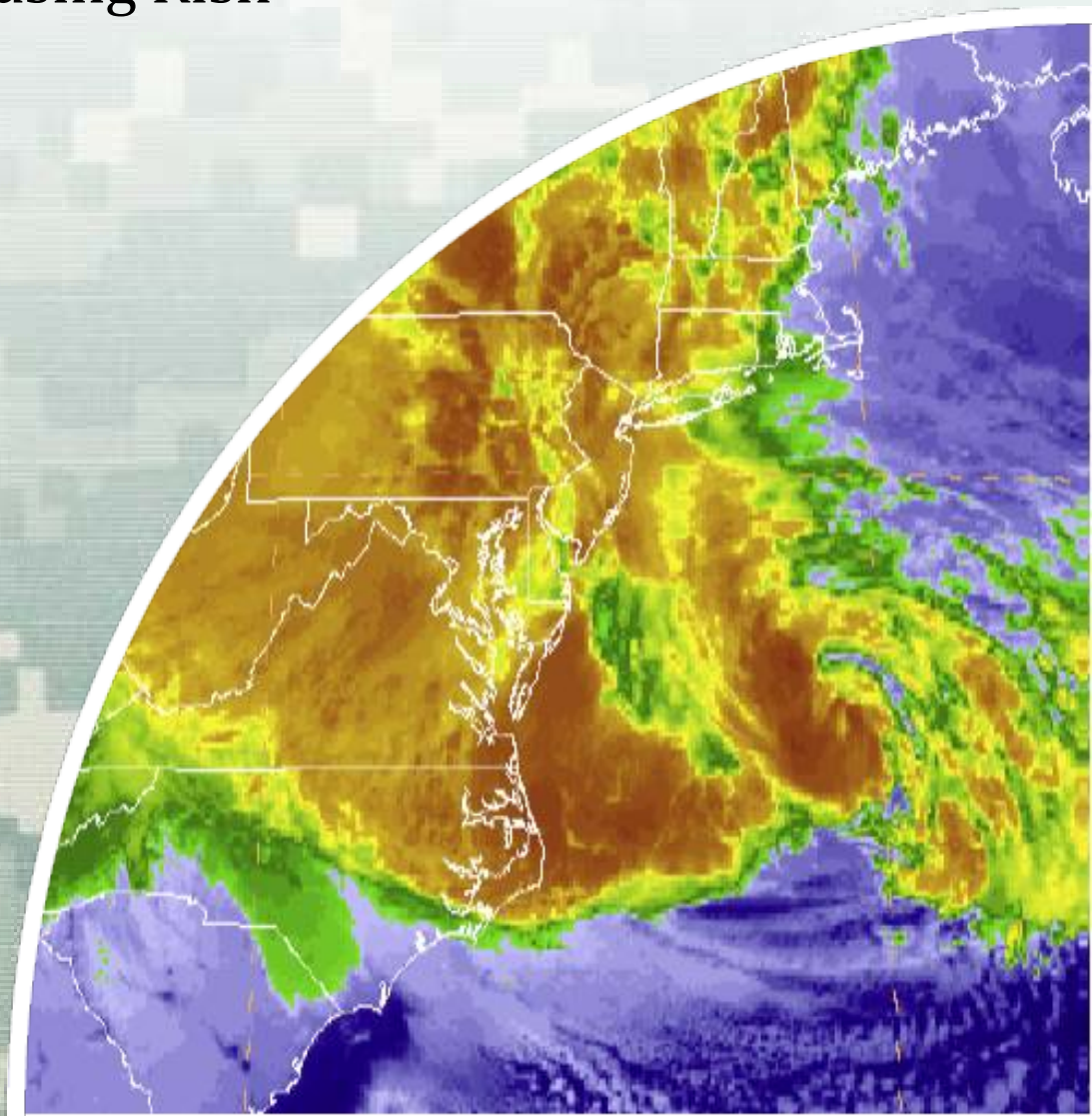
North Atlantic Coast Comprehensive Study

Resilient Adaptation to Increasing Risk

U.S. Army Corps of Engineers
National Planning Center for Coastal Storm Risk Management

19 March 2014



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US Army Corps of Engineers
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Presenters

- Amy Guise
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NACCS Background

- Hurricane/Post-Tropical Cyclone Sandy moved to the U.S. Atlantic Ocean coastline 22-29 October 2012
- Affected entire U.S. east coast:

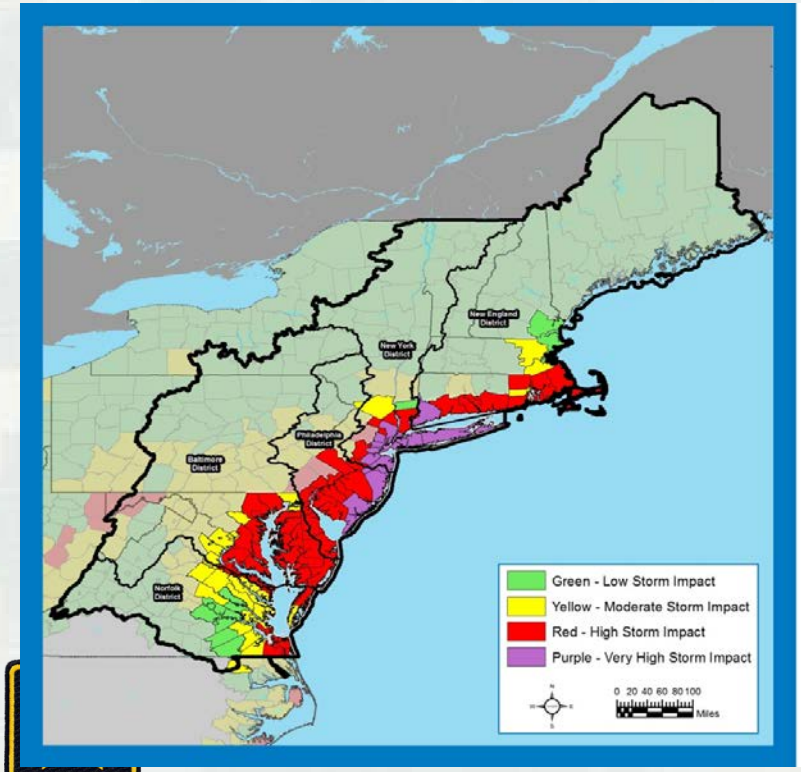
  24 States from Florida to Maine; New Jersey to Michigan and Wisconsin
- Areas of extensive damage from coastal flooding: New Jersey, New York, Connecticut
- Public Law 113-2 enacted

