

# Updating Technical Guidance on Sea Level Change

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Transforming the Marine  
Transportation System  
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US Army Corps of Engineers  
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# Outline of Presentation

- U.S. Army Corps of Engineers Mission Areas
- Approach to projected climate changes
- Adaptive management concepts
- Preliminary focus areas and ongoing activities
  - ▶ New Sea Level Change Engineering Circular
  - ▶ New Sea Level Engineer Technical Letter
  - ▶ Coastal Vulnerability Index
- Implementation questions relevant to MTS



# USACE Mission Areas

- Navigation
  - ▶ Breakwaters and Jetties
  - ▶ Harbors
  - ▶ Navigation Channels and Ocean Disposal Sites
- Hydropower
- Reservoir Regulation; Water Supply
- Coastal Storm Damage Reduction
  - ▶ Beach fills
  - ▶ Shoreline protection structures
- Flood Damage Reduction
  - ▶ Dams, levees, floodwalls
- Ecosystem Restoration
- Emergency Response
- Recreation
- Regulatory



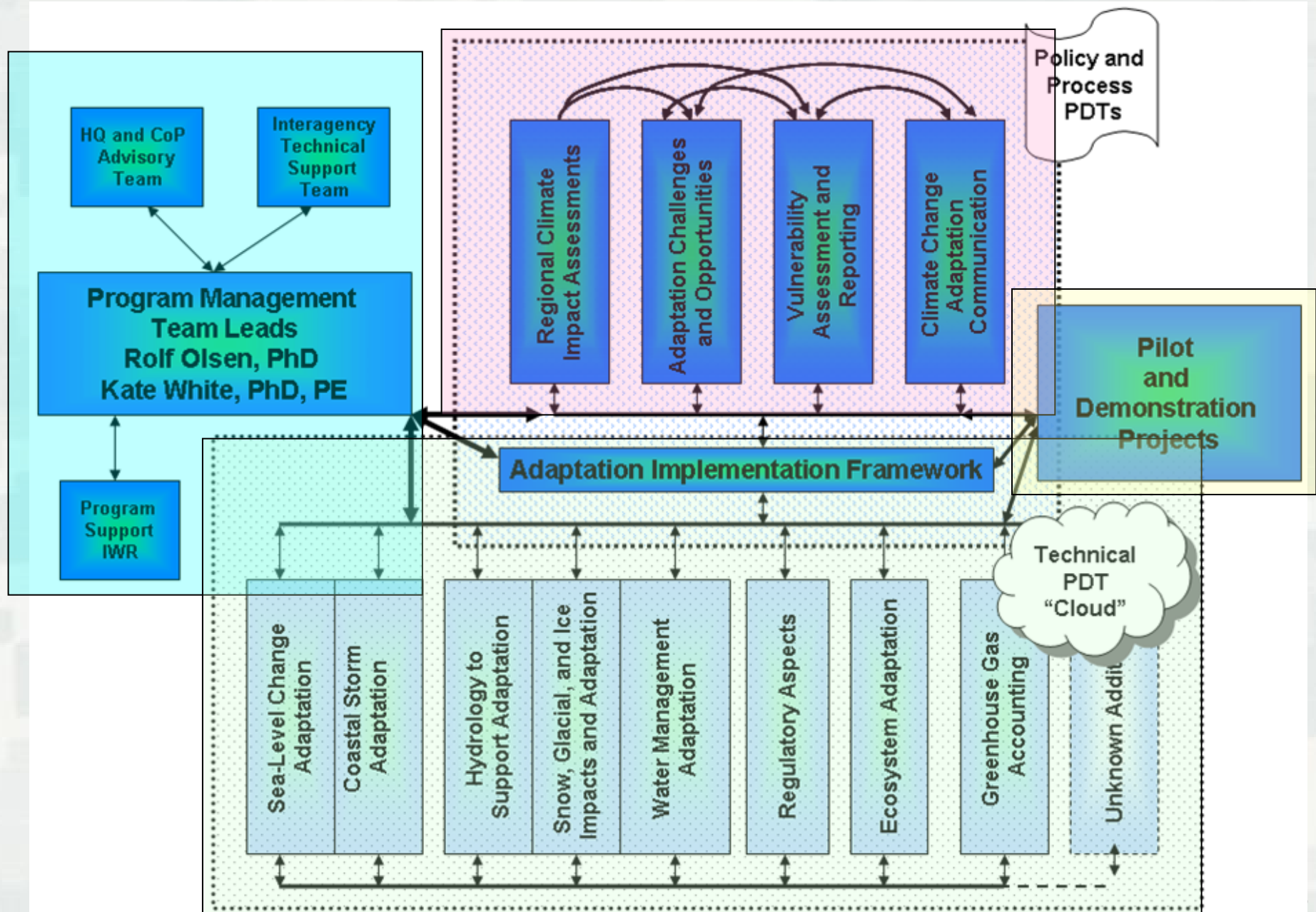
**Climate change  
has the potential  
to impact  
all USACE  
mission areas**

