Storm Damage Reduction Benefits of Natural Infrastructure in the JC NERR

November 3, 2017
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NATIONAL CENTERS FOR **COASTAL OCEAN SCIENCE**
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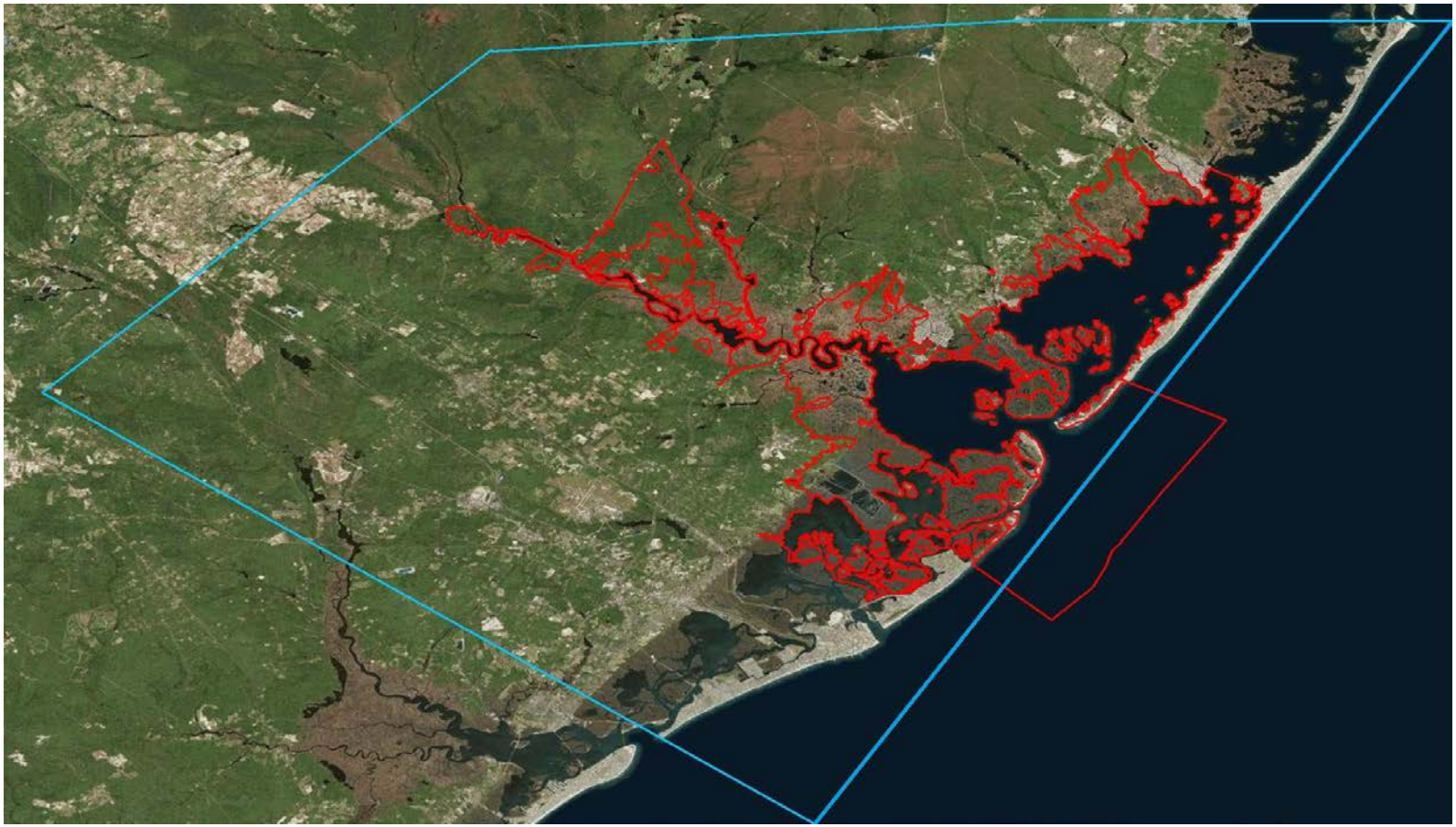


