Piermont Marsh's Role in Buffering the Village from Storms: Sharing the Latest Research

July 16, 2020

UF | UNIVERSITY of FLORIDA

NEW YORK STATE OF OPPORTUNITY | Hudson River National Estuarine Research Reserve

A program of New York State Department of Environmental Conservation in partnership with National Oceanic and Atmospheric Administration

Piermont Waterfront Resiliency Commission

National Estuarine Research Reserve System Science Collaborative

CBI CATALYZING COLLABORATION

Getting Started

Welcome, Introductions and Workshop Purpose

MEETING PURPOSE

Share findings on:

- Marsh buffering role in Superstorm Sandy
- Marsh buffering role with future storms and projected sea level rise
- Marsh role in avoided damages

Update attendees on Marsh condition and restoration plans

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Getting Started

Agenda Review

AGENDA TOPICS

7:00pm	Welcome
7:10pm	Piermont Marsh Introduction and Management Update
7:35pm	Piermont Marsh Study Results
8:20pm	Next Steps
8:30pm	Adjourn

Opportunity for participant questions and comments throughout

3

Getting Started

Workshop Discussion Protocols

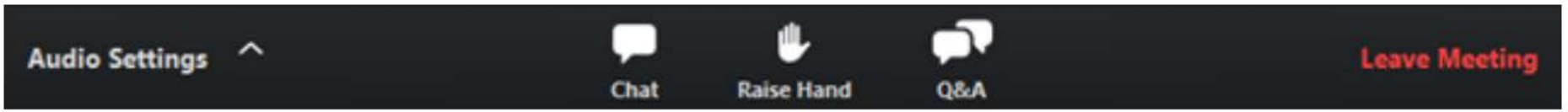
What we expect from each other:

- Be comfortable
- Stay focused
- Use Zoom to participate
  - Pose questions in “Q&A box”
  - Webinar participants on mute

Getting Started

To ask a question of a presenter:

- Pose in Q&A
- Raise “virtual” hand



- We’ll get to as many questions and comments as possible
- Webinar to be recorded; recording and slides available October 1
- Project summary also available October 1

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Getting Started

A note of thanks…..

To the end users who advised us on the project

- Ken DeGennaro, Klaus Jacob, Stan Jacobs, Edwin McGowan, Nathan Mitchell, Sylvia Welch, Usha Wright

To the planning and technical team

- Dr. Y. Peter Sheng, University of Florida
- Heather Gierloff, Emilie Hauser, and Sarah Fernald, NYS DEC Hudson River National Estuarine Research Reserve
- Plus many others to be introduced by Peter later

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Environmental
Conservation

Protecting Tidal Wetlands

HRNERR Mission

- Federal Program with NOAA
- Partnership with NYS DEC
- Designated in 1982
- 5,000 protected acres at 4 sites

Hudson River National Estuarine Research Reserve

A Network of 29 Research Reserves

LIST OF RESERVES

Great Lakes
1. Lake Superior, Wisconsin
2. Old Woman Creek, Ohio

Northeast
3. Wells, Maine
4. Great Bay, New Hampshire
5. Waquoit Bay, Massachusetts
6. Narragansett Bay, Rhode Island

Mid-Atlantic
7. Hudson River, New York
8. Jacques Cousteau, New Jersey
9. Delaware
10. Chesapeake Bay, Maryland
11. Chesapeake Bay, Virginia

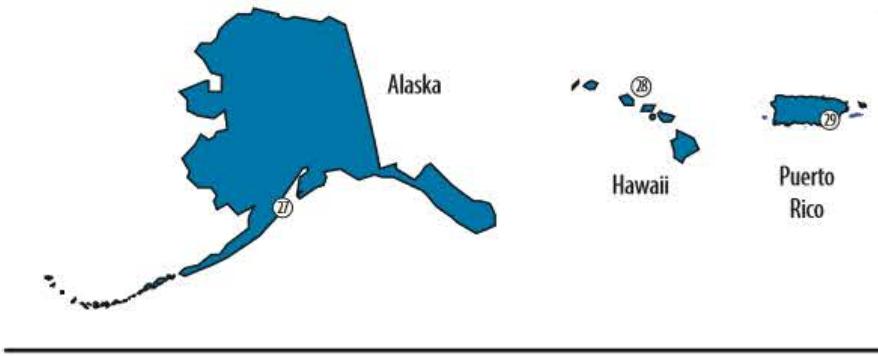
Southeast
12. North Carolina
13. North Inlet-Winyah Bay, South Carolina
14. ACE Basin, South Carolina
15. Sapelo Island, Georgia
16. Guana Tolomato Matanzas, Florida

Gulf of Mexico
17. Rookery Bay, Florida
18. Apalachicola, Florida
19. Weeks Bay, Alabama
20. Grand Bay, Mississippi
21. Mission-Aransas, Texas

West
22. Tijuana River, California
23. Elkhorn Slough, California
24. San Francisco Bay, California
25. South Slough, Oregon
26. Padilla Bay, Washington
27. Kachemak Bay, Alaska

Pacific
28. He'eia, Hawai'i

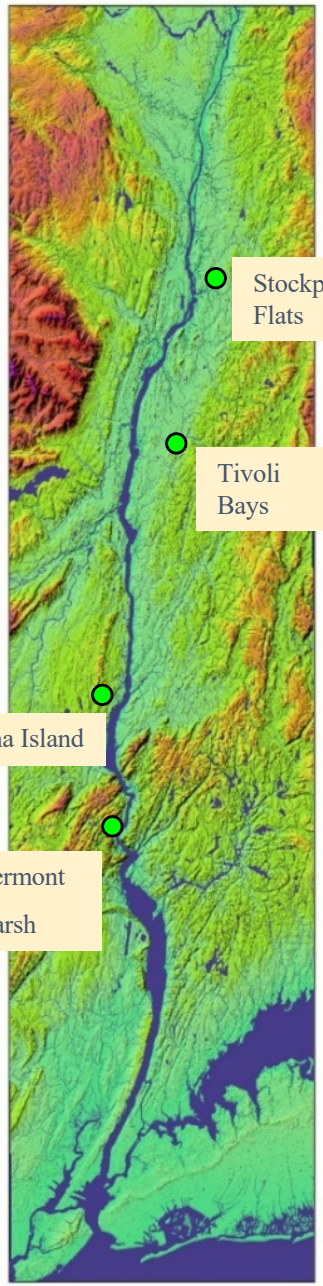
Caribbean
29. Jobos Bay, Puerto Rico



MISSION:

To promote stewardship of the Nation's estuaries through science and education using a system of protected areas

Hudson River National Estuarine Research Reserve



Stockport Flats

Tivoli Bays

Iona Island

Piermont Marsh

Norrie Point Environmental Center
HRNERR Headquarters

HRNERR Manager
Betsy Blair: 1984-2018
Heather Gierloff: 2018 - present

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Why protect tidal wetland function?

Piermont Marsh diversity, Photo by S. Fernald 2011

Healthy tidal marshes support a wide variety of native plants, animals, insects, and microorganisms.

Native vegetation supports marsh health and maximizes the benefits that these tidal wetlands provide for fish, wildlife, and humans. Potential threats to native vegetation need to be monitored

Piermont Marsh open water panne, Photo by S. Fernald 2013

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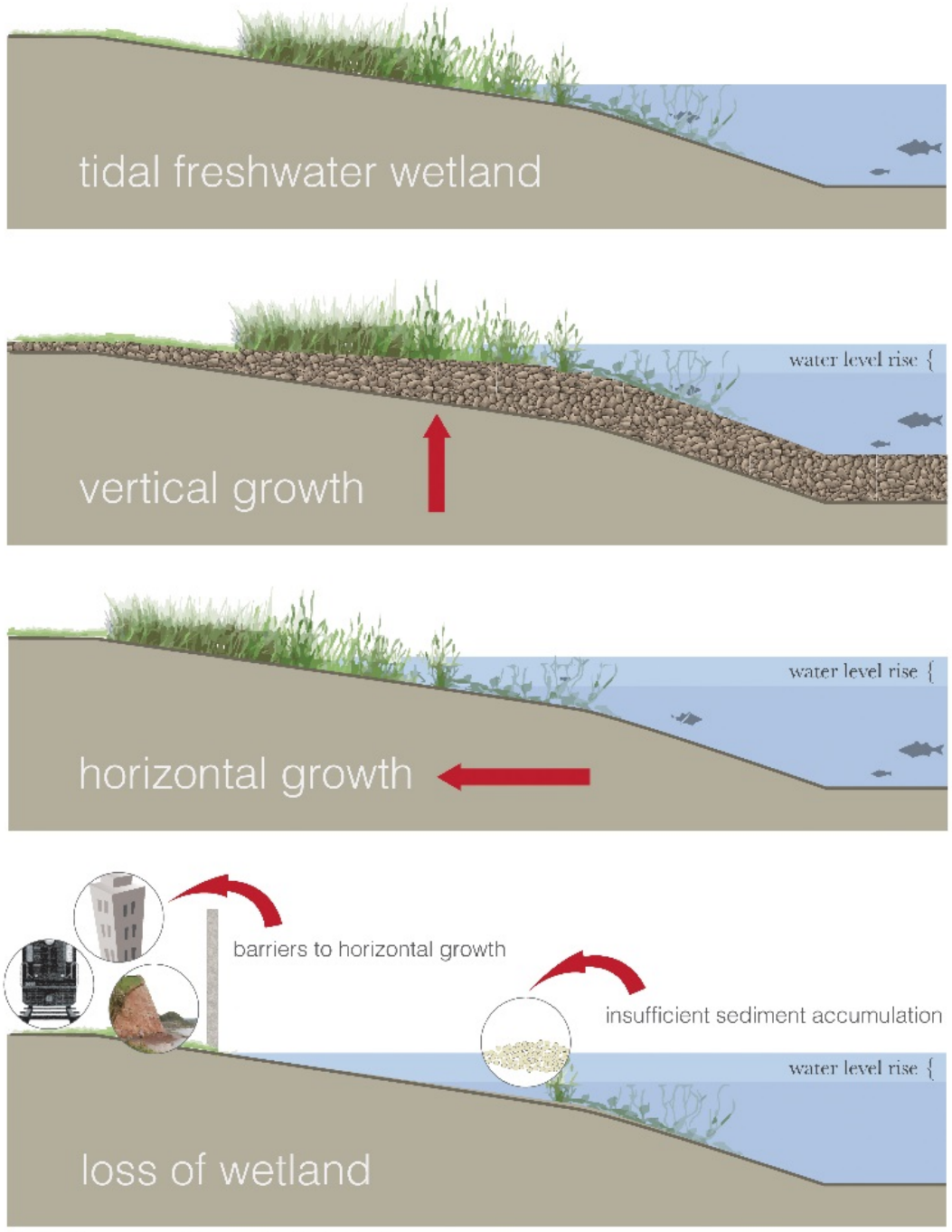
Tidal Wetlands and Rising Waters

- Vegetation in the intertidal zone
- Tides deposit sediment (vertical growth)
- Pathways for inland marsh migration (horizontal growth)
- Barriers to horizontal growth and insufficient vertical growth lead to loss of wetlands with sea level rise



Graphic: Cary Institute of Ecosystem Studies. L. Tumblety

A diverse assemblage of species helps to protect the marsh, as each species fills a different niche and provides a range of environmental services:

- Carbon sequestration
- Nutrient processing
- Nesting habitat for marsh birds
- Rest-stops for migratory birds
- Nursery habitat for estuarine fishes
- Foraging habitat for bees
- Recreation
- Storm protection (Sheng study)

Muskrat lodge, Photo by S. Fernald 2017

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Piermont Marsh Management by NYS DEC/HRNERR and NYS Parks

The Draft Plan has been put on hold.. But we are still assessing Marsh conditions

Piermont Marsh ’s Role in Buffering the Village from Storms

July 16, 2020

Draft Piermont Marsh Management plan

Goal 1: Maintain or enhance the Piermont Marsh Reserve's ability to provide storm protection

Goal 2: Sustain the presence of native marsh communities

Goal 3: Promote the structural and functional resiliency of the Piermont Marsh Reserve to storms, sea-level rise, and other disturbances.

