How Countries, States, and Florida Address Sea Level Rise

A Compendium of Climate Adaptation Research

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

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FLORIDA: GENERAL RESEARCH & PLANNING

Preparing for a Sea Change in Florida

Florida Coastal and Ocean Coalition

This report by the Florida Coastal and Ocean Coalition details how climate change could impact the state's coastal areas, and it broadly outlines possible adaptation solutions. It is intended to provide guidelines for concrete, science-based action on the critical issues Florida faces in light of climate change and to stimulate informed debate for the preservation of Florida's natural resources.

Four primary categories of impacts are discussed: sea-level rise, extreme weather events, higher ocean temperatures, and ocean acidification. The potential effects of sea-level rise are fully described, including beach erosion, saltwater intrusion, and the submersion of marshes and coastal property. Discussions of extreme weather events include severity, altering water flows, exacerbating runoff, and damaging coastal habitats. For each of the four impact areas, recommendations are outlined for state and local government responses, including specific agency actions, as well as regional and federal responses.

The Florida Coastal and Ocean Coalition is a group of environmental organizations working together to conserve, protect and restore Florida's coastal and marine environment. Member organizations include the following: Caribbean Conservation Corporation, Environmental Defense Fund, Gulf Restoration Network, Natural Resources Defense Council, National Wildlife Federation, Ocean Conservancy, Reef Relief, and the Surfrider Foundation.

Source:
http://www.flcoastalandocean.org/PreparingforaSeaChange/Climate_Change_Guide_for_Florida_Preparing_for_a_Sea_Change.pdf

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Florida: Public Opinion on Climate Change

I. Lead Agencies
   a. Yale School of Forestry and Environmental Studies
   b. University of Miami
   c. National Science Foundation
   d. Columbia University Center for Research on Environmental Decisions

II. Project description
   a. The goal of the study was to measure the perceptions of Florida residents about the causes and consequences of climate change, and about potential solutions. The main findings are presented in this report and are intended to aid policy makers, educators, the private sector, and environmental organizations in their planning efforts in response to climate change.

Source:

http://environment.yale.edu/uploads/FloridaGlobalWarmingOpinion.pdf

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Florida and Climate Change: The Costs of Inaction

I. Location: Tufts University

II. Lead Agencies

a. Global Development and environment institute

b. Stockholm environment institute – US Center

III. Project Description

a. The report is the first detailed analysis on the potential consequences of continued climate change for the state's economy. The report concludes that, if left unchecked, climate change will significantly harm Florida's economy in the next several decades, and that impacts on just three sectors – tourism, electric utilities, and real estate – together with effects of hurricanes would shrink Florida's Gross State Product by 5% by the end of this century.

Source:

http://www.ase.tufts.edu/gdae/Pubs/rp/Florida_hr.pdf?bcsi_scan_EAC41357C45D053C=0&bcsi_scan_f

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Climate Change and Land Use in Florida, Interdependencies and Opportunities

I. Lead Agencies
   a. Century Commission for a Sustainable Florida
   b. UF

II. Project Description
   a. This report shows that land use and climate change in Florida are deterministically linked issues. Changes in land use over the next decade can adversely affect climate change, while climate change itself will alter the form and function of the landscape. With its burgeoning growth Florida stands at a crossroads with respect to its options for climate mitigation and adaptation. Failure to develop and implement appropriate plans for proactive adaptation could cost billions in lost revenue, while endangering the health and wellbeing of our children, grandchildren and beyond. Alternatively, tremendous opportunity exists for economic development through land management for climate mitigation and participation in carbon markets. While all adverse effects of global warming cannot be avoided through mitigation, proactive adaptation can confer resilience to managed and natural ecosystems, while creating jobs and opportunities for enhancing the wellbeing of Floridians.

Source:

http://snre.ufl.edu/home/files/Climate%20change%20and%20land%20use%20in%20Florida%20V8-1s.pdf

I. Lead Agencies

a. Florida Institute for Conservation Science
b. The Nature Conservancy
c. Florida Native Plant Society
d. U.S. Fish and Wildlife Service
e. The Jelks Family Foundation
f. Disney's Animal Kingdom

II. Project Description

a. The Florida Institute for Conservation Science has initiated a project to study and communicate issues related to the impacts of (and adaptation to) sea level rise in Florida. The first phase of this project included a scientific symposium, which was held January 18-20, 2010, at Archbold Biological Station. This meeting brought together scholars from several disciplines to share information on sea level rise and its impacts in Florida and to develop recommendations for further research and for changes in policy and management. Future phases of this project include technical publications, communications with policy makers and the public, and a larger conference focused on policy and management and involving a diversity of stakeholders and decision makers. The latter conference is tentatively scheduled for August 2010 at Fairchild Tropical Botanic Garden in Miami.

Source:

http://flconservationscience.org/programs/symposiums.html

I. Lead Agencies

a. UF Conservation Clinic

b. Florida Sea Grant

c. Charlotte Harbor National Estuary Program

II. Project Description

a. The purpose is to present selected model comprehensive planning goals, objectives, and policies (GOP's) to address sea level rise adaptation in a hypothetical city/county in Florida (Southwest Florida).

Source:
http://www.flseagrant.org/coastalplanning/wpcontent/uploads/2012/03/sea_level_rise_Cons.Clinic_2010_v.2.pdf

Florida's Energy and Climate Change Action Plan

I. Principle conclusions from the Action Team Process

a. Florida's resources, communities, and economy are expected to experience significant impacts if the current trajectory of global greenhouse gas emissions is not reversed

b. Early actions to address global climate change has significant energy security benefits for Floridians, while positioning the state to become a regional and hemispheric hub of green technology innovation and investment
c. Energy efficiency, demand-side management, and energy conservation present florida with numerous opportunities to reduce energy costs, increase the buying power of Florida's families, and make the state's business sector more cost-competitive in the global market
d. Investments today in low-carbon energy sources will stimulate Florida's economy and redirect current expenditures on imported fossil fuels toward Florida-based energy sources retaining significant flows of money within local economies
e. Market-oriented regulations – many already authorized in Florida law – will efficiently guide a low-carbon economy while protecting energy consumers, maintaining Florida's agricultural competitiveness, and building more sustainable communities

II. Phase 2
a. Provides 50 separate policy recommendations, plus an additional set of comments toward the current regulatory work to develop Florida's cap-and-trade program to reduce harmful greenhouse gas emissions
b. The total net cost savings of all Action Team recommendations combined is more than $28 billion from 2009-2025
c. The action team recommends 50 policy actions relating to:
    i. Energy supply and demand
    ii. Transportation and land use
    iii. Agriculture, forestry, and waste management
    iv. Government policy and coordination
    v. Adaptation strategies associated with climate change

Source:
http://www.flclimatechange.us/ewebeditpro/items/O12F20136.PDF

Climate Change in Coastal Areas in Florida: Sea Level Rise Estimations & Economic Analysis to Year 2080

Funded by National Commission on Energy Policy and Reported by FSU

In this report the results of downscaled modeling efforts of the effect of sea level rise on six coastal counties in Florida are presented, including: Dade, Dixie, Duval, Escambia, Monroe and Wakulla counties.

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Additionally, assessments of the potential economic impacts that this phenomenon could have are presented. Using representative storms, estimates are provided of the damage that could be inflicted from storm surge and flooding, both of which will become more intense and more frequent as a consequence of climate change. The value of the land that will be affected by these intensified events was used to provide the basis for the economic assessment.

This is the scientific assessment report that supports the synthesized brief "Climate Change in Coastal Florida - Economic Impacts of Sea-Level Rise," published by the National Commission on Energy Policy.

Source:
http://www.manatee.wateratlas.usf.edu/upload/documents/FSU%208%2014%202008%20final.pdf

Florida Department of Transportation

Development of a Methodology for the Assessment of Sea Level Rise Impacts on Florida's Transportation Modes and Infrastructure

The purpose of this report is to provide a methodology for assessing the impacts of SLR on FL transportation infrastructure for planning purposes. Research was conducted by FAU by a DOT grant. Scope of the project includes a summary of global and state observations and projections of SLR, a discussion of the methodology used in developing consensus on SLR in Southeast FL, a recommended methodology for projecting SLR in FL, and

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identifying potentially vulnerable infrastructure, global to regional downscaling approaches, and data gaps in existing SLR scientific knowledge.

I. Methodology
   a. FAU recommends using the US Army Corps of Engineers (USACE) guidance for forecasting SLR in FL
   b. Considers scenarios of possible future rates of mean sea level change over various planning horizons
   c. Includes maps from Port Everglades, Dania Beach, and others

II. SE FL Regional Climate Change Compact Consensus Projections
   a. Planning Horizon:
      i. 2030 = 3-7 SLR in inches (low-high)
      ii. 2060 = 9-24 SLR in inches

III. FAU Research techniques
   a. FAU used the Weiss Overpeck 1-meter SLR projection for FL to illustrate a downscaling technique developed to identify potentially vulnerable transportation infrastructure
   b. FAU researchers applied the evaluation techniques to Dania Beach, Punta Gorda, and Key Largo, FL.
   c. Research includes a discussion of the potential impacts of SLR to transportation infrastructure, including drainage, roadway base, and surface water impacts, and a summary of adaptation strategies and tools
   d. SLE generally use Satellite altimetry and tidal data
   e. Two main types of data used for land analysis in SLR studies are LiDAR and contour DEMs (Digital Elevation Model)

IV. Short-term recommended actions
   a. Developing a sketch planning tool to apply the USACE methodology to produce statewide and regional projections of SLR and downscaling techniques to identify and assess potentially vulnerable infrastructure
      i. Downscaling evaluation approach = 4 step process
      ii. State SLR projections
         1. Integration of FDOT state roadway data and State SLR Projections for the years 2030, 2060, and 2100 using USACE methodology
         2. Preliminary identification of state road segments potentially vulnerable to a 3 ft of SLR
         3. Creation of inventory of potentially vulnerable state roadways
      iii. Regional SLR projections
         1. Evaluate roadways with more detailed topographic information
         2. Integration of regional FDOT state roadways data and low resolution LiDAR data
         3. Evaluation of current and year 2100 topographic conditions
         4. Identification of specific roadway sections potentially vulnerable to SLR
      iv. Localized SLR projections
         1. Integration of regional FDOT state roadways data and high resolution LiDAR data
         2. Evaluation of year 2100 topographical conditions of specific roadway links/identification of specific roadway sections potentially vulnerable to SLR

v. On The Ground (OTG) evaluation

1. Verification of vulnerability using construction drawings & survey data

V. Long-term recommended actions

a. Developing a no-regrets and gradual adaptive management strategy in transportation planning and integrating SLR projections with groundwater, surface water, and storm surge models to better assess the vulnerabilities of transportation modes and infrastructure

VI. Data Gaps

a. Data to understand land forms and where and how water will flow
b. Monitoring data and environmental drivers
c. Consistent SLR scenarios and projections across agencies to support local planning
d. Data to characterize vulnerabilities and impacts of SLR
e. Community characteristics – data on demographics, societal vulnerabilities, economic activity, public attitudes and understanding of risks, etc
f. Legal framework and administrative structure

VII. Tools needed for adaptation and planning of transportation infrastructure

a. Communication tools for stakeholder engagement, visioning, and consensus building
b. Tools to monitor and model current and future rates of SLR
c. Visualization and scenario-building tools
d. Implementation tools to build institutional capacity and implement adaptation plans
e. Interagency coordination on research, policy agendas, and funding are needed to provide the package of data, tools, and processes
f. Regional coordination of transportation planning
g. GIS maps as tools to identify infrastructure potentially at risk from SLR

Source:

http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_PL/FDOT_BDK79_977-01_rpt.pdf

Adaptive Response Planning to Sea Level Rise in Florida and Implications for Comprehensive and Public-Facilities Planning

I. Background

a. We will experience SLR for centuries if not millennia because of the lag in achieving temperature equilibrium between the atmosphere and the oceans
b. The long timescales of SLR suggest that coastal management, including spatial planning, needs to take a long-term view on adaptation to SLR and climate change, especially with long-life infrastructure
c. Areas that are not build out are where other options (besides protections) may be feasible

d. Recently published projections of SLR by 2100 relative to approximately 1990 range from less than 1 foot to more than 15 feet
    i. Based on analysis of current trends or derived from an array of scenarios and model projections build on different assumptions about future greenhouse gas emissions

II. Purpose and Focus
a. Focus on implications of SLR on planning and management of 3 major elements of local infrastructure
    i. Water supply systems that draw from aquifers or surface waters close to the coast
    ii. Centralized wastewater management systems located in low-lying areas near the coast, including those with surface water discharges of treated wastewater
    iii. Highways, bridges, and causeways in coastal areas
b. Interest with the state of adaptive response planning for such infrastructure

III. Regional Consideration
a. Differences in both relative and eustatic sea level observations
b. Local land subsidence or uplift are primarily responsible for differences in observed SL
c. Regional variations in wind patterns and ocean currents, as well as seawater temperature, salinity, and density, also may affect observed rates of eustatic SLR

IV. Potential Impacts
a. 4 major impacts
    i. Inundation and shoreline recession
    ii. Increased flooding from severe weather events
    iii. Saltwater contamination of ground water and surface water supplies
    iv. Elevated coastal ground water tables
b. For a 1-foot rise in SL, the shore will recede by 50-100 feet
c. Infrastructure that lies in the path of shoreline recession may be adversely affected in several ways
    i. Intermittent flooding from spring tides
    ii. Scouring and undermining of above-ground facilities, road bases, and bridge abutments
    iii. Interfere with navigation under bridges and may increase the exposure of bridges to saltwater spray with resultant increases in spalling of concrete and more rapid corrosion of steel bridge components and rebar in older bridges
    iv. As flood zones shift higher and further landward, facilities previously sited in what were considered to be safe zones, may experience floods formerly classified as 100-year events
    v. Structures designed to withstand the force of storm waves and moving floodwaters of a given intensity will be more likely to be subjected to stronger forces

V. Adaptive response options
a. 3 categories: protection, retreat, and accommodation
    i. Highly developed coastlines will be protected from SLR with a combination of hard and soft engineering measures
b. Protection
    i. The physical measures that can be used to protect developed areas from erosion and inundation include construction of flood protection works, beach nourishment, dune building, and marsh building
c. Retreat

i. "rolling easement" under which human activities are required to yield the right of way to naturally migrating shorelines

ii. FL law empowers the state DEP to require the adjustment, alteration, or removal of any structure that intrudes onto sovereignty lands of the state below the mean high water line of any tidal water body

1. The agency has rarely, if ever, invoked this authority

iii. Question of what to do with infrastructure threatened by inundation and shoreline recession

d. Accommodation

i. SLR can be accommodated over the short term by elevating structures and/or the land upon which they are built

ii. Longer-term SLE accommodation will require directing new development away from areas that are anticipated to be affected by inundation, shoreline recession, and advancing coastal flood boundaries

1. Setbacks

iii. Prohibit development in larger hazard zones that are and will be susceptible to both shoreline and coastal storm flooding

VI. State policies

a. 35 states have prepared or are in the process of preparing climate action plans concerned with mitigating greenhouse gas emissions

b. 6 states (AZ, CA, MD, NC, OR, and WA) explicitly do or will address climate change adaptation in those plans