RED = JC NERR boundary

BLUE = Study Area Boundary

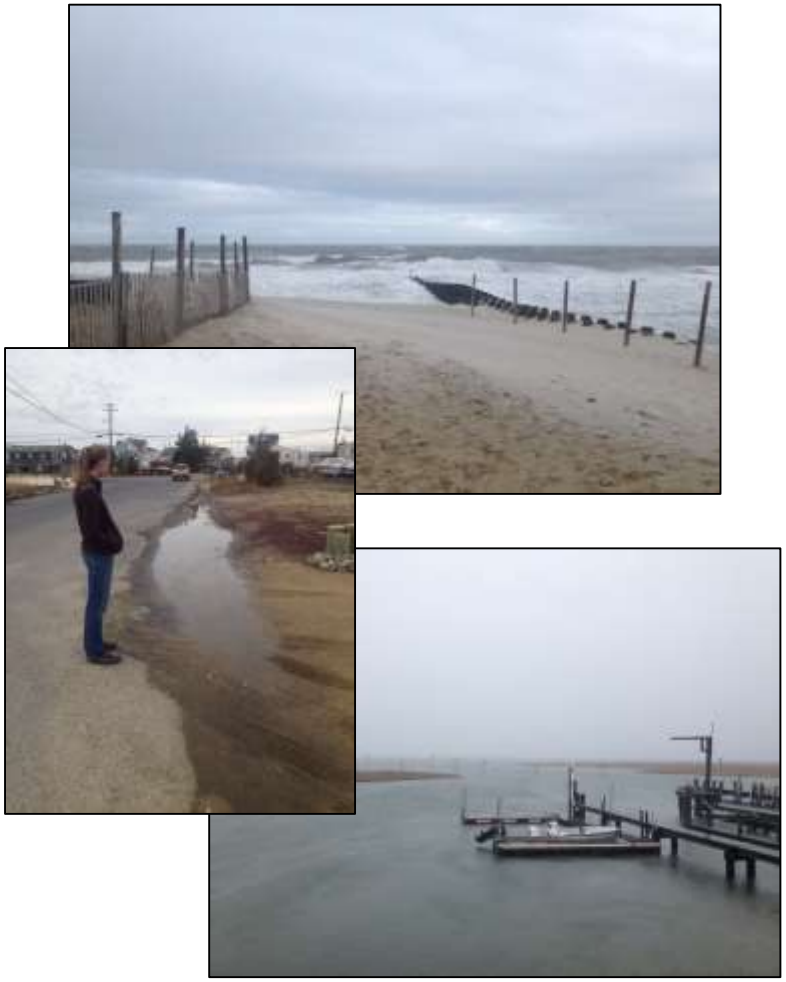
Project Overview

- Ecosystem service valuation
- Site selection process
- Stakeholder engagement
- Inundation modeling and property damage estimation under baseline conditions
- Inundation modeling and property damage estimation under year 2050 conditions
- Storm damage reduction value of the marsh in a 25-yr, 50-yr, and Hurricane Sandy storm events
- Value of flood insurance premium savings attributed to open space preservation

Motivation

Why is this being done?

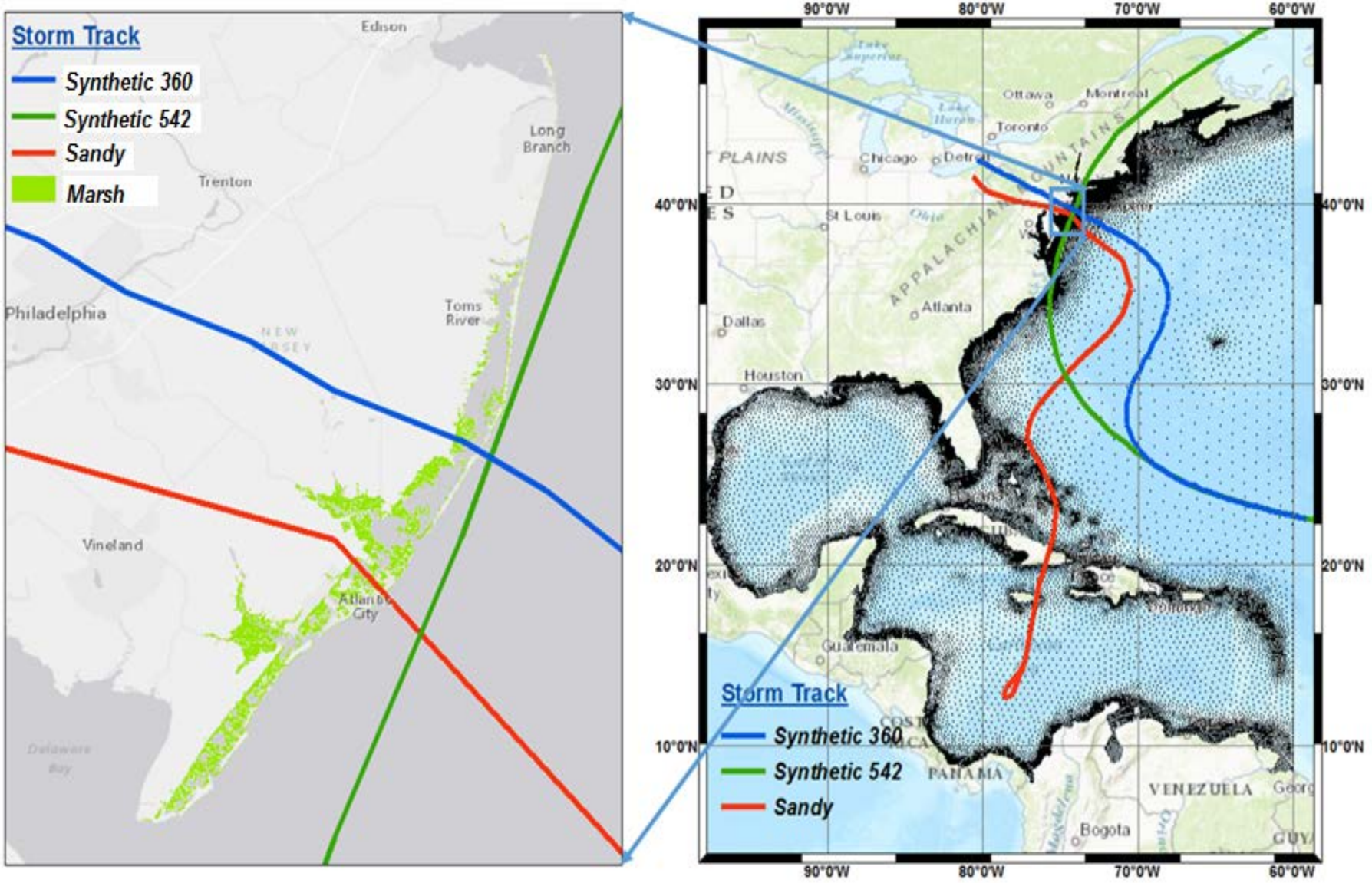
- Increase knowledge and awareness of ecosystems and their contribution to human wellbeing
- Promote necessity of protecting ecosystems to provide benefits for future generations
- Gain support for restoration and for future projects that will help protect the ecosystem