Goal 4: Increase scientific knowledge

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The Draft Plan has been put on hold..

Updated Draft will be available for Public Comment in 2021

It Will:

- Remove large areas of Phragmites control
- Be responsive to public comments
- Include progress and results from 2019/2020 Monitoring
- Use Dr. Sheng's final results to update the draft

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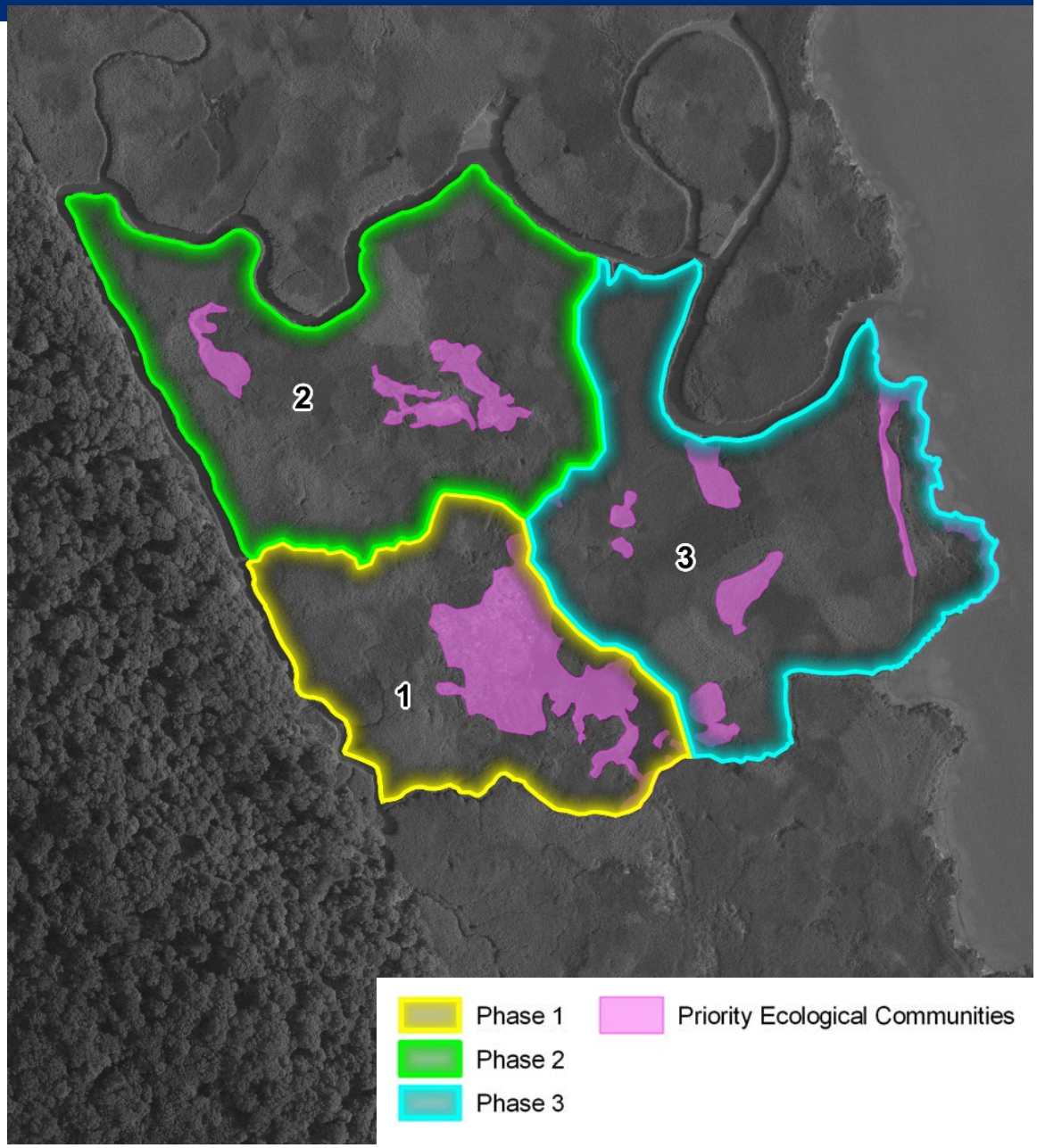
Draft Management Plan (2017)

- Protect Native vegetation by controlling 40 acres of *Phragmites* in three phases over 10 years

2020 Plan still Draft

- Use of chemical for Phragmites control has been put on hold
- Assessing success of installation of 9,300sqft of geotextile to control phragmites



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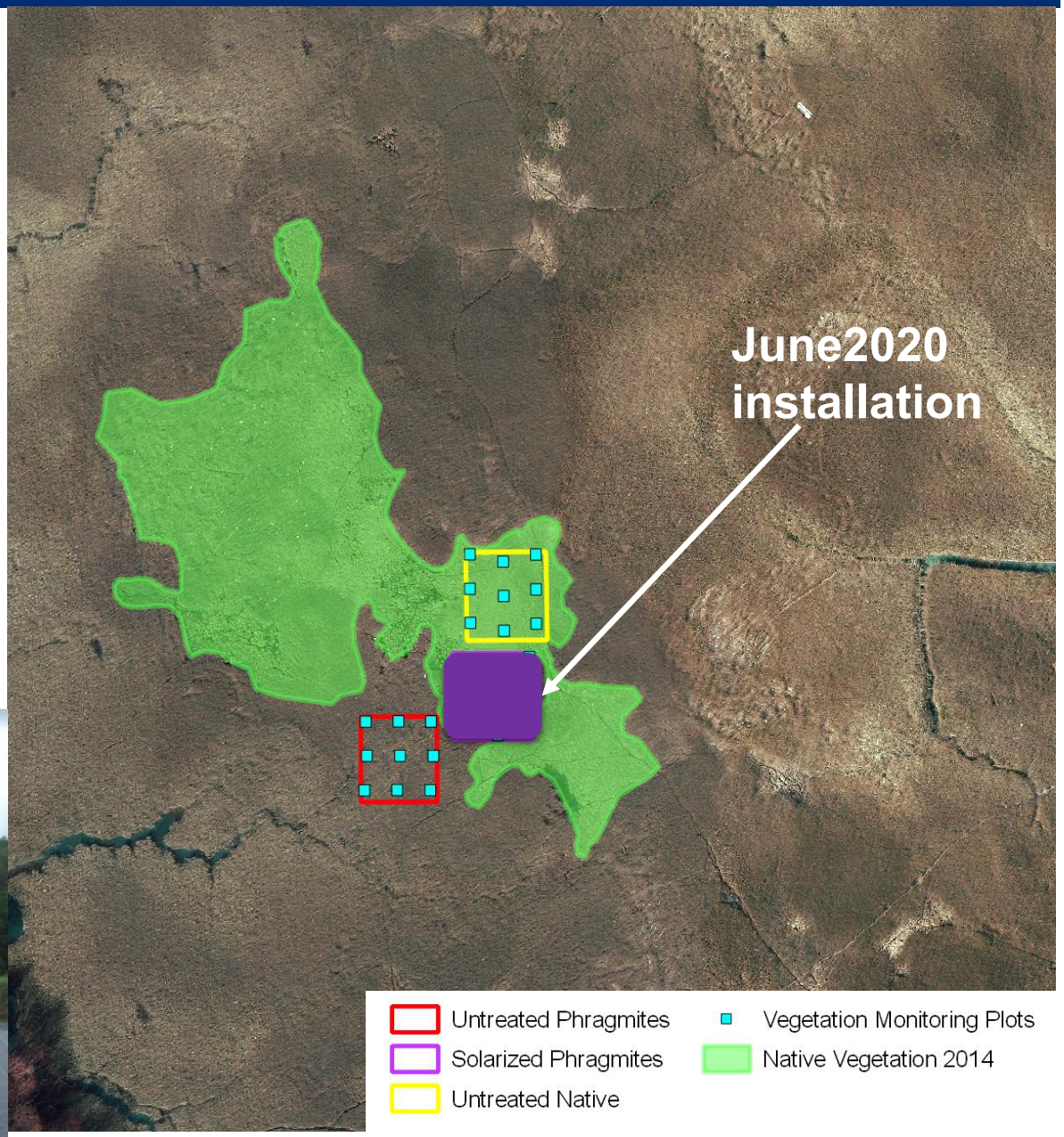
Phragmites Management

- Management to protect existing native plant community
- Collected baseline vegetation data in August 2019
- Geotextile installed in June 2020