VII. FL Planning/Policy Findings

a. There are no explicit requirements that state, regional, or local planning entities address SLR in land use or infrastructure planning

b. Statutory planning time frames are generally too short to directly encompass SLR impacts

c. There are provisions within these planning frameworks that offer appropriate contexts within which SLR adaptive response planning could be addressed

Source:

http://www.coss.fsu.edu/durp/sites/coss.fsu.edu.durp/files/WPS_08_02_Deyle.pdf

Initial Estimates of the Ecological and Economic Consequences of Sea Level Rise on the Florida Keys through the year 2100

I. Method

a. Future shoreline locations and distributions of major habitats of Big Pine Key in the year 2100 were estimated using sea level rise scenarios described in the scientific literature

b. In every scenario the island became smaller, marine and intertidal habitat moves upslope at the expense of upland habitat, and property values are diminished; Inundation would displace native species dependent on upland habitat and threaten property

c. Use of LIDAR and SLAMM

d. Scenarios

i. 1: 18 cm, best-case: $11 billion in property value and 58,800 acres are at risk of inundation

ii. 2: 35 cm
iii. 3: 59 cm
iv. 4: 100 cm
v. 5: 140 cm

II. Results/recommendations
   a. Need to identify long-term impacts of SLR on the FL keys and to begin taking near-term steps to minimize the negative consequences of those impacts
   b. Approach for protecting natural areas and ecosystems
      i. Identification of "core areas" with the best chances of persistence during SLR
      ii. Intensive management of core areas to minimize loss of biodiversity
      iii. En-situ conservation, including relocation of vulnerable species to less vulnerable areas
   c. Identifying core areas
      i. Elevation
      ii. Representation
      iii. Replication
      iv. Connectivity
      v. Effective management

III. "No regrets" strategy for managing Florida Keys natural areas for SLR
   a. Fire management
      i. SLR is expected to accelerate forest succession, and the careful application of prescribed fire is the only economically viable and ecologically appropriate antidote to that succession
   b. Invasive exotic species management
   c. Wetland restoration
      i. Filing or plugging ditches may be essential to prevent unnaturally rapid infiltration of interior wetland, transitional, and upland habitats by saltwater
      ii. Restoring hydrological connectivity by removing obsolete roadbeds and installing culverts under functional roads

Source:
http://frrp.org/SLR%20documents/FINAL%20-%20Aug%2021%20-WITH%20COVER.pdf

Climate Change and the FL Keys

I. Lead Agencies
   a. NOAA
   b. Socioeconomic Research and Monitoring Program
   c. Florida Keys National Marine Sanctuary Program

II. Project Description
   a. The study provides alternative estimates, using scenario-planning techniques, of the medium- and long-term socioeconomic effects that may arise from climate change in the Florida Keys. The researchers used four global scenarios from a 2000 report by the Intergovernmental Panel on Climate Change (IPCC); however, the scenarios for the Keys were updated based on scientific developments since 2000. Projections for the Keys were

developed for each scenario looking at population trends, income, remaining land, coral cover, and total income. A series of policy recommendations are included at the conclusion of the report.

Source:
http://sanctuaries.noaa.gov/science/socioeconomic/floridakeys/climate_change/welcome.html

Comprehensive Everglades Restoration Plan

I. Predictions
   a. Models estimate that sea level could rise by 3-5 feet which could jeopardize an estimated 13.5 million people that live within 25 miles of shoreline
II. Lead Agencies
   a. US Army Corps of Engineers
   b. South Florida Water Management District
III. CERP
   a. Outlines a framework to guide the restoration, protection, and preservation of the water resources of central and southern Florida
   b. One of the main goals of CERP is to redirect 1.7 billion gallons of freshwater a day into the areas that need it the most, such as the Everglades
   c. Approved by Congress and awarded $7.8 billion dollars of funding for projects.
IV. Purpose

a. CERP Climate Change Team was created with a vision to "minimize future negative impacts and adaptation costs… [by collaborating] to quickly identify climate change sensitivities in natural areas and developed areas" in order to create and implement adaptation policies by 2015.
b. CERP Partners are providing various tools and information to create sea level rise guidance for the everglades

V. Outcomes
a. Using the CERP framework to begin to adapt to the effects of climate change may hold promise because federal, state, and local partnerships have already been established and there is a pre-established source of funding for future projects.

Source:
http://www.evergladesplan.org/

Participatory Scenario Planning for Climate Change in Southern Florida's Greater Everglades Landscape

I. Location: MIT

II. Lead agencies:
a. U.S. Fish and Wildlife Service
b. U.S. Gelogical Survey

III. Project Description
a. Project developed a set of spatially-articulate potential future land use maps that allows the exploration of the interaction between global climate change, human population settlement preferences, and state and local policies. In particular, one can begin to judge the effectiveness of current conservation strategies against a landscape in which people - as well as species - are likely to relocate in response to climate change.

Source:

http://training.fws.gov/CSP/Resources/climate_change/resources.html

Climate Change Action Plan for the Florida Reef System 2010-2015

I. Purpose
   a. The action plan is intended to guide coordination of reef management across many jurisdictions and serve as a more detailed, Florida-specific companion to the climate change goal and objectives in "NOAA Coral Reef Conservation Program Goals and Objectives 2010-2015"
   b. 3 main goals: increase resiliency through active management, enhance communication and awareness, and conduct targeted research.
   c. Identifies ways to increase reef resiliency to climate change and minimize negative impacts on reef-dependent industries such as diving and snorkeling tourism, and commercial and recreational fishing
   d. Outlines a holistic, adaptable five-year program that Florida's reef managers can undertake in collaboration with reef users and other stakeholders to minimize the damage and associated impacts of climate change. It is intended to be adopted and updated at least every five years.

II. Top ten priority climate change actions for the Florida reef system
   a. Improve regulations and management that facilitate adaptation to climate change and ocean acidification

b. Develop and implement a marine zoning plan that incorporated resilience-based concepts
c. Integrate climate change predictions and uncertainties into Florida's comprehensive planning laws and procedures
d. Continue and expand the FRRP disturbance response monitoring
e. Decrease the likelihood of negative fishing, diving, and other reef use impacts by increasing law enforcement presence and regulatory compliance
f. Develop scientific climate change fact sheets
g. Forecast the potential social and economic effects of climate change on reef-dependent industries and communities to measure their vulnerability and resilience and determine cost-to-benefit ratios of any proposed climate change mitigation/adaptation measures
h. Increase awareness
i. Monitor environmental variables linked to coral bleaching and other climate change impacts
j. Develop scientific models of the Florida reef system to help predict its response to physical, chemical, and socio-economic shifts associated with climate change

Source:
http://www.frrp.org/SLR%20documents/FL%20Reef%20Action%20Plan-WEB.pdf

Ecological Effects of SLR in the Florida Panhandle and Coastal Alabama

I. Intended purpose:
   a. Improve scientific understanding of the factors and scales necessary to evaluate shore zone modification and help develop a predictive tool of ecosystem modification due to SLR
II. Project Background
   a. Pilot EESLR project began in NC in 2005
III. Project Implementation
   a. Workshop was held in January 2008
   b. 5 groups
      i. Geomorphology and physical processes
      ii. Subtidal habitats
      iii. Terrestrial biological resources
      iv. Water quality and hydrology
      v. Modeling

IV. General strategic recommendations

a. Perform targeted studies of biological and physiological tolerances to change

b. Utilize historical understanding of community retreat

c. Improve understanding of benthic, nearshore, and upstream habitat connectivity

d. Improve understanding of the present and future distribution of habitats and the ability of species to migrate

e. Use standardized parameters to help drive models

f. Ensure adequate time scales so that time scales of concern for ecological effects are as long as the time scales for planning critical infrastructure

V. Project outcomes and conclusions

a. Use relevant scientific data to determine the factors and scales necessary to evaluate shore zone modification and develop a predictive tool of ecosystem modification due to SLR

Source:
http://www.cop.noaa.gov/stressors/climatechange/features/SLRWhitePaper3-09.pdf

Retrospective and Prospective Model Simulations of SLR Impacts on Gulf of Mexico Coastal Marshes and Forests in Waccasassa Bay, Florida

I. Study Purpose

a. Florida has extensive low elevation coastal habitats

b. SLAMM simulation to improve understanding of the magnitude and location of these changes for 58,000 ha of the Waccasassa Bay region of Florida's central Gulf of Mexico coast

c. Prospective runs of SLAMM using .64 m, 1 m, and 2 m SLR scenarios predict substantial changes over this century in the area covered by coastal wetland systems including net losses of coastal forests (69%, 83%, and 99%), inland forests (33%, 50%, and 88%), but net gains of tidal flats (17%, 142%, and 3,837%)

II. Background

a. The 4 primary processes used to predict wetland fate with SLR are inundation, erosion, overwash, and saturation

b. Conducted both retrospective and prospective SLAMM analyses for an approximately 58,000ha area surrounding and including Waccasassa Bay Preserve State Park in the Big Bend region of Florida

c. Compare results of SLAMM hindcast with those from data from 13 permanent plots monitored since 1992

III. Results

a. Implication from findings at the site level is that undeveloped, unprotected, lands inland from the coastal forest should be protected to accommodate upslope migration of this natural community in response to rising seas

b. Results from SLAMM hindcast agree with field observations of the effects of SLR on the study area along the Gulf coast of Florida

c. 30% of the coastal forest was adjusted to saltmarsh in the model based on the elevation input layer – in actuality not really noticeable in some cases yet

d. Model predicts community composition when wetlands have come to equilibrium with a given sea level, meaning that it will not accurately predict short-term transitional effects

e. SLAMM also predicted higher conversion of coastal forest into saltmarsh than predicted by Castaneda and Putz

Source:

http://coaps.fsu.edu/~mhannion/Geselbracht.pdf

Bursting the Bubble of Doom and Adapting to SLR

I. Lead Agencies

a. RWPaskinsn Consulting, Inc.

b. FSU

c. Timothy Dixon

d. Reed Noss

e. Anthony Oliver-Smith

f. Francis Putz

g. Thomas Ruppert

h. Kenneth Edward Sassaman

i. Michael Volk

II. Project Description

a. The report discusses the adaptive management process that specifies one or more essential actions necessary to reduce the vulnerability of built and natural environments to rising seas.

Source:
http://www.spacecoastclimatechange.com/documents/resources/Bursting_the_Bubble_of_Doom_and_Adapting_to_slr.pdf

Integrated Modeling for the Assessment of Ecological Impacts of SLR

I. Lead Agencies
   a. UCF
   b. Dewberry, Inc.
   c. Northwest Florida Water Management District
   d. Florida State University
   e. University of Florida
   f. University of South Carolina
   g. NOAA

II. Project Description
   a. The study team, led by Scott Hagen, Ph.D., of the University of Central Florida, will develop sea level rise computer models to predict the impacts storms and rising water pose to the northern Gulf's coastline, including shoreline and barrier island erosion. The results of the study will be incorporated into coastal ecosystem planning for restoration efforts and other natural resource management decisions in the region. It may also help oil spill responders better understand oil that may reside in the subsided ecosystems.

Source:
http://www.cop.noaa.gov/stressors/climatechange/current/slr/abstracts.aspx

Effects of Climate Change on Florida's Ocean and Coastal Resources

A Special Report to the Florida Energy and Climate Commission and the People of Florida

The Florida Oceans and Coastal Council prepared this report in 2009 to provide a foundation for future discussions of the effects of global climate change on Florida's ocean and coastal resources, and to inform Floridians about the current state of scientific knowledge regarding climate change. The report provides a high-level overview of the impacts to infrastructure, human health and the economy, as well as key drivers such as increasing air temperatures, warming ocean temperatures, and sea level rise. For each driver, effects such as altered severity and frequency of hurricanes and precipitation patterns, are discussed in terms of probable and possible outcomes. Research priorities for the Council that support the impacts and effects identified are outlined.

The report is meant to provide important and easy to understand information for legislators, policymakers, governmental agencies, and members of the public who are working to address, or who are interested in, issues related to climate change in Florida.

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Source:

http://www.floridaoceanscouncil.org/reports/

Assessment of Redefining Florida's Coastal High Hazard Area

I. Purpose
   a. This report examines how the 2006 legislative change to coastal high hazard area (CHHA) policies introduced by HB 1359, changed the CHHA boundaries and may impact resiliency and land development in Florida's coastal communities
   b. The focus of this report is to assess the impact of the new boundary definition for the CHHA
   c. The policy case study also raises serious questions about the role of science and planning analysis in the policy formulation process.

II. Background
   a. New language HB 1359: the coastal high hazard area is the area below the elevation of the category 1 storm surge line is established by a SLOSH computerized storm surge model.

III. Methodology
   a. Research is based on Florida's three treasure coast counties
   b. Part II: provides a brief summary of the CHHA regulations, criticisms raised by opponents, and the controversy that spurred its re-examination
   c. Part III: summarizes the GIS methodology and the qualitative data used in the assessment of the impact of the new boundary delineations in the three treasure coast counties of Martin, St. Lucie, and Indian River
   d. Part IV: presents findings followed by the research conclusions, which frame the analysis in the context of maintaining and improving community resiliency to hurricanes and in terms of its potential to encourage additional land development
   e. Part V: presents a discussion of the evolving CHHA policy, why we believe HB 1359 represents a change in policy direction, and questions the adoption of the SLOSH category 1 criterion

IV. Findings

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a. The new definition based on the SLOSH model for a category 1 hurricane redefines the spatial geography of the zone in ways that may compromise resiliency
    i. It would remove CHHA regulations from some of the most vulnerable coastal lands, specifically coastal areas adjacent to the ocean, with the evacuation zone, but situated at higher base elevations
    ii. It adds land that is zones for conservation or recreation use and which is already protected from imprudent development by its zoning designations and wetland regulations
    iii. Change in boundaries might kindle redevelopment activity of "soft-sites" as several key parcels and desirable neighborhoods will become eligible for upzoning reconsideration
b. The most striking difference between the two boundary definitions is the shape of the regulated area. The new CHHA is topographically based and thus includes parts of this coastal strip that are below the storm surge level, but excludes areas of higher elevation despite proximity to the ocean or intercoastal waterway. Therefore the CHHA is no longer a contiguous blanketed area, but rather resembles "swiss cheese" where lands above the topographic level of the storm surge for a category 1 storm are removed from the CHHA zone

V. Recommendations
a. The time has come to holistically consider the environmental, hazard mitigation, land use, and economic development issues related to coastal planning
b. In terms of the coastal high hazard area, it should be broadened to embrace diverse aspects of natural hazard mitigation. Defined at a regional scale through a coastal sector plan that reflects variability of local geo-morphology an socio-political linkages among neighboring jurisdictions
c. The CHHA regulation ought to be reexamined and perhaps new language should be developed that revisits the purpose and objectives of the CHHA holistically

Source:
http://docs.cdsi.fau.edu/cues/CHHAFINALREPORT-MAY212008.pdf

Florida's Resilient Coasts: A State Policy Framework for Adaptation to Climate Change

I. Lead Agencies
a. FAU
b. Center for Urban and Environmental Solution
c. National Commission on Energy Policy

II. Project Description
a. The project presents a comprehensive policy framework which will assist Florida state government 1) in assessing the likely impacts of climate change on its coastal regions and communities and then 2) developing and adopting policies and programs that will enable the state, its communities, and its residents to adapt to and adaptively manage those impacts over the near and long term.

