Climate Change and Water Management in South Florida

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Sea Level Rise Adaptation in the Florida Keys
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Potential Climate Change Impacts to SFWMD

Climate Change Drivers

Natural Cycles
- Interannual (e.g. El Nino and La Nina) to Multi-decadal (e.g. AMO*)

Human Induced
- Land use changes
- Greenhouse gases
  -> Global Warming

Quartet of change: Stressors

- Rising Seas
- Temperature
- Rainfall, floods, and droughts
- Tropical Storms & Hurricanes

Water Management Impacts

- Direct landscape impacts (e.g. storm surge)
- Water Supply (e.g. droughts, saltwater intrusion)
- Flood Control (e.g. urban flooding, hurricanes)
- Natural Systems (e.g. ecosystem impacts, both coastal and interior)

*Atlantic Multi-decadal Oscillation of temperature in the Atlantic Ocean
Two Important Questions:

- Which decisions are likely to be affected and could benefit from adaptation strategies (Type I) in the short term?
  - “No Regret Strategies”

- Which decisions are likely to be affected but for which adaptation strategies (Type II) could be deferred without serious consequences?
Future Projections of Sea Level Rise: 
Polar Ice Uncertainty

Greenland
(~ 2 million sq.km.)

Antarctica
(~5.4 million sq. km.)
What is the future rate of acceleration?

- Rapid acceleration due to ice sheet loss
- Medium acceleration
- Continuing current trend
- Resilience
- Adaptive Capacity
- “no regret strategies”
- Adaptive Management

- Alternative Futures
- Contingency Plans
Are we seeing more of these?

Florida Keys
(Monroe Co)

Photo Credit: The Nature Conservancy
Impacts of Rising Seas: Flood Control

Coastal Structure

Ocean Side (tailwater)

Land Side (headwater)
Vulnerable Structures

- Preliminary review based on original designs
- 28 gravity structures on the East Coast
- Six gravity structures on the west coast
- Most vulnerable structures are in Miami-Dade and Broward counties
  - Prioritized 3 structures
Potential Impact of Rising Seas: Southern Everglades

- Relocation and possible reduction of mangrove forests
- Forced migration of wading birds northward
- Potential peat collapse, coastal erosion, and redistribution of sediments
- Salinity intrusion into freshwater marshes can: discharge toxic hydrogen sulfide, cause coastal fish kills, and increase habitat loss
Saltwater - Groundwater Interface

- Review groundwater monitoring network used to develop the map of the saltwater-groundwater interface
  - Identify gaps
  - Identify utilities at risk

Lake Worth
Lantana
Saltwater Intrusion Mapping and Monitoring Network Evaluation
Water Supply and Water Conservation

- Continue looking at opportunities and technologies to reduce amount of additional freshwater needed for water supply
- Look at opportunities to use reuse as a hydraulic barrier
- Implement water conservation measures
- Develop alternative water supply options
Flood Inundation Tools – Digital Elevation Maps (DEM) Project

- Improved support for operations and projects
- Hydrologic and hydraulic models
- Sea-level rise, storm surge, dike-failure study
- Ecological studies – plant communities vs. landscape position, black-mangrove die-off areas, etc.
- Identify historical features – river channels, logging trams, shell midden sites
Model Development

- **Flood Protection**
  - Working with the Hydrologic Engineering Center of the U.S. Army Corps of Engineers to develop a surface water/groundwater model. Currently the model is being tested in the C-4 Basin.

- **Water Supply**
  - USACE, DOI and SFWMD collaborating on the development of saltwater intrusion models for the coastal belt.
    - West coast model under development by our Big Cypress Basin office.
Questions!

Recent cabinet meeting of the island nation, Maldives
Relative Sea Level Rise Scenarios for South Florida

Notes: Projections are for historic, modified National Research Council (NRC) Curve I and modified NRC Curve III rates of sea level change developed for South Florida, per USACE Engineering Circular (EC) 1165-2-211. This EC is based on guidance in the NRC report, Responding to Changes in Sea Level: Engineering Implications, dated September, 1987. The projection is developed using the historic rate of sea level rise at Key West as reported by NOAA (2.24 mm/yr). The dashed line indicates that the EC equation is being used past the year 2100. The underlying documents supporting the EC do not address dates beyond 2100.

<table>
<thead>
<tr>
<th>Year</th>
<th>Historic</th>
<th>Modified NRC Curve I</th>
<th>Modified NRC Curve III</th>
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<tbody>
<tr>
<td>2010</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>2030</td>
<td>2</td>
<td>3</td>
<td>7</td>
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<td>4</td>
<td>9</td>
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<td>8</td>
<td>19</td>
<td>57</td>
</tr>
<tr>
<td>2110</td>
<td>9</td>
<td>23</td>
<td>67</td>
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The graph shows the relative sea level rise in inches for 100-year planning horizon, with projections for 2000 to 2110 years.
# Estimated Timeframes for 1 to 3 ft SLR
based on USACE SLR Projection for SE FL Region

<table>
<thead>
<tr>
<th>Projected Sea Level Rise</th>
<th>Estimated Time Occurrence</th>
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</thead>
<tbody>
<tr>
<td>1 foot</td>
<td>2040 - 2070</td>
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<tr>
<td>2 feet</td>
<td>2060 - 2115</td>
</tr>
<tr>
<td>3 feet</td>
<td>2078 - 2150</td>
</tr>
</tbody>
</table>

*Table Credit:* A Unified Sea Level Rise Projection for Southeast Florida (in review). April 2011. Table 5.