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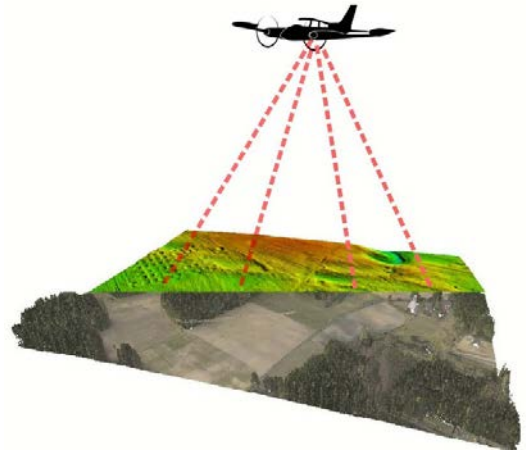
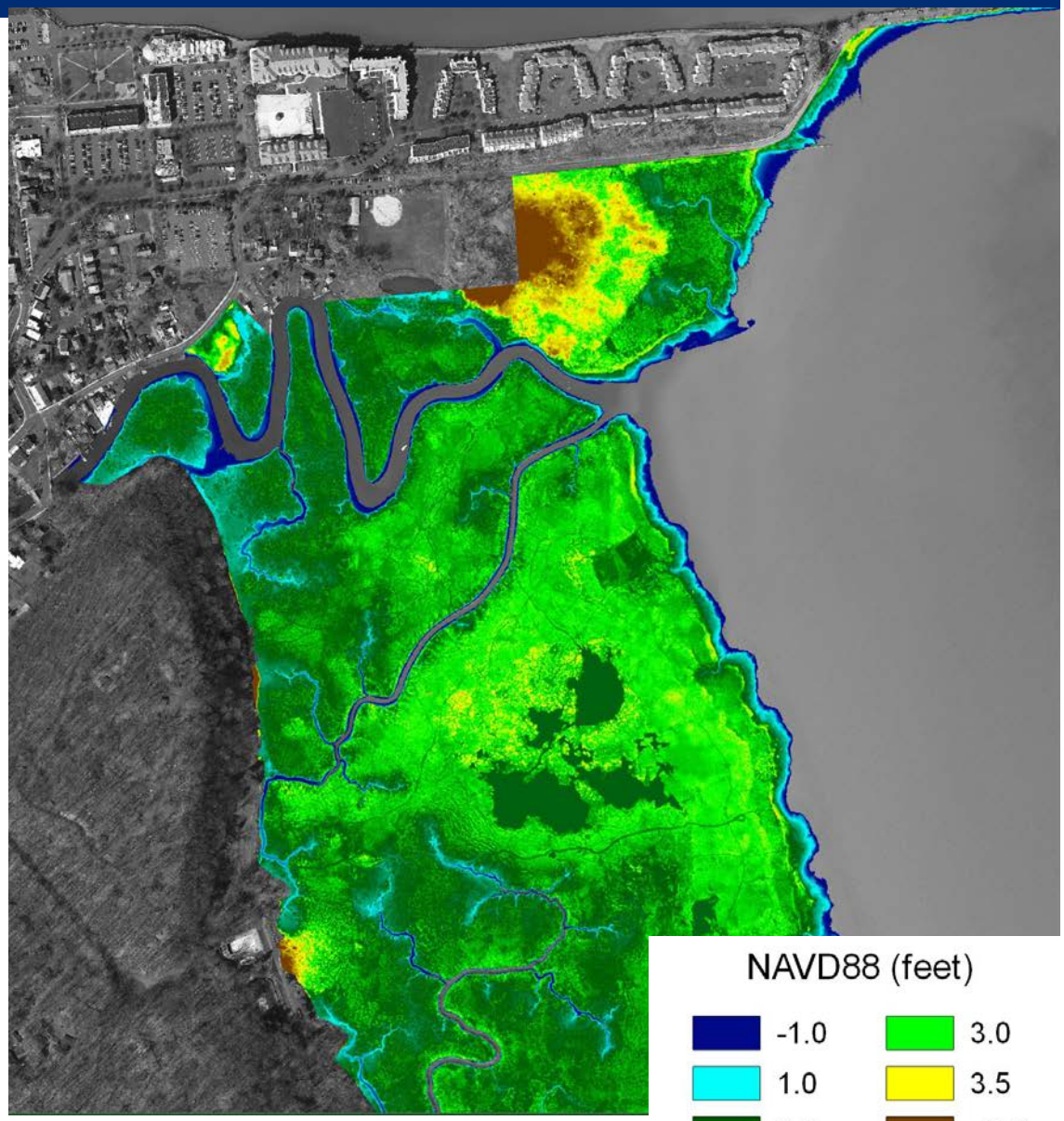
LiDAR Survey

- Update 2012 Coastal NY LiDAR for Piermont Marsh
- Flyover completed April 7th, 2020
- Allows assessment of changes in shoreline morphology and surface topography





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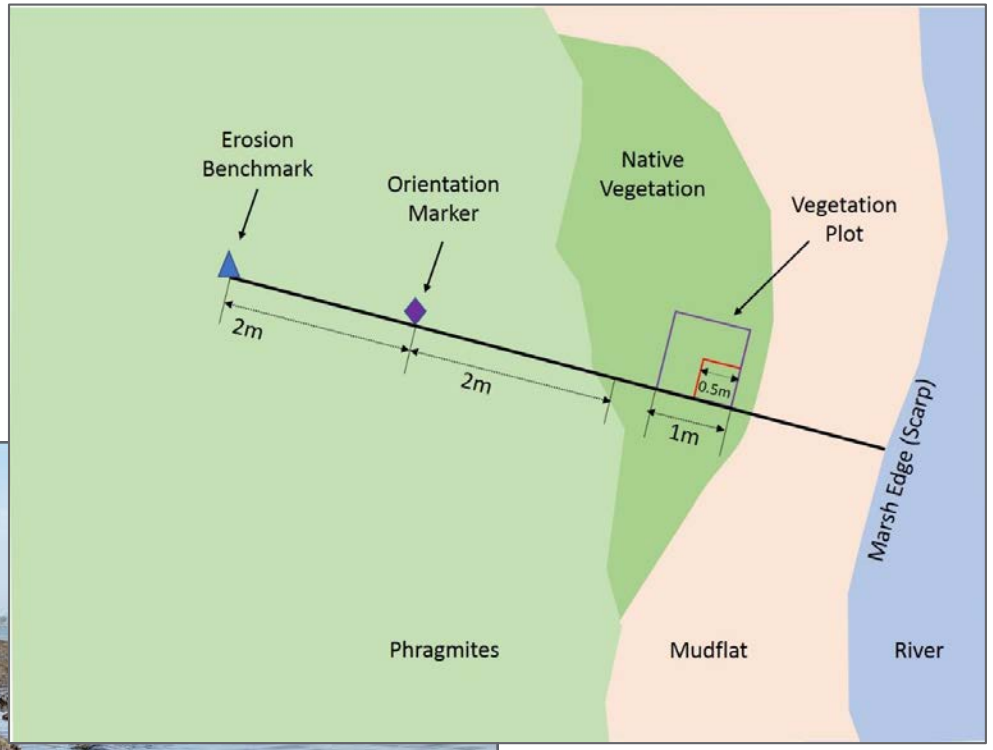
Edge Monitoring

At least 50 feet of marsh edge has eroded since the 1920's

Monitoring will help with understanding

- Shoreline change
- Wave energy



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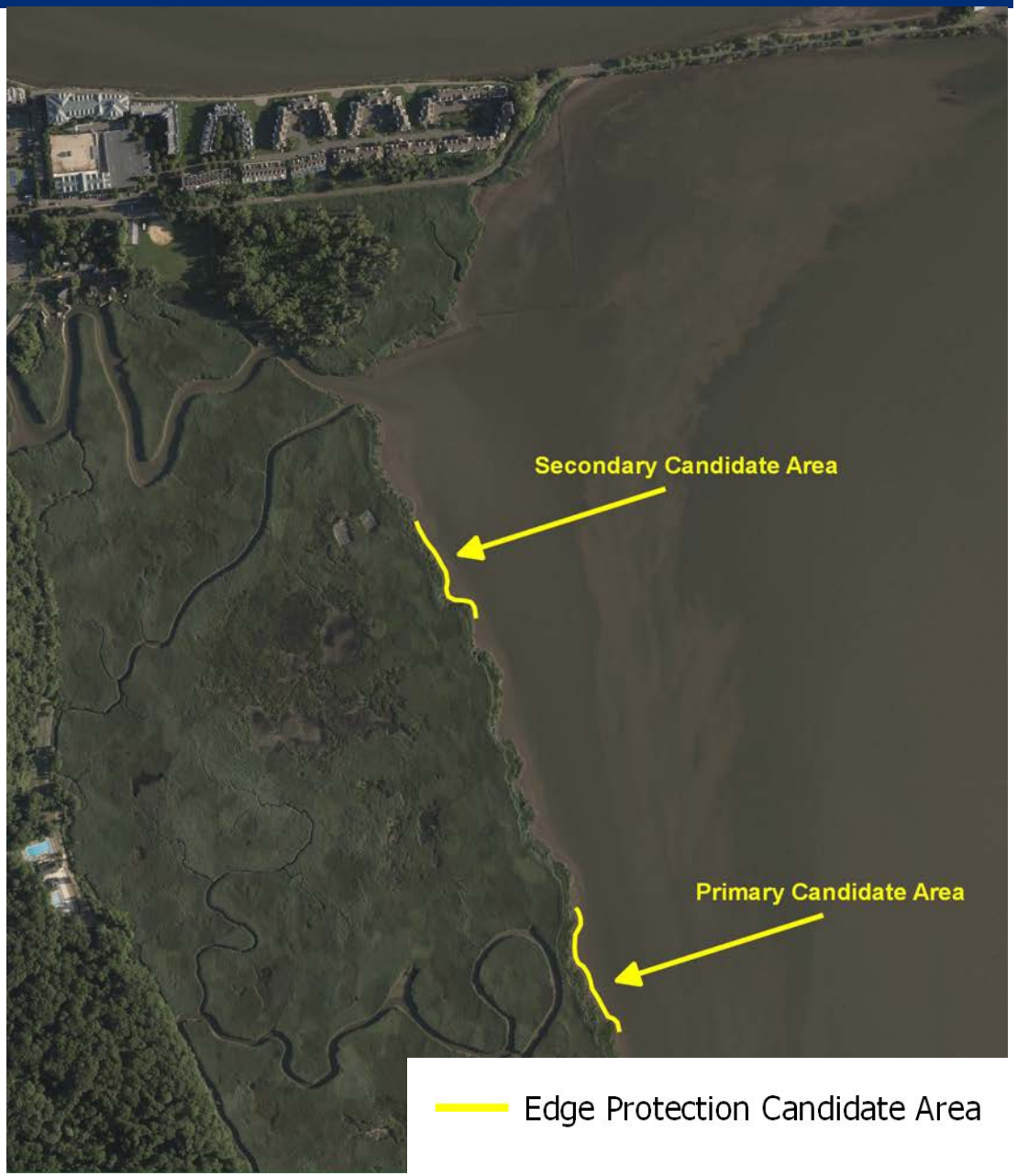
Edge Protection Pilot Project

- Candidate sites selected based on shoreline erosion rate, slope, and vegetation type.



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Pilot Project Design 2020

Stabilization Techniques

- Reduce erosion
- Increase sediment deposition

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Questions?

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https://www.hrnerr.org/

https://www.dec.ny.gov/lands/4915.html

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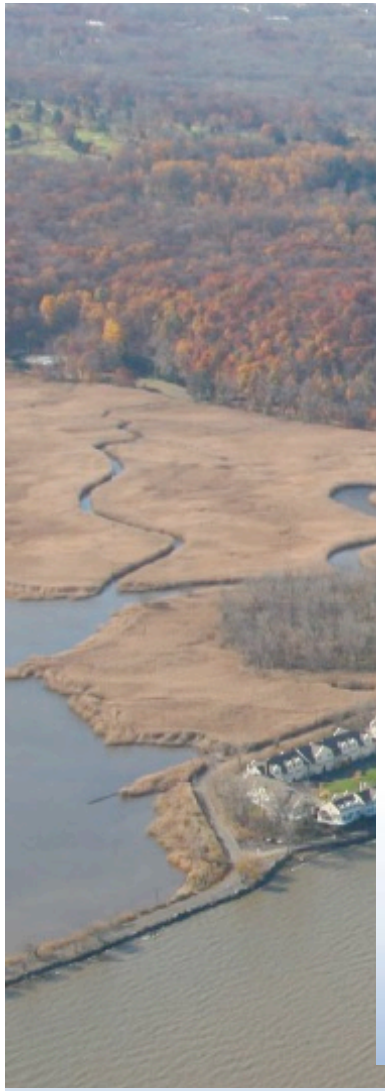
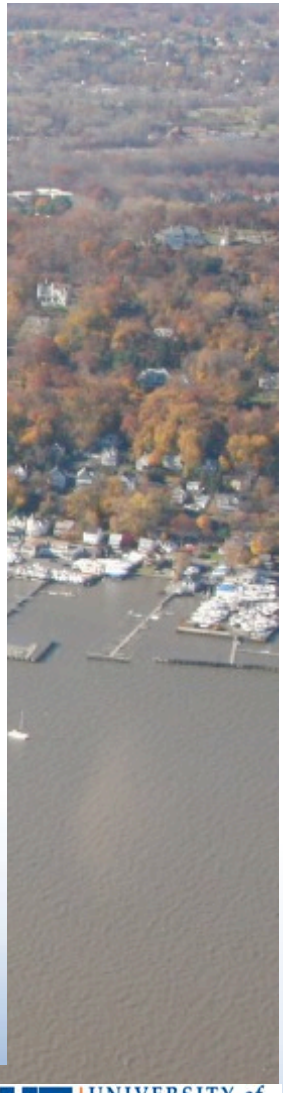
Piermont Marsh Buffer Project: Assessing and Enhancing the Value of Coastal Marshes for Protecting Coastal Communities from Storm Surge and Flooding in a Changing Climate



End User Engagement in Project Development

Project concept was identified, shaped and advanced by scientists, marsh managers, and community leaders in sincere collaboration, over many months, in public forums, and through much discussion.

