rise measured by gauges located at Myrtle Beach, Charleston, and Savannah, Georgia. *Created using information from NOAA (2017)*

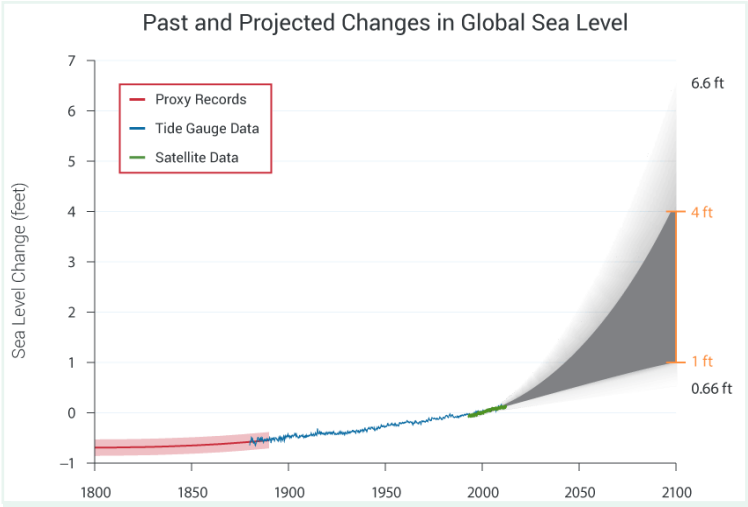

Figure 1.7 Past record and future projection for sea level change. *National Climate Assessment (2014)*

It is important to note that although there are a range of possibilities, planners can now use this information to make safety and economic decisions for communities. Using what is called "no regrets" planning, communities can consider

different scenarios of sea level rise when siting development and creating new development standards. In other words, if the expected life-span of a structure is short or the risk is low, such as a homeowner's dock or a snack bar on the beach, then a low estimate can be used. If sea level rises faster, there is little safety or economic risk for the decision. For development that has long-term consequences, the higher estimate for sea level rise is used. For example, the building of a sewage treatment plant or a high-rise housing unit would have a high risk to safety and large economic risk if flooded or damaged. "No-regrets" refers to the level of risk society is willing to accept.

Coastal Flooding

The coast of S.C. experiences regular tidal flooding in streets, school yards, residential properties, and businesses. During full moon or new moon periods, or if strong winds push ocean waters our way, high tide washes into our communities (**Figure 1.8**). As sea level rises, the number of days with extreme high tides increases. During the 1980s such flooding occurred about four times a year. From 2000 through 2014, the annual average hovered around 10 days of flooding. In 2016, Charleston dealt with a record 50 days of tidal flooding. By the 2040s, Charleston is forecast to experience 180 days per year of nuisance tidal flooding and impassable roads (**Figure 1.9**). If it happens to rain during these high tides, the stormwater has no place to go, and thus there will be more flood water.