  29 January 2013

NACCS Background

"That using up to $20,000,000* of the funds provided herein, the Secretary shall conduct a **comprehensive study** to address the flood risks of **vulnerable coastal populations** in areas that were affected by Hurricane Sandy within the boundaries of the North Atlantic Division of the Corps…" (*$19M after sequestration)

- **Complete by January 2015**



Goals

- Provide a **Risk Reduction Framework** , consistent with USACE-NOAA Rebuilding Principles

- Support **Resilient Coastal Communities** and robust, sustainable coastal landscape systems, considering future sea level rise and climate change scenarios, to reduce risk to vulnerable population, property, ecosystems, and infrastructure

Findings, Outcomes, and Opportunities

- Findings
  - ► Shared Responsibility to address increasing vulnerability, particularly low-lying shorelines
  - ► Improved storm risk management strategies
    - Robust, Redundant, and Resilient array of strategies and management measures
  - ► Interaction between fluvial and coastal flooding
    - Watershed, coastshed, and stormwater

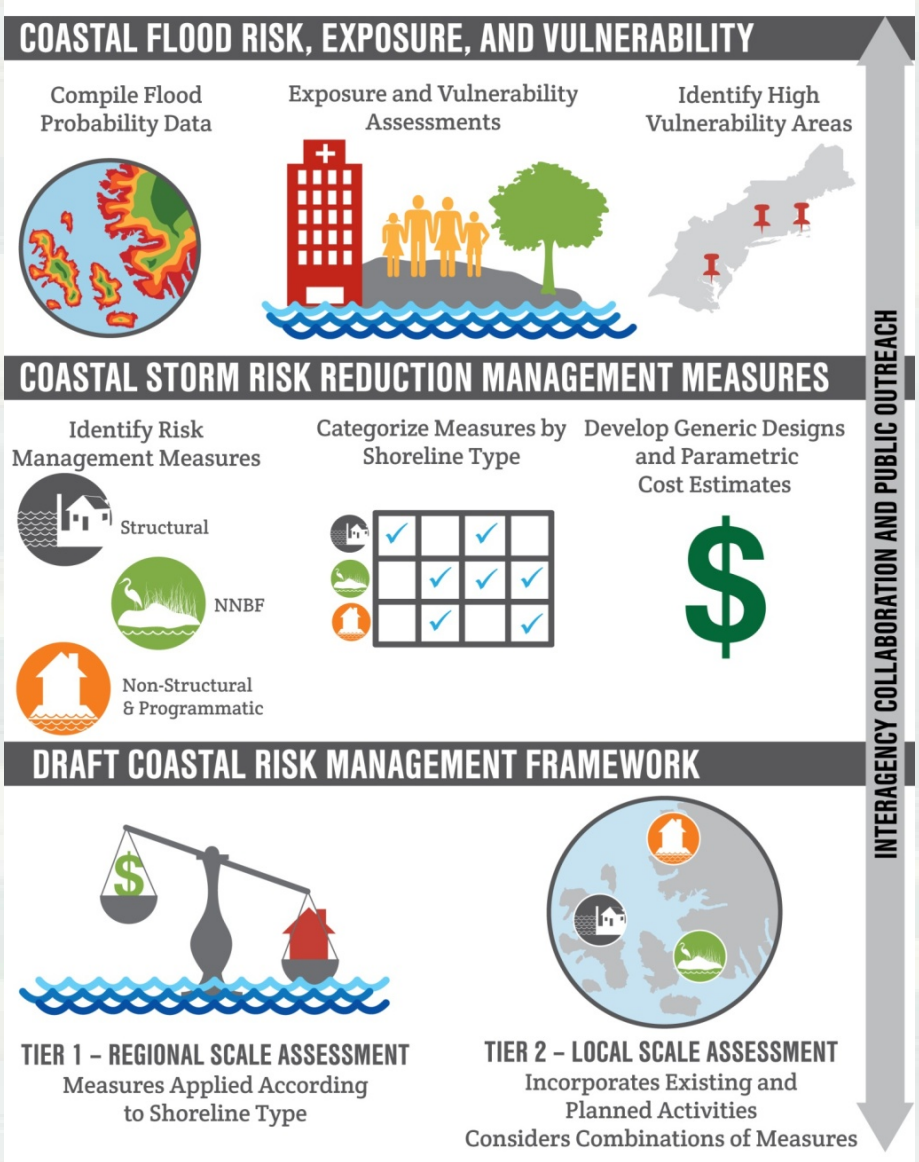
Findings, Outcomes, and Opportunities

- Outcomes
  - ▶ Coastal Storm Risk Management Framework
    - States and District of Columbia
  - ▶ Collaboration
  - ▶ Closing Data Gaps and Enhanced Tools
  - ▶ Tools to expedite future investigations and evaluations

