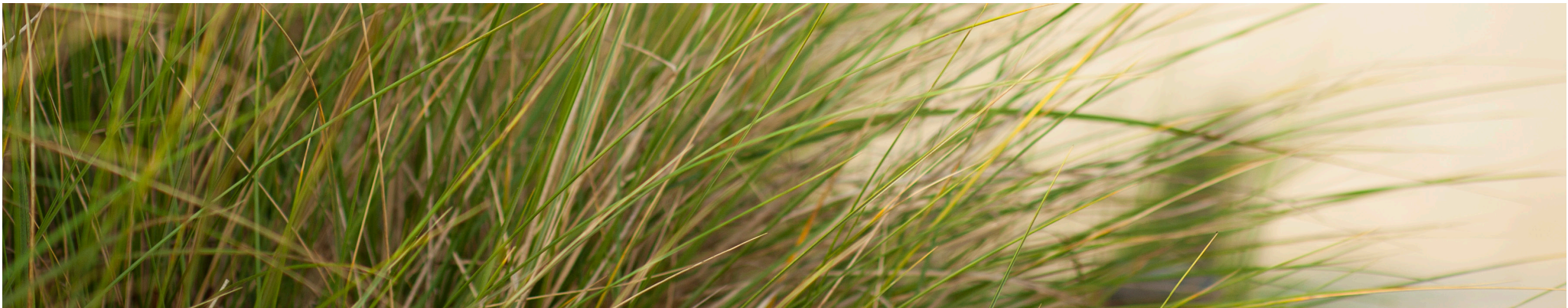
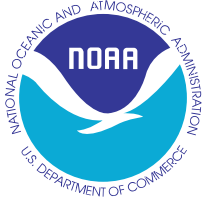


Recommendations for Local, Regional, and State-Level Approaches for Determining Sea-Level Rise Vulnerability



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This document is excerpted from the “Sea-Level Rise Vulnerability Assessment Tools and Resources: A Guide for Florida’s Local Governments.” The larger guidebook provides guidance for approaching, developing, and completing sea-level rise risk and vulnerability analyses and scenarios and for incorporating the appropriate process and process outputs into local planning efforts.

This document is a report that highlights a selection of 10 of the 33 tools and resources included for consideration in the *Sea-Level Rise Vulnerability Assessment Tools and Resources* guidebook, divided by their origin as a federal, state, non-profit, or privately created product, which provide some of the most accessible features within their tool/resource group. The recommendations presented in this document are centered around ease-of-use. The discussion is geared toward local governments who are newly approaching their vulnerability assessment options, and who have engaged with the pre-assessment questions set forth in the section *Selecting the Right Tool*. However, the information provided can also be used by communities that have already conducted a vulnerability assessment since the tools and resources discussed can be used to support previous findings or as references for future assessment changes and future actions.

Recommendations for Local Governments

While considering these recommendations, communities are encouraged to keep in mind their own needs in terms of population, vulnerability, and capacity/capability. Capacity and capability may be considered as a community’s access to administrative, technical, fiscal, and political capital.

Important considerations for communities as they investigate appropriate sea-level rise vulnerability assessment tools and resources are: (1) what are the driving factor(s) that are leading the community to conduct the assessment?; and, (2) are the respective driving factor(s) planning-based (e.g., incorporation of the results into hazard mitigation plans, comprehensive plans, land use plans), decision-based (e.g., development studies, public health studies), or otherwise motivated? Understanding the purpose for the assessment will likely assist communities in better understanding the most appropriate tool or tools for their use.

Another important factor to consider will be how much funding (or staff time) a community has available or is willing to invest on the assessment. Funding allocations may ultimately help make the decision easier about which tool or resource to use. A community with more options for funding will have a larger selection of tools available.

The discussion below summarizes some of the key findings from the guidebook. Vulnerability assessment tools have been arranged into four categories, with recommended tools set forth within each category:

- Federal Government Resources
- State Government Resources
- Public Non-Profit Resources
- Private Resources

General recommendations for these resource categories are made within each narrative.

Federal Governmental Resources

For decades, NOAA, the U.S. Army Corps of Engineers (USACE), and the U.S. Geological Survey (USGS) have been leaders at the federal level in sea-level rise data and tool development. These agencies have demonstrated long-term commitment to bringing attention to potential impacts of sea-level rise and have dedicated significant resources on developing tools and providing information about hazards and how to estimate potential future impacts.