# Approach

- Recognize we can't predict the future without uncertainty
- Be prepared to implement flexible planning and engineering adaptations accounting for a range of possible changes
  - ▶ Objectives are to enhance resilience or reduce vulnerability to observed or expected changes in climate
  - ▶ Encourage decisions to be made sequentially over a longer planning horizon
- Must be able to recognize meaningful changes that may require additional response → multiple plausible scenarios
- Determine level of detail and accuracy required with respect to potential risks and consequences



# Responses to Climate Change (RCC) Team Structure



# ISSUES OF SCALE

## Objective setting and Management at different scales

Upper Mississippi River Basin

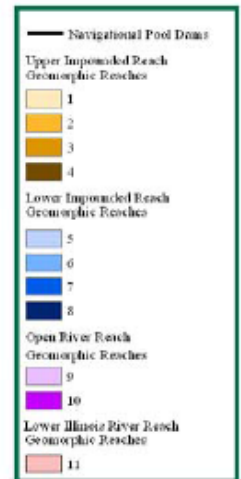
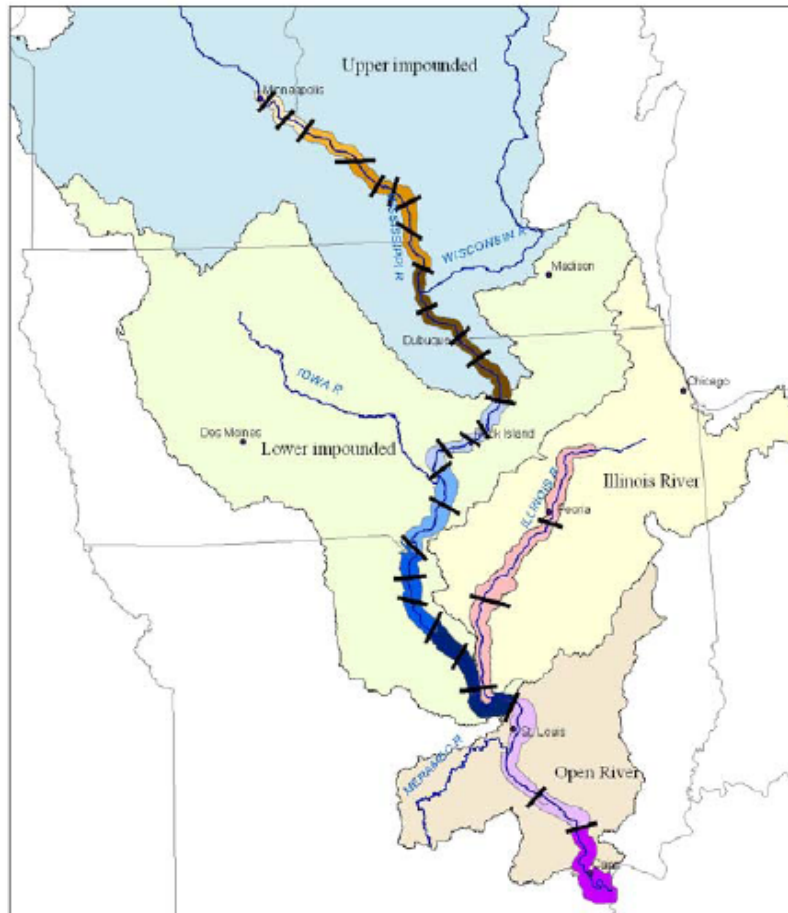
Upper Mississippi River System