Methodology – Scenario Selection

- The NCCOS team met with JC NERR partners to develop storm and habitat scenarios in November 2015
- Three storm events, 2 habitat scenarios, and 2 sea level/marsh migration time periods were selected:

Sea level/marsh conditions	Storm Event	Marsh Scenario
Current sea level/marsh conditions	Hurricane Sandy	Marsh present
		Marsh absent (converted to open water)
	50-year storm	Marsh present
		Marsh absent (converted to open water)
	25-year storm	Marsh present
		Marsh absent (converted to open water)
Year 2050 sea level/marsh conditions	Hurricane Sandy	Marsh present
		Marsh absent (converted to open water)
	50-year storm	Marsh present
		Marsh absent (converted to open water)
	25-year storm	Marsh present
		Marsh absent (converted to open water)


Storm Track
Synthetic 360
Synthetic 542
Sandy
Marsh
Edison
Long Branch
Trenton
Philadelphia
Toms River
Vineland
Atlantic City
Delaware Bay
90°0'W
80°0'W
70°0'W
60°0'W
40°0'N
30°0'N
20°0'N
10°0'N
Ottawa
Montreal
Toronto
Chicago
Detroit
St Louis
Atlanta
Dallas
Houston
Guatemala
PANAMA
VENEZUELA
Bogota
Storm Track
Synthetic 360
Synthetic 542
Sandy

Methodology – Inundation Modeling

- Advanced Circulation Model (ADCIRC)
  - Outputs:
    - Water velocity
    - Water elevations
    - Water depth
- Simulating Waves Nearshore (SWAN)
  - Outputs:
    - Wave height
    - Period
    - Direction

Methodology – Inundation Modeling

- Sea Level Affecting Marshes Model (SLAMM)
  - Used to predict sea level and marsh coverage in the future

- ADCIRC and SWAN models are then both ran again in the “2050” environment

Methodology - Damages Avoided

- By combining outputs from:
  - The ADCIRC and SWAN models
  - New Jersey parcel data
  - US Army Corps of Engineers depth damage functions
- The storm damage reduction benefits provided by natural infrastructure in the JC NERR study area is calculated

Methodology – Community Rating System

- The Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements
  - Discounted flood insurance premium rates