NOAA Tools

- **Sea-Level Rise and Coastal Flooding Impacts Viewer (Visualization Tool - Online Mapper)**
- **Sea Level Trends (Visualization Tool - Online Mapper)**
- **U.S. Climate Resilience Toolkit and Climate Explorer (Database of Resources)**

USACE Tools

- **Sea Level Change Curve Calculator (Modeling Tool)**

USGS Tools

- **National Assessment of Coastal Vulnerability to Sea-Level Rise: Coastal Vulnerability Index (Visualization Tool - Online Mapper)**

The major benefit of all of these tools is that they are continuously updated. By virtue of their connection to the network of NOAA-maintained tidal gauge stations, their projections will be continuously updated to reflect valid, current measurements of local sea-levels. The USACE Curve Calculator, for instance, reports on recent and historical measurements of sea-levels from a selected gauge station, and runs those values with the National Research Council sea-level rise low and high curve.

NOAA's *Sea Level Trends* visualization tool is recommended for starting a generalized discussion on historical sea level trends across the globe. This visual can help users understand or communicate that sea level fluctuations are constantly occurring all over the globe, at different rates and even in different directions – both up and down (e.g., Alaska's southern coast has been experiencing a significant sea level drop over the last 80 years due to geologic uplifting of the continental shelf).

USGS's *National Assessment of Coastal Vulnerability to Sea-Level Rise* is helpful for expanding on NOAA's observed trends by providing a coastal vulnerability index for the entire U.S. coast, with risk rankings from low to very high. These risk rankings can be helpful for identifying and prioritizing planning for areas in a community that are at a higher risk to the exacerbated coastal impacts associated with sea-level rise.

NOAA's *Sea-Level Rise and Coastal Flooding Impacts Viewer* is recommended for local governments to use for visualizing the local potential impacts of sea-level rise. The tool shows how various levels of sea-level rise will impact a coastal community through a "horizon year" slider bar that illustrates inundation levels based upon a future year, and it provides simulations of sea-level rise at local landmarks. The tool can also communicate the spatial uncertainty of mapped sea levels, model potential marsh migration due to sea-level rise, overlay social and economic data onto potential sea-level rise, and examine how tidal flooding will become more frequent with sea-level rise.

NOAA's *U.S. Climate Resilience Toolkit* is also recommended for local governments to use as a good source of information on the vulnerability assessment tools, data, resources, and other information and expertise available for sea-level rise adaptation planning. The U.S. Climate Resilience Toolkit also includes

Climate Explorer which is an interactive tool that offers communities visualizations for exploring maps and data related to sea-level rise. The maps available include inundation from 1, 2, and 3 feet of sea-level rise as well as the population density, coastal vulnerability to sea-level rise, and social vulnerability index, which conveys important information on risk as well as the people and assets potentially impacted.

Another resource available from NOAA is a short publication entitled *Incorporating Sea Level Change Scenarios at the Local Level*. This is an excellent resource for communities to review as they begin to investigate how to address sea-level rise as a hazard. The document outlines eight steps to help communities calculate sea level change scenarios and communicate impacts. Using the information provided in the document, communities can develop a process that incorporates a range of possibilities and factors. With this information, various scenarios can be developed, both in terms of projections and responses, to meet the specific circumstances of a community. Moreover, working through the scenario development process provides the data and information that officials will need to make communities readily adaptable to changing circumstances.

State Government Resources

The State of Florida has produced at least three resources that map hazards. More specific information about state-level efforts can be found later in this report in the discussion on Recommendations for State-Level Coordination (see pages 5 to 9). This report recommends the following for communities looking into sea-level rise:

- **FDOT Sea Level Scenario Sketch Planning Tool (Visualization Tool – Online Mapper, Data Download)**
- **Geospatial Assessment Tool for Operations and Response (Database of Resources)**

From the State of Florida-created tools, FDOT's *Sea Level Scenario Sketch Planning Tool* stands out for its commitment to directly addressing sea-level rise impacts. Generally, however, it can be utilized for visualizing potential impacts of sea-level rise. While the focus of the tool is on visualizing sea-level rise impacts on transportation infrastructure, it can also be used for more general planning purposes.

Florida Division of Emergency Management's (FDEM) *Geospatial Assessment Tool for Operations and Response (GATOR)* online Geographic Information System (GIS) visualizer is also recommended for its ability to map storm surge zones and storm surge depths. Since storm surge can be considered a hazard with the potential to occur annually, visualization of these zones and depths can help support longer-term sea-level rise planning strategies and decisions.