Findings, Outcomes, and Opportunities

- Opportunities
  - Dynamic Collaboration
  - Creative Incentives
  - Public-Private Partnerships
  - Resource Optimization
  - Improve Implementation of Natural and Nature-Based Features
  - Flexibility and Adaptive Management

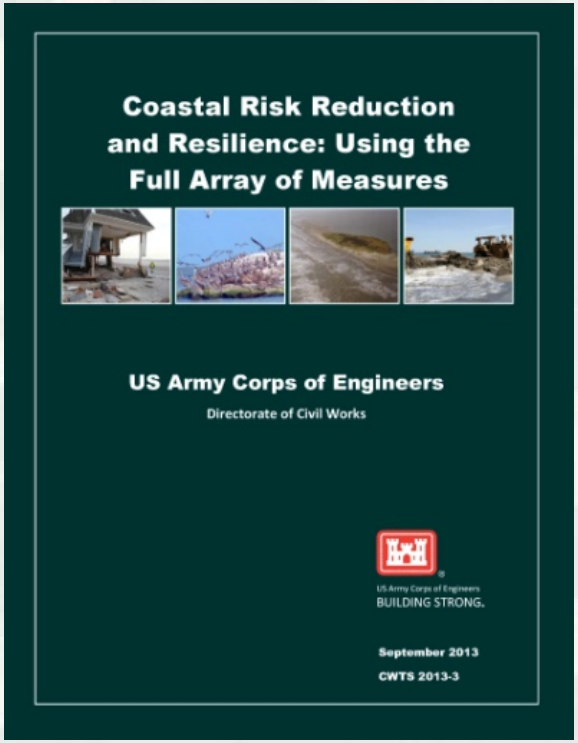
NACCS Framework



- **Identify** flood risk?
- **Who and What** is exposed to flood risk?
- What are the **appropriate strategies** and management measures to reduce flood risk and how do they align with **each other and other regional plans**?
- What is the **relative cost** of a particular measure compared to the anticipated risk reduction?
- What **data are available** to make a **RISK-INFORMED decision**?
- What **data gaps exist/can be closed** through the NACCS?

Risk Management Measures

- **Structural**
  - Storm surge barriers, levees/floodwall, breakwaters, beach fill/dunes
    - **NNBF**
      (e.g., living shorelines, wetlands, oyster reefs, sub-aquatic vegetation restoration)
- **Non-Structural**
  - Floodproofing, elevation, acquisition
  - Evacuation, flood warning systems
- **Policy/Programmatic**
  - Floodplain management, land use planning
  - State/Local Coastal Zone Policies, Flood Insurance Programs
  - Natural resources/surface water management



USACE Coastal Risk Reduction and Resilience: Using the Full Array of Measures

Collaboration

- Four Working Meetings
  - Measures, Modeling, NNBF (technical and policy)
- Five Collaboration Webinars
- Two Tribal Stakeholders Webinars
- Three Federal Register Notices
- Multiple Mailings/Emails to Federal, State and NGO SMEs or POCs

Collaboration

- Over 100 completed strategic engagements
- Seven Visioning Sessions (in coordination with NOAA)
- Public Website
  - ▶ 5,039 visits and 7,742 page views
  - ▶ Over 165 subscribers

Natural and Nature-Based Features

- Natural landscapes or engineered ecosystems, and blended solutions
- Provides multiple, diverse benefits
- Intrinsically dynamic, adaptive, and potentially more resilient than built systems

The NACCS will

- Evaluate the performance of NNBF during Hurricane Sandy
- Identify features that were especially resilient to storms
- Develop tools for evaluation of benefits
- Consider the use of NNBF to reduce the impacts of coastal storm flooding, erosion, etc. at a larger scale and as a system
- Work towards building a Federally-shared perspective on NNBF, and its benefits

Incorporation of Climate Change

Complete

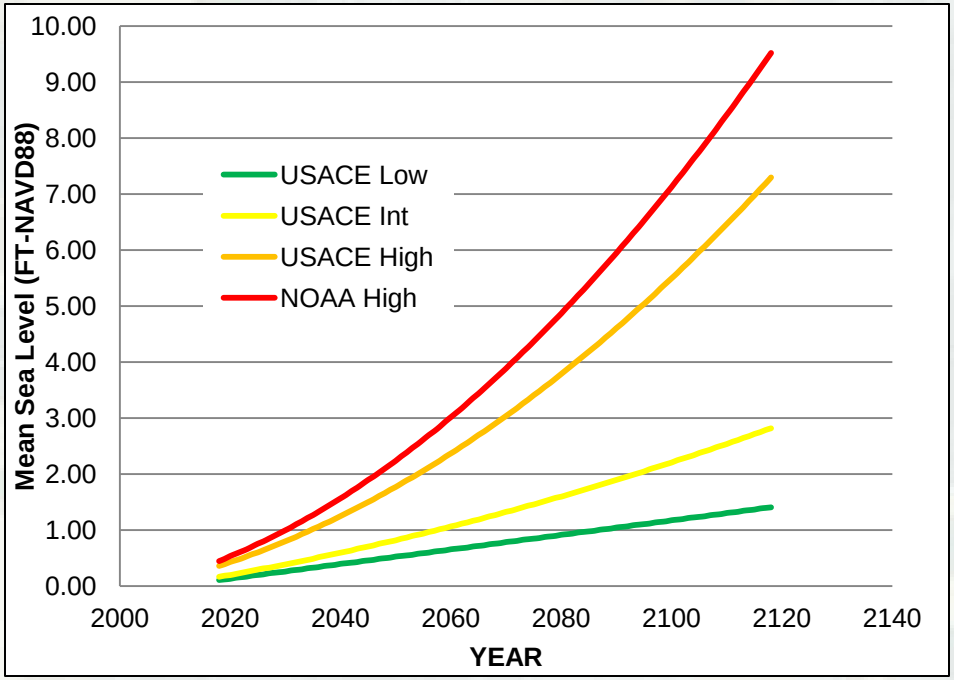
- Evaluate relative sea level rise scenarios
- GIS mapping of relative sea level rise in 50 and 100 years
- Statistical analysis of historical extreme water levels