Source:

www.communicationsmgr.com/projects/1349/docs/FAUResilientCoasts.pdf

Florida Water Management and Adaptation in the Face of Climate Change

I. The report addresses water resources and adaptation issues across the state. The primary objectives of this report are: (1) to identify Florida's water resources and water-related infrastructure that are vulnerable to climate change; (2) show demographics in the state that are vulnerable to climate change impacts with a focus on water resources and sea level rise; and (3) highlight some of the alternative technologies currently being used to solve water resource supply issues in the state that are likely to expand and be challenged under various scenarios of climate change.Lead Agencies

II. It is of use to Water Management districts and local governments concerned with planning for the future of water sources and municipal supply

III. The white paper's Appendix discusses SLR methodology. It cites IPCC assumptions and science, but also notes a Quadratic SLR Acceleration Formula by Heimlich et al (2009). It goes on to note a 1 to 3 foot rise for Florida planning purposes but mentions that constant monitoring and model updating will be required for an accurate, ongoing estimate

IV. This white paper highlights climate change issues relevant to water management, but also recognizes the financial challenges to implement adaptation measures to address climate change solutions. Implementing adaptation measures will require an unprecedented level of resource leveraging and coordination among academic, governmental, non-governmental, and private sector entities.

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Source:
http://floridaclimate.org/docs/water_managment.pdf

FLORIDA CITIES

City of Punta Gorda Adaptation plan

V. Location: City of Punta Gorda

VI. Lead Agencies

a. Charlotte Harbor National Estuary Program

b. Southwest Florida Regional Planning Council

VII. Project Description

a. This report identifies the alternative adaptations that could be undertaken to address the identified climate change vulnerabilities for the City of Punta Gorda. These adaptations are presented in the order of prioritized agreement from the public meetings. Only the highest agreement adaptation in each vulnerability area is fully developed for potential implementation. One of the utilities of this approach is that it provides a variety of adaptation options, which the City could select for implementation, adaptive management, and subsequent monitoring.

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COMMUNITY RESILIENCY

Source:
http://www.georgetownclimate.org/resources/city-of-punta-gorda-adaptation-plan

City of Satellite Beach

Municipal Adaptation to Sea-Level Rise

I. Project Purpose
   a. In the fall of 2009, the City of Satellite Beach, Florida, authorized a project designed to:
      i. Assess municipal vulnerability to rising sea level
      ii. Initiate the planning process to properly mitigate impacts

II. Facts
   a. High precision satellite altimeters indicate sea level has been rising at 3.3+/- 0.4 mm per year
   b. Three basic option in responding to sea-level rise
      i. Protect
      ii. Retreat
      iii. Accommodate
   c. Results indicate about 5% of the City landscape will submerge during the initial +2ft rise, with inundation generally restricted to fringing wetlands and finger canal margins proximal to the Banana River
   d. The "tipping point" towards catastrophic inundation is +2ft, forecast to occur around 2050.
   e. The City has about 40 years to formulate an implement a mitigation plan

III. Methodology
   a. Bathtub model – based upon the flooding of static terrain
   b. Not a serious weakness because:
      i. Project designed as a pilot program to provide base-line
      ii. Likely magnitude of geomorphic change would not be significant

iii. Presence of extensive coastal armoring along municipal shorelines

IV. Adaptive management

a. On-going and iterative process that specifies one or more essential actions necessary to reduce the vulnerability to rising seas

V. Initial steps

a. Comprehensive Planning Advisory Board approved a series of updates and revisions to the City's Comp Plan

i. If approved, the amendments will provide a legal basis for implementing an adaptive management plan and specific actions designed to mitigate the City's vulnerability to sea-level rise

VI. Three steps

a. Development of a 3-D model or "base map" of the City

b. Compilation and mapping of "critical infrastructure and assets"

c. Quantification of the extent to which the City and its critical assets would be inundated by sea-level rise

Source:

http://spacecoastclimatechange.com/documents/100730_CSB_CRE_Final_Report.pdf

Municipal Adaptation to SLR – Satellite Beach

I. Location: Satellite Beach

II. Lead Agencies

a. RWParkinson Consulting, Inc

III. Project Description

a. In the fall of 2009, the City of Satellite Beach, Florida, authorized a project designed to: assess municipal vulnerability to rising sea level and initiate the planning process to properly mitigate impacts.

IV. Integration into Local Plan Framework

a. Comprehensive Planning Advisory Board to approve a series of updates and revisions to the City's Comp Plan. If approved, the amendments will provide a legal basis for implementing an adaptive management plan and specific actions designed to mitigate the City's vulnerability to sea-level rise

V. Methodology/Predictions

a. Plan uses the bathtub model, based upon the flooding of static terrain. High precision satellite altimeters indicate sea level has been rising at 3.3+/- 0.4 mm per year. Results indicate about 5% of the City landscape will submerge during the initial +2ft rise, with inundation generally restricted to fringing wetlands and finger canal margins proximal to the Banana River. The "tipping point" towards catastrophic inundation is +2ft, forecast to occur around 2050.

VI. Project/Actions/Conclusions

a. The City has about 40 years to formulate an implement a mitigation plan

Source:
http://spacecoastclimatechange.com/documents/100730_CSB_CRE_Final_Report.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Yankeetown, FL

Coastal Forests Retreat

I. UF research
   a. Investigating coastal forest decline and replacement by saltmarsh in Yankeetown since mid-1990s
   b. Results: consequence of chronic stresses of SLR coupled with the punctuated disturbances of storms and droughts
      i. Salt is the primary culprit

II. Salt
   a. Health and diversity of the river side forests is testimony to occasional cleansing by fresh water
   b. Greenhouse experiments involving potted plants grown in salt solutions in colorful plastic swimming pools confirmed the ranking of tree species' salt tolerance observed in the field
      i. Salt tolerance increase with tree size
   c. For salt-sensitive species, even the occasional sea surge, especially if followed by dry conditions, can be fatal

III. Important to remember that the forests are being replaced by saltmarshes, which have their own virtues

Source:
http://people.biology.ufl.edu/fep/SeaLevelRiseFlorida2012inThePalmetto.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

FLORIDA COUNTIES & REGIONS

Lee County Climate Change Vulnerability Assessment

I. Five Future Scenarios for 2100
   a. A condition that involves a future in which mitigative actions are undertaken to reduce the human influence on climate change
   b. A 90% probable future predicted by the intergovernmental panel on climate change
   c. A 50% probable future predicted by IPCC
   d. A 5% probable future predicted by IPCC
   e. A "very worst" future in which no actions are taken to address climate change

II. Report assesses significant potential climate-related changes in air and water and the effects of those changes on climate stability, sea level, hydrology, geomorphology, natural habitats and species, land use changes, economy, human health, human infrastructure, and variable risk projections

III. Prioritized ranking for climate change vulnerabilities
   a. Altered hydrology
   b. Climate instability/storm severity
   c. Habitat and species changes
   d. Geomorphic (landform) changes
   e. Sea level rise and water temperature and chemistry changes
   f. Infrastructure impacts and land use changes
   g. Air temperatures and chemistry changes and human health
   h. Human economy
   i. Variable risk

IV. 5 major stressors of climate change
   a. Changes in the ratio of atmospheric gases
   b. Changes in air temperature and water vapor
   c. Changes in water body temperature
   d. Changes in water chemistry
   e. Changes in sea level

Source:

http://www.leecounty.com/gov/dept/sustainability/Documents/Lee%20County%20Climate%20Change%20Vulnerability%20Assessment%20Final%20201.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Lee County Climate Change and Resiliency Strategy

I. Lead Agencies

   a. SW FL Water Management District

II. Project Description

   a. The CCRS includes a process for identifying potential climate change resiliency strategies through coordination and consultation with local government leadership in 39 Lee County departments and divisions, including constitutional offices. Identification of resiliency strategies that could be utilized by Lee County to reduce the negative effects of climate change will also help in positioning the County to take advantage of potential climate prosperity opportunities. The CCRS is a toolbox that contains a wide variety of ideas and opportunities for the County to employ in climate change planning, energy savings, and cost savings. The CCRS informs the County of options and opportunities but it does not prioritize those actions or direct County policy. Prioritization would require a full public planning process incorporating public participation as part of a full adaptation plan.

Source:

http://www.swfrpc.org/content/Natural_Resources/Ecosystem_Services/Lee_County_Climate_Change_Resiliency_Strategy.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Sarasota County, FL: Current and Future Vulnerability to Hurricane Storm Surge and Sea Level Rise

I. Goal:
   a. Develop a comprehensive vulnerability assessment framework that integrates geospatial analysis and stakeholder input to facilitate enhanced community resilience through planning

II. Elements
   a. Vulnerability assessment including SLR
   b. Decision-support methodology incorporating scientific understanding with value-based human dynamics
   c. Inject SLR scenarios into long-range planning activities

III. Methodology
   a. SLOSH model: Sea, Lake, Overland Surges from Hurricanes Model
   b. Prior Research
   c. Impact of each category storm – results determined by percentage of total population in surge zone in specific neighborhoods
   d. Focus groups divided into subgroups:
      i. Business
      ii. Environmental
      iii. Planners
      iv. Facilities & infrastructure
      v. Government officials

IV. Results
   a. Broken down into subgroups
      i. Overall: location of development, location of urban service boundary, infrastructure inside hazard zone, cost of shifting development
      ii. Business: ID beach specific businesses, rebuilding with FEMA restrictions, moving critical and essential facilities, and imposing mitigation restrictions
      iii. Environmental: mitigate SLR impacts on environmental areas, transfer development rights, develop land swaps, replenish wetlands for surge mitigation
      iv. Planners: increase density outside hazards zones, incentives to steer development, strategies to retreat from coast, and limited by economic realities
      v. Facilities & infrastructure: mitigate now (move dated infrastructure, ensure functional flexibility, revise existing plan), plan better for future (cautiously place infrastructure in hazard zones, evacuation)
      vi. Government officials: evaluate placement of urban service boundary, mitigation need vs. cost of moving (facilities & infrastructure), locate high density residential outside hazard zones, and transportation add more N to S on Highway 75

V. Conclusions
   a. Development constricted to hazards zones
   b. Specific adjustments: Relax urban service boundaries; Steer development out of hazards zone; Relocate/replace infrastructure; Explore evacuation alternatives
   c. Urban growth boundaries in coastal communities could contribute to hurricane hazards exposure

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Source:

http://www.scgov.net/pdrp/documents/PSUHurricaneStudy070609.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Sarasota, FL: Influence of Potential Sea Level Rise on Societal Vulnerability to Hurricanes Storm-surge Hazards, Sarasota County, FL

I. Purpose
   a. Concern: climate change, specifically potential SLR, could influence the impacts of future hurricanes
   b. Assessment: variations in socioeconomic exposure in Sarasota County, FL, to contemporary hurricane storm-surge hazards and to storm-surge hazards enhanced by SLR scenarios
   c. Finding: significant portions of the population, economic activity, and critical facilities are in contemporary and future hurricane storm-surge hazard zones

II. Recent modified projections suggest global SLR by .8-2.0 meters by 2100

III. In addition to increase in storm-surge inundation zones due to SLR, the potential for future hurricanes disasters is exacerbated by the continuing trend of populations migrating to coastal areas

IV. Paper
   a. Examines the influence of SLR on societal vulnerability to hurricane storm-surge hazards
   b. Objective: determine if and how SLR predictions may alter the potential socioeconomic impacts of future storms and how these impacts may vary among communities
   c. Growth and development may intersect with SLR to increase vulnerability to hurricane storm surge

V. Hazard Assessment
   a. To delineate hurricane storm-surge hazard zones, we used outputs from the SLOSH model provided by NHC (National Hurricane Center)
   b. To delineate the effect of SLR on hurricane storm-surge, we developed hazard scenarios based on the 4 contemporary storm-surge hazard zones for each Saffir-Simpson hurricane category that are each then enhanced by SLR projections

VI. Vulnerability assessment
   a. 28 communities in Sarasota County
   b. GIS to determine the amount and percentage of the following socioeconomic attributes in the various hazard zones of each city: Residents, employees, critical and essential facilities, parcel value, and land use

VII. Results
   a. Population and asset exposure in enhanced storm-surge hazard zones
      i. Trend: addition of SLR scenario to hurricane storm-surge zones often results in a doubling of pop and asset exposure
      ii. Trend: addition of SLR to contemporary category 1&2 hurricane storm-surge causes societal exposure to be equal to or greater than what is in the hazard zone of the next higher contemporary Saffir-Simpson hurricane category

VIII. Discussion
   a. Important for public officials to understand the societal risk of their communities to the combination of SLR and hurricane storm surge
   b. First steps in determining socioeconomic risk = understanding societal exposure of assets in relationship to the various storm-surge hazard zones, how SLR alters this exposure, and the ways this increased asset exposure varies from community to community

Source:
http://stormsmart.org/wp-content/blogs.dir/1/files/group-documents/22/1290533117-Frazier_etal_2010_GIS.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Planning for SLR and Hurricane Storm Surge in Sarasota County

I. Location: Sarasota County

II. Lead Agencies

   a. Penn State University
   b. University of Idaho
   c. NOAA
   d. US Geological Survey
   e. National Science Foundation

III. Project description

   a. A three-year study that led to the creation of a collaborative methodology that local government officials and stakeholders can use as they plan for the changes expected to result from the future rise in sea level. This new model integrates scenarios about storm surge, population growth and economic and infrastructure development into the long-range planning options for coastal communities.