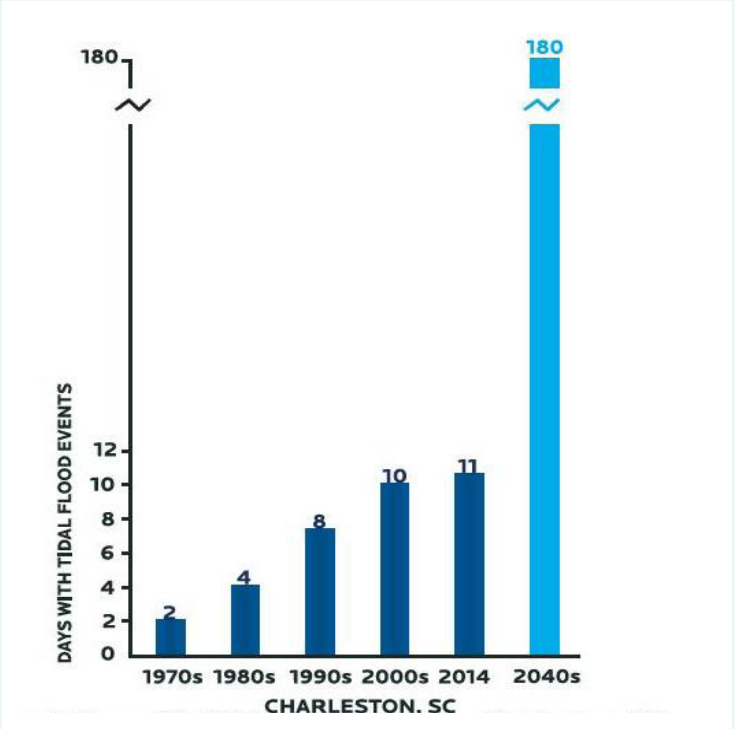

Figure 1.9 Days per year with tidal flooding. *City of Charleston (2015)*

Sea level rise is also a factor in the amount of destruction caused by storm surge during hurricanes and other coastal storms. The higher the tide, the farther inland ocean water travels with the storm surge, increasing the amount of land and structures in danger (**Figure 1.10**). Saltwater pushed inland due to sea level rise also threatens fresh water in rivers and aquifers. Coastal cities rely on fresh river water for their drinking water supplies. Aquifers are our natural freshwater storage areas underground. Many people have deep water wells for drinking and shallower wells for irrigation. As sea level rises, more saltwater travels up rivers and into areas where drinking water is withdrawn. Saltwater

Figure 1.8 Tide reaching into downtown Charleston street. *Elizabeth Fly, S.C. Sea Grant Consortium (2014)*

Figure 1.10 Tidal flooding along waterfront in Beaufort, S.C. *Jeramie Stanley as reported to King Tide Report (October 27, 2015)*

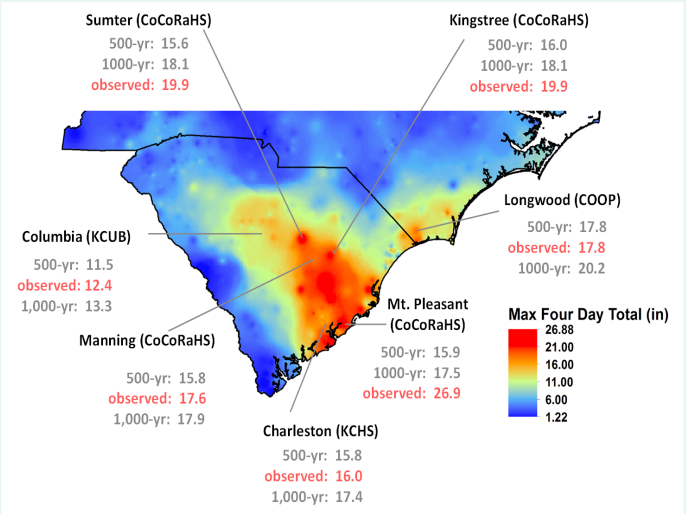

Figure 1.11 Rainfall during the October 2015 extreme event. *Carolinas Integrated Sciences and Assessments (CISA) (2016)*

can intrude into the aquifers. Not only does this change local ecosystems, but it also has potential health and economic impacts. Some impacts include public utilities that provide water to residents and for emergency backup services. Drilling deeper wells or finding additional sources of freshwater may be necessary. Other options may include desalination for drinking water. The cost of moving water treatment plants and pipes is challenging. We have built houses, roads, and other infrastructure in the path of a rising sea, all of which may have to be modified or relocated in the future.

Extreme Rainfall

Extreme rains like those we saw in the fall of 2015 and 2016 can cause devastating flooding. CoCoRaHS, a national volunteer precipitation monitoring network, allows scientists to collect data all over the state during these sorts of events. The map in **Figure 1.11** shows the maximum rainfall totals that fell over a four-day period (Oct. 2-5, 2015). The data was obtained from CoCoRaHS sites and weather stations. The 500-year and 1,000-year maximum rainfall projections are based on historical records. They indicate there is a 0.2 percent chance of 15.9 inches of rain, or 0.1 percent chance of 17.5 inches, in a four-day period in Mount Pleasant in any year. Mount Pleasant was slammed with 26.9 inches, or worse than a 1,000-year rainfall. Most of the hardest hit areas were closer to 500-year rainfall during the 2015 storm. Many of the same areas experienced 500-year rainfall the following October as Hurricane Matthew churned offshore.