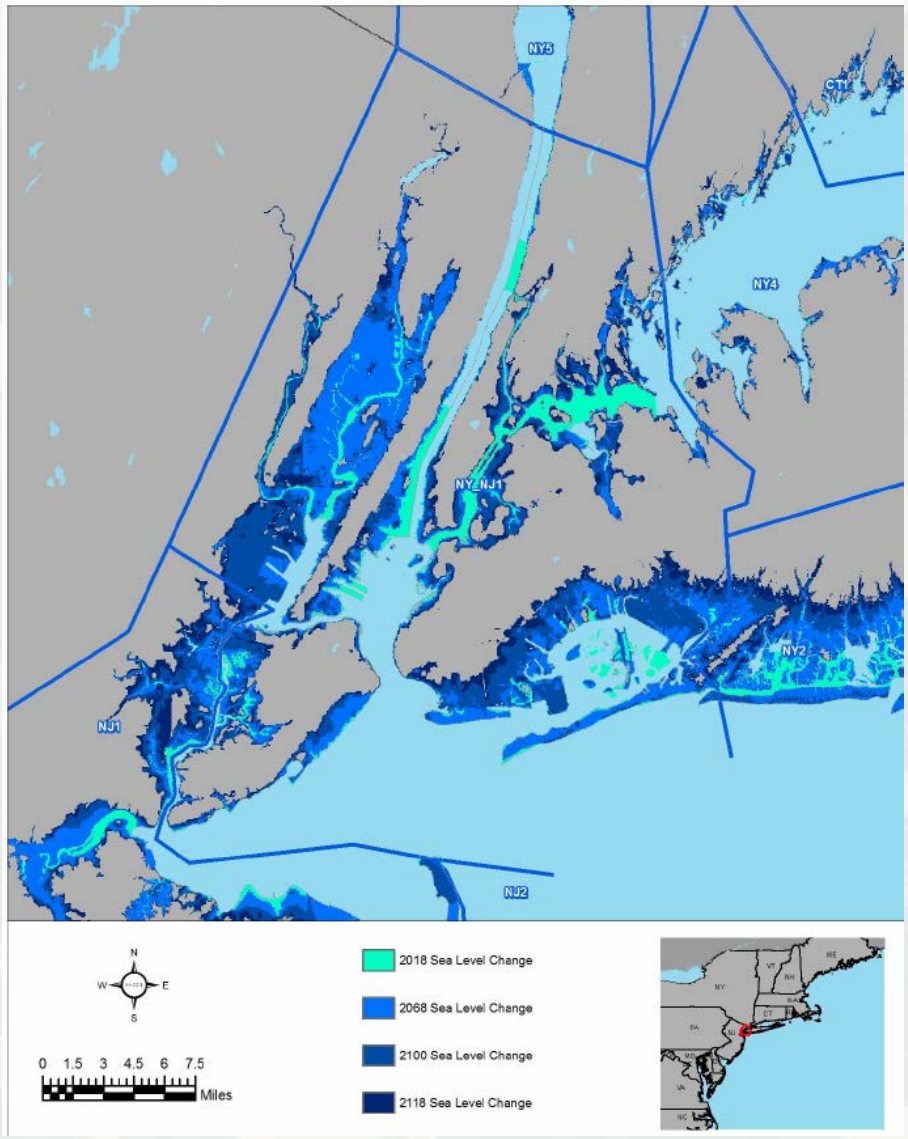
Ongoing

- Climate change adaptation methods and example
- Sea level change scenario integration into numerical modeling of storms

Relative Sea Level Rise Scenarios

- USACE (2014) ER 1100-2-8162: *Incorporating Sea-Level Change in Civil Works Programs*
- NOAA (2012): *Global Sea Level Rise Scenarios for the US National Climate Assessment*
- 35 Locations from VA to ME, NOAA long term (>40 year data record) water level stations
- Future mean sea level mapping