Source:

http://www.scgov.net/pdrp/documents/PSUHurricaneStudy070609.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Sea Level Rise in the Tampa Bay Region

I. Purpose

a. Tampa Bay Regional Planning Council (TBRPC) was contracted by the Southwest Florida Regional Planning Council (SWFRPC) through a grant from USEPA to participate in a nationwide project promoting awareness of, and planning for, SLR

b. National effort to encourage the long-range thinking necessary to plan for SLR and impacts

c. SLR project hopes to stimulate government planning for adaptation to SLR effects on uplands and wetlands

II. Tool

a. Maps that visualize the anticipated response of local governments to SLR, based on current land use designations and future planning policies

b. Current 5-ft contour line was used as mean sea level shoreline for mapping purposes

III. Predictions

a. 2050

i. 50% probability 15 cm

ii. 90% 4.6 cm

iii. 10% 28 cm

b. 2100

i. 50% 34 cm

ii. 90% 10 cm

iii. 10% 65 cm

c. 2200

i. 50% 81 cm

ii. 90% 22 cm

iii. 10% 196 cm

IV. Policies

a. Currently no specific SLR policies exist on the local level

Source:
http://www.tbrpc.org/mapping/pdfs/sea_level_rise/Tampa%20Bay%20-%20Sea%20Level%20Rise%20Project%20Draft%20Report%20without%20maps.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Land Use Impacts and Solutions to SLR in East Central Florida

I. Purpose

a. East Central Florida Planning Council (ECFRPC) was contracted by the Southwest Florida Regional Planning Council (SWFRPC) through a grant from USEPA to participate in a nationwide project promoting awareness of, and planning for, SLR

b. Bring more local awareness to the issue of SLR and aid local governments of Brevard and Volusia counties in long-term planning for SLR so that both property and the environment can be preserved

II. Methods

a. Maps created for the coastal zones of Brevard and Volusia counties that distinguish the shores that are likely to be protected from erosion, inundation, and flooding, from those shores where natural shoreline retreat likely will take place

b. Maps have two audiences:

i. State and local planners and others concerned about long-term consequences

ii. Policy makers and citizens concerned about long-term climate change

c. Maps illustrate the areas that planners within this region expect will be protected from erosion and inundation in the coming decades

III. Results

a. Little doubt that a continuation of rising sea level will affect Brevard and Volusia counties

b. Effects:

i. Affect not only residents, but may have a major effect on tourist destinations as well, which may result in dramatic effects on the economic well being of the counties

ii. Inundation and higher flood elevations

iii. Shoreline erosions

iv. Salt water intrusion and contamination of the aquifer may occur resulting in the contamination of wells

c. There is a 90% probability that there will be over a foot rise in sea level by 2150 along the Florida coast

d. Local issue:

i. Erosions is considered critical when there is a threat of loss of one of the following four interests: recreation, wildlife habitat, upland development, or important cultural resources

ii. Almost half of the beaches in the study area are considered critically eroding or eroding substantially

IV. Recommendations

a. Even if satisfied preserving approximately 1/3 of coastal wetland ecosystems, they are most likely to protect property values, and the commercial, industrial, tourism, and residential economies if we start factoring the implications of rising sea level into the planning process now, rather than later

b. Currently, land use regulations address flood mitigation and not SLR

i. Many of these can be used as SLR planning

c. Currently no specific SLR policies exist on the local level

Source:
http://research.fit.edu/sealevelriselibrary/documents/doc_mgr/446/East_Central_SLR_Adaptation_-_ECFRPC_2004.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Climate Change and Sea-Level Rise in Florida

An Update of the Effects of Climate Change on Florida's Ocean & Coastal Resources

I. Prepared by the Florida Oceans and Coastal Council: Tallahassee, FL

II. Purpose

   a. Provide a foundation for discussions of the effects of SLR on FL's oceans and coastal resources and to inform Floridians about the current state of scientific knowledge regarding SLR and how it is likely to affect FL

   b. Two main processes are causing SLR: expansion of ocean water caused by increasing ocean temperature and the addition of "new" water from melting reservoirs of ice

   c. Causing SLR by 2100 to range b/n .5 meter to more than a meter

III. Changes in Barrier Islands, Beaches, and Inlets

   a. Continued SLR will exacerbate erosion

   b. SLR may shift the beach profile, and therefore the shoreline, landward

   c. Correlation b/n the long-term erosion rates and SLR rates

   d. Island breaching

   e. SLR = increase size of bays, increase tidal prism

IV. Changes in Estuaries, Tidal Rivers, and Coastal Forests

   a. Tidal wetlands may be keeping pace with current rates of SLR change by accreting vertically, migrating upward, or both if there is a source of sediment or space landward of current wetlands

   b. Low-lying coastal forests will be lost during the next 1-3 centuries as tidal wetlands expand across low-lying coastal areas and the retreat of forests is blocked by urban development

V. Higher storm surge and impacts on coastal infrastructure

   a. The risk of flood damage to coastal infrastructure is likely to increase in parallel with SLR

VI. Threats to coastal water supply and wastewater treatment

   a. Surficial coastal aquifers are already experiencing saltwater intrusion

VII. Increase in beach erosion and renourishment

   a. Erosion will increase, and beaches will require more frequent renourishment

   b. Dangers to species that are reliant on beach – sea turtles

VIII. Increased Flooding Risks

   a. What is currently considered a 100-year flood event will likely become a 50- or 20-year event as sea level continues to rise

IX. 2010 recommendations for Florida research

   a. In the following categories: oceanography, geology and hydrology, ecology, and decision making

Source:
http://www.floridaoceanscouncil.org/reports/

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Comprehensive SW FL/Charlotte Harbor Climate Change Vulnerability Assessment

I. Report Purpose
   a. Assess significant potential climate changes in air and water and the effects of those changes on climate stability, sea level, hydrology, geomorphology, natural habitats and species, land use changes, economy, human health, human infrastructure, & variable risk projections in SW Florida
   b. Outputs communicated to local governments, stakeholder groups, and the public
      i. For use in developing coastal and land use planning
      ii. For use in avoidance, minimization, mitigation, and adaptation of climate change impacts throughout the CHNEP study area
   c. SWFRPC and CHNEP conducted the vulnerability analysis

II. 5 major stressors of climate change addressed in this document:
   a. Changes in the ratio of atmospheric gases
   b. Changes in air temperature and water vapor
   c. Changes in water body temperature
   d. Changes in water chemistry
   e. Changes in sea level

III. 12 categories
   a. Air temperature and chemistry
   b. Altered hydrology
   c. Climate instability
   d. Geomorphic changes
   e. Habitat and species changes
   f. Sea level rise
   g. Water temperature and chemistry
   h. Human ecology
   i. Human health
   j. Infrastructure
   k. Land use changes
   l. Variable risk

IV. Projections: Stanton and Ackerman extremes
   a. Rapid stabilization case
      i. 2025 – 1.8
      ii. 2050 – 3.5
      iii. 2075 – 5.3
      iv. 2100 – 7.1
   b. Business-as-usual case
      i. 2025 – 11.3
      ii. 2050 – 22.6
      iii. 2075 – 34
      iv. 2100 – 45.3

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Source:
http://www.swfrpc.org/content/Natural_Resources/Ecosystem_Services/Vulnerability_Assessment_Final.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Sea Level Rise in the Treasure Coast Region

I. Purpose

a. Report is designed to support the EPA's national effort encouraging the long-term thinking required to deal with the issues associated with sea level rise

b. The report creates maps of the Teasure Coast Region that distinguish the shores that are likely to be protected from erosion, inundation, and flooding from those areas where natural shoreline retreat is likely to take place

II. Goal

a. To diminish losses to life and property from coastal hazards such as erosion and inundation, and to ensure the long-term survival of coastal wetlands

III. Predictions

a. 2025: 2.8 inches to 10.7 inches

b. 2200: 21.0 inches to 177.3 inches

c. Based on EPA report which relied on various scientific opinions regarding sea level changes affected by factors such as radiative forcing caused by both greenhouse gases and sulfate aerosols, global warming, and thermal expansion, polar temperatures and precipitation, and the contributions to sea level from Greenland, Antarctica, and small glaciers.

IV. Proposed policies

a. Consider the impact of sea level rise in all land use amendments in coastal areas less than 10 feet in elevation

b. Obtain detailed topographic maps showing one foot contours in the coastal zone to assist in planning for sea level rise

c. Develop a plan to protect or relocate all critical public facilities that are located in areas projected to be impacted by sea level rise in the next 50 years

d. Closely monitor updates to sea level rise forecasts and predictions

e. Develop a sea level rise response plan that specifically identifies the areas where retreat, accommodation, and protection will be implemented

Source:
http://www.tcrpc.org/special_projects/TCRPC%20SLR%20Report%2012-05-05.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

South Florida Water Management District

Climate Change & Water Management

I. Purpose
   a. Provide high-level foundation for future discussions of the effects of global climate on water management planning and operations
   b. Focus the global concepts of climate change at the regional level by providing an overview of how it may affect South Florida's resources and the mission responsibilities of the SFWMD

II. Includes
   a. Initial vulnerability assessment of the potential threats of climate change and SLR to water supply, flood control, coastal ecosystems, and regional water management infrastructure

III. Organization & Techniques
   a. Impacts divided into 4 areas: rising seas; temperature and evapotranspiration; rainfall, floods, and draught; and tropical storms and hurricanes.
   b. Planning period of approximately 50 years – to 2060 – is generally used

IV. Predictions
   a. Over the next 50 yrs, South Florida may experience seas that are in the range of 5 to 20 inches higher than current levels
   b. Two primary factors for SLR
      i. Thermal expansion
      ii. Melting ice

Source:
http://research.fit.edu/sealevelriselibrary/documents/doc_mgr/447/South%20Florida%20Water_Management_&_CC_-_SFWMD_2009.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Developing a Sea Level Rise Vulnerability Framework for South Florida

Indicators, Metrics, and Models

I. Lead Agencies
   a. FIU
   b. US Geological Survey

II. Project Description
   a. The workshop, the result of an existing collaboration between USGS, FIU, and FAU, focused on conceptualizing and evaluating vulnerability and quality of life (QOL) metrics in the context of sea level rise (SLR), and changing land development patterns. This collaboration is an extension of a long-term effort by the USGS, NPS and others to develop the Ecosystem Portfolio Model (EPM), a Geographic Information System-based multi-criteria decision-support web tool meant to evaluate land use plans and proposed land use/land cover changes.

Source:
http://www2.fiu.edu/~ipor/climatechange/FAU_FIU_USGS_JUNE2010_WORKSHOP_REPORT.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

South Florida SLR Project

I. Lead Agencies
   a. South Florida Regional Planning Council
   b. EPA
   c. SW FL Regional Planning Council
   d. Treasure Coast Regional Planning Council

II. Project Description
   a. This project examined the effects of long-term sea level rise on seven coastal counties in Florida, including Broward, Monroe, Miami-Dade, Indian River, Palm Beach, Martin, and St. Lucie counties. The primary objective was to examine what South Florida might look like in 200 years under climate change scenarios that would cause significant sea level rise. Sea level rise is expected to significantly affect Florida's coastal tourism industry. Public and private infrastructures located in vulnerable areas are likely to be damaged and/or destroyed with increased sea levels and erosion.

Source:
http://www.sfrpc.com/gis/SFRPC%20SLR%20Study%20(September%202005).pdf

Past and Projected Trends in Climate and Sea Level for South Florida

I. Lead Agencies

a. South Florida Water Management District

II. Project Description

a. This report represents the culmination of several investigations aimed at assessing the current state of knowledge on these issues as they pertain to south Florida. The first section provides an assessment of natural climate variability and how it influences the south Florida climate. This is followed with an in-depth analysis of historical trends in precipitation and temperature, and their projections produced by General Circulation Models (GCMs) and Regional Climate Models (RCMs). Next, sea level rise trends and projections are reviewed including examination of potential changes to storm surges and coastal drainage capacity, followed by a brief summary of exploratory hydrological modeling conducted to understand the water resources impacts of these projected changes.

Source:
http://my.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/ccireport_publicationversion_14jul11.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Florida Forever Work Plan

I. Lead Agencies

   a. Suwannee River Water Management District

II. Project Description

   a. The plan contains a list of lands that sequester carbon, provide habitat, protect coastal lands or barrier islands, and otherwise mitigate to help adapt to the effects of sea level rise.

Source:
www.srwmd.state.fl.us/documents/Land%20Acquisition%20and%20Management/FloridaForeverWorkplan_2008.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Southeast Florida Regional Climate Change Compact

A Region Responds to a Changing Climate

A collaborative effort among Broward, Miami-Dade, Monroe, and Palm Beach Counties to develop a climate change action plan. Specific accomplishments include the development of regionally-consistent methodologies for mapping sea-level rise impacts, assessing vulnerability, and understanding the sources of regional greenhouse gas emissions. The compact calls for concerted action in reducing greenhouse gas emissions and anticipating and adapting to regional and local impacts of a changing climate.

I. Policy recommendations will be implemented through several approaches:
   a. The development of policy guiding documents by local and regional governing bodies
   b. The development of operational guidance documents
   c. The development of consistent goals and measures throughout the various governments in the region
   d. A coordinated multi-disciplinary outreach and education program
   e. Processes for focused and prioritized investments

II. Methodology
   a. Based on the USACE July 2009 Guidance Document
   b. Two key planning horizons:
      i. 2030 – SLR projected to be 3-7 inches
      ii. 2060 – SLR projected to be 9-24 inches
   c. A SLR of one foot is projected to occur between 2040-2070 with sea level continuing to rise into the future
   d. Review projection after 4 years
   e. Mapping was completed to include different sea level rise inundation scenarios to help identify areas at potential risk and aid in planning for adaptation strategies

III. Structure of the Regional Climate Action Plan: 6 categories
   a. Sustainable communities and transportation planning
   b. Water supply, management, and infrastructure
   c. Natural systems and agriculture
   d. Energy and fuel
   e. Risk reduction and emergency management
   f. Outreach and public policy

IV. Next steps

Source:
http://webapps.broward.org/NewsRelease/Attachments/3467_237_12072011_DRAFT%20SE%20Florida%20Regional%20Climate%20Change%20Action%20Plan.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

A Unified Sea Level Rise Projection for Southeast Florida

I. Objective
   a. Work toward developing a unified SLR projection for the SE Florida region for use by the SE Fl regional climate compact counties and partners for planning purposes to aid in understanding potential vulnerabilities and to provide a basis for outlining strategies for the SE FL region

II. Conclusions and Recommendations
   a. Provides guidance for the compact counties and their partners to initiate planning to address the potential impacts of SLR on the region
   b. Strategic long-term (beyond 2060) policy discussions will be needed to include development of guidelines for public and private investments which will help reduce community vulnerability to sea level rise impacts beyond 2060
   c. Recommendations from the Technical Ad hoc Work Group
      i. The SE FL Unified SLR Projection should be based on the US Army Corps of Engineers (USACE) July 2009 guidance document using key west data (1913-1999) as the foundation of the calculations and referencing the year 2010 as the starting date for SLR projections
      ii. This projection should be used for planning purposes, with emphasis on the short and moderate term planning horizons of 2030 (USACE- 3-7 inches) and 2060 (USACE- 9-24 inches)
      iii. A science-based narrative for 2060 and beyond provides context for the current state of scientific understanding and the potential issues which must be considered when looking toward the end of the 21st century and beyond
      iv. The unified SE FL sea level rise projection will need to be reviewed as the scientific understanding of ice melt dynamics improves. The projection should be revised within four years of final approval.
      v. Users of the projection should be aware that at any point in time, sea level rise is a continuing trend and not an endpoint
      vi. The acceleration of sea level rise can be slowed and the magnitude reduced by actions to reduce greenhouse gas emissions

III. Adoption
   a. This document was adopted by the SE FL regional climate change compact staff steering committee on May 6, 2011 for use by the regional climate change work groups in development of the SE FL regional climate change action plan

Source:
http://www.broward.org/NaturalResources/ClimateChange/Pages/SoutheastFloridaRegionalClimateCompact.aspx

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Development of an Adaptation Toolbox to Protect Southeast Florida Water Supplies from Climate Change

I. Purpose
   a. Connection between sustainable water supplies and Everglades restoration
   b. Outline potential effects of SLR scenarios for coastal southeast Florida and develop a toolbox of options for adaptation for water, wastewater, and stormwater utilities to apply
   c. Developed milestones to trigger infrastructure investments, as climate changes may occur more rapidly or more slowly than currently projected

II. Climate change in Florida
   a. Temperatures are higher, but extremes are greater
   b. Additional research and high-resolution climate modeling for the Florida peninsula is needed
   c. Global projections of SLR of 2-4 feet by 2100 are in line with the results seen from the FL stations
   d. South Florida among the world's most vulnerable coastal regions to climate change especially as it relates to SLR
   e. Rising seas also means rising groundwater, so more intense rainfall will increase the risk of flooding, not only in the low-lying coastal areas, but also in the interior flood plains due to the loss of soil storage capacity for percolation
   f. Primary goal of CERP is to restore the natural freshwater flow to the everglades, which becomes even more imperative in light of potential SLR impacts

III. Tools to protect water resources
   a. Install local stormwater pumping
      i. Localized pumping stations will need to be installed to drain water to reduce ponding.
   b. Water conservation
      i. Useful in reducing the need for expansion of water supplies because they encourage reduced per capita water usage
   c. Armoring the sewer system
      i. An effective infiltration and inflow reduction program will combat the need for expensive membrane treatment for water reclamation in the short term
   d. Wastewater reclamation and reuse
   e. Aquifer recharge
      i. Various methods of recharging surficial aquifers:
         1. Stormwater diversion to impoundments located on permeable land
         2. Treated water discharge into surface waters for aquifer recharge
         3. Direct injection of treated stormwater or surface water from reservoirs
         4. Percolation ponds or wetlands using tertiary treated wastewater
         5. Direct injection of highly treated wastewater using reverse osmosis
   f. Protection of existing water sources
      i. Limiting wellfield withdrawals
      ii. Coastal salinity structures, horizontal wells, and hydrodynamic barriers
   g. Desalination
   h. Aquifer storage and recovery

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

    i. Management tool (not alternative water supply)

i. Regionalization of alternative water supplies and reclamation projects

Source:
http://www.evergladeshub.com/lit/pdf11/Bloetscher11envRev19-397-417-ProtectWatSupClimChge.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

U.S. STATES

California

Hazard Mitigation Plan

Sea level rise is a profiled hazard but is grouped with coastal flooding and erosion. Potential losses are outlined and current mitigation actions are discussed. There are also boxes from the 2010 update about the progression of SLR, coastal flooding and erosion actions. They also fully profile Climate Related Hazards which include avalanches, coastal flooding, coastal erosion, sea level rise, droughts and water shortages and extreme heat.