January, 2015 Forum on the Marsh's Role in Community Storm Resilience



Piermont Waterfront Resiliency Commission

USGS

National Estuarine Research Reserve System Science Collaborative

NASA

NOAA

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cbi Consensus Building Institute

SCENIC HUDSON

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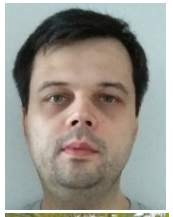
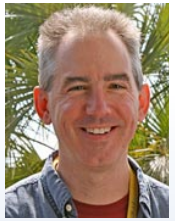
UNIVERSITY OF MIAMI

Project Team

Students

Principal Investigator	Peter Sheng Research Professor University of Florida		R. Zou A. Rivera-Nieves
Team Member (ecologist)	Christine Angelini Assistant Professor University of Florida		S. Sharp
Team Member (wave and water level data)	Justin Davis Research Assistant Scientist University of Florida		
Team Member (coastal modeling)	Vladimir Paramygin Research Assistant Scientist University of Florida		
Team Member (economist)	David Letson Professor, University of Miami		
Team Member (climate scientist)	Timothy Hall Sr Scientist, NASA Goddard Institute		

Team Member **(hydrologist)**	Ronald Busciolano Supervisory Hydrologist United States Geological Survey
Team Member & End User	Edwin McGowan, Director of Science NYS Palisades Interstate Park Commission
Team Member & End User	Klaus Jacob Appointed Representative Piermont Waterfront Resilience Commission
Team Member & End User	Nathan Mitchell Village of Piermont
Collaborative Co-Lead	Bennett Brooks Senior Mediator Consensus Building Institute, Inc.
Collaborative Co-Lead & End User	Heather Gierloff / Betsy Blair (former) Reserve Manager NYS DEC Hudson River NERR
Team Member Outreach/Education Lead	Emilie Hauser Coastal Training Coordinator NYS DEC Hudson River NERR
Team Member Research Coordinator	Sarah Fernald Research Coordinator NYS DEC Hudson River NERR







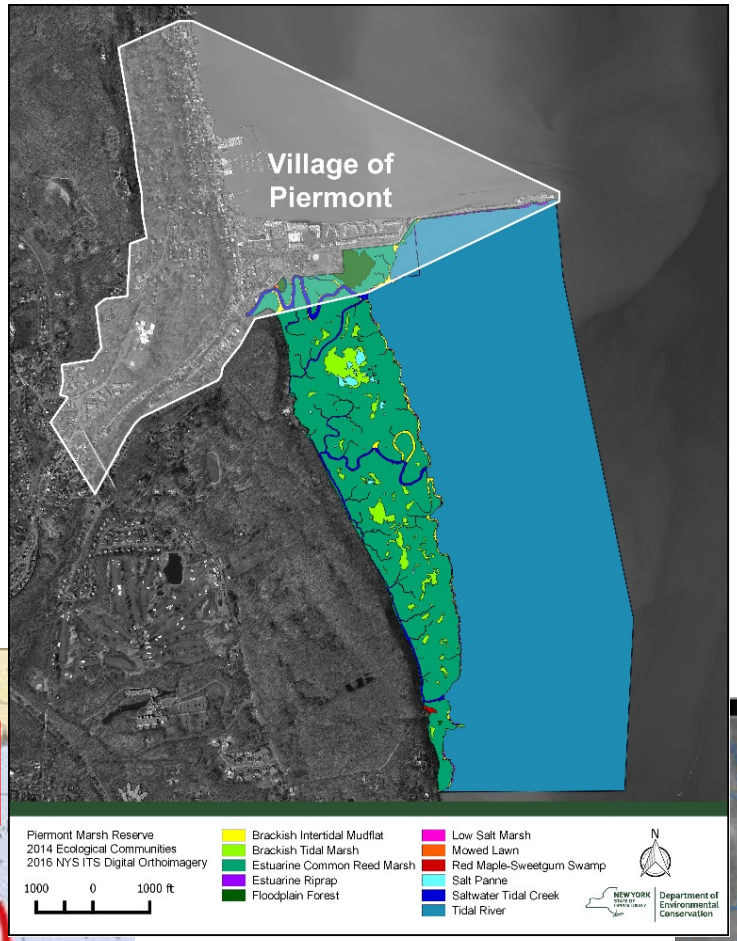


Research Goal, Outputs, and Outcomes

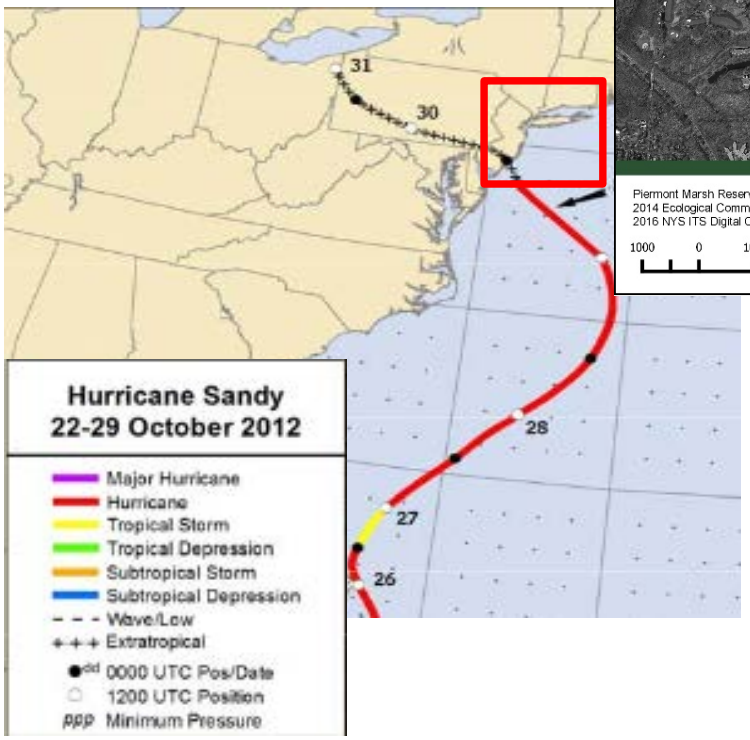
- To understand Piermont Marsh's capacity in buffering flood, wave, and structural loss during Sandy and potential future storms, to inform marsh management and community resilience-enhancing decisions.
- Key outputs include a quantitative assessment of Marsh's buffering capacity under future climatic conditions and originally proposed management scenarios, and an economic valuation of this service.
- Primary outcomes are better-informed management decisions and increased understanding of coastal wetlands' role in enhancing community resilience.

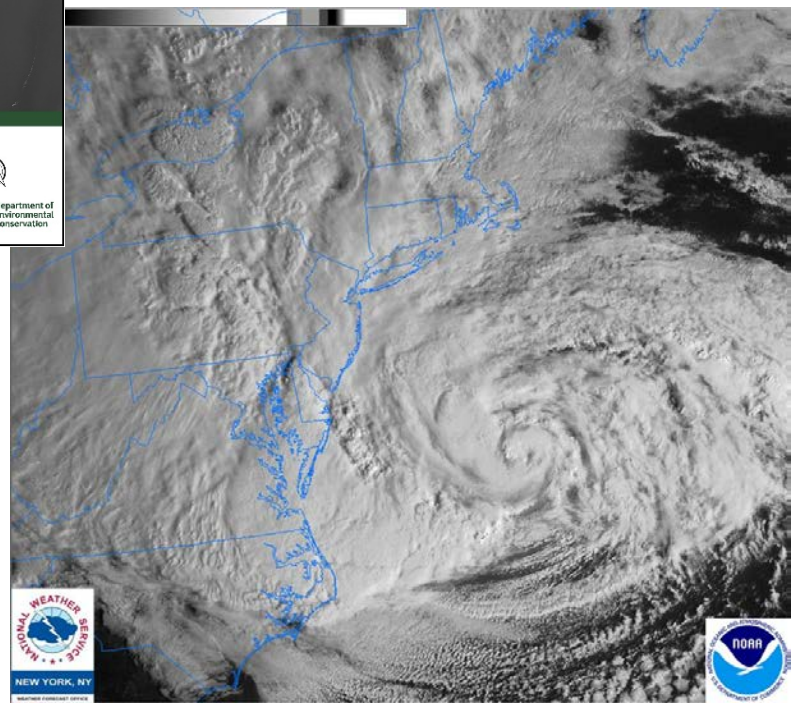
Piermont Marsh and Village

Superstorm Sandy (2012)



Huge Size (d=1100mi)
NJ Landfall
Cat 1
High Tide





Piermont Marsh and Village during Sandy (2012)

Water Elevation (NAVD88)

Strong wind

22-44 mph

Marsh Ht ~12ft

12 ft

May 11.58

Storm tide 9.5ft

3ft

Hudson River

2012

Fish

Wading Birds

1.96-2.62 ft peak wave was dissipated significantly within 500 ft

Relatively narrow Marsh width dissipated little storm tide

Village

KJ

Dense and tall Phragmites marsh blocked flow and debris

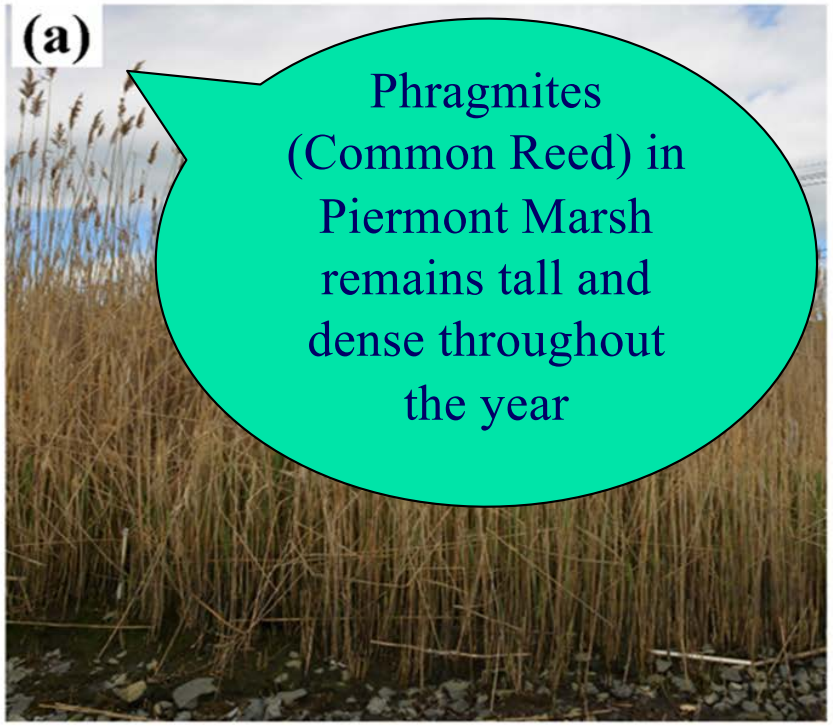
Village suffered ~$11.8M structural damage, but avoided
$ 902,000 loss due to Marsh