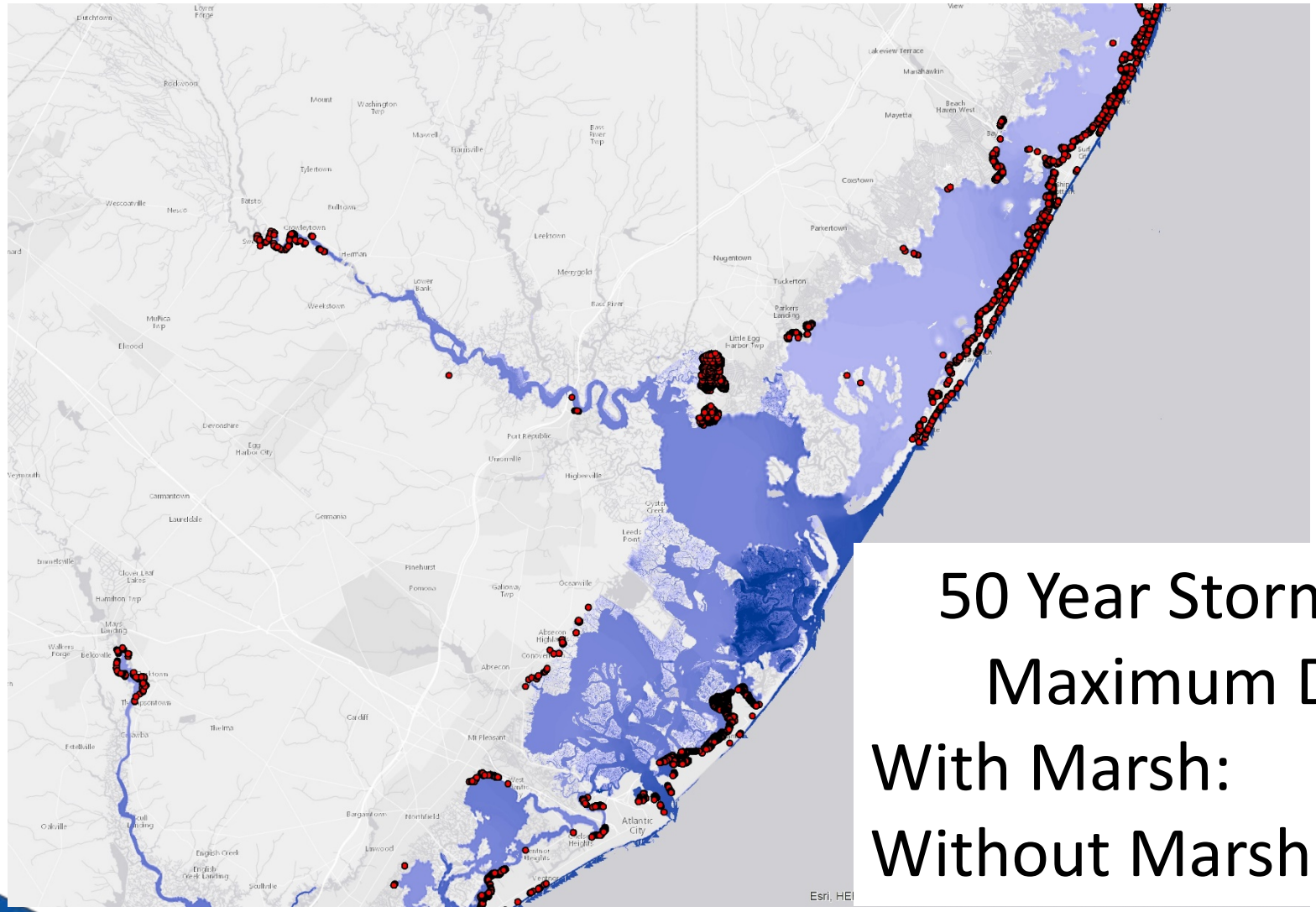
- "Credit Points" are issued to communities that engage in these floodplain management activities

Methodology – Community Rating System

- One of the CRS activities is Open Space Preservation (OSP)
- The JC NERR is considered preserved open space
- The preservation of Open Space leads to NFIP discounts in CRS-participating communities
  - Since people are saving money on flood insurance premiums, they have additional discretionary income to spend elsewhere in the economy
- Marginal Propensity to Consume
- Economic Ratios and Multipliers