Drought

With the changes in weather patterns, the Southeast can expect more extreme dry periods as well. With this comes drought. Although the rains of 2015 and 2016 soaked the coastal counties, this was a relief from a long period of off-and-on drought. From July 2010 through October 2015, at least one coastal county was considered in constant drought conditions by the S.C. Drought Response Committee. During 2012, most of our coastal area was in extreme drought (**Figure 1.12**). This means less freshwater flowing down rivers and into our groundwater, allowing saltwater to travel farther up rivers and ultimately into our aquifers. Too little water can be as challenging as too much.

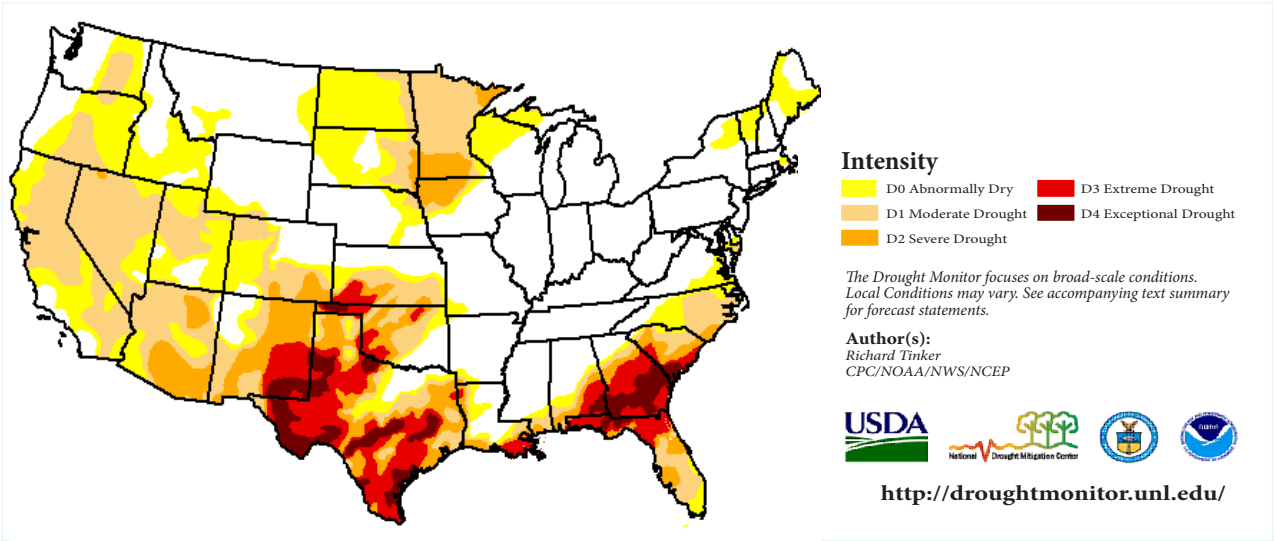

Figure 1.12 U.S. Drought Monitor data for February 14, 2012. *National Drought Mitigation Center (2017)*

Figure 1.13 Folly Beach, Lighthouse Inlet Heritage Preserve. *Lee Bundrick, S.C. Sea Grant Consortium (July 2017)*

What Can We Do?

Help collect climate data for CoCoRaHS, Community Collaborative Rain, Hail, and Snow network, a community-based network of citizen scientists who report rain, hail, and snow measurements using low-cost materials

Report to MyCoast: South Carolina, a S.C. Department of Health and Environmental Control (SCDHEC) resource to collect and analyze pictures and data to assess hazards and to enhance awareness among decision-makers and stakeholders

Develop strategies for the community to respond to different scenarios of sea level rise

Update current infrastructure (e.g. roads, bridges, seawalls) to respond to the effects of climate change

Reduce development in high-risk flooding areas

Introduce desalination facilities that turn saltwater into drinking water

Conserve groundwater from aquifers and preserve natural waterways for sustainable usage of water resources

Respond to drought conditions that are met with heavy, but infrequent, rainfall events