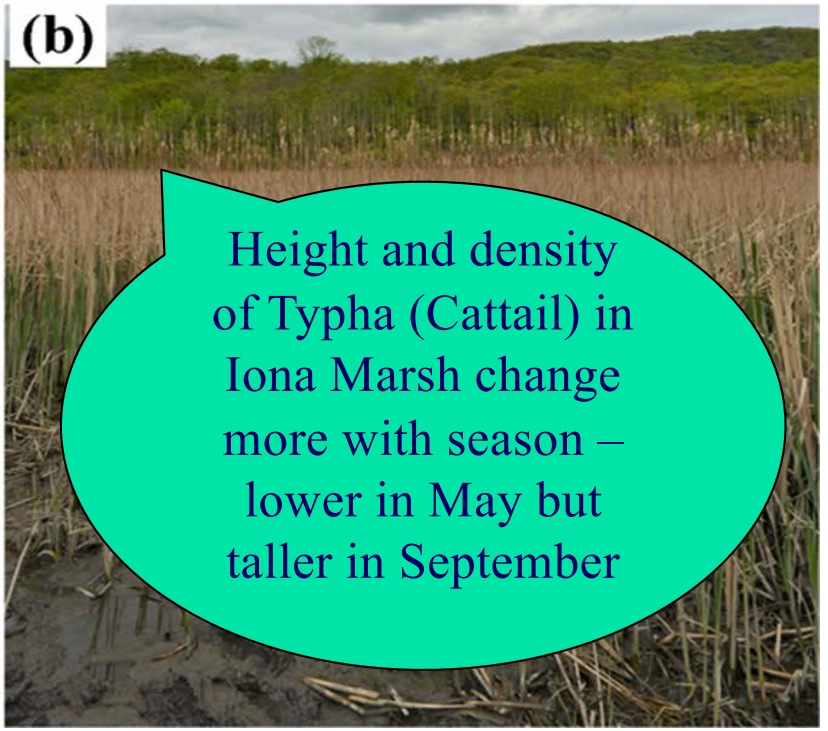
300 600 900 1200 1500 ft

@Peterzheng

On a typical day, Piermont Marsh is 12 ft tall and much higher than the water level and wave in Hudson River

What if taller/rigid *Phragmites (a)* were replaced by shorter/flexible *Typha (b)*?





Marsh Buffering Capacity	Existing Phragmites (Common Reed) Marsh	Typha (Cattail) Marsh (Sept)	Typha Marsh (May)	No Marsh
Surge/Flood	<1%	<1%	<1%	
Wave	>2/3	>2/3	nil	
Current/Debris	100%	100%	nil	nil

Flood at southern village vs. flood at marsh edge

Wave at southern village vs. wave at marsh edge

Unlikely to have a hurricane in May

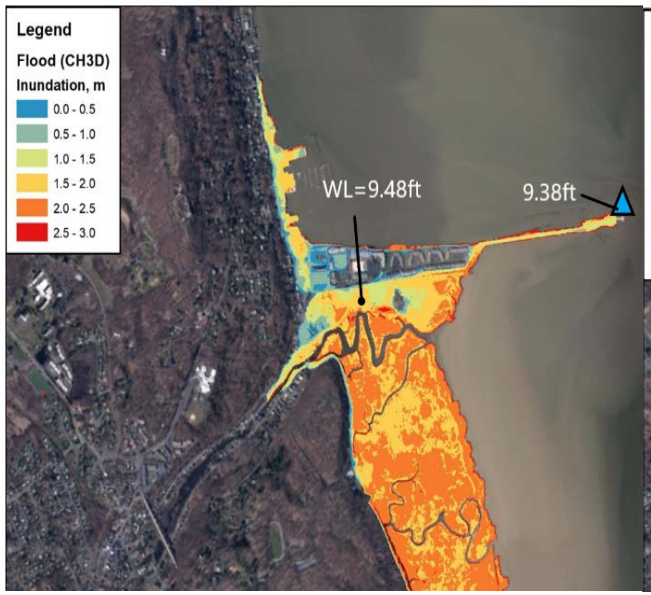
Let's keep the marsh!

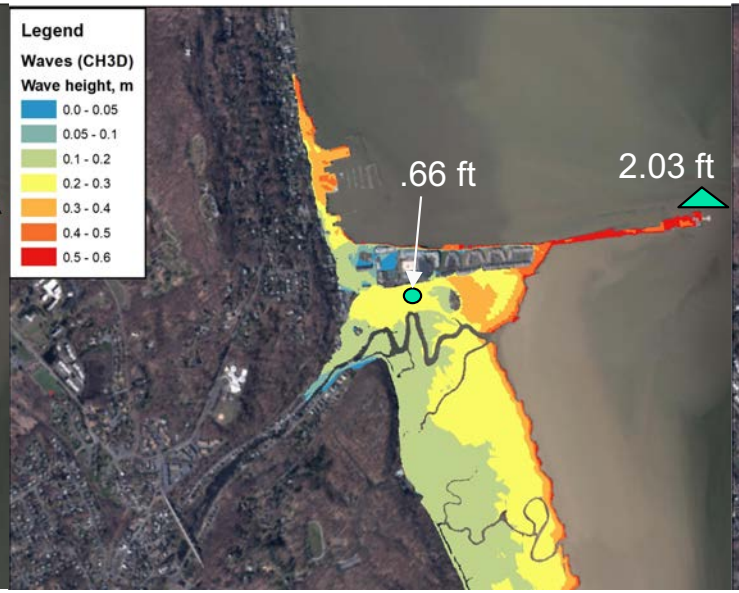
Piermont Marsh Buffered Wave and Debris but not Flood during Sandy

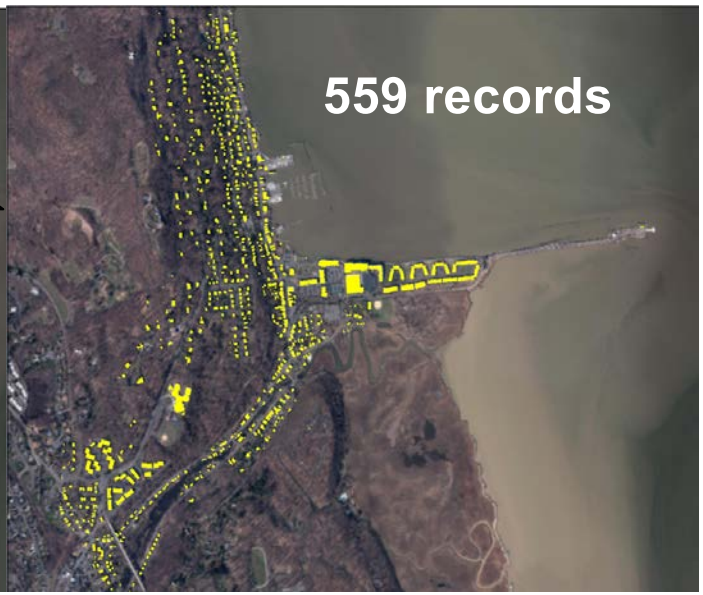
Economic Analysis

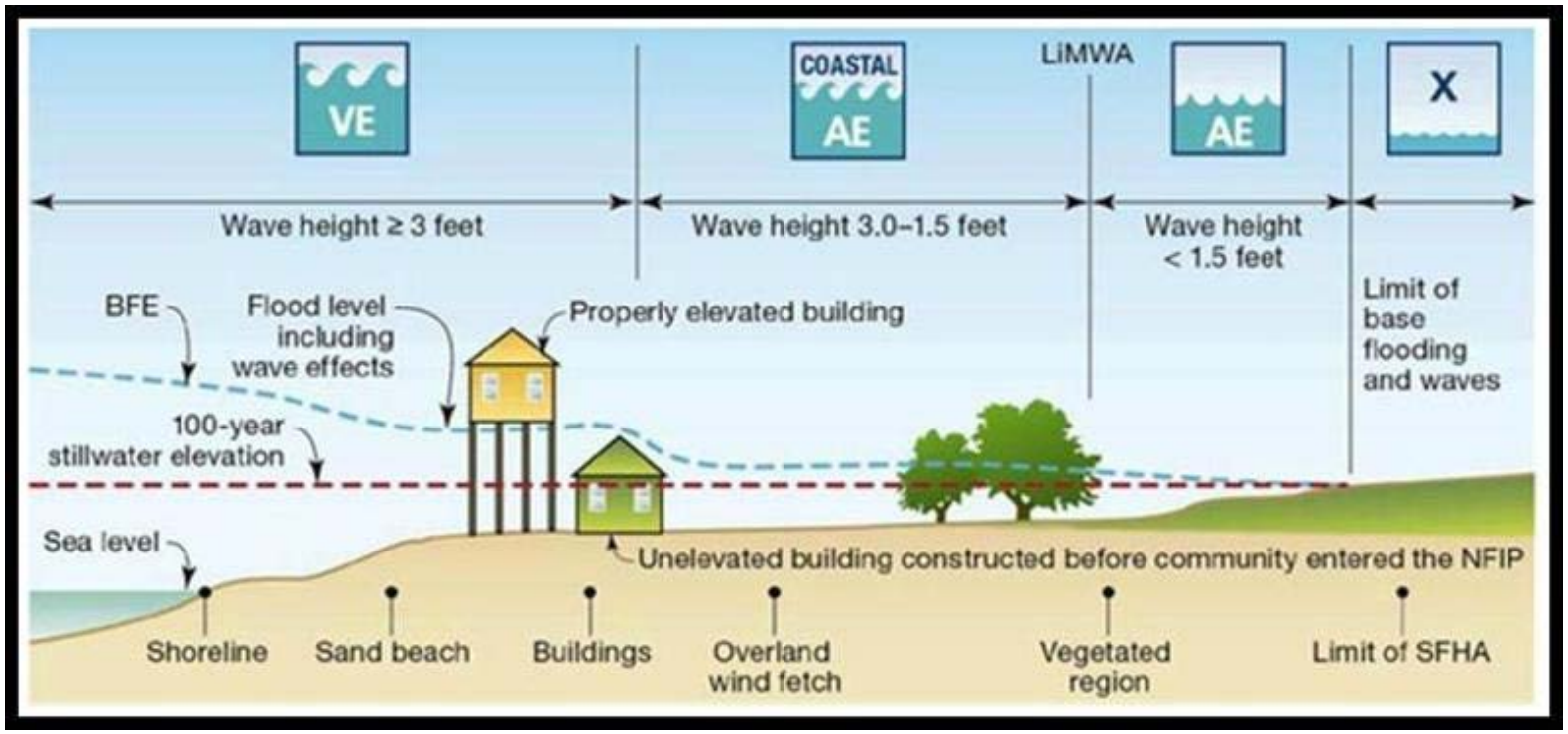
Parcel-based structural loss due to flood and wave during storms

- What was the structural loss of the Village due to flood and wave during Sandy? How does the estimate compare to FEMA NFIP loss payouts?
- How much additional damage would incur if Piermont Marsh were removed?
- Would the original marsh restoration impact the structural loss of the Village in the future?