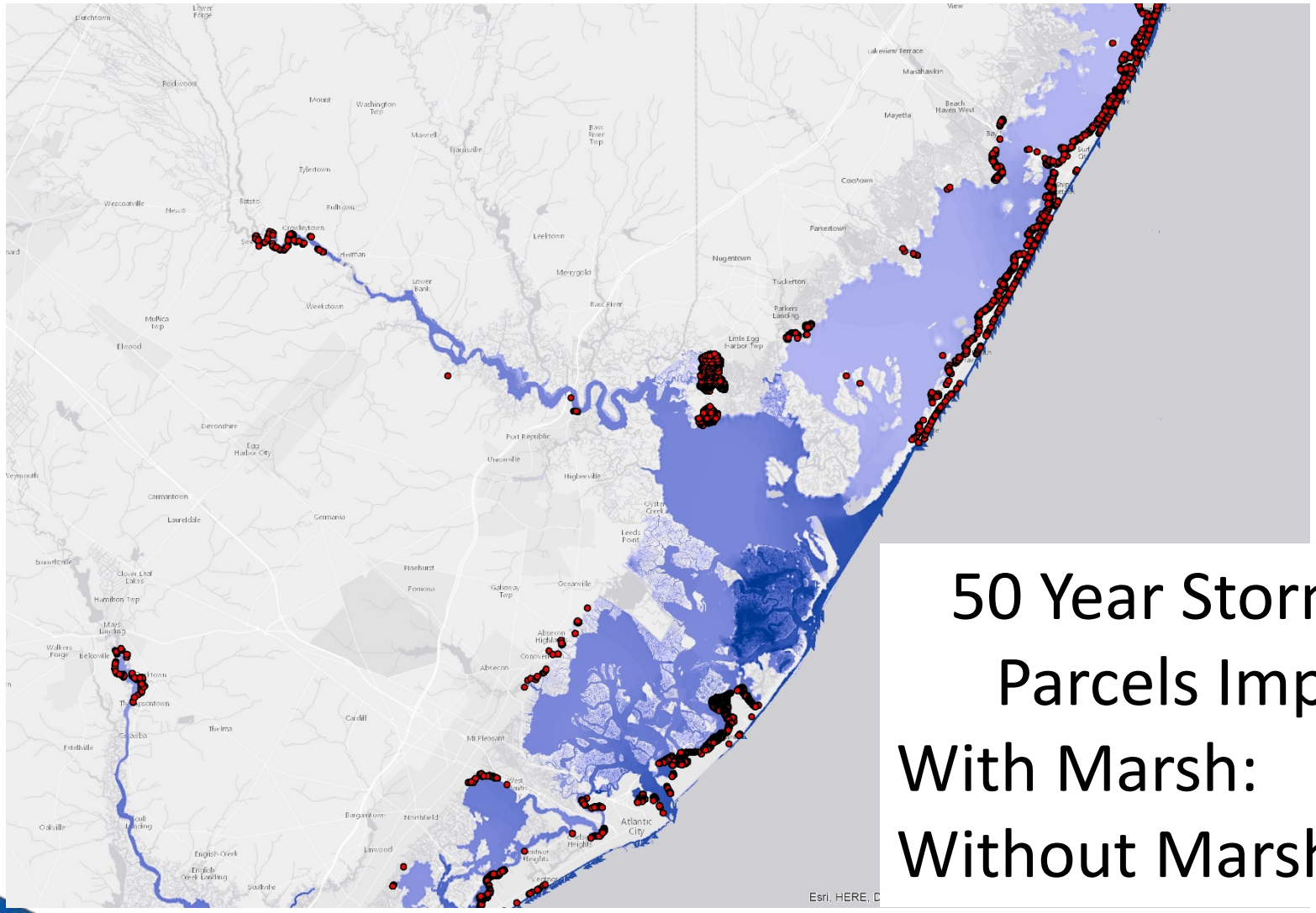
RESULTS

Results – Flood Depths



50 Year Storm Event
Maximum Depth
With Marsh: 9.18 ft
Without Marsh: 10.33 ft

Results – Parcels Impacted



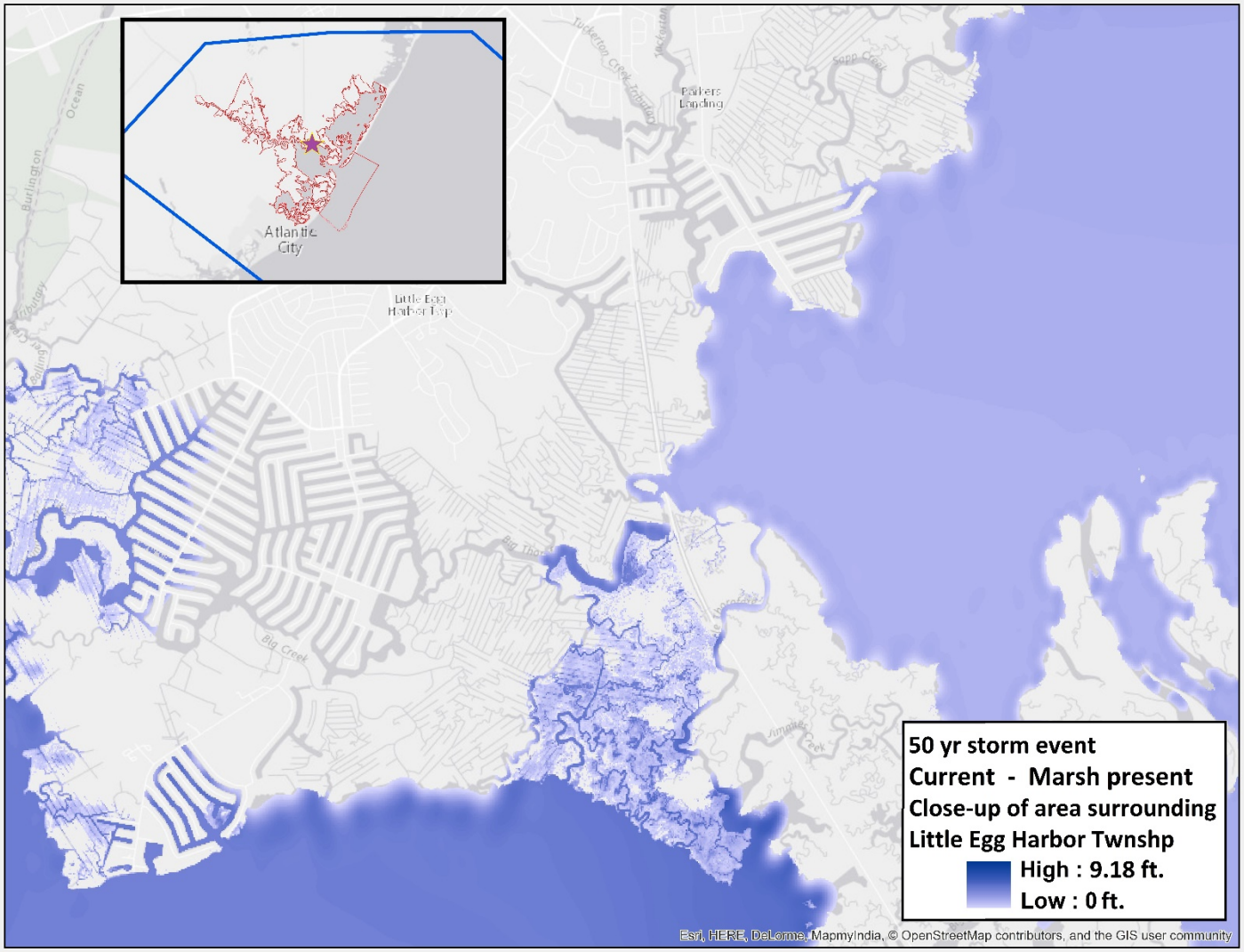
50 Year Storm Event

Parcels Impacted

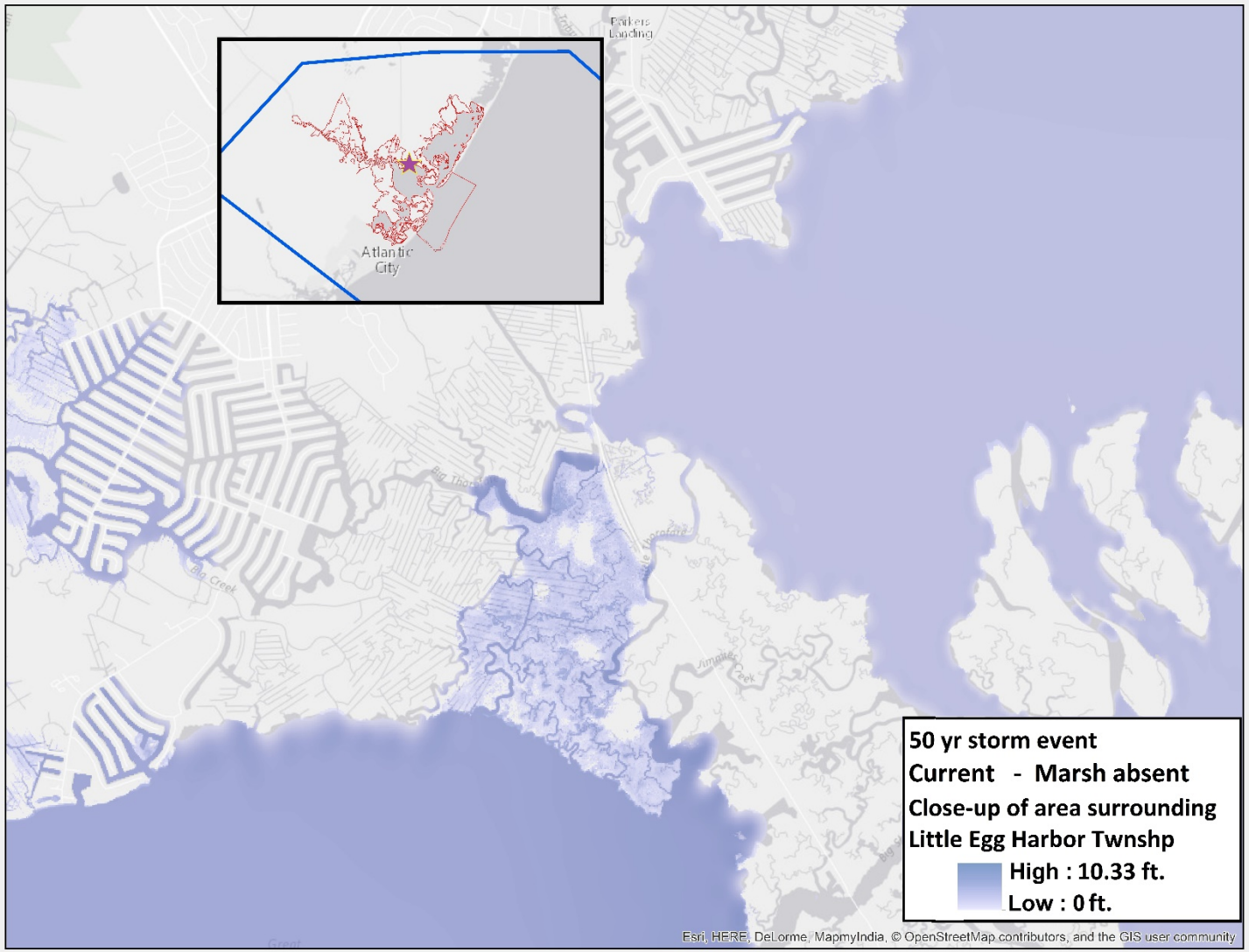
With Marsh: 5083

Without Marsh: 5878

Results


Atlantic City
Parkers Landing
Little Egg Harbor Twp
Big Creek
50 yr storm event
Current - Marsh present
Close-up of area surrounding
Little Egg Harbor Twnshp
High : 9.18 ft.
Low : 0 ft.
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Results


Parkers Landing
Atlantic City
Big Creek
Jimmies Creek
50 yr storm event
Current - Marsh absent
Close-up of area surrounding
Little Egg Harbor Twnshp
High : 10.33 ft.
Low : 0 ft.
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Damages Avoided Results