Resources for More Information

- **CoCoRaHS** for mapping precipitation. Website: https://www.cocorahs.org/
- **MyCoast: South Carolina**. SCDHEC. Website: https://mycoast.org/sc
- **South Carolina tides and currents, data and maps.** NOAA. Website: https://tidesandcurrents.noaa.gov/map/index.shtml?region=South%20Carolina
- **King Tides and Climate Change**. **U.S. Environmental Protection Agency (USEPA).** Website: https://www.epa.gov/cre/king-tides-and-climate-change
- **City of Charleston Sea Level Rise Strategy.** Report. Website: http://www.charleston-sc.gov/DocumentCenter/View/10089
- **Beaufort and Port Royal Sea Level Rise Task Force**. Website with link to their final report: https://bprsealevelrise.wordpress.com/
- **SeaRise.** South Carolina Aquarium. Website: https://searise.scaquarium.org/
- **Hazard Vulnerability Assessment Tool**. SCDHEC. Website: http://www.scdhec.gov/HomeAndEnvironment/Docs/HVA_Tool_Info%20(GSAA)%20(1).pdf
- **Coastal Flood Exposure Map**. NOAA. Website: https://coast.noaa.gov/floodexposure/#/splash

The complete Briefing Book for the Our Coastal Future Forum can be found at the link below
http://www.scseagrant.org/pdf_files/OCFF-Briefing-Book-Updated.pdf

Our Ocean Mineral and Energy Resources

Sand, Our Coastal Mineral Resource

Coastal South Carolina's lovely sand beaches and coastal islands are perfect for outdoor adventures. Yet, while our beaches are a draw for South Carolina, they are constantly in flux. The sand that makes up our beaches is constantly shifting. It is driven by waves, currents, and wind, which change day to day and throughout each year. Sand moves along the coast with currents within the surf zone and may also be driven offshore and lost from the beach system, particularly during storms. Beach sand can move within tidal inlets for extended periods and episodically escape back onto the adjacent beaches. As a result, locally more sediment may be gained or lost from the beach resulting in accretion or erosion. Overall, our beaches are losing sand and natural sources to replace that sand are limited.

This erosional process is worsened by rising sea levels and increased storm intensities which have been documented along our coastal counties. One way we have tried to remedy these disappearing beaches is through beach renourishment, in which sand from off shore, such as borrow pits or other areas, is brought to eroding beaches via pipes, barges, or dump trucks. For years, large and repeated efforts have sustained beaches in South Carolina. For example, the Army Corps of Engineers has regularly renourished Folly Beach. The most recent renourishment at Folly Beach cost $30 million.

Figure 5.1 Eastern section of the Battery, a seawall in Charleston. *S.C. Sea Grant Consortium.*

The federal government covered 85 percent of the cost for the Folly Beach renourishment as mitigation for the construction of Charleston Harbor's three-mile long jetties in 1895. Anchored on each side of the harbor, the jetties prevent the natural movement of sand from the north down to Folly's shores. For other federal restoration, there is a 65 percent cost-share between local, state, and federal funding for renourishment projects. Acquiring funds and permits can be an arduous process. Keeping up with Mother Nature means some beachfront communities begin saving for the next renourishment as soon as the previous renourishment has finished. In addition, this strategy requires mining and transporting sand from outside the beach system. In many areas committed to nourishment, there is a limited sand resource close to the coast. This can be expected to cause competition and cost issues for many of our coastal communities in the future. In other areas, there may be an abundance of sediment nearby but it is located within tidal inlet deltas. Tidal inlets are complex, and changes within them can significantly affect the adjacent beaches, which occurred with the manipulation of the Charleston Harbor entrance.

Human Engineering

Other tools for dealing with coastal erosion include manmade groins and sea walls. Groins are created to catch sand moving down the coast to protect beaches, but that means the areas south of groins are denied the sand. Groins are often wooden structures stretching out 75-100 feet into the ocean and dot many South Carolina beaches. The Charleston Harbor jetties serve as a giant groin. In addition to robbing Folly Beach of sand, the jetty has contributed to the extreme shifting of undeveloped Morris Island, once home base for an iconic lighthouse that is now surrounded by water.

While groins catch sand, sea walls are designed to create a barrier between property and the erosional power of storm waves and rising seas. The Battery (**Figure 5.1**) in the Southeast region of

Charleston peninsula is the most famous South Carolina sea wall. South Carolina now places strict regulations on the construction of beachfront sea walls, though many were built before regulations were in place. Sea walls can prevent direct intrusion of saltwater, but they require constant maintenance.