Flood and Wave can both damage buildings (FEMA)

Damage Assessment in a nutshell:

Calculate flood elevation
Calculate wave height
Calculate flood elevation and wave crest
Find out which flood zone each house is in
Calculate damage to individual buildings due to flood and wave

Structure Loss due to Flood and Wave in Piermont during Sandy

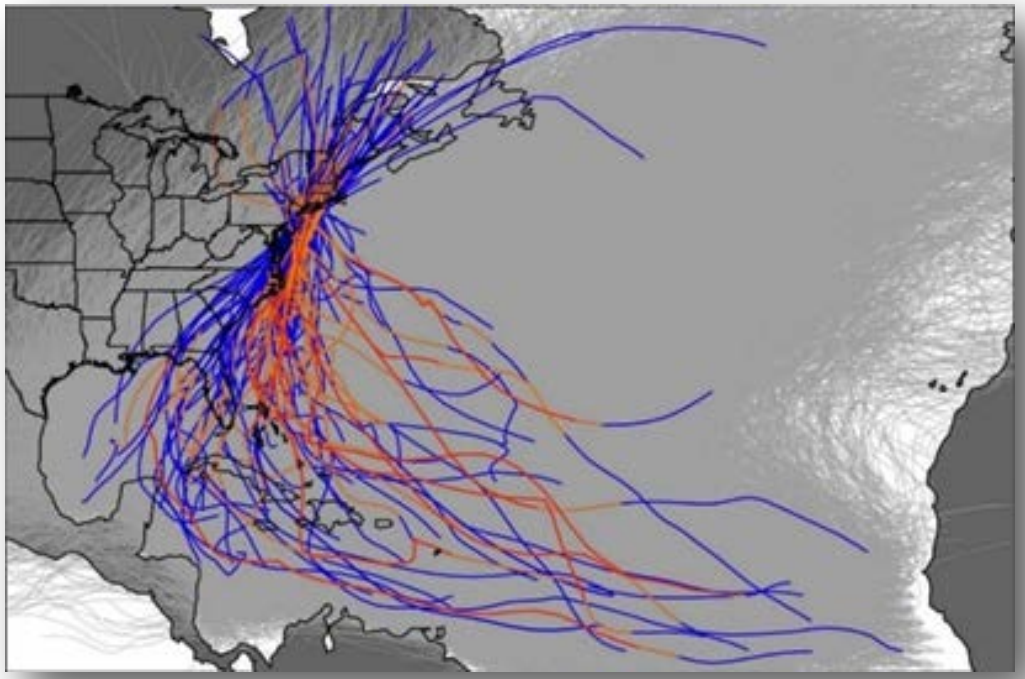
Parameters (41 properties)	With Wetland	Without Wetland	Avoided Loss	
Structural Loss (Flood)	$2.61M	$2.61M	$796	0.001%
Structural Loss (Wave)	$1.11M	$1.67M	$562K	50.8%
Structural Loss (Flood+Wave)	$3.72M	$4.28M	$563K	15.1%

- NFIP payouts $3.47M
- NFIP = National Flood Insurance Program

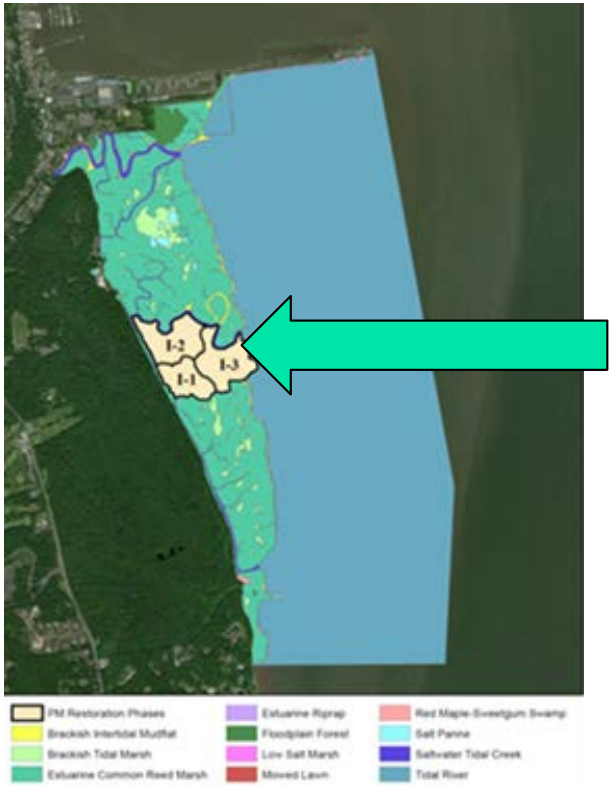
Parameters (All buildings)	With Wetland	Without Wetland	Avoided Loss	
Structural Loss (Flood)	$8.50M	$8.50M	$2,400	.0001%
Structural Loss (Wave)	$3.44M	$4.34M	$899K	26.2%
Structural Loss (Flood+Wave)	$11.9M	$12.8M	$902K	7.6%

- PWRC(2014) estimated loss~$20M (buildings, docks, marina, etc.)

Coastal Resiliency Planning and Marsh Management cannot be based on Sandy

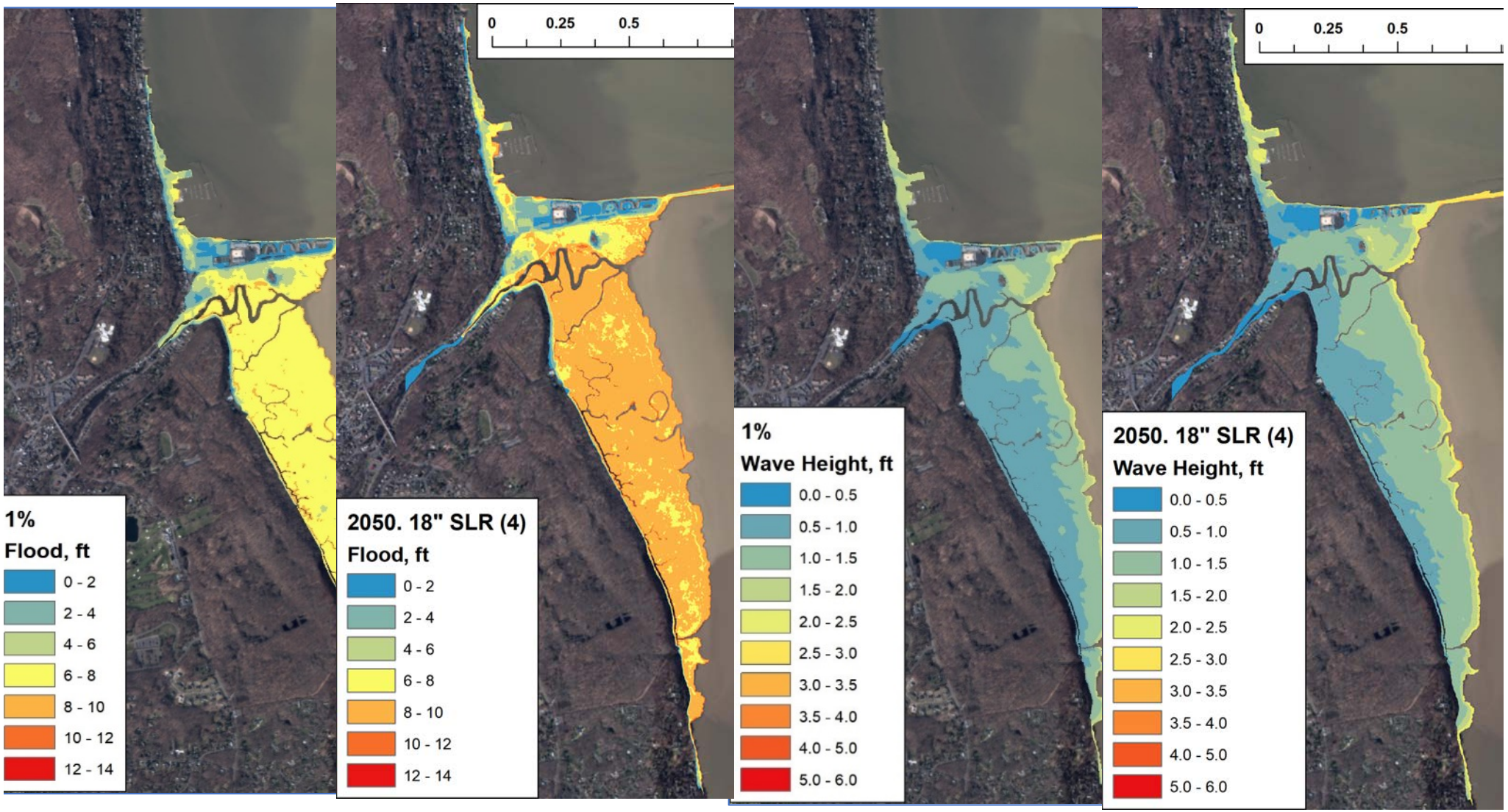


Storm ensemble predicted by Hall (2020)



40-acre originally proposed marsh management area replacing Phrags with Typha in phases