Public Non-Profit Resources

There are several non-profit organizations that have developed tools and resources for communities considering sea-level rise vulnerability. Several of these tools are highly effective and it is recommended that communities take a closer look at these tools as they consider which are most appropriate for them.

The Nature Conservancy Tools

- **Coastal Resilience Mapping Portal (Visualization Tool – Online Mapper)**

Other Non-Profit Resources

- **Social Vulnerability Index (Visualization Tool – Online Mapper, Data Download)**

The Nature Conservancy *Coastal Resilience Visualization Tool* offers a richly layered analysis of the Florida Keys and some visualization for other parts of the State. As a visualizer, it may also be utilized as a tool to use as a foundation (i.e., emulate or copy) if a community wishes to create its own layered analysis of sea-level rise within a GIS.

The *Social Vulnerability Index (SOVI)* is useful for examining a community's vulnerability to sea-level rise because it ranks locations (census tracts) based upon 32-42 variables that are believed to affect a human population's ability to respond to disasters, such as household income, number of cars owned, and age of inhabitants.

Private Resources

Solutions from the private sector can be very effective for helping communities take a more detailed look at determining and communicating sea-level rise vulnerability, but, at times, private tools can prove to be more expensive than what local governments can afford. Those communities that have the means to acquire and implement these resources are able to develop more specific and more detailed analyses than that which can be done with some of the more economical options. Consulting firms also provide other options for those communities interested in working with them. For those communities just beginning to engage with private sector vulnerability assessment options, the following is recommended:

- **Climate Central's Surging Seas (Visualization Tool)**

Climate Central's Surging Seas offers a free, web-based visualization tool called *Submergence Risk Map* that communities can use to depict scenarios of sea-level rise and identify vulnerable populations, infrastructure, and assets using its searchable data toolkit called *Risk Finder*. It provides an easily understood assessment of sea-level rise, including a mapping of social vulnerability, and a calculator of the total value of impacted structures (e.g., based upon the viewing area, and the amount of sea-level rise, "X" dollars of structural damage will result).

Recommendations for Regional Approaches for Sea-Level Rise

Florida Councils of Governments play a strong role in leading regional planning efforts in the State. COGs have the ability and expertise to take the lead with regional sea-level rise assessments and should consider the tools found in the guidebook for the purposes of conducting regional sea-level rise vulnerability assessments.

In addition, sea-level rise has spurred new regional partnerships to emerge, specifically with a focus on confronting sea-level rise and other climate-induced hazards. The Southeast Florida Regional Climate Compact (The Compact) represents a partnership between Monroe, Miami-Dade, Broward, and Palm Beach Counties. Together, they have created their own consensus sea-level rise projection and vulnerability assessment. Counties wishing to build social capital amongst one another within their own regions may visit The Compact's website ([click here¹](http://www.southeastfloridaclimatecompact.org/)) or refer to this [list of contacts²](http://www.southeastfloridaclimatecompact.org/who-we-are/) in order to reach out for additional information.

One of the best ways to learn which tools and methodologies work best for different regions and local governments is to learn through multi-jurisdictional collaboration, including learning from other communities, other regions, and other states. The State's Community Resiliency Initiative is working to provide a clearinghouse for communicating lessons learned. More information about the Community Resiliency Initiative can be found under the discussion of state-level coordination in the following section.

¹ <http://www.southeastfloridaclimatecompact.org/>

² <http://www.southeastfloridaclimatecompact.org/who-we-are/>

Recommendations for State-Level Coordination

Community Resilience Initiative Background

In 2011-2016, the State's land planning agency, Department of Economic Opportunity (DEO) was responsible for coordinating the Community Resiliency Initiative, a five-year project to integrate adaptation to potential sea-level rise into current planning mechanisms including the local comprehensive plan, local hazard mitigation plan, and local post-disaster redevelopment plan. This effort was steered by a Focus Group of statewide experts on adaptation and coastal vulnerability as well as stakeholders in the coastal area. In the first year of the initiative, DEO researched similar efforts in other states as well as how the "adaptation action area" may be implemented at the local level. During the next phase of the initiative, adaptation planning was piloted in three coastal communities. Finally, after 2016 - all lessons learned will be compiled and disseminated statewide.

As the coasts of Florida continue to change, existing programs will likely be adapted for coordinating and guiding efforts to help Floridians safely adapt to changing conditions. In the near future, the Community Resiliency Initiative will be transitioning into its next five year initiative, which will likely continue to promote adaptation efforts across Florida communities. In addition to the promotion of adaptation planning, several kinds of monitoring will need to be in place, and undertaken by state agencies, to ensure that the phenomenon, and reactions and changes to it, are being recorded.