Reaches

Geomorphic reaches

Nav. Pools

Project areas



# Building Guidance

## 1. Site Prep: Datum

- ▶ EC 1110-2-6065/6070, Comprehensive Evaluation of Project Datums
- ▶ Engineer Regulation 1110-2-8160, Policies for Referencing Project Elevation Grades to Nationwide Vertical Datums
- ▶ Engineer Manual 1110-2-6065, Standards and Procedures for Referencing Project Elevation Grades to Nationwide Vertical Datums

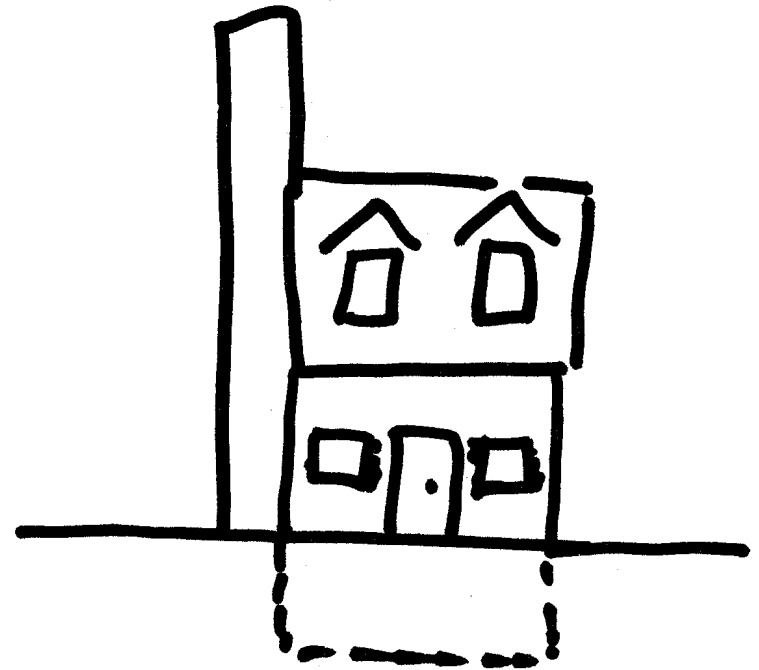
## 2. Foundation: Sea Level Policy Guidance

- ▶ EC 1165-2-211, Incorporating Sea-Level Change Considerations in Civil Works Programs