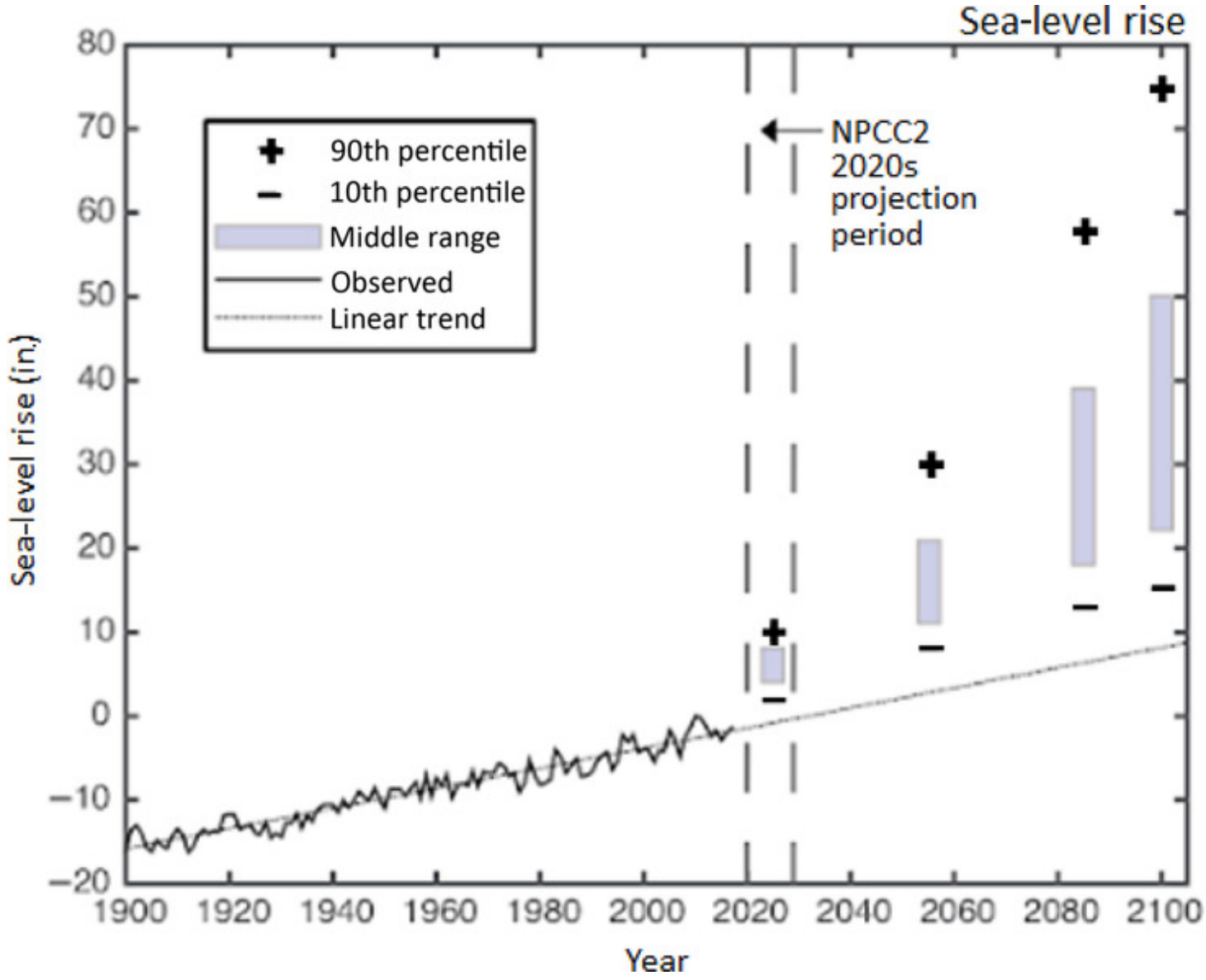
- Sandy is a 700-year storm which generated high surge tide and wave.
- The storm ensemble includes many less intense but more frequent storms which come in different sizes and from different directions.
- Each storm generate different flood and wave at the Marsh and the Village. In some storm with southeasterly wind, flood is buffered by the Marsh. In others like Sandy, wave is buffered by the Marsh.
- The cumulative effect of various storms generate the 1% annual chance flood and wave event in the Village.
- Coastal resiliency planning should be based on the role of Marsh in buffering flood, wave, and damage in 1% event.



1% Flood 1% Flood w/ 18” SLR 1% Wave 1% Wave w/ 18” SLR

Both 1% flood elevation and 1% wave height increase over time

Sea Level Rise at Battery (NPCC, 2019)



Sea Level Rise scenarios based on end user (Klaus) input and team consent

	Year	SLR in	Marsh Phase	Area 1	Area 2	Area 3	Other Areas	Loss ($M)	Loss (%)
Sandy	2012	0		Current	Current	Current	Current	11.9	2.06
Sandy	2012	0		No Veg	No Veg	No Veg	No Veg	12.8	2.21
Avoided Loss due to Marsh ($ and %)	=	(Loss without Marsh – Loss with Marsh) / Loss with Marsh						901K	7.6

% of total 2018 market value (~$580M)

1% annual chance flood and wave event

Scenario 0	2020	0		Current	Current	Current	Current	18.8	3.24
Scenario 0	2020	0		No Veg	No Veg	No Veg	No Veg	21.0	3.61
Avoided Loss due to Marsh								2.13	11.3

Marsh buffered more flood and loss

1% annual chance event with SLR & potential marsh management

1	2020	0	1	No Veg	Current	Current	Current	18.8	3.24
2	2022	0	2	Low Typha	No Veg	Current	Current	18.8	3.24
3	2025	6	3	High Typha	Low Typha	No Veg	Current	21.4	3.69
4	2050	18	Done	High Typha	High Typha	High Typha	Current	28.1	4.85

Storms dominate the property loss until 2050 when SLR & storms become equal contributor to loss

From 2050 to 2100

	Year	SLR in	Marsh Phase	Area 1	Area 2	Area 3	Other Areas	Damage $M	Damage % property
4	2050	18	Done	High Typha	High Typha	High Typha	Current	28.1	4.85
5	2050	18	None	Current	Current	Current	Current	28.1	4.85
6	2100	114	Extreme	Marsh Lost	Marsh Lost	Marsh Lost	Marsh Lost	63.3	10.92

- At 2050, storms and SLR contribute equally to property damage.
- If the 40 acres were replaced by Typha, the buffering capacity of the Marsh would not have changed.
- At 2100, with the marsh lost due to the extreme SLR value, SLR would overwhelm the storms as the dominant factor for property damage. 29.3% of the Village property value is estimated to be lost.
- Number of properties damaged increases with time.
- Uncertainties of storms and SLR increase significantly after 2050, hence we did not consider any time between 2050 and 2100.

Summary

- Piermont Marsh was effective in buffering wave, current, and debris during Sandy, but not effective in buffering surge (storm tide) and flood;
- Originally proposed plan to replace Phragmites with Typha in the 40-acre area would not have diminished the buffering capacity of Piermont Marsh for wave, surge, and debris;
- 41 properties received $3.47M from FEMA NFIP Sandy payouts, compares to $3.72M estimated loss; Considering ALL structures, estimated loss would be $11.9M and, with the Marsh, $901,862 would be added to it.
- Structural loss during future 1% surge/wave event will increase due to storms, SLR, and marsh loss in 21st century, but Marsh will continue to provide significant buffering capacity except 2100 when Marsh is overwhelmed by SLR.
- A Piermont Marsh Project (PMP) Tool is developed to allow end user access for resilience planning.
- To enhance the Piermont Marsh's buffering capacity, ensure sediment supply and prevent marsh edge erosion.

Acknowledgement

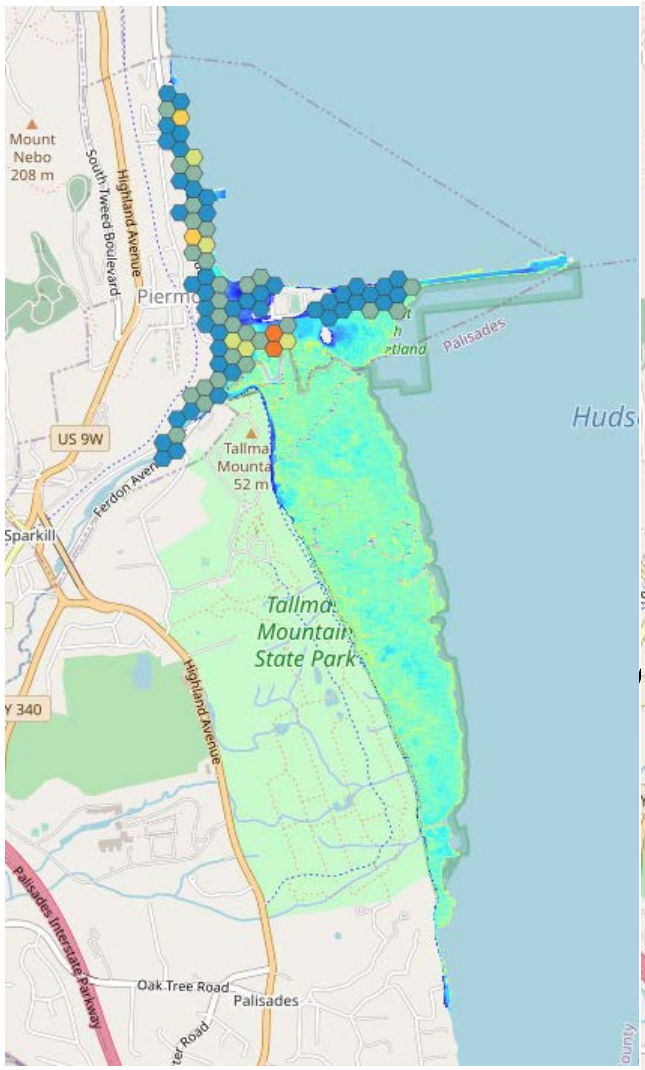
- This work was sponsored by the National Estuarine Research Reserve System Science Collaborative, which supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is funded by the National Oceanic and Atmospheric Administration and managed by the University of Michigan Water Center (NAI4NOS4190145). Lynn Vaccaro is the project manager. We also appreciate the support from NOAA Climate Program Office Grant NA11OAR4310105, SECOORA (NOAA/NOPP) (IOOS.11[033]UF.PS.MOD.1).

- PMP webtool:
- https://aces.coastal.ufl.edu/Piermont/ (website is under maintenance)
- Contact pete@coastal.ufl.edu if you are interested in the webtool.

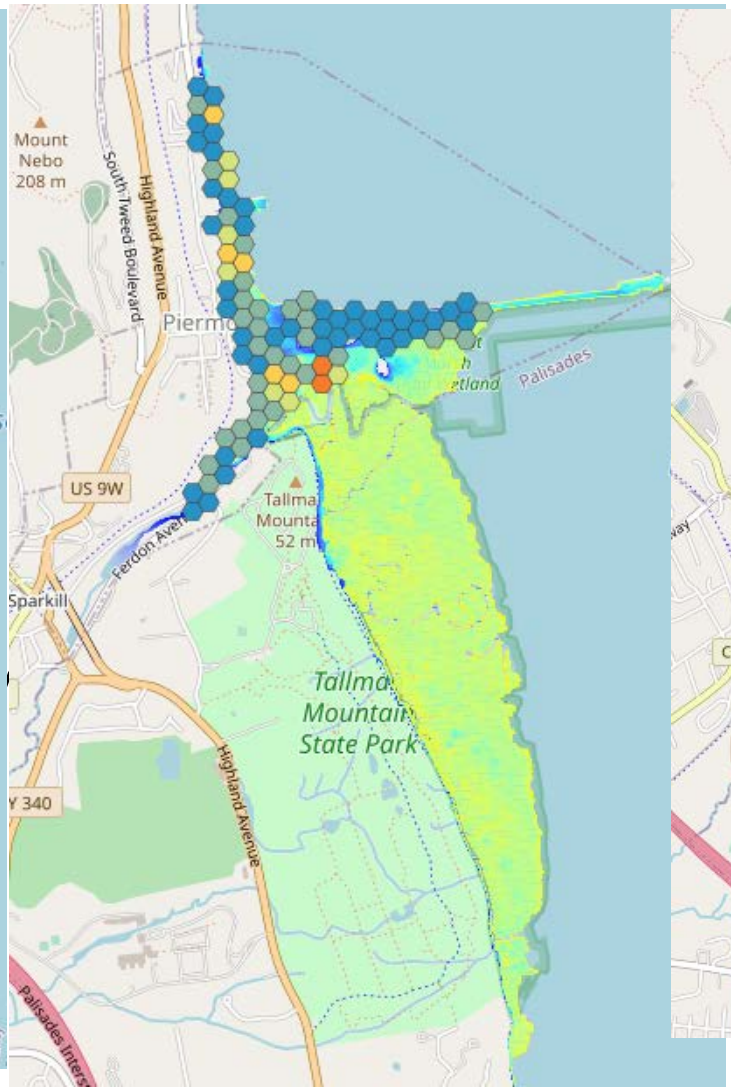
https://aces.coastal.ufl.edu/Piermont (under maintenance)