Current Baseline Conditions

Event	Residential Property Damage; 2015$ (Marsh Absent)	Residential Property Damage; 2015$ (Marsh Present)	Damages Avoided (Value of the Marsh)	Percent Reduction in Damages Due to Marsh Presence	Per Acre Value of the marsh
Hurricane Sandy	$2,331,067,963	$2,322,731,031	$8,336,932	-0.36%	$136
50 Year Storm	$107,972,822	$94,888,388	$13,084,434	-13.79%	$213
25 Year Storm	$91,894,099	$82,062,657	$9,831,442	-11.98%	$160

Damages Avoided Results

Projected 2050 Conditions

Event	Residential Property Damage; 2015$ (Marsh Absent)	Residential Property Damage; 2015$ (Marsh Present)	Damages Avoided (Value of the Marsh)	Percent Reduction in Damages Due to Marsh Presence	Per Acre Value of the marsh
Hurricane Sandy	$2,594,648,892	$2,562,559,835	$32,089,057	-1.25%	$557
50 Year Storm	$349,122,514	$329,190,819	$19,931,695	-6.05%	$346
25 Year Storm	$126,980,226	$125,436,468	$1,543,758	-1.23%	$27

Damages Avoided Results

Statistical Analysis

	Effect of Marsh Presence		Effect of SLR and Marsh Migration	
	Current Conditions	2050 Conditions	Marsh Present	Marsh Absent
Number of parcels inundated (25-year storm)	DECREASE (p<0.01)	N/A	INCREASE (p<0.01)	INCREASE (p<0.01)
Number of parcels inundated (50-year storm)	DECREASE (p<0.01)	DECREASE (p<0.01)	INCREASE (p<0.01)	INCREASE (p<0.01)
Number of parcels inundated (Hurricane Sandy storm)	N/A	DECREASE (p=0.05)	N/A	N/A
Mean parcel inundation depth (25-year storm)	N/A	N/A	INCREASE (p<0.01)	INCREASE (p<0.01)
Mean parcel inundation depth (50-year storm)	N/A	DECREASE (p<0.01)		
Mean parcel inundation depth (Hurricane Sandy storm)	DECREASE (p=0.01)	DECREASE (p<0.01)		
Mean proportional structural damage (25-year storm)	DECREASE (p<0.01)	N/A	INCREASE (p<0.01)	N/A
Mean proportional structural damage (50-year storm)	DECREASE (p=0.02)	DECREASE (p<0.01)		INCREASE (p<0.01)
Mean proportional structural damage (Hurricane Sandy storm)	N/A	DECREASE (p<0.01)		INCREASE (p<0.01)

Community Rating System Results

Area of interest community that Participates in the CRS	Number of NFIP policy holders (2013)	Total CRS credit points (2013)	CRS Credit points associated with OSP (2013)	CRS class (2013)	Total CRS Discount aggregated across NFIP policy holders (2013)	Discount dollars attributed to OSP (2013$)	MPC (2014)	Expected increase in expenditures due to OSP CRS savings (2013$)	Expected increase in expenditures due to OSP CRS savings (2015$)
Barnegat Light	1,039	1214	368	8	$100,544	$41,688.16	0.6987	$29,125.66	$29,633.27
Beach Haven	2,485	2108	212	6	$649,876	$190,210.25	0.6768	$128,743.16	$130,986.91
Brigantine	7,637	2023	543	6	$1,221,373	$610,686.50	0.7410	$452,541.80	$460,428.75
Margate City	5,770	2007	51	6	$1,194,682	$349,667.89	0.6870	$240,208.81	$244,395.20
Stafford	3,675	2076	250	6	$777,326	$227,513.21	0.7436	$169,183.32	$172,131.87
TOTAL						**$1,419,766**			**$1,037,576**

- $1,419,766 in flood insurance savings attributed to open space preservation
  - Leads to $1,037,576 in additional direct expenditures in the community
- Output contribution = $938,973
- Income contribution = $451,500
- Employment contribution = 12 full time jobs.

Summary of Results – The Takeaways

- Residential property damage is predicted to be **GREATER** with marsh absent when compared to marsh present for all storm events