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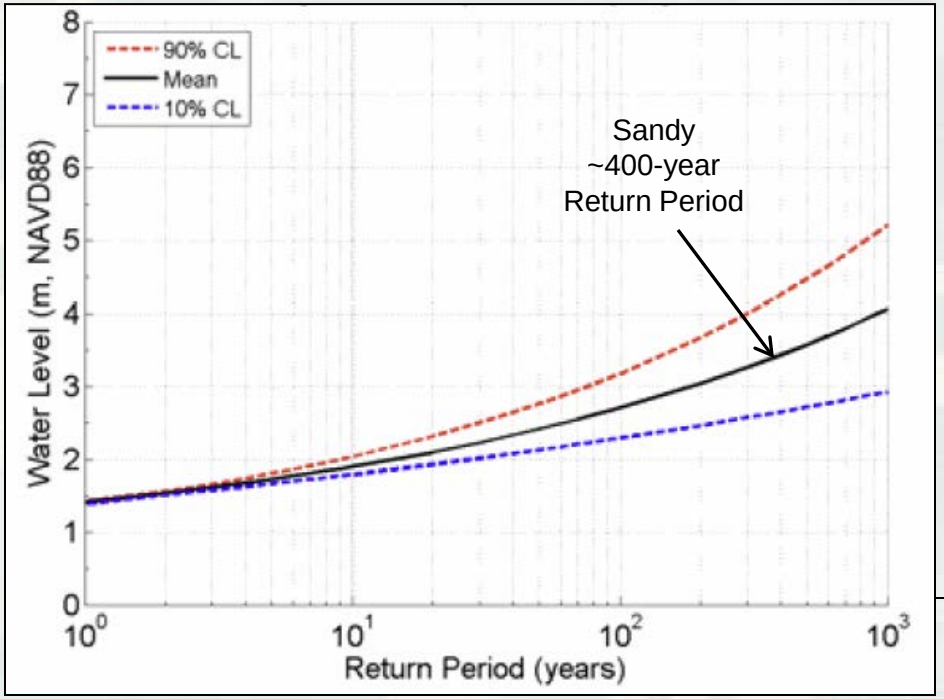
Combined Extreme Water Levels and Relative Sea Level Rise

Example: Sandy Hook, NJ

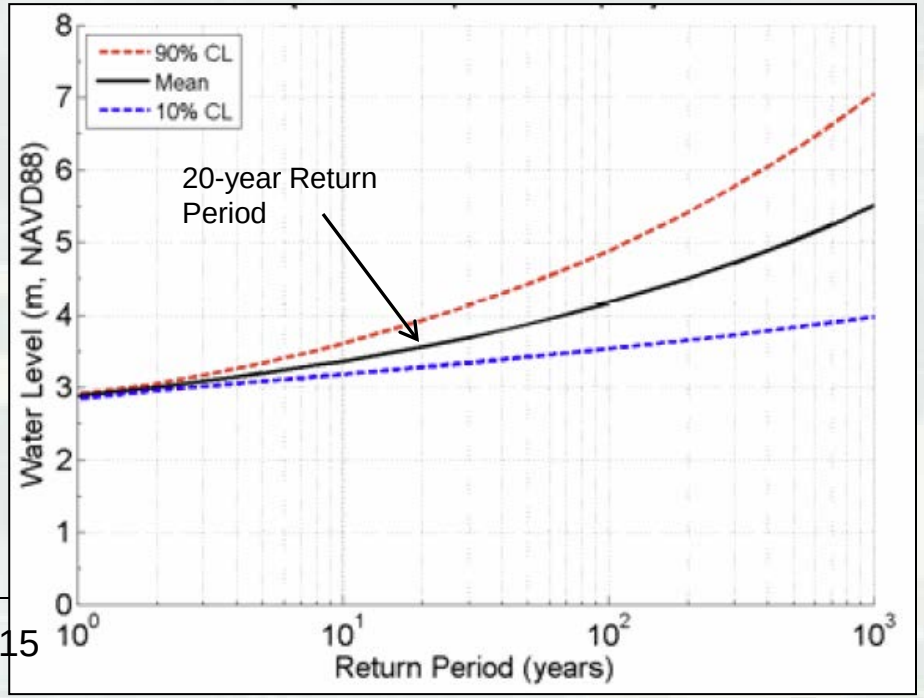
Statistical analysis of historical extreme water levels

- Combined with relative sea level rise scenarios = future extreme water level exceedance probability
- 23 NOAA water level stations with sufficient data quality/quantity

Historical Extreme Water Level



USACE 'High' Relative Sea Level Rise, 100 years



Ongoing Work

Climate change adaptation methods and example

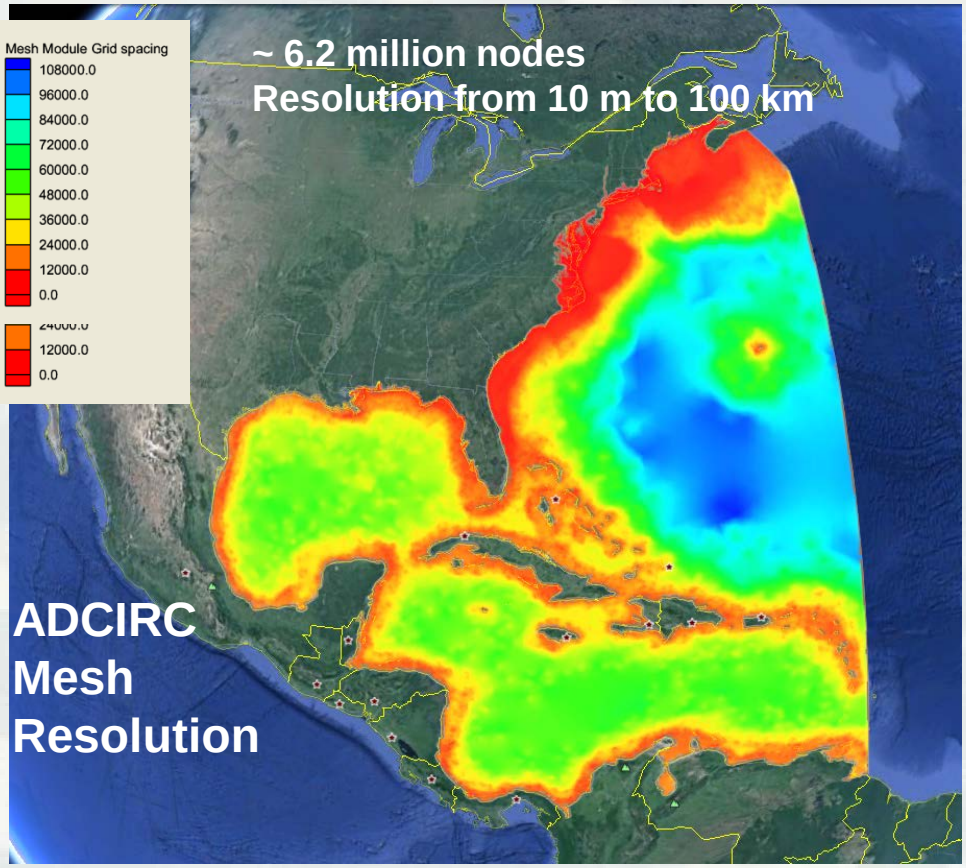
- Decision support given climate and response uncertainty
- Scenario-based analysis and planning
- Low-Regret measures: benefits under current climate and future scenarios e.g. non-structural, NNBF, etc.