Opportunities for Sea-Level Rise Monitoring by Florida's State Agencies

There are many opportunities that exist for sea-level rise monitoring and evaluation activities to be overseen by state agencies. Monitoring sea-level rise many consist of several different activities, including the following list of recommended activities:

- **Monitoring coastal change from a human settlement standpoint—** Coastal change as it affects human settlements relates to the ways in which coastal flooding affects residential and business structures, as well as infrastructure. Extreme high tides may affect numerous city functions, from beach-dependent tourism activities, to stormwater infrastructure overload, to building damage. The job of monitoring this kind of coastal flooding should fall primarily to communities themselves, although the Division of Emergency Management may monitor and predict instances when coastal flooding will occur. The State Land Planning Agency (DEO, Division of Community Development) may monitor flooding and impacts over the long term and the way that communities are adapting their planning mechanisms, accordingly. Water Management Districts could also monitor the changes to the freshwater/saltwater found at different drinking water wells in their areas.

- **Monitoring coastal change from a geological standpoint—**Geologic change consists of sedimentary, dune, and coastal terrain changes brought about by eustatic sea-level rise (total volume of water increases and expands) and subsidence, among other forces. Coastal geological change would likely best be monitored by the Department of Environmental Protection (DEP) Florida Geological Survey in conjunction with NOAA's tidal gauge stations.
- **Monitoring coastal change from a biological standpoint—**Biological change consists of alteration to species habitats, and the living habitats themselves, as a result of flooding and sea-level rise. The Community Resilience Initiative references the Florida Natural Resources Inventory (FNAI), FDEP, FWC, and state national parks located in Florida, alongside other not-for-profit entities, when describing biological change as a result of sea-level rise. In the future, these same agencies may continue to monitor biological change, such as through FWC's "tipping points" mechanism³, to determine how habitats and species migrate, expand, or shrink as a result of sea-level rise and coastal flooding.
- **Being aware of, compiling, and organizing sea-level rise planning occurring in the state—**Planning for sea-level rise (i.e., "adaptation planning") refers to the participatory process by which a community sets goals, assesses vulnerabilities, creates adaptation strategies, and develops a means by which those activities can be integrated into regulatory documents. The Community Resiliency Initiative has actively followed sea-level rise planning activities. In the future, the state land planning agency at DEO may be responsible for continuing to follow, document, and make visible these planning efforts for use and reference by other Florida communities.

³ The *Tipping Point* mechanism was described to DEO as a system wherein wildlife managers, when noticing a change in a species or habitat, refer to a reference guide describing tipping point signs and effects. If the change expressed by the species or the habitat matches a predicted tipping point, it may mean that the species is adapting, thriving, or shrinking in response to sea-level rise and other climate change impacts.

- **Being aware of, compiling, and organizing sea-level rise policy making in the state**—Sea-level rise policy consists of regulatory mechanisms for surveilling or adapting to sea-level rise. Policy at the state originates at the legislature and may be monitored by the Department of State (DOS) or by the state land planning agency at DEO. In addition, hazard mitigation plans are prepared by the Division of Emergency Management. Instances of sea-level rise within these plans may be documented and shared with DEO and DOS. At the local level, these changes may appear in comprehensive plans, zoning ordinances, special area management plans, or other regulatory documents. The state land planning agency at DEO should continue to monitor developments in local policy and consolidate it as the Community Resiliency Initiative has done.
- **Being aware of, compiling, and organizing sea-level rise adaptation projects occurring in the state**—Adaptation projects cover a wide range of Protection, Accommodation, and Retreat activities. They may appear as zoning overlays, incentive programs, other regulation, and physical projects. At the regional level, these projects may be implemented during the building of inter-jurisdictional infrastructure, such as a road or a water supply network. They may also be highly localized, such as a permit to plant native landscaping on a single private parcel of land. Permitting and implementing agencies for these projects include Florida Department of Transportation (FDOT), DEP, and Water Management Districts. At the local level, they include the building and permitting section of the planning department, as well as the public works department through their Capital Improvements Plan. DEO can monitor local adaptation project policy, permitting, and construction. An agreement may be reached between FDOT, DEP, DEO and the Water Districts to amass data about projects within one central location, such as the University of Florida/Geoplan Sea-Level Scenario Sketch Planning Tool website.