Projects:

- Local Coastal Programs
  - Analyze the effects of 55 inch sea level rise and its implications for coastal erosion
- Vulnerability of Transportation Systems
  - Identify impacts of flooding on tunnels, and airport runways, washout of coastal highways and rail lines, and submersion of dock and port facilities from a 55-inch rise in sea level.
- San Francisco Bay Conservation and Development District (BCDC) Climate Change Planning Program
  - Update sea level rise maps to show areas vulnerable to 16 inches of sea level rise at mid-century and 55 inches at the end of the century. Develop strategies for adapting to a dynamic and changing bay. Provide planning assistance to local governments

Source:
http://hazardmitigation.calema.ca.gov/plan/state_multi-hazard_mitigation_plan_shmp

CA Climate Change Regulation

I. Primarily focuses on monitoring greenhouse gas emissions and shifting to renewable energy resources

II. Governor's Executive Order # S-13-08 addresses sea level rise

   a. Directs state agencies to plan for sea level rise and climate impacts through coordination of the state Climate Adaptation Strategy

Source:
http://www.climatechange.ca.gov/

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

2009 California Climate Adaptation Strategy Report to the Governor

I. Projections:

a. 12-18 inches by 2050

b. 21-55 inches by 2100

c. This projection accounts for the global growth of dams and reservoirs and how they can affect surface runoff into the oceans, but it does not account for the possibility of substantial ice melting from Greenland or the West Antarctic Ice sheet, which would drive sea levels along the CA coast even higher

II. Objectives:

a. Analyze climate change risks

b. Identify sector-specific, and cross-sectoral adaptation strategies that help reduce vulnerabilities

c. Explore cross-cutting supportive strategies

d. Formalize criteria for prioritizing identified adaptation strategies

e. Specify future direction

f. Provide recommendations for immediate and near-term priorities for implementing identified adaptation strategies

g. Inform and engage the CA public about climate risks and adaptation strategies

III. Key recommendations:

a. A Climate Adaptation Advisory Panel (CAAP) will be appointed to assess the greatest risks to CA from climate change and recommend strategies to reduce those risks building on CA's Climate Adaptation Strategy

b. CA must change its water management and uses because climate change will likely create greater competition for limited water supplies needed by the environment, agriculture, and cities

c. Consider project alternatives that avoid significant new development in areas that cannot be adequately protected (planning, permitting, development, and building) from flooding, wildfire, and erosion due to climate change.

d. All state agencies responsible for the management and regulation of public health, infrastructure or habitat subject to significant climate change should prepare as appropriate agency-specific adaptation plans, guidance, or criteria by sept. 2010

e. All significant state projects, including infrastructure projects, must consider the potential impacts of locating such projects in areas susceptible to hazards resulting from climate change.

f. The CA emergency management agency (Cal EMA) will collaborate with CNRA, the CAT, the Energy Commission , and the CAAP to assess CA's vulnerability to climate change, identify impacts to state assets, and promote climate adaptation/mitigation awareness through the Hazard Mitigation Web Portal, and My Hazards Website as well as other appropriate sites

g. Using existing research the state should identify key CA land and aquatic habitats that could change significantly during this century due to climate change

h. The best long-term strategy to avoid increased health impacts associated with climate change is to ensure communities are healthy to build resilience to increased spread of disease and temperature increases

i. The most effective adaptation strategies relate to short and long-term decisions

j. State fire fighting agencies should begin immediately to include climate change impact information into fire program planning to inform future planning efforts

k. State agencies should meet projected population growth and increased energy demand with greater energy conservation and an increased use of renewable energy

l. Existing and planned climate change research can and should be used for state planning and public outreach purposes; new climate change impact research should be broadened and funded

Source:
http://www.climatechange.ca.gov/adaptation/

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Sea Level Rise Adaptation Strategy for San Diego Bay

I. Project Partners
   a. ICLEI – Local Governments for Sustainability USA
   b. The San Diego Foundation
   c. Tijuana River National Estuarine Research Reserve – Coastal Training Program

II. Projections
   a. Between 10-17 inches in 2050 and 31-69 inches in 2100

III. The assessment was conducted through a combination of modeling, mapping, and intensive consultation with the project's Technical Advisory committee

IV. Next steps
   a. Many of the recommendations in this strategy are intended for consideration and implementation in each of the participating local jurisdictions in their own planning processes
      i. such as Climate Mitigation and Adaptation Plans in the City of San Diego and Port of San Diego, and in bayfront planning in Chula Vista
   b. Both the Port of San Diego and the City of San Diego are developing adaptation policies in their climate action plans, targeted for adoption in 2012, and the City of National City also recently adopted a climate action plan

V. Guiding Principles and Development principles
   a. Established to align the region with the State's approach

VI. Planning process deliverables
   a. Existing conditions report
   b. Vulnerability assessment
   c. Policy recommendations
   d. Adaptation strategy

Source:
http://www.icleiusa.org/climate_and_energy/Climate_Adaptation_Guidance/san-diego-bay-sea-level-rise-adaptation-strategy-1/san-diego-bay-sea-level-rise-adaptation-strategy

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Goleta Beach 2.0: Managed Retreat to Mitigate Coastal Erosion

I. Project summary/overview
   a. In 2009, the Goleta Beach 2.0 Concept planning process was established to reexamine managed retreat options for the park in order to mitigate coastal erosion
   b. Goleta Beach 2.0 managed retreat may prove to be the most resilient strategy for the beach as sea level rises
   c. Two major strategies:
      i. A structural solution
      ii. Major retreat
   d. Environmental review picked structure solution (i.e. permeable pier addition) as preferred option
   e. CA coastal commission voted in july 2009 to turn down the plan
      i. Told to rethink retreat option

II. Project outcome and conclusions
   a. Several areas that are vulnerable to coastal erosion
      i. Prime erosion zone
      ii. Major utility lines (within those zones)
   b. Configured ten future actions to enhance Goleta Beach County Park
   c. Goleta Beach 2.0 has not yet resulted in a specific engineering plan, but it has outlined a conceptual plan that will lead to an engineering proposal and environmental review

Source:
http://www.countyofsb.org/parks/parks07.aspx?id=16864

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

San Francisco Bay Conservation and Development Commission

I. Role of Bay Plan

a. Serves as mandatory state policies that are enforced by the Commission through its regulatory authority

b. Some Bay Plan policies are declarations of the Commission's intention to undertake future studies or planning

c. Other policies offer advice to local governments, other agencies, and organizations in dealing with Bay management issues

d. Both state law and the Bay Plan stipulate that any such recommendations are advisory only and cannot be enforced by the Commission

II. Changes since previous amendments to Bay Plan

a. IPCC – represents a wide range of scientific opinion, its conclusions are generally conservative but widely accepted

b. Effects of climate change are now being observed

c. Research determines that climate change is largely caused by humans

Source:
http://www.bcdc.ca.gov/

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Chula Vista, California: Adaptation Planning with No Budget and No Experience

Chula Vista's climate change adaptation plan was developed in 2011. It recommended 11 strategies in seven focus areas to help the city adapt to the impacts of climate change. The focus areas are: infrastructure and resources; energy management; public health; business and economy; water management; wildfires; and ecosystems and biodiversity.

I. Process of Institutionalization
   a. In 2008, the San Diego Foundation commissioned a study called Focus 2050, modeled on the study by the same name undertaken for King County, Washington. The study uses climate change projections, generated by scientists at the Scripps Institution of Oceanography, to explore what the San Diego region will be like in 2050 if current trends continue.
      i. The Focus 2050 report was vital because it distilled the technical information about climate change impacts in the region and made it digestible for a broader readership
   b. In 2010, Chula Vista began to work on developing an adaptation Plan
      i. Formed the Climate Change Working Group (CCWG) comprised of residents, businesses, nonprofits, and community organization representatives
   c. In 2011, the CCWG recommended 11 strategies in 7 focus areas to help the community adapt to the impacts of climate change.
      i. The Conservation Department, a branch of the Department of Public Works, has spearheaded the process of institutionalization
   d. After developing the strategies, the working group hosted a public forum where they presented information about climate change on poster boards, and the public could ask questions and give feedback

II. Who made it happen?
   a. The Resource Conservation Commission (RCC) – a standing, city-council-appointed committee – played a key role in institutionalizing the adaptation plan

III. Progress report
   a. As of October 2011, "of the more recent 11 climate adaptation strategies and their 30 associated implementation components, only one component dealing with storm water pollution prevention and reuse and two components dealing with biological monitoring have been delayed due to funding shortages"

Source:
http://www.chulavistaca.gov/clean/conservation/Climate/ccwg1.asp

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Delaware

The City of Lewes: Hazard Mitigation and Climate Adaptation Action Plan

Lewes participated in Project Impact an initial FEMA hazard mitigation effort. The pilot project resulted in the first-ever community action plan that successfully combines the two planning processes. The City created a Mitigation Planning Team, a unique group able to help the city mitigate the effects of natural hazards. Thus far the City has had great success in wildfire mitigation and disaster preparedness efforts.

I. Purpose and Goal
   a. Increase overall awareness
   b. Enhance the understanding of Lewes' vulnerability to climate change
   c. Provide assistance and guidance to the City of Lewes to develop a plan for hazard mitigation and climate adaptation that will improve community sustainability and resiliency
   d. Design a methodology that combines hazard mitigation planning and climate change adaptation
   e. Create a final action plan that the city can use to implement the chosen initiatives

II. Implementation guidance
   a. Alignment with existing priorities and co-benefits
   b. Administration and staffing
   c. Potential implementation steps
   d. Timeline information
   e. Financing and budget
   f. Monitoring

III. Range of regional climate condition: sea level rise
   a. Global or eustatic sea level rise is based on the rising waters due to the thermal expansion of water and the melting of land-based ice commonly called glaciers.
      i. The IPCC estimated that global sea level rise will increase from 0.59 ft to 1.9 ft based solely on thermal expansion of water (IPCC, 2007, p. 45). However, many scientists consider these estimates to be low due in part to the fact that they do not include glacial melt. More recent estimates that incorporate additional components of sea level rise, including land-based ice melt, suggest that eustatic sea level rise could be as high as 4.6 ft
   b. The historic sea level rise observations and trend for Lewes indicates that Lewes has seen about 1 foot (0.32m) of sea level rise over the past century.

IV. the State of Delaware's Department of Natural Resources and Environmental Control is currently working with the range of future sea level rise between 1.6 ft and 4.9 ft by 2100 for planning purposes

Source:
http://www.ci.lewes.de.us/Hazard-Mitigation-Climate-Adaptation-Action-Plan/

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Preparing for SLR Development of a SLR Initiative

SLR Initiative Project Compendium September 2011

I. Mission of Delaware Coastal Programs Section

a. To preserve, protect, develop, and enhance the resources of our coastal zone through effective administration of the Delaware Coastal Management Program and the Delaware National Estuarine Research Reserve

i. Manages coastal resources through innovative research projects, grant programs, and policy development

ii. Administers the coastal zone federal consistency certification program

iii. Provides special area management program

iv. Provides assistance to state and local governments for local land use planning

v. Offers other special on-the-ground projects related to Delaware's coastal resources

II. Predictions

a. Based on the US Climate Change Science Program's 2009 document which recommends that states should prepare for sea level to rise by at least one meter by 2100

b. Current rate of SLR measured by a tide gauge in Lewes Delaware is 13 inches per 100 years

III. SLR Initiative goal:

a. Providing scientific and technical support for decision-making

b. Implementing on-the-ground project in partnership with stakeholders

c. Providing educational and outreach opportunities for stakeholders and the public

d. Improving existing policies and management practices and/or developing new policies and management practices where necessary

IV. Purpose of SLR Initiative Compendium of Projects

a. To provide an at-a-glance inventory of the projects and initiatives that are being conducted as part of the DE Coastal Programs' SLR Initiative. It is intended to help increase collaboration between agencies, reduce redundancy, and overlap in projects relating to SLR and to relay information about new (or soon to be available) data, information, and tools

V. Scientific and Technical Support

a. DE Coastal Programs have partnered with the National Wildlife Refuge System, the University of DE, local Estuary programs, and other state agencies to fill gaps in our knowledge about coastal storms, tide levels, and marsh sediment accretion

b. Projects/Studies

i. Bombay Hook Hydrology/sediment movement study

ii. Coastal Impoundment Accretion Rate Study

iii. Coastal Monitoring Gap Analysis

iv. Coastal Storm History

v. Development of Coastal Inundation Maps

vi. Digital Coast

vii. Hydrologic Monitoring of the Kitts Hummock Area

viii. Marsh Loss Analysis (interior Open Water Creation)

ix. Marsh Vulnerability Index

x. Prime Hook NWR Salinity/Nutrient/Sediment/Water level study

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

xi. Sediment Elevation Tables

VI. Implementation

a. DE Coastal Programs staff have partnered with the City of New Castle and the Town of Bowers Beach to help them improve their preparedness for coastal storms and future SLR

b. Projects:

i. City of New Castle Coastal Resiliency Project: dike maintenance and improvement plan

ii. Development of a coastal flood monitoring system for DE

iii. Development of a coastal resiliency action plan for bowers beach

VII. Policy Development

a. Development of a Statewide SLR Adaptation Plan

b. Mid-Atlantic Regional Council on the Oceans (MARCO)

i. DE, NY, NJ, MD, and VA

c. Sustainable Coastal Communities – incorporation of coastal hazard and natural resource considerations into local comprehensive plans

VIII. Communication, training, and public involvement

a. Comprehensive marketing & outreach strategy for SLR

b. SLR Map Viewer

c. Statewide Survey to gauge public knowledge and opinions on SLR and its impact in DE

Source:
http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/SLRCompSept2011.pdf

Development of a Coastal Resiliency Action Plan for Bowers Beach, DE

A Plan to Address Existing and Future Coastal Hazards

I. Background:

a. Project is designed to assist the community in their efforts to reduce hazard vulnerability that currently exists and that could potentially increase in the future due to the impacts of climate change

II. Project Goal

a. To develop a community-wide action plan that increase the resiliency of Bowers Beach, DE to the current and future affects of coastal storms and climate change

b. Develop a proactive plan that outlines the specific vulnerabilities of the community and the best actions to be pursued to address these issues

III. Work Plan

a. Analyze the physical, social, economic, and environmental vulnerability at the community level

b. Phase 1: data collection and synthesis

i. Identify where outside expertise should be brought in to provide additional technical assistance

c. Phase 2: vulnerability assessment

i. Will include detailed workshops to conduct a more detailed vulnerability assessment

ii. The assessment will be used as a guide for developing mitigation strategies and prioritizing mitigation projects to be included in the Bowers Beach Coastal Resiliency Action Plan

d. Phase 3: strategy development

i. Will utilize the detailed results of the vulnerability assessment to develop a final prioritization of needs and a set of strategies to address these needs

e. Phase 4: implementation

i. Long term effort to implement the action plan.