## 3. Next Step: Engineering Technical Letter

- ▶ Procedures to Evaluate Sea Level Change Impacts, Responses, and Adaptation

## 4. Add on Later: Tides, Waves, Storms

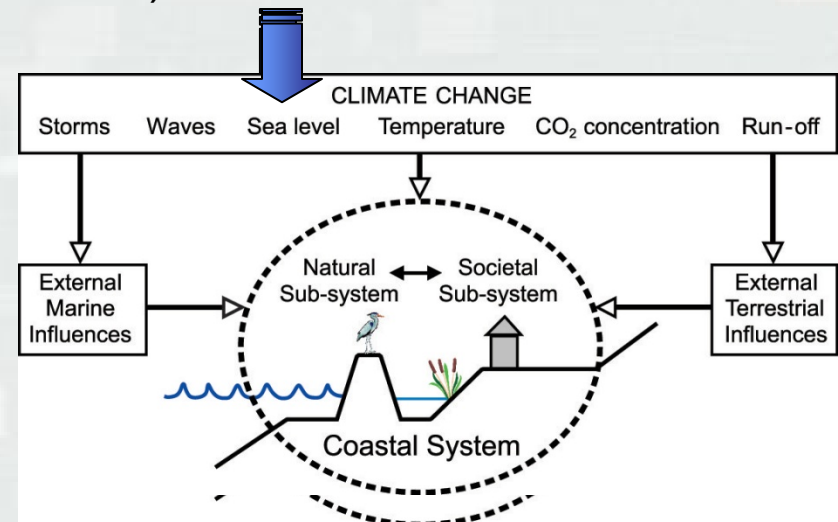


# Guidance on Sea Level Change

- Review, discussion, analysis of
  - ▶ Current guidance
  - ▶ NRC 1987 (Responding to Changes in Sea Level: Engineering Implications)
  - ▶ IPCC AR4 WG1 (Physical Science Basis)
  - ▶ CCSP SAP 4.1 (Coastal Sensitivity to Sea Level Rise: A Focus on the Mid-Atlantic Region (S. Gill co-author))
  - ▶ Other recent scientific literature



- Develop standard glossary
- Provide background on sea level change (SLC)
- Use multiple scenario approach
- Determine historic trends
- Estimate future change in local MSL