Sea level scenarios and numerical modeling of storms

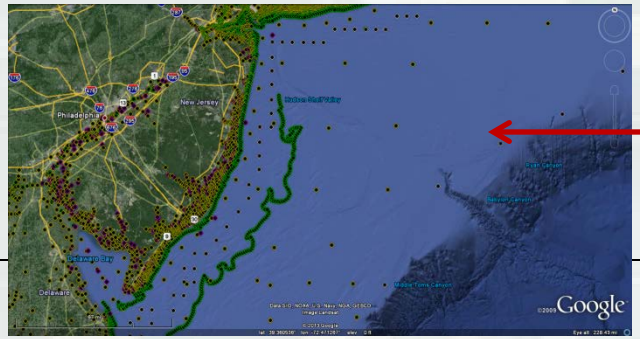
Coastal Storm Numerical Modeling

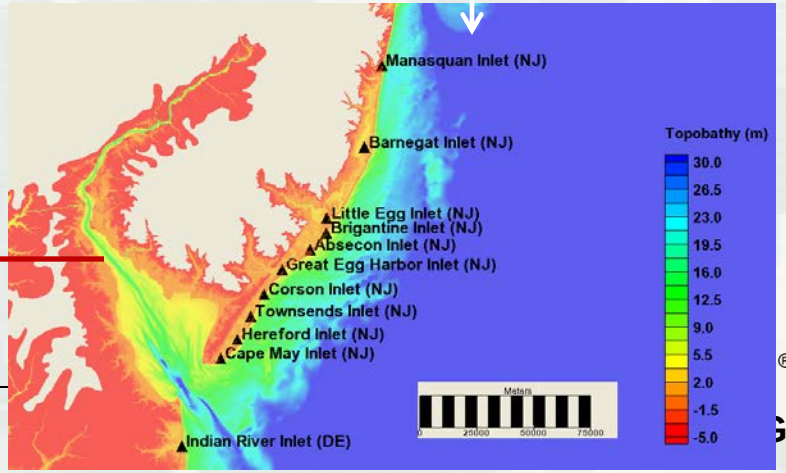
- Refine regional storm suites and storm surge, wave forces.
  - Waves and Water Levels for Risk Assessment and Design for future analysis and studies (historical and synthetic-hypothetical)
- Define the coastal storm probability space (tropical and extra-tropical) for the study area for coastal risk assessment and project design.
- CSTORM- DB will store storm parameters (water surface elevation, water and wind velocity, wave conditions) for future, more detailed studies, by the completion of the NACCS study (Jan 2015). Data will be available on the web.
- The product of this CSTORM-MS simulation work will serve the coastal engineering and management communities of practice from VA to ME for years to come.

Coastal Storm Numerical Modeling
Grids and Data Save Points



18,977 Finalized High-Frequency Collocation Points





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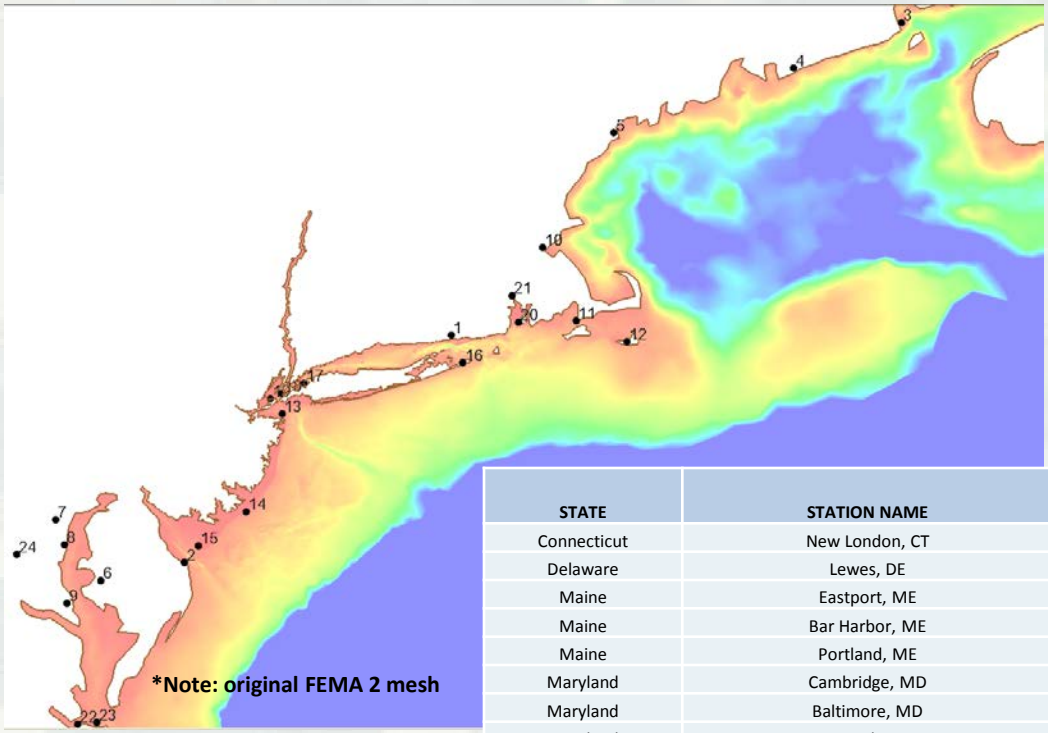
CSTORM-DB: Extra Tropical Storm Censoring Module