Source:
http://www.dnrec.delaware.gov/coastal/Documents/CoastalResiliency/Bowers%20Beach%20Grant%20Project.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Georgia

SLR On GA's Coast: A Study from the River

I. Purpose of Study

   a. In 2008,the River Basin Center was awarded a three-year grant to research the impacts of SLR on the Georgia coast and prov ide guidance for future development of the area

II. Methods:

   a. Computer model was created to forecast the results of a 1 meter rise in sea level by 2100

   b. Used Sea Level Affecting Marshes Mode (SLAMM)

III. Findings:

   a. First year focused on the Georgia coast as a whole, defined by the 6 counties of Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden

   b. The study also provided aerial images of how specific coastlines may be affected

IV. Next

   a. The River Basin Center is currently developing a guidance document that will assist government officials in planning for future development along the Georgia coastline

Source:
http://www.georgiaconservancy.org/uploads/Coast/SeaLevelRise-fact_sheet-lowres.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Tybee Island

The University Carl Vinson Institute of Government and Georgia Sea Grant are developing a climate adaptation plan for the barrier island community of Tybee Island through funding from the National Oceanic and Atmospheric Administration.

The recommendations developed by the project, titled the Sea Grant Community Climate Adaptation Initiative, will help the City of Tybee Island prepare for and adapt to sea level rise through appropriate local ordinances, infrastructural improvements and other municipal actions.

Source:
http://georgiaseagrant.uga.edu/article/5_8_12_Tybee/

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Louisiana

Recommendations for Anticipating Sea-Level Rise Impacts on LA Coastal Resources during Project Planning and Design

Objective of the technical report is to make recommendations for incorporating sea-level rise into the planning and engineering of habitat restoration and storm protection projects.

The Technical Report recommends that CPRA staff assume that Gulf sea-level rise will be 1 meter (3.3') by 2100, with a bounding range of 0.5-1.5 meters (1.6/-4.9'). This needs to be combined with predictions of subsidence and marsh vertical accretion. (Both of which are not the primary subject of the paper due to their evolving nature.)

I. Objective
   a. the objective of the technical report is to make recommendations for incorporating sea-level rise into the planning and engineering of habitat restoration and storm protection projects
      i. summarizes the state of the science on patterns of increase to support recommendations
      ii. describe how recommended rates of local sea-level rise should be combined with the highly variable spatial patterns in coastal subsidence and wetland vertical accretion to predict relative sea-level rise at specific points in the LA coastal zone

II. Historical sea-level rise
   a. They have chosen to follow the weight of scientific opinion that sea-level rise is in fact accelerating

III. Projections of future sea-level rise
   a. Suggests an assumption that Gulf sea-level rise will be 1 meter (3.3') by 2100, with a bounding range of 0.5-1.5 meters (1.6' - 4.9')
   b. Consistent with other similar efforts ongoing in other states

IV. Sum of Factors influencing sea-level rise
   a. The change in the surface elevation change of the Gulf of Mexico
   b. Local land surface elevation change, which in LA is exclusively represented as subsidence
   c. Marsh vertical accretion, which can offset some sea-level rise impacts

V. Summary and Recommendations
   a. SLR for the available period of record is best represented as a single, non-linear function, which has important implications for relating RSLR and GSLR estimates, and especially for assumptions of the differential representing local land surface change
   b. Use local observations of historical sea-level rise from contemporary satellite altimetry just offshore of coastal LA, in order to account for the substantial east-west gradient in documented rates
   c. Calculate the acceleration constant that assumes a MSL increase of 1 meter by 2100 as the most heavily-weighted project alternative, while also testing MSL increase of .5 meters and 1.5 meters to account for uncertainty in the literature
   d. Add in local subsidence values obtained from the most proximate local source
   e. Use the sum of the above three elements to establish an inundation function, especially the rate of inundation for the period of analysis, in order to predict local response of marsh vertical accretion as those models and data products become available

Source:
http://coastal.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=240

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Maryland

Commission on Climate Change

On April 20, 2007, Governor Martin O'Malley signed Executive Order 01.01.2007.07 establishing the Maryland Commission on Climate Change (MCCC). The MCCC was charged with developing a Climate Action Plan to address the drivers and consequences of climate change, to prepare for its ensuing impacts in the State, and to establish firm benchmarks and timetables for Plan implementation. To accomplish its goals, the MCCC worked with the Center for Climate Strategies in conducting an extensive stakeholder-based process. This process used public input to formulate, analyze, and build consensus for forty-two mitigation and nineteen adaptation policy recommendations for the state of Maryland to pursue. The MCCC completed its work in August 2008 with the release of its final Climate Action Plan (2008 Plan). Since August 2008, Maryland State agencies have been working to implement each of the forty-two mitigation strategies and nineteen adaptation strategies through the development of an implementation plan for each of the policy recommendations.

One of the Plan's policy recommendations, to adopt science-based regulatory goals to reduce Maryland's greenhouse gas (GHG) emissions, was realized with the passage of the Greenhouse Gas Emissions Reduction Act of 2009 (GGRA). The law requires Maryland to reduce its GHG emissions to 25 percent below 2006 levels by 2020. It directs the Maryland Department of the Environment to work with other lead State agencies to prepare an implementation plan to meet this goal as a first step toward achieving longer term science-based reductions. An interim plan will be submitted to the Governor and the General Assembly during the 2012 legislative session, and the final plan (GGRA Plan) will be submitted on or before December 31, 2012. The GGRA Plan builds on the 2008 Plan and ensuing implementation work of the State agencies.

Source:
http://www.mdclimatechange.us/

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Maryland's Coastal Zone Enhancement Plan: Coastal Zone Management Act Section 309 Assessment and Strategy 2011-2015

I. Chesapeake and Coastal program (CCP)

a. In 2007 the state of Maryland consolidated the administrative and management functions of the CZMA and EPA section 117 awards as well as State's Chesapeake and Atlantic Coastal Bays Trust Fund to a single program –CCP

b. The program is better able to leverage core competencies from different programs, avoid duplicate efforts, leverage and efficiently prioritize resources to advance the goals of the CZMA

c. CCP is administered by the State Department of Natural Resources

i. Partnership among the local, regional, and state agencies

ii. Also collaborates with many private organizations such as local land trusts and economic development groups

d. CCP conducts research, provides technical services and distributes federal and state funds to enable on-the-ground projects that benefit Maryland's coastal communities

II. Select Accomplishments

a. This is the 4th assessment and strategy that the Maryland program has submitted under Section 309 of the federal coastal zone management act

b. The overall goals of the 2006-2010 section 309 strategy were to:

i. Integrate coastal hazard planning into state and local programs and policies

ii. Improve the understanding and management of near shore resources

iii. Develop a framework for future ocean planning and management efforts

iv. Advance CZMA goals related to cumulative and secondary impacts at the local community level

c. In April 2007 – established the Maryland Commission on Climate Change (MCCC)

d. In August 2008, the MCCC released the State's Climate Action Plan which included 19 policy recommendations aimed at reducing the State's vulnerability to sea level rise and coastal storms

e. Lists key implementation activities for those policy recommendations as of September 2010

Source:
http://www.dnr.state.md.us/ccp/funding/pdfs/SFY13_TrustFundAnnualReport.pdf

Massachusetts

Hazard Mitigation Plan

Outlines "Climate Change Impacts" as a future natural hazard. It outlines some of the background as well as projections for increased temperature and precipitation, risks to public health and harm from sea level rise. It also talks about the Massachusetts law the "Global Warming Solutions" Act.

Projects:

- Massachusetts Office of Coastal Zone Management's StormSmart Coasts Program
    - This is a technical assistance program that was designed to help communities address the challenges arising from erosion, storms, floods, sea level rise, and other climate change impacts. The program operates on two levels – a website that provides a suite of tools for successful coastal floodplain management and direct technical assistance to communities through its pilot projects program

Source:
http://www.mass.gov/eopss/docs/mema/disaster-recovery/mass-haz-mit-plan2010-official.pdf

New Hampshire

Keene, New Hampshire: The Economics of Energy Efficiency

Keene first developed a climate mitigation plan in 2004. It was followed in 2007 by a climate adaptation plan. The city worked with ICLEI – Local governments for Sustainability to produce both of the plans. The climate adaptation plan has been incorporated into Keene's master plan and, by extension, into other key plans and decisions that tier from the master plan.

Because adaptation strategies are incorporated into the master plan, all city plans and ordinances that tier from the master plan must also consider climate change. For example, every year the city revisits its capital improvements plan that projects major capital facilities needs six years out. The operating budget process is similar, each department's operating budget must have a tie back to the master plan, forcing a conversation around sustainability and climate adaptation.

Source:
http://www.ci.keene.nh.us/sites/default/files/Keene Report_ICLEI_FINAL_v2_1.pdf

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COMMUNITY RESILIENCY

New York

Hazard Mitigation Plan

The State Plan does not talk about sea level rise. However, it recommends that when conducting a risk assessment a Jurisdiction evaluate (1) the likelihood of an event occurring, (2) the impact on the population, and (3) the impact on property within the Jurisdiction. Jurisdictions should also **take into account the affect that climate change** may have on their vulnerability to each hazard, for example increased frequency of occurrence and/or severity.

Source:
http://www.nyc.gov/html/oem/html/about/planning_hazard_mitigation.shtml

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COMMUNITY RESILIENCY

North Carolina

Hazard Mitigation Plan

This plan mentions sea level rise under long term hazards. This section is roughly 4 pages explaining climate change, sea level rise, changes in weather patterns. Within these it explains the impacts, addressing climate change and what NC will do to address climate change.

Source:
http://www.nccrimecontrol.org/index2.cfm?a=000003,000010,001623,000177,002107,001563

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COMMUNITY RESILIENCY

North Carolina Sea-Level Rise Assessment Report

Report on the known state of SLR for North Carolina. Asked the following questions: an explanation of how SLR is measured; relative SLR ranges for different sections of the North Carolina coast; relative SLR ranges for North Carolina expressed in time slices for years 2025, 2050, 2075, and 2100; relative SLR rate curves for North Carolina through 2100; discussion of confidence interval; recommendations for what needs to be done for improved SLR monitoring in the state of NC; and recommendations as to how frequently the state of NC should update its projected SLR ranges and rates.

I. Data
   a. IPCC 4th assessment report contains forecasts for global average SLR ranging from .18 meters to .59 meters by the year 2100
   b. There is consensus that the rate of SLR will increase during the 21st century and beyond

II. Factors influencing sea level rise
   a. Global sea-level change
   b. Local vertical land movements (subsidence or uplift)
   c. Changes in tidal range
   d. Changes in coastal currents
   e. Changes in water temperature
   f. Gravitational effects

III. 4 studies provide data on rates of RSL rise in North Carolina
   a. First three studies utilize geological data whereas the study covering the shortest time interval utilizes instrumental data
   b. Cumulative data from these 4 investigations indicate that RSL change varies as a function of latitude along the NC coast, with higher rates of rise in the north, and lesser rates of rise in the south
   c. This is a function of the local geology as well as differential crustal subsidence and uplift
   d. Panel has chosen to use the tide gauge data for projections because the tide gauge data represents a more direct indicator of sea level

IV. Projections
   a. The IPCC reports rely on emissions scenarios as the basis for projecting future SLR ranges
   b. Recommendation of the Panel that a single set of sea-level curves be adopted for planning purposes
   c. Panel feels most confident in the data retrieved from the Duck gauge, given its installation, continuous length of service and lack of influence by maritime navigation projects
   d. Panel believes that the Rahmstorf method is robust and 1.4 meters is a reasonable upper limit for projected rise
   e. Panel recommends that a rise of 1 meter be adopted as the amount of anticipated rase by 2100, for policy development and planning purposes

V. Recommendations
   a. Believes that an acceleration in the rate of SLR is likely
   b. Recommended that the long-term tidal observations be maintained and new stations added to the long-term record to provide better geographic coverage of our coast
   c. New, better-distributed water level gauges are maintained or installed to develop long-term records

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COMMUNITY RESILIENCY

d. In other areas new water level gauges should be installed to achieve comprehensive geographic coverage
e. State should consider installing tide monitoring stations in the estuarine system, and establishing a program for continuously monitoring and measuring land subsidence on the coastal plain

Source:
http://dcm2.enr.state.nc.us/slr/NC%20Sea-Level%20Rise%20Assessment%20Report%202010%20-%20CRC%20Science%20Panel.pdf

North Carolina DENR Climate Change Initiative Strategy Framework

The goal of this initiative is to address climate change in a comprehensive way, using mitigation and adaptation strategies to increase resilience of North Carolina's resources to these complex changes.