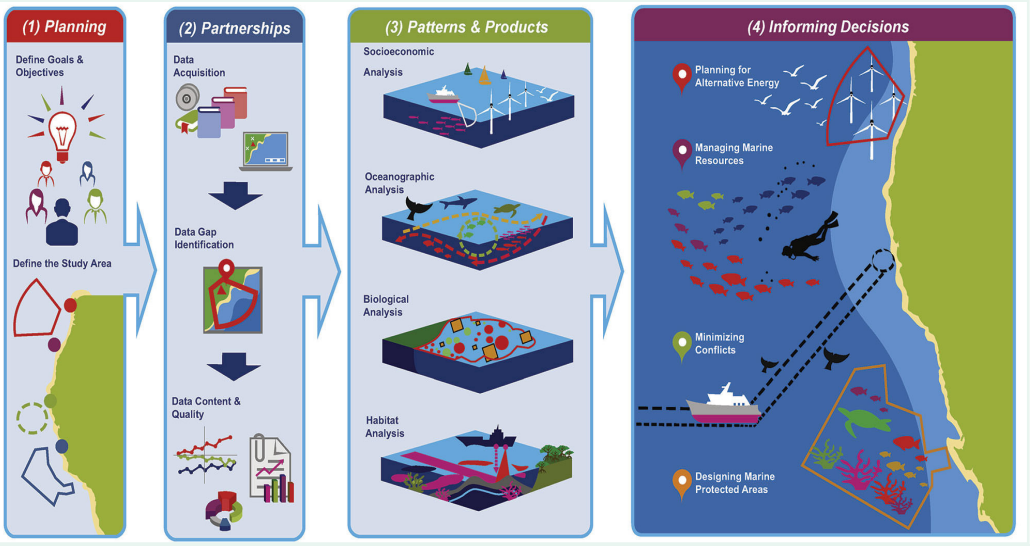

Figure 5.2 The four-step Biogeographic Assessment Framework is often developed and used to support marine spatial planning, used in energy development decision-making. *NOAA NCCOS (2014)*

In terms of environmental impacts, sea walls have positives and negatives. They can decrease diverse habitat for plants and animals that live in marsh or sand, but they can increase habitat for animals such as barnacles and oysters that need hard substrates. They also tend to increase erosion at the ends of their structure, and beach sand can be scoured in front of sea walls impacted by heavy waves. So while human engineering can protect property and some animals, it can create problems elsewhere.

One option for combating rising sea levels and shifting coastline is to retreat. This means moving entire communities landward. In some areas of the floodplains in Mississippi and Louisiana, towns have picked up and moved inland. Yet, this could be a costly and problematic solution in South Carolina. Some of the most valuable homes and commercial buildings in the state are on beachfronts and along tidal waterfronts.

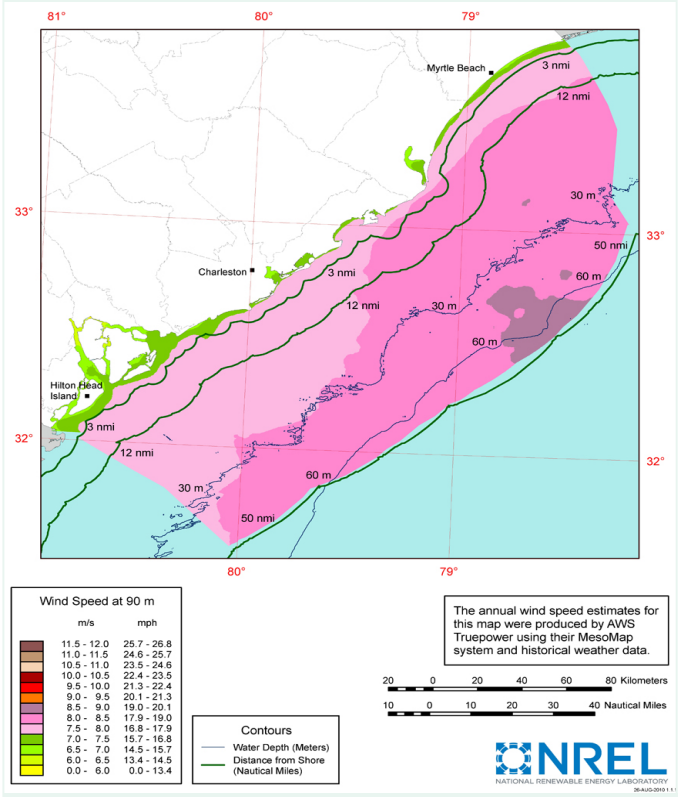

Figure 5.3 Coastal Offshore Wind Speed in South Carolina at 90 meters; such charts are used to position wind farms. *WINDExchange, US Department of Energy (2017)*