24 water levels gages
30-yr record length
250 storms identified

100 extra-tropical storms selected

STATE	STATION NAME	LATITUDE	LONGITUDE	START YEAR	END YEAR	LENGTH	
Connecticut	New London, CT	41° 21.6 N	72° 5.4 W	1938	2013	76	100+
Delaware	Lewes, DE	38° 46.9 N	75° 7.2 W	1957	2013	57	75+
Maine	Eastport, ME	44° 54.2 N	66° 58.9 W	1958	2013	56	50+
Maine	Bar Harbor, ME	44° 23.5 N	68° 12.3 W	1950	2013	64	
Maine	Portland, ME	43° 39.4 N	70° 14.8 W	1910	2013	104	
Maryland	Cambridge, MD	38° 34.4 N	76° 4.1 W	1979	2013	35	
Maryland	Baltimore, MD	39° 16 N	76° 34.7 W	1902	2013	112	
Maryland	Annapolis, MD	38° 59 N	76° 28.8 W	1928	2013	86	
Maryland	Solomons Island, MD	38° 19 N	76° 27.1 W	1979	2013	35	
Massachusetts	Boston, MA	42° 21.2 N	71° 3.2 W	1921	2013	93	
Massachusetts	Woods Hole, MA	41° 31.4 N	70° 40.3 W	1958	2013	56	
Massachusetts	Nantucket Island, MA	41° 17.1 N	70° 5.8 W	1965	2013	49	
New Jersey	Sandy Hook, NJ	40° 28.0 N	74° 0.5 W	1910	2013	104	
New Jersey	Atlantic City, NJ	39° 21.3 N	74° 25.1 W	1911	2013	103	
New Jersey	Cape May, NJ	38° 58.1 N	74° 57.6 W	1965	2013	49	
New York	Montauk, NY	41° 2.9 N	71° 57.6 W	1959	2013	55	
New York	Kings Point, NY	40° 48.6 N	73° 45.8 W	1957	2013	57	
New York	The Battery, NY	40° 42.0 N	74° 0.8 W	1920	2013	94	
New York	Bergen Point West Reach, NY	40° 38.2 N	74° 8.5 W	1981	2011	31	
Rhode Island	Newport, RI	41° 30.3 N	71° 19.6 W	1930	2013	84	
Rhode Island	Providence, RI	41° 48.4 N	71° 24.0 W	1979	2013	35	
Virginia	Sewells Point, VA	36° 56.8 N	76° 19.8 W	1927	2013	87	
Virginia	Chesapeake Bay Bridge Tunnel, VA	36° 58 N	76° 6.8 W	1975	2013	39	
Washington DC	Washington, DC	38° 52.4 N	77° 1.3 W	1931	2013	83	