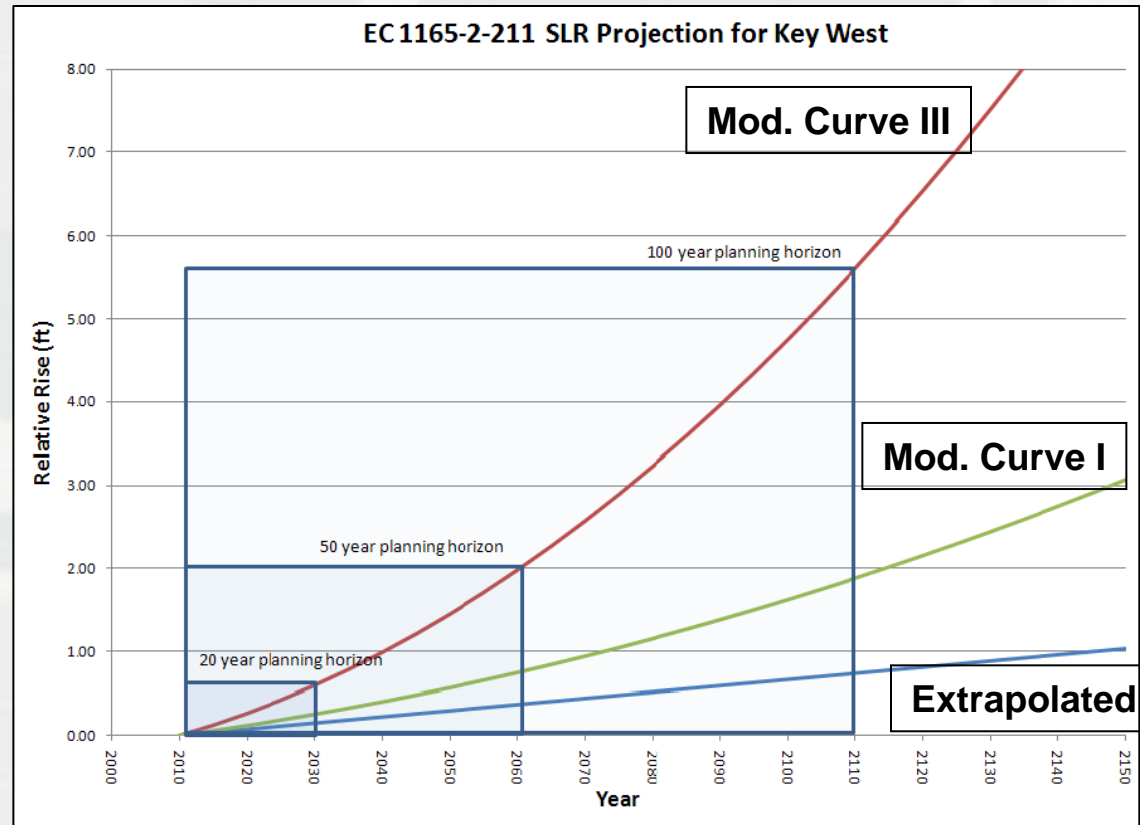


IPCC 2007 AR4 WG2 Figure 6.1. Climate change and the coastal system showing the major climate change factors, including external marine and terrestrial influences.



# Sea Level Change Policy Guidance

- Three estimates of future SLC must be calculated for all Civil Works Projects within the extent of estimated tidal influence:
  - ▶ Extrapolated trend
  - ▶ Modified NRC Curve I
  - ▶ Modified NRC Curve III
- Requires time and money to evaluate options



# SLC Engineering Technical Letter

- Purpose:
  - ▶ To take next step to implementation at the project level and apply the EC policy/guidance
  - ▶ Evaluate SLC impacts and describe how to plan and engineer for them
- Approach:
  - ▶ Utilize national interdisciplinary team within Corps and include outside agency experts
  - ▶ Develop region-by-region information and examples
  - ▶ Include sensitivity and risk tools
  - ▶ Develop a road map that lays out the engineering and planning procedure for full range of projects
  - ▶ Convey to the field the level of detail required as a function of project type, planning horizon, and potential consequences
  - ▶ Identify the potential for adaptation through project life or project phasing

External Experts

USGS (Robert Thieler, Nate Plant)

NOAA (Steve Gill, Billy Sweet, Kristen Tronvig)

Bureau of Reclamation (Mike Tansey)

FEMA

Navy (Tim McHale, Shun Ling)

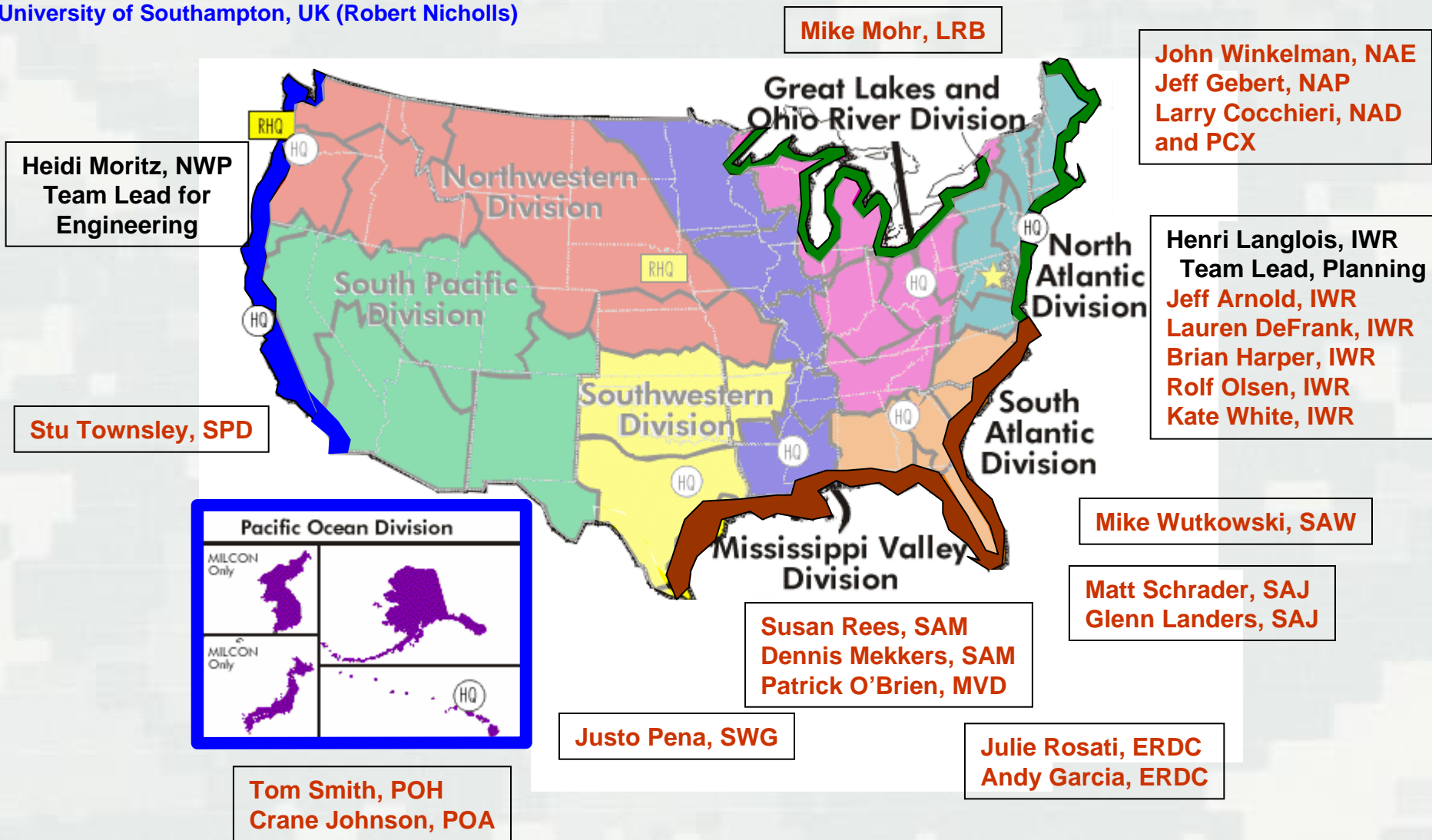
FHWA (Kevin Moody)