In fact, South Carolinians have done the opposite of retreating. After Hurricane Hugo devastated thousands of homes along the coast in 1989, many were built back larger and, in some cases, closer to the water. As Charleston dealt with a record number of nuisance flooding days in 2016, construction crews worked on multiple new high-rise hotels on the city's historic peninsula.

Offshore Wind

As the population increases, so does South Carolina's energy demands. New possible energy alternatives have arisen to help meet that growing demand. One such alternative is offshore wind power.

According to a report from the Clemson University Restoration Institute and Strom Thurmond Institute of Government and Public Affairs, a 1,000-megawatt offshore wind farm constructed between 2016 and 2025 would create an average of more than 3,800 jobs per year throughout the 10-year construction period. It would generate nearly $2 billion in wages and nearly $620 million in combined state and local government revenue.

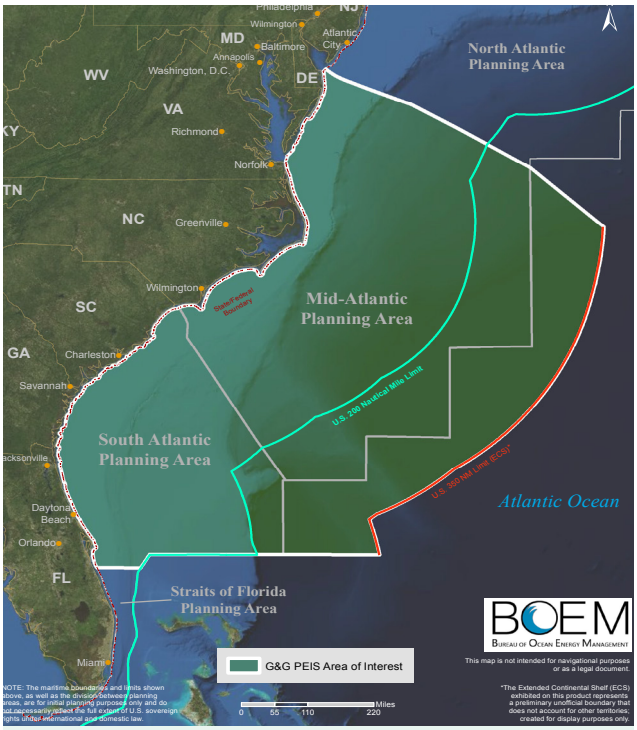

Figure 5.4 Atlantic Outer Continental Shelf Geological and Geophysical Programmatic Environmental Impact Statement area of interest. *This is the area currently being used for energy development decision making. BOEM (2013)*

With energy-related manufacturers like General Electric, IMO Group, and Prysmian already in South Carolina, there is the potential to significantly expand the industrial base. The Clemson University Restoration Institute in North Charleston features a test facility for large wind turbines, and state-owned power company Santee Cooper operates a 2.4-kilowatt, land-based wind turbine at North Myrtle Beach. In 2008, legislators created the Wind Energy Production Farms Feasibility Study Committee. This led to studies on the regulatory challenges and the production potential for wind energy off South Carolina's coast. Currently some market barriers stand in the way of offshore wind development, but the S.C. General Assembly is seeking to change this.

Wind turbines have an additional benefit of putting the state on the forefront of wind energy. North Myrtle Beach has chosen to position itself as a major proponent of offshore wind energy to promote coastal tourism.

While wind energy may have benefits, it also has costs. The placement of wind turbines will have to be strategic because some people consider them a blemish on the horizon. **Figure 5.5** demonstrates the visibility of wind turbines from two miles to eight miles off the coast. They can have a substantial presence the closer they are to shore, dependent on clear weather. Additionally, they could have ecological impacts on birds, sea turtles, and other wildlife. This could also impact recreation and commercial fishing communities. However, these costs are all dependent on the location of wind farms. The Bureau of Ocean Energy Management (BOEM) studies have determined areas for potential wind farm locations with the least impact on environment and recreation.