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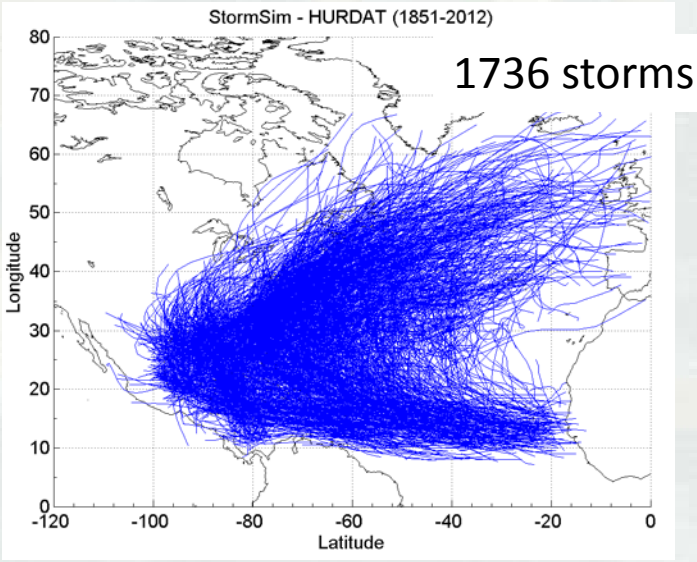
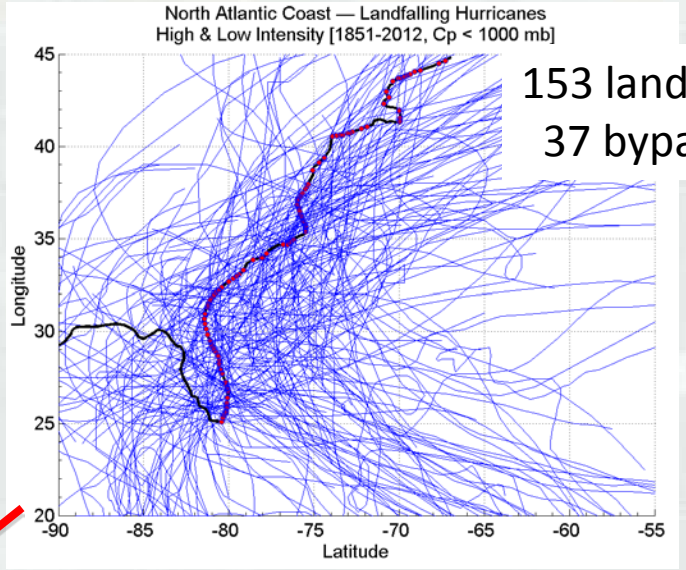
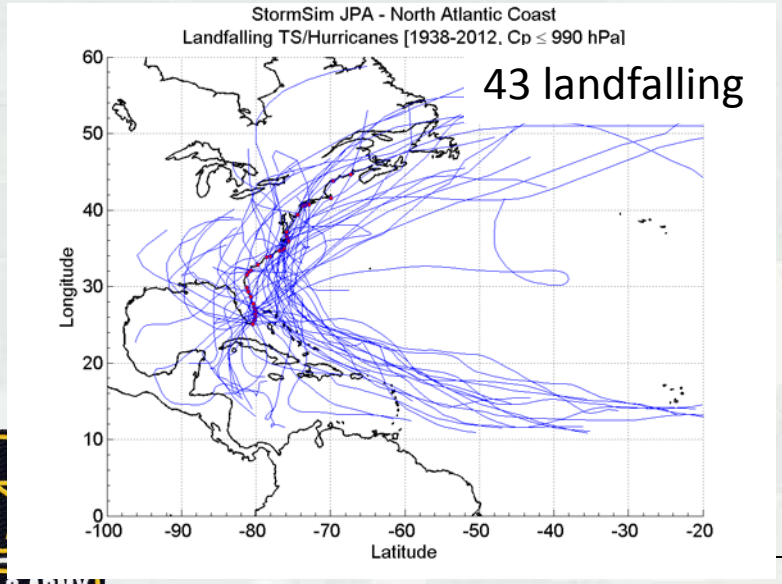
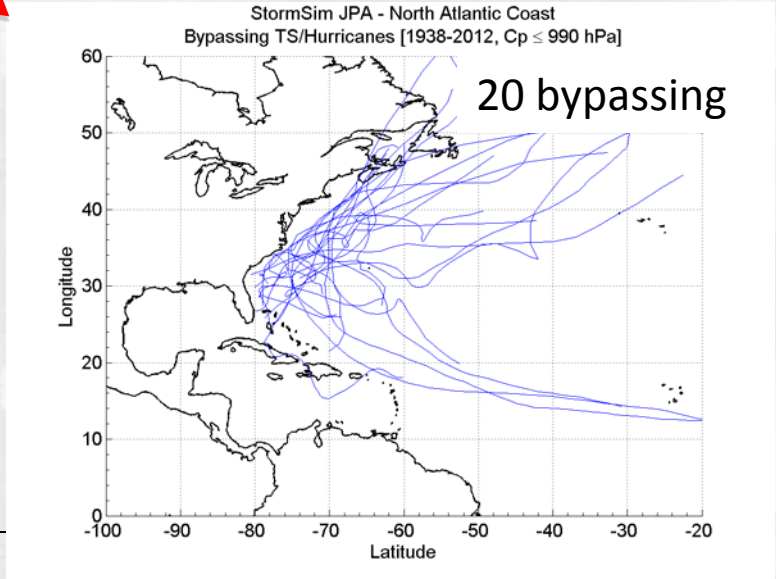
CSTORM-DB: Tropical Storm Censoring Module









For model validation, SLR analysis, and for synthetic storm development

ONGOING ECONOMICS

Depth-Damage Function Refinement

- Measurement of direct physical effects of Hurricane Sandy to better estimate their economic consequences
- Development of depth-emergency cost and infrastructure damage relationships for the storm
- Gathering data to refine Corps current depth-fatality model to better estimate the effects of coastal storms
- Establishment of lines of causation for secondary and tertiary effects of the event to inform development of a method to apply them in Corps benefit calculations

What Happens Next?

- The NACCS team will receive comments for integration into the NACCS report
  - ► Mid-April 2014
- Integration
  - ► Mid-April/May 2014
- Draft Final Report production
  - ► June 2014
- Final USACE vertical team review
  - ► July – December 2014
- Submit to Congress
  - ► **January 2015**

Review Information

- Review documents are DRAFT and NOT FOR DISTRIBUTION
- Download the documents via AMRDEC
  - See email from No-Reply@amrdec.army.mil
- Review the draft analyses documentation
- Follow the link to the feedback form
  - Keep the feedback questions in mind during your review
  - Complete the online feedback form
- Tune into subject-specific webinars
- All feedback forms due by **April 14, 2014**

Subject Specific Webinars

- Outlook invitations will be sent later this week
  - Risk, Exposure, and Vulnerability
  - Strategies and Management Measures (including NNBF)
  - Sea Level Rise and Climate Change Adaptation
  - Institutional and Other Barriers

What Happens Next?

- Technical Challenges with accessing document and comment forms?
- General issues or for further coordination?
- Contact via email:

Dave Robbins

Baltimore District, USACE

Email: David.W.Robbins@usace.army.mil

Questions