I. Steps:
   a. Develop a focused approach to address climate change policy actions at state, regional, and federal levels
   b. Identify short-term, mid-term, and long-term potential impacts
   c. Coordinate strategies with other local, state, federal, and nongovernmental partners

II. Climate Change Mitigation Strategies
   a. Reduce human-induced contributions to climate change, such as greenhouse gas emissions, as recommended by the Climate Action Plan Advisory Group
   b. Become an environmental leader in energy and water efficiency and carbon management

III. Climate Change Adaptation Strategies
   a. Proactively prepare for and adapt to changes we cant prevent
   b. Develop a comprehensive adaptation strategy across DENR programs, to effectively identify and address potential impacts to the environment and natural resources that DENR is charges with protecting
   c. Sea level rise adaptation: goals and objectives
      i. Coastal habitat protection plan
         1. Underway: update coastal habitat protection plan to address climate change impacts on each habitat type
      ii. Coastal management
         1. Completed: conduct a public survey to assess state residents' perceptions about sea level rise, its threats to the NC coast, and what action respondents think should be taken to prepare and adapt
         2. Underway: hold a public science forum to present the coastal resource commission report
         3. Underway: develop a public education and outreach campaign
         4. Underway: monitor and assess variable rates of sea level rise at sentinel sites on representative coastal ecosystems in different regions of NC coast and inform resource management decisions at reserve sites and in NC coastal communities
      iii. Climate ready estuaries
         1. Underway: assess general public and public officials' awareness and concern about climate change, sea-level rise, and possible actions
         2. Underway: develop a communications strategy for outreach and engagement in the targeted counties
         3. Underway: create blueprint to build a climate ready estuary system with steps to improve the area's resilience and adaptation capacity
         4. Underway: recommend priority actions for Comprehensive Conservation and Management Plan to APNEP Policy Board
         5. Underway: coordinate strategies with other coastal programs (CHPP, DCM)
         6. Underway: work with regional and federal partners on climate change adaptation actions (NCCF, TNC, EPA, NOAA)

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Source:
http://www.climatechange.nc.gov/pages/ClimateChange/NCDENR_Climate_Change_Initiative_strategy_framework_June_2010.pdf

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COMMUNITY RESILIENCY

Oregon

Oregon Global Warming Commission: Report to the Legislature 2011

I. Summary
   a. Update on success of legislated climate change actions
   b. State agencies collaborated with each other and OCCRI (Oregon Climate Change Research Institute) to produce the first comprehensive Oregon policy framework for climate change adaptation planning in December 2010
   c. Worked with state agencies and local governments to implement existing policies and commenting on federal climate change policies

II. Goals:
   a. 2020 – 10% below 1990 levels
   b. 2050 – 75% below 1990 levels (nearly 90% below 2010 levels)

III. Transformational themes: the Next Big Ideas
   a. Embed carbon in the planning process
   b. Embed carbon in the price of energy – partial reliance on carbon taxes
   c. Leverage the inherent carbon efficiencies of cities – "complete communities"
   d. Leverage the inherent carbon efficiencies of buildings – zero net carbon building designs are being demonstrated
   e. Ramp down oil, shift transportation loads to electricity and gas
   f. Ramp down coal, shift electric loads to efficiency and renewable
   g. Capture carbon across the board
   h. Total of 169 recommendations in the full Interim Roadmap to 2020 report

IV. Key Sectors
   a. Energy
   b. Transportation and land use
   c. Industrial
   d. Agriculture
   e. Forestry
   f. Materials management

Source:
http://www.oregon.gov/energy/GBLWRM/docs/OGWC_2011_Leg_Report.pdf?ga=t

South Carolina

Shoreline Change Initiative

I. Project summary/overview
   a. Aims to improve upon the existing regulatory coastal management framework established by the Beachfront Management Act of 1988
   b. 23 experts, including scientists, managers, planners, and non-governmental representatives formed the shoreline change advisory committee

II. Implementation
   a. Overview of existing shoreline regulations and four goals and 13 specific actions to improve coastal management in SC
   b. Goals:
      i. Minimize risk to beachfront communities (5 recommendations)
      ii. Improve the planning of beach renourishment projects (3 recommendations)
      iii. Maintain prohibitions and further restrict the use of hard stabilization structures (3 recommendations)
      iv. Enhance the management of sheltered coastlines (2 recommendations)

III. Outcomes and conclusions
   a. Staff will review recommendations and provide specific responses to help local and state officials develop a coordinated shoreline management response to SLR, coastal storms, and erosion

Source:
http://www.scdhec.gov/environment/ocrm/shoreline_change.htm

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COMMUNITY RESILIENCY

Texas

Hazard Mitigation Plan

I. Mentioned briefly in coastal erosion hazard.

II. Projects:

a. None

Source:
http://www.txdps.state.tx.us/dem/documents/txHazMitPlan.pdf

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COMMUNITY RESILIENCY

Washington

Hazard Mitigation Plan

Sea level rise is profiled as an impact of climate change. There is a brief discussion of the property, jurisdictions and businesses at risk.

Projects:

None

Source:
http://www.emd.wa.gov/plans/washington_state_hazard_mitigation_plan.shtml

Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy

Department of Ecology

Washington State is addressing the challenge of climate change and has adopted policies to reduce energy use, limit greenhouse gas emissions, and build a clean energy economy. The document lays out a framework to protect their communities, natural resources, and economy from the impacts of climate change and build their capacity to adapt to expected climate changes.

I. Document Structure
   a. Describes existing and new state policies and programs that better prepare WA to respond to the impacts of climate change
   b. Calls on state agencies to make climate adaptation a standard part of agency planning and to make scientific information about climate change impacts readily accessible to decision makers in the public and private sectors
   c. Recommends that state agencies strengthen existing efforts and build partnerships to help local and tribal governments, private and public organizations, and individuals reduce their vulnerability to climate change impacts

II. Strategies and actions for the following areas:
   a. Human health
   b. Ecosystems, species, and habitats
   c. Ocean and coastlines
   d. Water resources
   e. Agriculture
   f. Forests
   g. Infrastructure and the built environment
   h. Research and monitoring
   i. Climate communication, public awareness, and engagement

III. Predictions – SLR
   a. Relative SLR will be greatest in south Puget Sound and lease on the northwest tip of the Olympic Peninsula
   b. Puget Sound: medium estimate is 6 inches by 2050 and 13 inches by 2100
   c. Central and Southern WA coasts: medium estimate is 5 inches by 2050 and 11 inches by 2100
   d. Olympic Peninsula: medium estimate is 0 inches by 2050 and 1 inches by 2100
   e. Increases of up to 3 feet for the northwest Olympic Peninsula, 3.5 feet for the central and southern coast, and 4 feet for Puget Sound by 2100 cannot be ruled out at this time due to large ranges for accelerating rates of ice melt from Greenland and Antarctica

Source:
https://fortress.wa.gov/ecy/publications/publications/1201004b.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Olympia, Washington: Vulnerable to Sea Level Rise from Climate Change

I. Olympia's concern and policy

a. Downtown Olympia sits at only 18-20 feet above sea level, making it vulnerable to rising sea levels

b. City of Olympia has developed a variety of strategies to reduce its vulnerability to flooding of the downtown area due to sea level rise

i. In the early 1990s, the city council passed a resolution for the city to mitigate and prepare for climate change

ii. Maps and simulation models were produced to show the effects on the city of rising sea levels due to climate change

iii. The city council created an interdepartmental Global Warming Task Force

iv. The task force recommended short-term action and long-term action plans. Long term included:

1. Updating the comprehensive plans to address the impacts of sea level rise, increasing the height of the seawall, and developing an institutional framework for addressing climate change

II. What was the process

a. The Global Warming Task Force's first assignment was to prepare a background report on the implications of climate change for Olympia

b. The final report identified where the City of Olympia had authority to act, steps the city had already taken, and possible future actions

c. This finding prompted the city to undertake a follow-up report, released in 1993, called "the preliminary assessment of sea level rise in Olympia, Washington: Technical and Policy Implications" which more specifically identified rising sea levels and potential flooding as a problem

d. In 2009, the Climate Impacts Group released "the Washington Climate Change Impacts Assessment" with updated regional sea level rise predictions for 2100

i. The predictions varied, from an increase of 2 inches to 50 inches

e. City council played a key role in institutionalizing the climate adaptation policies

Source:
http://olympiawa.gov/community/sustainability/climate-change

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COMMUNITY RESILIENCY

COUNTRIES

Australia

Queensland Coastal Plan

I. Implementation

a. The management policies are primarily intended to be implemented by the managers of state and local government controlled coastal land and owners of private coastal land.

b. The state planning policy (SPP) will inform future regional plans as well as local government planning schemes and decisions on development applications.

c. for those local governments whose jurisdiction includes part of the coastal zone, the SPP will also provide detailed guidance about how to design and local development to avoid coastal hazard risks - especially those increased by climate change related sea-level rise

II. Review of the State Policy for coastal management

a. a report will be provided on the state of the coast zone at least every four years as part of Queensland's comprehensive report on the state of the environment.

b. report will include an assessment of the conditions of coastal resources and evaluate the efficiency and effectiveness of coastal management strategies, programs, and activities in relation to the protection, restoration, and enhancement of the coastal zone

III. Application of SPP

a. coastal hazards (CH)

i. specific policy outcome:

1. communities and development are protected from adverse CH impacts, taking into account the projected effects of climate change, the protective function of the natural environment, and the preference for allowing the natural fluctuations of the foreshore and foreshore ecosystems to continue

ii. defining coastal hazard areas

1. CH areas are to be identified in accordance with the methodology set out in the CH guidelines using the following factors to account for the projected impacts of climate change by the year 2100:

a. a sea-level rise factor of 0.8 meters & an increase in the maximum cyclone intensity by 10 per cent

2. review of the methodology in the CH guideline and the factors to account for the projected impacts of climate change will be initiated within 6 months of either the

a. release of a new assessment report by the UN IPCC that refers to global emissions, temperature, or sea-level rise trends

iii. development limited in coastal hazard areas

iv. development limited in erosion prone areas

v. development only allowed in certain areas if congruent with coastal protection work

vi. development limited specifically in high and medium coastal hazard areas

Source:
http://www.derm.qld.gov.au/coastalplan/

Canada

Halifax Climate SMART: The Climate Sustainable Mitigation and Adaptation Risk Toolkit

I. Project summary/overview
   a. Two goals
      i. To develop a plan to reduce HRM's greenhouse gas emissions
      ii. To create a management plan to prepare the municipality for projected climate change impacts
   b. Overall objective:
      i. Mainstream climate change mitigation and adaptation strategies into overall municipal decision-making
   c. Intended to serve as a prototype for future projects

II. Project implementation
   a. Toolkit to help guide the municipality to mainstream climate change mitigation and adaptation into overall municipal decision making
   b. Includes:
      i. Risk assessment tool
      ii. Community-based vulnerability assessment and risk management tool
      iii. Cost/benefit assessment tool
      iv. Environmental impact assessment tool
      v. Communications and outreach tool
   c. Original objectives of the Climate SMART initiative have been continued by various groups in an ad hoc fashion
   d. Project outcomes and conclusions
      i. Overall objectives:
         1. Reduce HRM's greenhouse gas emissions
         2. Increase HRM's resilience to climate change through a vulnerability assessment and incorporated adaptation measures
         3. Incorporate extreme weather event and disaster preparedness in HRM

Source:
http://www.halifax.ca/climate/

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Tasmania

Climate Change Vulnerability Assessment and Adaptation Planning for Mangrove Systems

I. Background
   a. The IPCC 4th assessment projected a global sea level rise of up to .59 m by 2099, and subsequent authorities have projected up to 1 m or more.
   b. Mangrove accretion rates are usually less than these projected rates of SLR, resulting in dieback at the seaward edge and inland migration
   c. Procedures are needed to assess the vulnerability of mangrove systems to climate change impacts; to plan actions that help those systems adapt to those impacts; and to support adaptation efforts by mangrove-dependent communities

II. Purpose
   a. Methods manual is intended for use by conservation practitioners and mangrove managers to carry out an assessment of mangrove vulnerability to climate change, leading to informed and effective adaptation planning
   b. Objectives: describe methodologies and give examples for carrying out such a vulnerability assessment; and to demonstrate how the results can be analyzed and applied to prioritize adaptation actions
   c. This manual provides guidance for each of the components listed below on what it is, why to do it, hot to collect data, how to analyze results, how to interpret vulnerability, and what are the component's strengths and limitations

III. Methods
   a. Agencies: Global Environmental Facility, UN Environmental Programme, and World Wildlife Fund
   b. Tested mangrove vulnerability assessment methodologies and adaptation strategies in 3 countries: Cameroon, Tanzania, and Fiji

IV. Pilot projects:
   a. Involved interdisciplinary data collection using both high and low technology methods and analysis of how each method helped to understand the vulnerability of a particular mangrove ecosystem
   b. Also used these vulnerability assessment results to identify and test a range of adaptation options
   c. Findings guided the development of this generalized methodology

V. Mangrove Climate Change Vulnerability assessment Methodology Components:
   a. Forest assessment of mangroves
   b. Recent spatial changes of mangroves
   c. Ground elevations in and hind mangroves
   d. Relative seal level trends
   e. Sedimentation rates under mangroves
   f. Adjacent ecosystem resilience
   g. Climate (rainfall) modeling
   h. Compilation of local community knowledge

VI. Synthesizing data
   a. Vulnerability ranking based on results from each component
   b. Facilitates the identification of adaptation actions that reduce the identified vulnerabilities and increase resilience
   c. Three categories of action: reduction of existing threats, direct adaptation actions, and ongoing monitoring

Source:
http://worldwildlife.org/publications/climate-change-vulnerability-assessment-and-adaptation-planning-for-mangrove-systems

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

MISCELLANEOUS

FEMA Climate Change Adaptation Policy Statement

Purpose is to establish an agency-wide directive to integrate climate change adaptation planning and actions into Agency programs, policies, and operations.

I. Challenges posed by climate change
   a. Could significantly alter the types and magnitudes of hazards faced by communities and the emergency management professionals serving them
   b. Impacts on mitigation, prepardedness, response, and recovery operations
   c. Resiliency of critical infrastructure and various emergency assets
   d. Climate change could trigger indirect impacts that increase mission risks

II. 7 initial actions to help integrate climate change adaptation considerations into our programs and operations
   a. To enhance climate research, monitoring, and adaptation capabilities, FEMA will continue to establish partnerships with other agencies and organizations that possess climate science and climate change adaptation expertise
   b. FEMA will continue to study the impacts of climate change on the national flood insurance program (NFIP) and incorporate climate change considerations in the NFIP reform effort
   c. FEMA will evaluate how climate change considerations can be incorporated into grant investment strategies with specific focus on infrastructure and evaluation methodologies or tools such as benefit/cost analysis
   d. FEMA will seek to understand how climate change will impact local communities and engage them in addressing those impacts
   e. FEMA will promote building standards and practices, both within FEMA programs and in general, that consider the future impacts of climate change
   f. Through partnerships with the climate science community, FEMA will evaluate the potential impact climate change may have on existing risk data and the corresponding implications for Threat Hazard Identification Risk Assessment (THIRA) development and operational planning
   g. FEMA will continue to pursue a flexible, scalable, well equipped, and well trained workforce that is educated about the potential impacts of climate change

Source:
http://stormsmart.org/wp-content/blogs.dir/1/files/group-documents/22/1328980794-FEMACCAPolicyStatement12312.pdf

Incorporating Sea Level Change Scenarios at the Local Level

NOAA

I. Scenario approach

   a. Using the information provided, 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

II. Define the context

   a. What type of plan is being developed

      i. Considering a range of possibilities lends itself to the adaptive management style required in a changing environment

   b. What scale is meaningful

      i. Local projections should be used for most local and regional coastal planning and mapping application

   c. What is the current political environment

      i. Adaptive scenarios incorporate components that are measured (highly likely) and those that are predicted (less certain)

III. Determine which components to include in local projection scenarios

   a. Most scenarios are based on a combination of historical local information, global rates, and models that predict future conditions

IV. Research what other communities are doing

V. Calculate sea level change scenarios

   a. Scenarios that incorporate global projections and local change rates

   b. Scenario chosen should be relevant to the timescale of decisions being made

   c. The selected sea level change increments should be derived from a reputable source and the vertical distance between increments supported by the vertical accuracy of the land elevation data, particularly if maps of sea level change will be produced

VI. Understand uncertainty

VII. Consider changes to flood frequency and duration

   a. Officials must factors in all current flood-producing events, because sea level rise will likely increase the reach, frequency, and duration of "normal" flooding

   b. Tide heights, storm surge, extreme water levels

VIII. Consider potential impacts

IX. Communicate the impacts

   a. Encourage the citizens to become knowledgeable and involved in the process

   b. Visualization

      i. NOAA's Coastal County Snapshots: www.csc.noaa.gov/snapshots

      ii. Sea Level Rise and Coastal Flooding Impacts Viewer: www.csc.noaa.gov/SLR

Source:
http://csc.noaa.gov/digitalcoast/publications/slcscenarios

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Protecting the Public Interest through the National Coastal Zone Management Program: How Coastal States and Territories Use No-Build Areas along Ocean and Great Lake Shorefronts