Offshore Drilling

Another energy resource being considered in South Carolina is oil and gas. In December 2016, President Obama imposed a federal moratorium on drilling in the Atlantic continental outer shelf, but President Trump announced plans in April 2017 to reverse that ban. While drilling could increase economic opportunity for South Carolina, an offshore accident leading to an oil spill could have large environmental and economic impacts.

To move forward with offshore drilling, more thorough estimations of oil deposits along the coast would have to be made. This requires seismic testing using air guns that shoot loud blasts of compressed air toward the ocean floor. The reflection of those sounds off the ocean floor help indicate the location of oil and gas beneath the surface.

The loud compressed air blasts can have negative impacts on sea creatures, especially marine mammals, such as whales and dolphins. These animals rely on sonar for communication and movement. To move forward with offshore

Figure 5.5 Landscape simulation of wind turbines at mile intervals between 2-8 miles offshore. *Santee Cooper and Clemson University (2009)*

drilling, seismic testing would be necessary across the continental shelf.

If sizeable deposits of oil or gas were to be found off the coast, extracting them could bring oil refineries and jobs to the state, boosting the economy. South Carolina's manufacturing base and port in Charleston make South Carolina well-positioned to benefit economically from offshore drilling. An analysis by the University of Wyoming School of Energy Resources determined the benefits of offshore drilling outweigh the environmental costs by a 2-1 margin. Drilling opponents disagree with those findings, claiming the potential economic damage of an oil spill is much greater than the economic opportunity of the oil reserves off South Carolina.

Leaders in multiple coastal communities have come out against offshore drilling and seismic testing. Their reasons are two-fold. An oil spill would be detrimental to tourism, which relies on pristine marshes and beaches. And the onshore infrastructure needed for an oil refinery would have negative environmental impacts. The commercial fishing industry also opposes seismic testing and drilling due to possible impacts on the fisheries. Offshore drilling is a complex issue, and many coastal communities remain firmly against oil and gas development.

What Can We Do?

Consider costs and benefits of continuing beach renourishment efforts

Use environmental engineering techniques such as living shorelines to decrease erosion and protect shorelines

Consider long-term strategies for responding to sea level rise and increased flooding events in coastal communities, such as retreating

Implement building codes for new construction to respond to sea level rise, such as site elevation requirements

Consider the pros and cons of sea walls as a method of adapting to sea level rise

Weigh the costs and benefits of offshore wind, particularly in the northern S.C. area

Weigh the costs and benefits of conducting seismic tests to determine the extent of oil and gas deposits in the Atlantic continental outer shelf

Resources for More Information

- **U.S. Department of Energy, Make Your Home Green document.** Website: http://www.energy.sc.gov/files/MakingYourHomeGreen.pdf
- **The Nature Conservancy, South Carolina: Goldbug Island Living Shoreline.** Website: https://www.nature.org/photos-and-video/video/south-carolina-goldbug-island-living-shoreline
- **Charleston Jetties, The Incidental Reef.** Pete Laurie**,** SCDNR. Website: http://www.dnr.sc.gov/magazine/articles/marapril2014/chasjetties.html
- **South Carolina Department of Health and Environmental Control, Interactive S.C. Beach Renourishment GIS Map**. Website: https://gis.dhec.sc.gov/renourishment/
- **British Petroleum. BP statistical review of world energy 2013**. Website: http://large.stanford.edu/courses/2013/ph240/lim1/docs/bpreview.pdf
- **Bureau of Ocean Energy Management (BOEM).** Website: https://www.boem.gov/South-Carolina/
- **South Carolina Department of Natural Resources. Comprehensive spatial database on S.C.'s coastal resources. GIS Data Resources.** Website: http://www.dnr.sc.gov/GIS/gisenergy
- **South Carolina Energy Office.** Website: http://www.energy.sc.gov/
- **S.C. Sea Grant Consortium, *Coastal Heritage*: Offshore Wind**. Website: http://scseagrant.org/pdf_files/ch_winter_10.pdf

The complete Briefing Book for the Our Coastal Future Forum can be found at the link below
http://www.scseagrant.org/pdf_files/OCFF-Briefing-Book-Updated.pdf

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