- **Ensuring that state-level knowledge and understanding of sea-level rise and climate change science is current and sophisticated**—Sea-level rise science originates from numerous sources: the Intergovernmental Panel on Climate Change (IPCC), U.S. Army Corps of Engineers (USACE), NASA, the National Academy of Sciences (NAS), and academic institutions. Projections may apply to global eustatic rise (such as IPCC) or may include local rates of erosion and subsidence (USACE). Although the Community Resiliency Initiative follows general trends in climate science, it does not continuously evaluate the validity of different projections⁴. DEP Office of Coastal Resource Management may have a meteorologist review new projections as they arise, and prepare reports on them.

The above recommended activities address sea-level rise monitoring from a variety of perspectives and through numerous agency supports. While they provide a good level of detail about sea-level rise events, there is some lack of cohesion and central organization. Consequently, DEP may wish to coordinate with Department of Agriculture and Consumer Services (FDACS), Office of Energy in order to revive or evolve the governor's task force on climate change that was created in 2007 by an executive order. Through a central coordinating entity at the state level, the monitoring activities and records of each agency could be compiled, organized, and outreach to interested communities facilitated.

⁴ The resource *Sea Level Rise Projection, Needs Capacities and Alternative Approaches* examines 12 eustatic projections and 9 major sea level rise projection methods. This evaluation should remain valuable for years to come, although other projections and updates will need to be added.

Recommendations

If the State of Florida wishes to conduct a statewide vulnerability assessment, or drive a standard set of community assessments, it should determine different planning horizons (for example, 20-year, 40-year, etc.). This will help the State set realistic goals, adjust to changing science about the hazard, and help determine whether the message about the hazard should be revised over time. There are two recommended vehicles to consider using to help establish planning horizons: 1) through a Focus Group comprised of statewide experts on adaptation and coastal vulnerability; and, 2) through the State Hazard Mitigation Plan Advisory Team. The Focus Group was formed as part of the Community Resiliency Initiative to “establish sea-level rise scenarios, determine appropriate and comprehensive planning horizons based on the requirements of Title 44 CFR Sec. 201, determine data requirements for addressing sea-level rise in the State Hazard Mitigation Plan and to explore the feasibility of developing Memoranda of Understanding [between state agencies and partners].” As such, it is recommended that a similar Focus Group continue to be considered a strong proponent for promoting sea-level rise awareness statewide.

Other state agencies with direct involvement in communicating risks associated with rising sea levels include, but may not be limited to the following:

- Department of Environmental Protection
- Division of Emergency Management
- Florida Coastal Management Office (DEP)
- Florida Department of Transportation
- Department of State, Division of Historical Resources
- Department of Health
- Fish and Wildlife Conservation Commission

These agencies should be coordinated with closely when determining any state-wide priorities related to sea-level rise.

Coordination of sea-level rise vulnerability analyses at the state level may best take place through the State Hazard Mitigation Plan Advisory Team (SHMPAT). The State Hazard Mitigation Plan Advisory Team is comprised of a variety of stakeholders from State Government, Federal Government, the private sector and other non-governmental agencies and associations. The SHMPAT is charged with keeping the State Hazard Mitigation Plan updated every five years. The most recent version of the plan was last completed in 2013.

Sea-level rise is already identified in Florida’s State Hazard Mitigation Plan in the discussion of the flood hazard, although sea-level rise is not identified as a separate hazard. General vulnerability assessment information from a Nature Conservancy analysis is provided in the plan.

Available opportunities for updating the State Hazard Mitigation Plan (in 2018/2019) are recommended to take advantage of the following:

- Recommendations from a Focus Group comprised of statewide experts on adaptation and coastal vulnerability.
- A review of updated sea-level rise vulnerability assessment tools and methodologies to determine what approaches may be most appropriate for conducting a statewide assessment.
- A review of the different approaches for incorporating results and products from the vulnerability assessment into existing state agency planning processes.
- Community Resiliency Initiative report entitled – *Recommendations for a Statewide Vulnerability Assessment* (Year 3, DEP agreement CM403, deliverable 3.13), which examines sea-level rise projection methodologies and tools, and provides recommendations for conducting a statewide vulnerability analysis.

- As part of the first year set of Community Resiliency deliverables, the Florida Planning and Development Lab produced recommendations for updating the State Hazard Mitigation Plan. The Florida Planning and Development Lab produced CM 223 Del. 3.9 “Final Proposed Amendments to Florida’s State Hazard Mitigation Plan....” (Butler et al., 2013) which included proposed amendments to incorporate sea level rise into the SHMP.