NRDC

I. Study Purpose

a. To better understand and communicate how states CMPs (Coastal Management Plans) manage ocean and Great Lake shorefront development

b. Looks specifically at where states are employing shorefront no-build areas to protect the public interest

c. A compilation of the laws and regulations of those states with federally approved CMPs that include no-build areas, typically on dry, privately owned land, along their ocean and/or Great Lake shorefronts as they were in effect in December 2011

d. Reports considers a loose and broad definition of "development" that includes residential structures, hotels, motels, commercial establishments, industrial facilities, and the like

II. Findings

a. 94% of the 33 coastal states with federally approved CMPs have a role in regulating shorefront development on dry land

b. 81% of the states that regulate ocean or Great Lake shorefront development (outside of submerged lands) employ no-build areas along some portion of their shorefront

c. Today, roughly 36% of the states that employ no-build areas are using erosion rates to delineate them along some portion of their shorefront

d. In addition to erosion rates, shorefront no-build areas are delineated and defined based on:

i. Fixed distances measured horizontally from reference features that range from 20 to 200 feet

ii. Designated natural resource areas, such as beaches, dunes, and bluffs

iii. Other areas designated based on plane coordinates or mapped districts or zones

e. Only Maine explicitly factors the potential for increases in SLR during the 21st century into a provision that establishes the state's shorefront no-build areas

Source:
http://coastalmanagement.noaa.gov/resources/docs/nobuildareas.pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

An Assessment: Policy Tools for Local Adaptation to SLR

I. Location: Marine Policy Institute at Mote Marine Laboratory

II. Lead Agencies:

   a. Gulf Coast Community Foundation of Venice

III. Project Description

   a. high-level foundation for future discussions of the effects of global climate on water

Source:
http://www.mote.org/clientuploads/MPI/Synopsis-Policy%20Tools%20for%20Local%20Adaptation%20to%20Sea%20Level%20Rise(fin).pdf

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Adapting to Climate Change: A Planning Guide for State Coastal Managers

I. Location

   a. NOAA - Office of Ocean and Coastal Resource Management

II. Project Description

   a. The purpose of this guide is to help U. S. state and territorial (state) coastal managers develop and implement adaptation plans to reduce the impacts and consequences of climate change and climate variability (climate change) in their purview. It was written in response to a request from state coastal managers for guidance from the National and Oceanic and Atmospheric Administration (NOAA) on adaptation planning in the coastal zone. It is intended as an aid, not as a prescribed directive, and a state may choose to use individual steps or chapters or the entire guide, depending on where they are in the planning process.

Source:
http://coastalmanagement.noaa.gov/climate/docs/adaptationguide.pdf

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COMMUNITY RESILIENCY

Increasing Community Resilience to Future Hurricane Storm Surge

Collaborative Decision Support in Sarasota, FL

I. Lead Agencies

a. Penn State University

b. US Geological Survey

II. Project Description

a. The goal of the proposed research is to develop a methodology that helps local government officials and planners understand a range of options that allow coastal communities to grow their populations and develop their economies and infrastructures with less risk of significant loss from future hurricane storm surges. To reach that goal, the investigators will conduct a case study based in Sarasota, Florida where they will work with officials, planners, and other stakeholders to include scenarios of sea level rise in long-range planning activities and extend those activities to horizons more in line with sea level rise projections.

Source:
http://www.cpo.noaa.gov/index.jsp?pg=./cpo_pa/cpo_pa_index.jsp&pa=sarp&sub=projects/abstracts/2007/byarnal.jsp

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

Effects of Near-term SLR on Coastal Infrastructure

I. Lead Agencies

a. Strategic Environmental Research and Development Program (SERDP)

b. Environmental Security Technology Certification Program (ESTCP)

II. Project Description

a. The primary goal of this project is to quantify the potential impact and risk to coastal military infrastructure from near-term sea-level rise and the attendant increases in hurricane activity. Specific objectives include: (1) identify and quantify the responses of coastal system components to sea-level rise over the next century; (2) refine a large-scale numerical model for quantifying the hazard risk to coastal military facilities; (3) develop probability models for quantifying and managing uncertainty; and (4) enable cost-effective mitigation and adaptation strategies.

Source:
http://www.serdp.org/Program-Areas/Resource-Conservation-and-Climate-Change/Climate-Change/Vulnerability-and-Impact-Assessment/RC-1700

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COMMUNITY RESILIENCY

Implications of Takings Law on Innovative Planning For Sea Level Rise in The Gulf of Mexico

I. Lead Agencies
   a. Texas Sea Grant
   b. Florida Sea Grant
   c. Louisiana Sea Grant
   d. Mississippi/Alabama Sea Grant Consortium

II. Project Description
   a. This project will specifically seek to address this fear through (1) legal analysis of existing takings jurisprudence and laws, (2) development of legal arguments that consider the imperative of sea-level rise, and (3) identification and development of specific, innovative land use policies designed to withstand takings claims.
   b. In Phase I of the project, the co-PIs will provide a fresh, comprehensive examination of takings law in Florida, Alabama, Mississippi, Louisiana, and Texas to provide a foundation for addressing the source of regulatory hesitancy in Phase II and developing innovative land use planning policies for adaptation to the GOM's changing landscape in both the short and long term that are resistant to takings claims in Phase III.

Source:
http://www.masgc.org/page.asp?id=511

FLORIDA DEPARTMENT of ECONOMIC OPPORTUNITY

COMMUNITY RESILIENCY

A Parameterized Climate Change Projection Model for Hurricane Flooding, Wave Action, Economic Damages, and Population Dynamics

I. Lead Agencies

a. Texas Sea grant

b. Florida Sea grant

c. Louisiana Sea grant

d. Mississippi/Alabama sea grant consortium

II. Project goal

a. Our project goal is to quantify the potential impact of sea level rise and hurricane intensification on hurricane-induced economic damages and on population dynamics at the coast.

III. Objectives

a. To develop a general, parameterized response model for hurricane flood elevation and wave damage potential as a function of SLR and hurricane intensification.

b. To determine potential acceleration in hurricane flood elevation and wave height probability as a function of SLR and hurricane intensification.

c. To determine potential acceleration in hurricane-induced economic damages and population affected at the coast due to accelerating flood elevation and wave height probability.

d. To determine potential short and long-term shifts in population dynamics at local and regional levels as well as the socioeconomic dimensions of such shifts.

Source:
http://www.masgc.org/page.asp?id=509

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COMMUNITY RESILIENCY

World Resources 2010-2011: Decision Making in a Changing Climate – Adaptation Challenged and Choices

I. Lead Agencies

a. World Resources Institute (WRI)

b. United Nations Development Programme

c. United Nations Environment Programme

d. World Bank

II. Project description

a. This publication explores five key elements - public engagement, decision-relevant information, institutional design, tools for planning and policymaking, and resources - that we believe will significantly strengthen the ability of national governments to make effective adaptation decisions. Our arguments for why decision makers should focus on these elements are based upon the results of a wide-ranging and interactive research program. Over 100 adaptation experts, public officials, sector-based practitioners, and civil society representatives, from more than 30 countries, contributed to our research effort.

III. Project/actions/conclusions

a. Updating the comprehensive plans to address the impacts of sea level rise, increasing the height of the seawall, and developing an institutional framework for addressing climate change

Source:
http://pdf.wri.org/world_resources_report_2010-2011.pdf

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COMMUNITY RESILIENCY

State and Local Governments Plan for Development of Most Land Vulnerable to Rising Sea Level along the US Atlantic Coast

I. Overview

a. On the basis of 131 state and local land use plans, we estimate that almost 60% of the land below 1 meter along the US Atlantic coast is expected to be developed and thus unavailable for the inland migration of wetlands

b. Results suggest that shore protection does have a cumulative impact. If SLR is taken into account, wetland policies that previously seemed to comply with federal law probably violate the Clean Water Act

c. This letter maps and quantifies a baseline, business-as-usual scenario of coastal development and shore protection for the Atlantic coast of the US from MA to FL.

II. Purpose

a. With this analysis, planners from the local to national level can assess the extent to which coastal wetlands might migrate inland or be lost (and identify infrastructure that would eventually require remedial attention) and then evaluate other options

III. Predictions

a. Global SLR of approximately 20-60 cm during the 21st century if polar ice sheets remain stable but possibly more than 1 meter if ice sheets become unstable

b. Two pathways: shore protection and retreat

IV. Results and Implications

a. Considering our entire study area, 42% of the dry land within 1 meter above the tidal wetlands is developed and most likely to be protected given business-as-usual

b. Almost 60% of the lowest dry land is likely to be developed and eventually protected as SLR.

c. B y contrast, only 9% of this land has been set aside for conservation purposes that would allow coastal ecosystems to migrate inland

d. Maps provided by this study can serve as an initial benchmark for evaluating the environmental consequences of the business-as-usual response to SLR and possible alternatives that would better preserve the environment and comply with the law.

Source:
http://iopscience.iop.org/1748-9326/4/4/044008/fulltext/

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COMMUNITY RESILIENCY

Hotspot of Accelerated Sea-Level Rise on the Atlantic Coast of North America

I. Research purpose
   a. Presents evidence of recently accelerated SLR in a unique 1,000-km long hotspot on the highly populated North American Atlantic coast north of Cape Hatteras and show that it is consistent with a modeled fingerprint of dynamic SLR

II. Findings
   a. Between 1950-1979 and 1980-2009, SLR rate increases in this northeast hotspot were about 3-4 times higher than the global average
   b. They analyzed tide-gauge records along the North American Atlantic coast for increasing rates of SLR

III. Results
   a. SLR superimposed on stormsurge, wave run-up, and set-up will increase the vulnerability of coastal cities to flooding, and beaches and wetlands to deterioration

Source:
http://www.nature.com/nclimate/journal/vaop/ncurrent/full/nclimate1597.html

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COMMUNITY RESILIENCY

SLR HORIZON YEAR AND PROJECTIONS TABLE

Year and Location	Minimum (or Median)	Maximum
2025: SW/Charlotte Harbor, FL	1.8	11.3
2025: Treasure Coast, FL	2.8	10.7
2030: FL DOT	3	7
2030: SE FL Compact	3	7
2050: CA	12	18
2050: Central & South WA	5	
2050: Olympic Peninsula, WA	0	
2050: Puget Sound, WA	6	
2050: San Diego	10	17
2050: San Fran	16	
2050: Satellite Beach, FL	24	
2050: South Florida	5	20
2050: SW/Charlotte Harbor, FL	3.5	22.6
2050: Tampa Bay, FL	1.8	11
2060: FL DOT	9	24
2060: SE FL Compact	9	24
2075: SW/Charlotte Harbor, FL	5.3	34
2100: Aus	31	
2100: CA	21	55
2100: Central & South WA	11	
2100: DE	13	
2100: Florida	20	39
2100: Georgia	39.6	
2100: LA	39.6	
2100: Lewes, DE	19.2	58.8
2100: NC	39.6	
2100: Olympic Peninsula, WA	1	
2100: Puget Sound, WA	13	
2100: San Diego	31	69
2100: San Fran	55	
2100: Sarasota County, FL	31.5	79
2100: SE Florida	24	48
2100: SW/Charlotte Harbor, FL	7.1	45.3
2100: Tampa Bay, FL	3.9	26
2100: Treasure Coast, FL	21	177.3
2150: East Central FL	12	
2200: Tampa Bay, FL	8.7	77

SLR PROJECTIONS GRAPH

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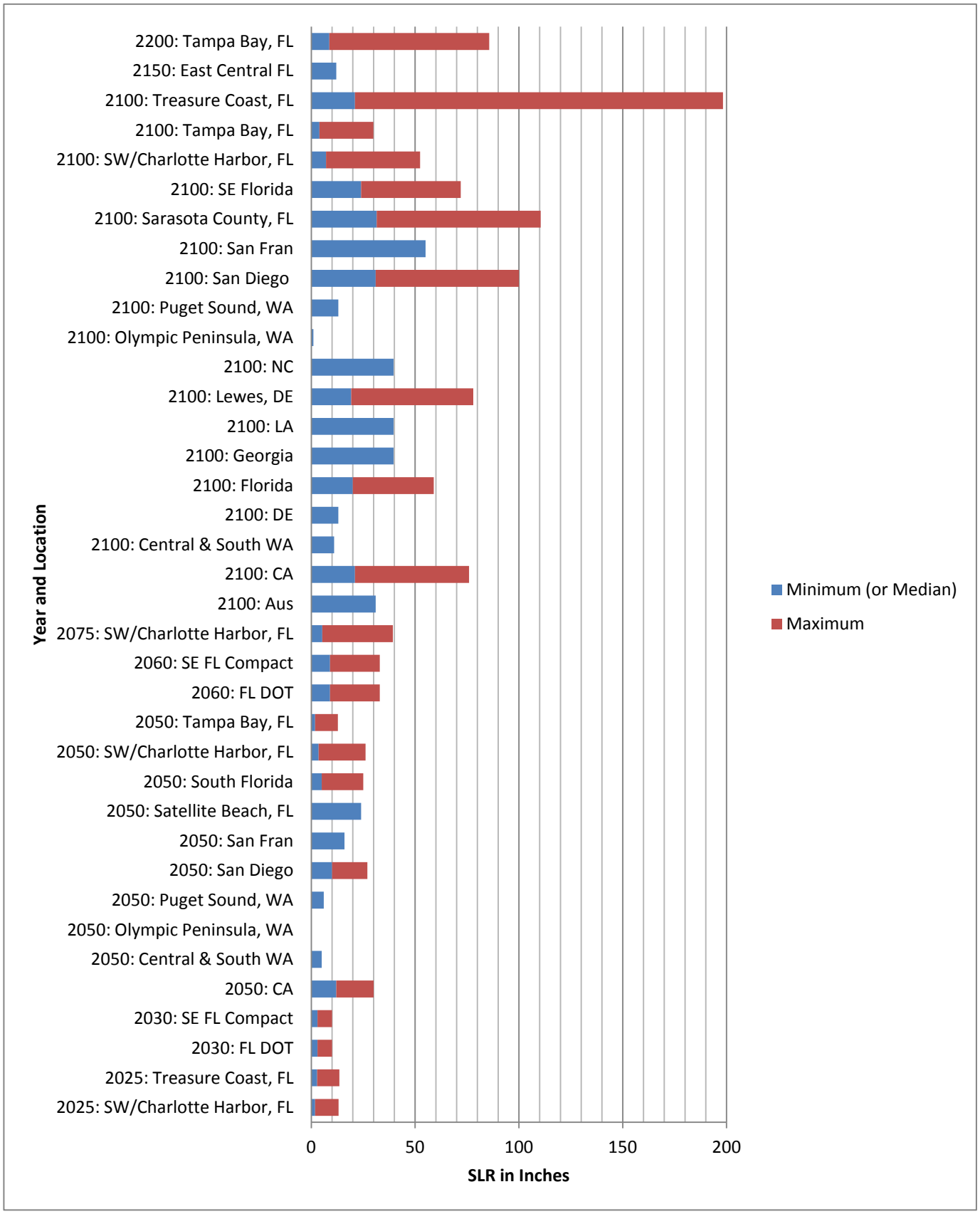
COMMUNITY RESILIENCY



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