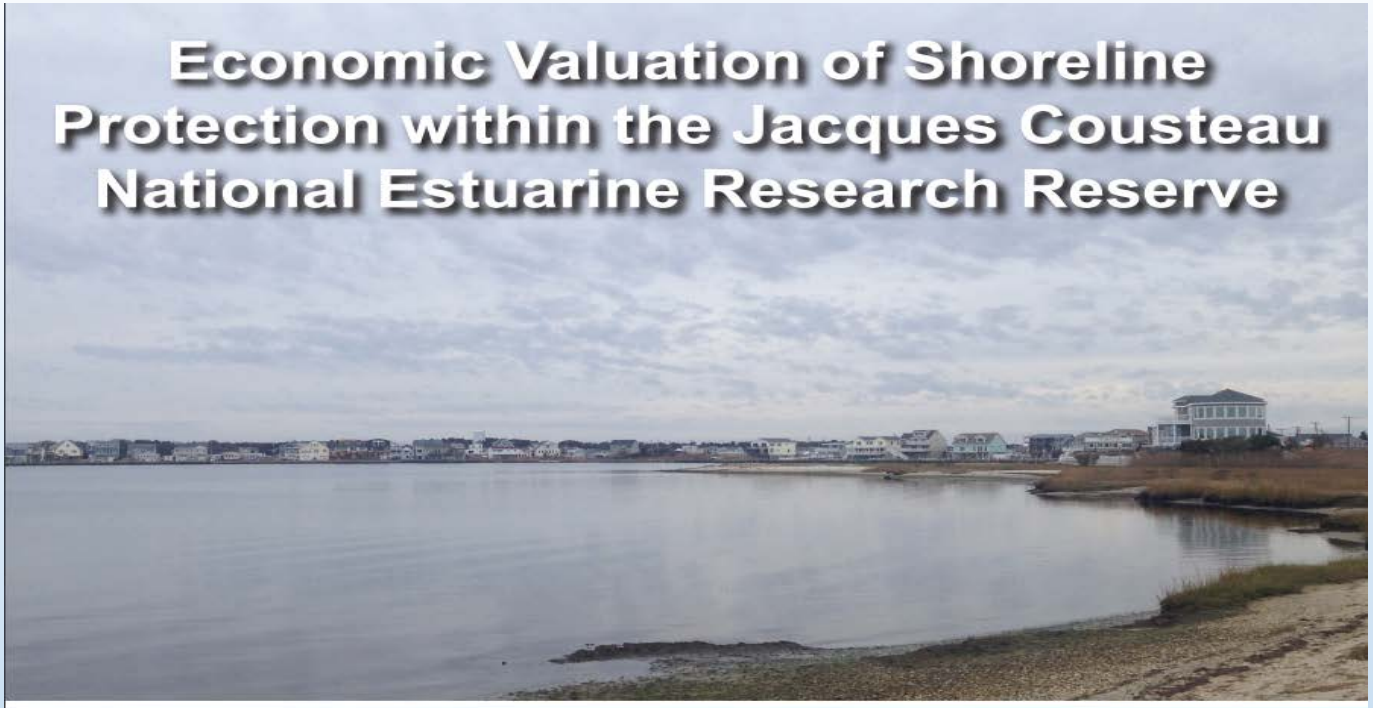
- Residential property damage is predicted to be **GREATER** in 2050 when compared to current times for all storm events

- The CRS is a valuable tool for saving money on flood insurance premiums which induces economic stimulus

Next Steps

- Dissemination of Technical Report
- Communicating Findings
- Publication of Peer-Reviewed Journal Article

Economic Valuation of Shoreline Protection within the Jacques Cousteau National Estuarine Research Reserve



NOAA National Centers for Coastal Ocean Science
Marine Spatial Ecology

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September 2017

NOAA TECHNICAL MEMORANDUM NOS NCCOS 234

NOAA NCCOS MSE

Resources

- Report Link: https://cdn.coastalscience.noaa.gov/publication-attachments/nccos-tech-memos/NCCOS-TM-234_Loerzel_2017.pdf
- Project Webpage: https://coastalscience.noaa.gov/project/economic-valuation-shoreline-protection-natural-infrastructure-coastal-community/
- New Jersey Restoration Community Planning Tool: http://maps.coastalresilience.org/newjersey/#
- CRS Open Space Preservation Planning Tool example: http://maps.coastalresilience.org/northcarolina/#

Resources

- **Series of Community Rating System Webinars:**
  - Organizer: Southeast and Caribbean Climate Community of Practice
  - "This free webinar series will specifically highlight how communities may achieve success in the green elements of the program. This four-part webinar series is your opportunity to learn more about nature-based solutions for community resilience, hear success stories from around the country, ask questions, and share input. CRS experts will share their experience and knowledge about tools, regulations and the process for building community resilience through the CRS. Information in the webinar series will demonstrate how you can reduce flood insurance premiums while enhancing your community's resilience."
  - The CRS Green Guide and Natural & Beneficial Functions of Floodplains
    - October 30, 2017 2:00 - 3:00 PM EST
    - Register: https://register.gotowebinar.com/register/3265883238098920 97
  - Building CRS Capacity: Success Stories at the Local and State Level
    - November 6, 2017 2:00 - 3:00 PM EST
    - Register: https://register.gotowebinar.com/register/5692724036845120513
  - CRS Open Space Preservation (Activity 420) Tools, Guidance and Success Stories
    - November 13, 2017 2:00 - 3:00 PM EST
    - Register: https://register.gotowebinar.com/register/5707053971889935617
  - CRS Stormwater Management (Activity 450) and Urban Flood Management Best Practices
    - November 27, 2017 2:00 - 3:00 PM EST
    - Register: https://register.gotowebinar.com/register/6971550617948615425

Thank you!

Project Partners

- NOAA NCCOS
- Jacques Cousteau National Estuarine Research Reserve
- National Estuarine Research Reserve System
- George Mason University
- Rutgers University

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