HR Wallingford, UK (Jonathan Simm)

University of Southampton, UK (Robert Nicholls)

# Procedures to Evaluate Sea Level Change Impacts, Responses, and Adaptation

Engineering Technical Letter Team



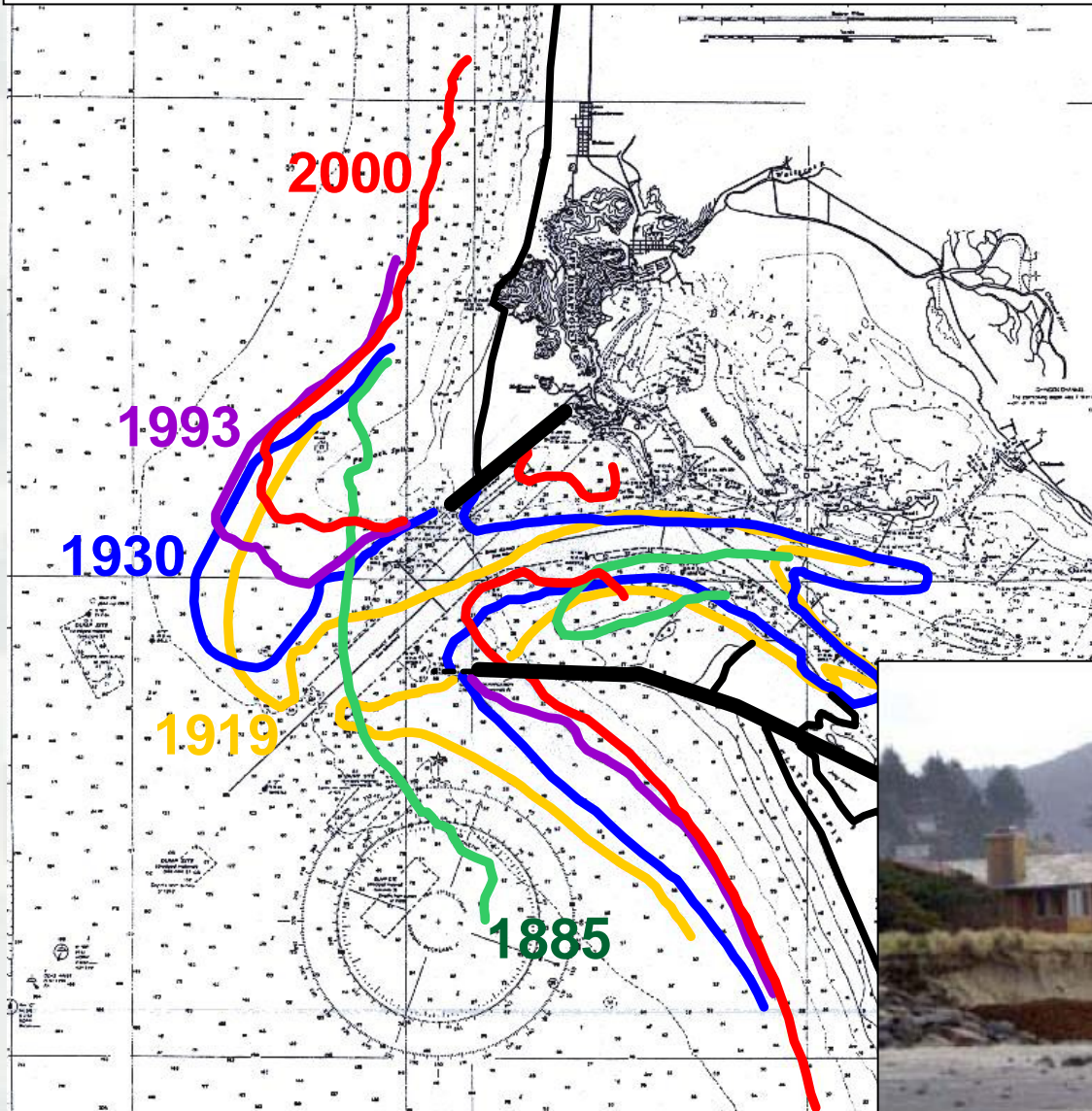
# Water Level Variation Contributors

- Tidal range
- Global Sea Level Change
- Regional and local Sea Level Change
- Storm and hurricane surge
- Infragravity surge
- Seasonal water level changes
- El Nino / La Nina cycles
- Different spatial and temporal scales
- Dramatic magnitude shifts, tsunami and/or subduction earthquake
- Relevant threshold elevations
  - ▶ Reefs, barrier islands
  - ▶ Foredunes
  - ▶ Levees
  - ▶ Structures





# Measure and Evaluate Responses to Climate Change (to inform process and assess adaptation measures)



The ebb tidal shoal is receding at an accelerated rate between 1993 and 2000.



# Implementation Questions Relevant to MTS

- Port infrastructure resilience and maintenance
- Increase in storminess and severe events
- Changes to project performance
- Dredging and sediment management issues
- Impacts on community water resources infrastructure
- Environmental stewardship
- Safety



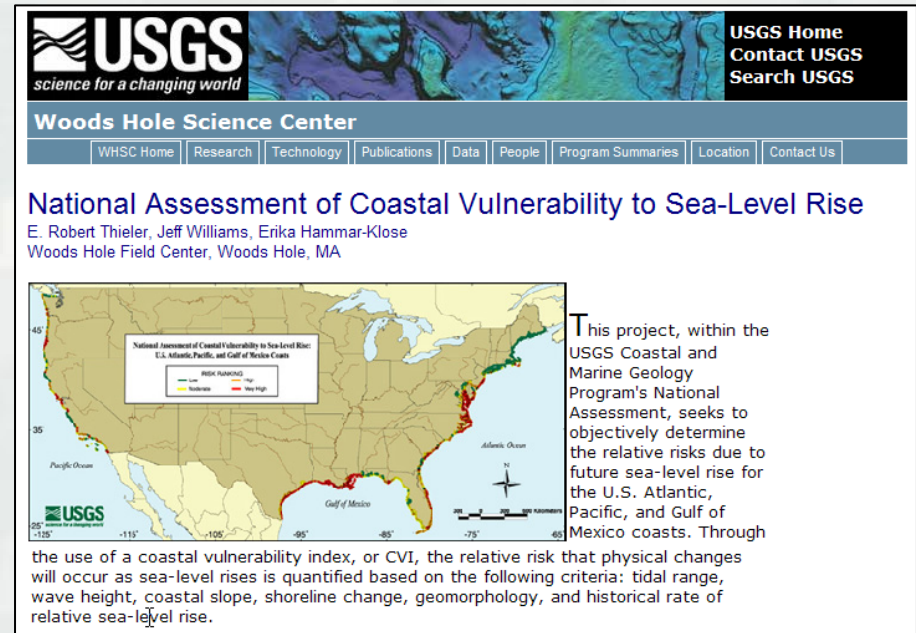
# Example Impacts to Operations and Maintenance

- Wave transmission into harbors; harbor resonance
- Functioning of coastal navigation inlet channels
- Changes in patterns in channel shoaling
- Decrease in clearance beneath bridges
- Harbors of refuge; Coast Guard operations
- Expected decreased water level in Great Lakes and interior water bodies



# Ongoing Activities

- Evaluation of **coastal vulnerabilities**
- Build on USGS Coastal Vulnerability Index
  - ▶ Already upgraded for use by Park Service
  - ▶ Joint update with NOAA planned



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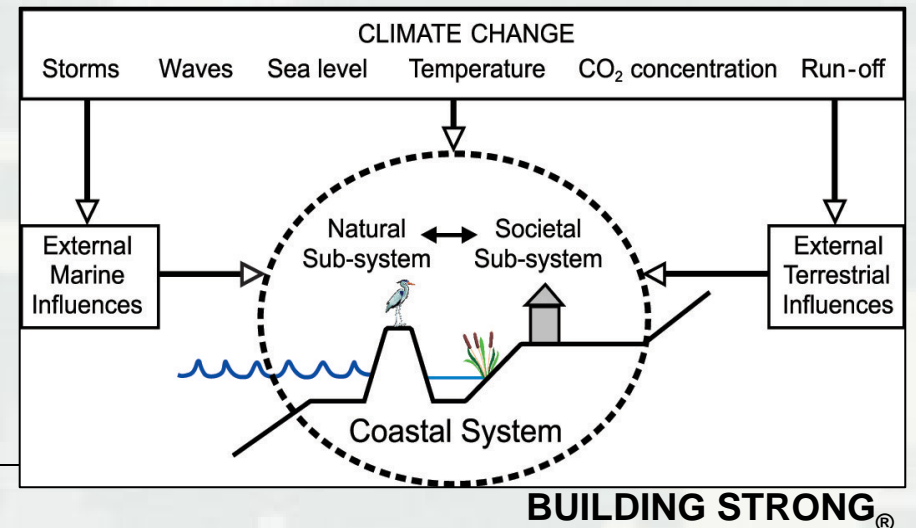
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### National Assessment of Coastal Vulnerability to Sea-Level Rise

E. Robert Thieler, Jeff Williams, Erika Hammar-Klose  
Woods Hole Field Center, Woods Hole, MA



This project, within the USGS Coastal and Marine Geology Program's National Assessment, seeks to objectively determine the relative risks due to future sea-level rise for the U.S. Atlantic, Pacific, and Gulf of Mexico coasts. Through the use of a coastal vulnerability index, or CVI, the relative risk that physical changes will occur as sea-level rises is quantified based on the following criteria: tidal range, wave height, coastal slope, shoreline change, geomorphology, and historical rate of relative sea-level rise.







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