Piermont Marsh Proiect (PMP) Tool – not final until 9/30/2020

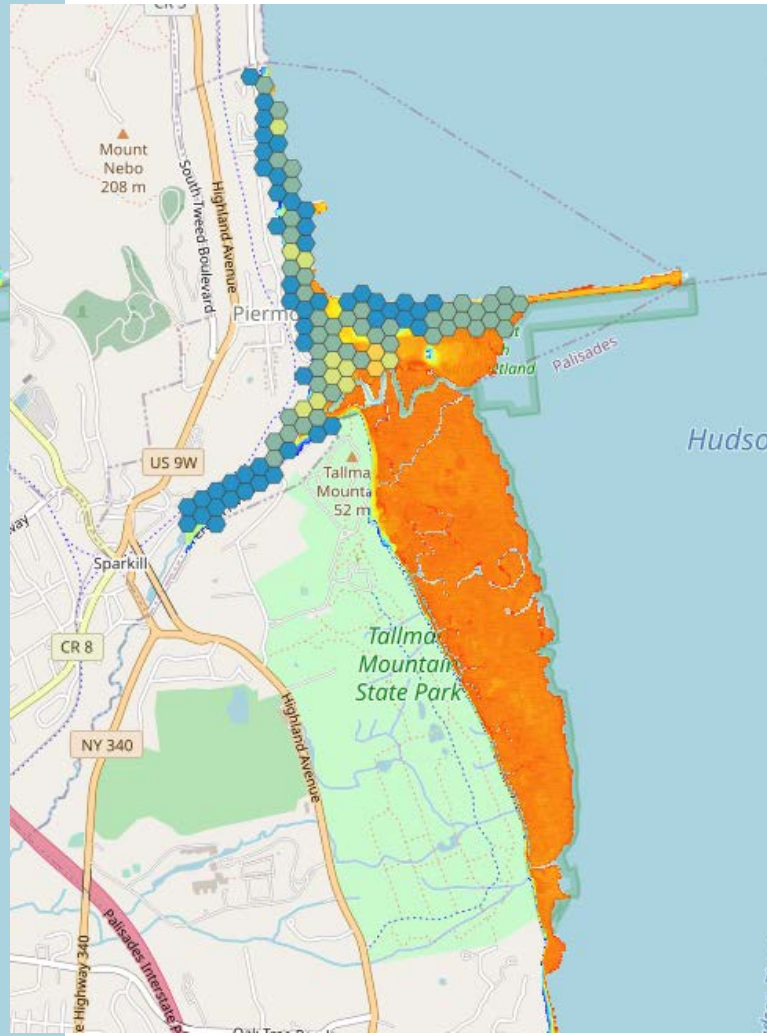
2020



2050



2100



May Piermont remains a place with outsize appeal, where

The people are happy and healthy,
The non-Native gets along with the Native, and
The Village is Flood- and Covid- free!

What we learned from this Project-

- The Marsh significantly reduced Sandy wave damages in adjacent properties
- The Marsh will provide a valuable buffer in future storm events
- We may lose that buffer protection to Sea Level Rise or other stressors

How this helps us plan for the Future

Buffer project:

- Sea Level Rise in model scenarios highlights future impacts
- Web tool provides best data so far in estimating future storm damage impacts
- Web tool provides guidance for Village and property owners

Related projects

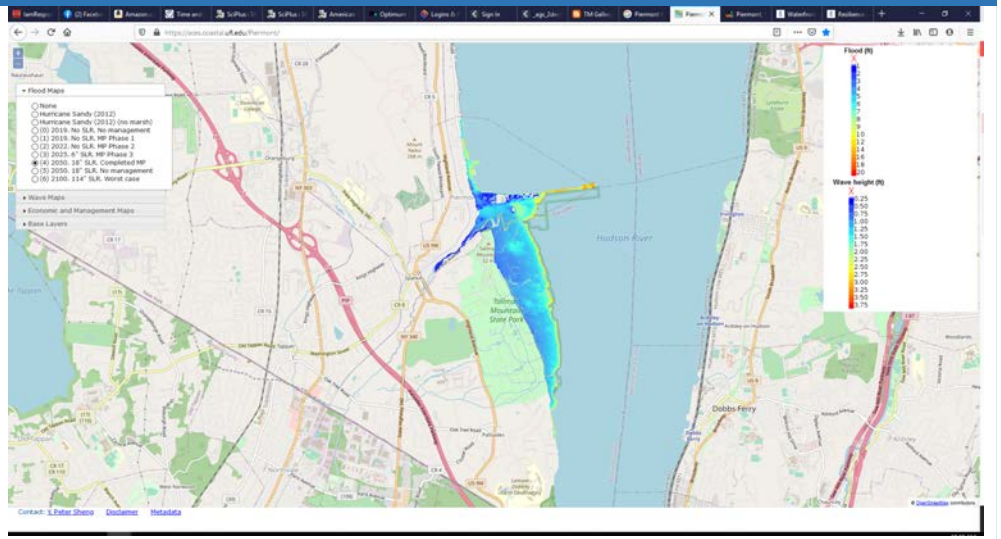
- LiDAR mapping benchmarks marsh shoreline erosion and informs future marsh protection projects
- Shows that living shoreline projects in other vulnerable areas in Piermont could provide additional buffering services.

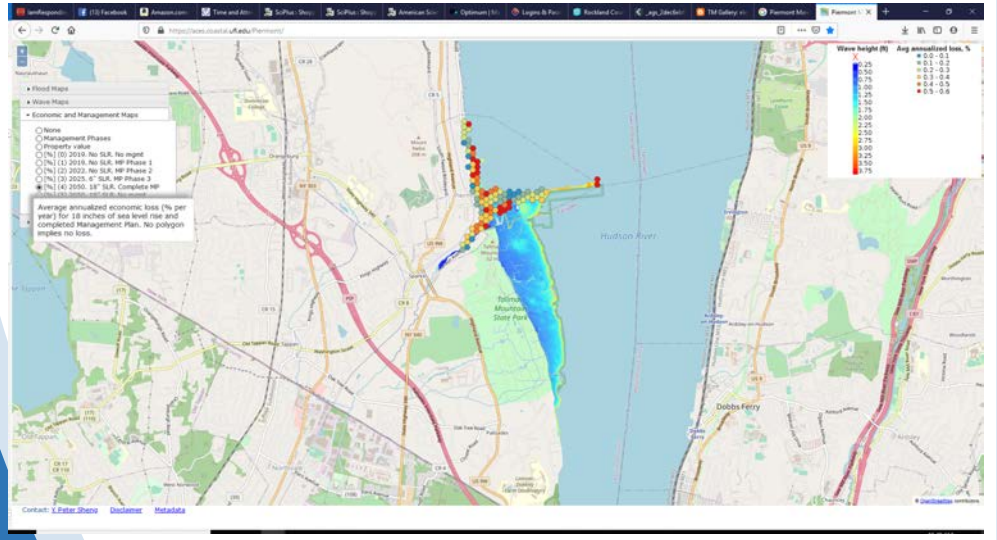
Using the Web Tool

(Available 10/1/2020)

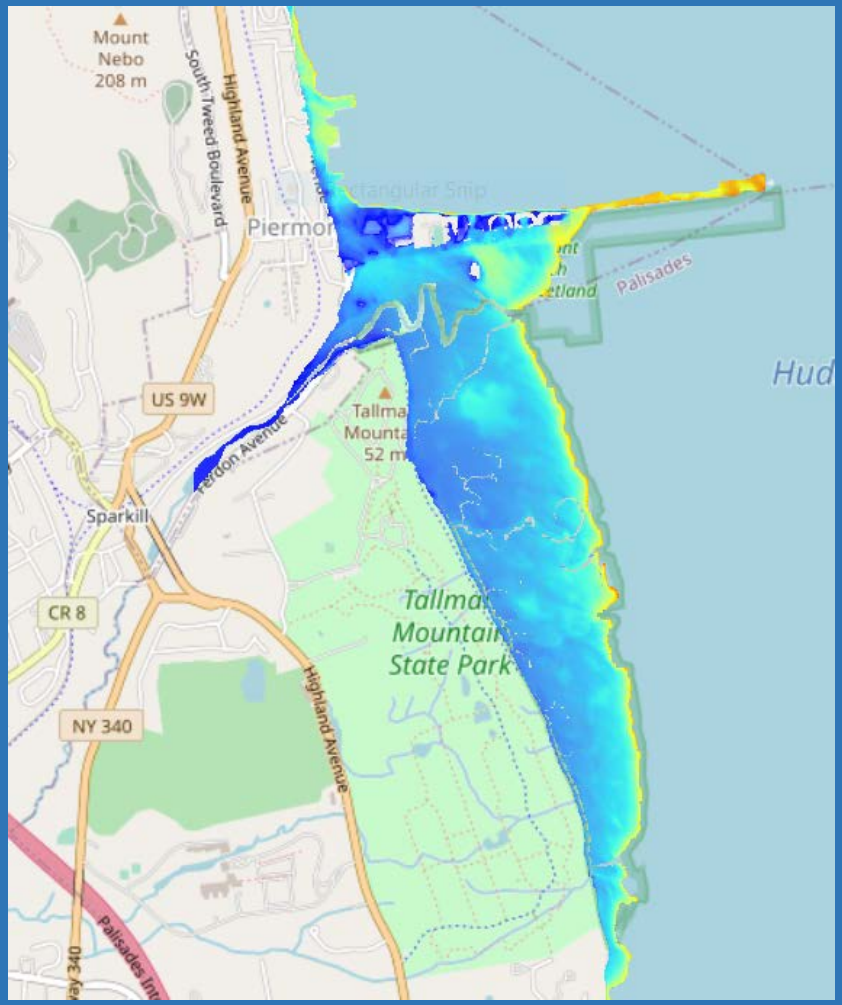
- The web tool created by the Sheng project team allows us to examine future storm impacts both in terms of flood depth and wave height, as well as damage to property.

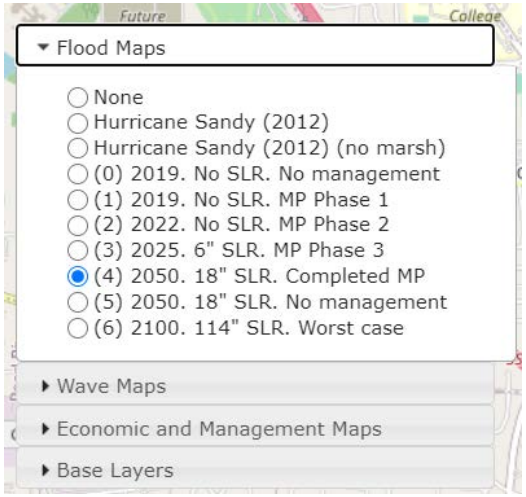
- The model can be viewed with no SLR, or several future SLR levels, 6”, 18”, and 114”.

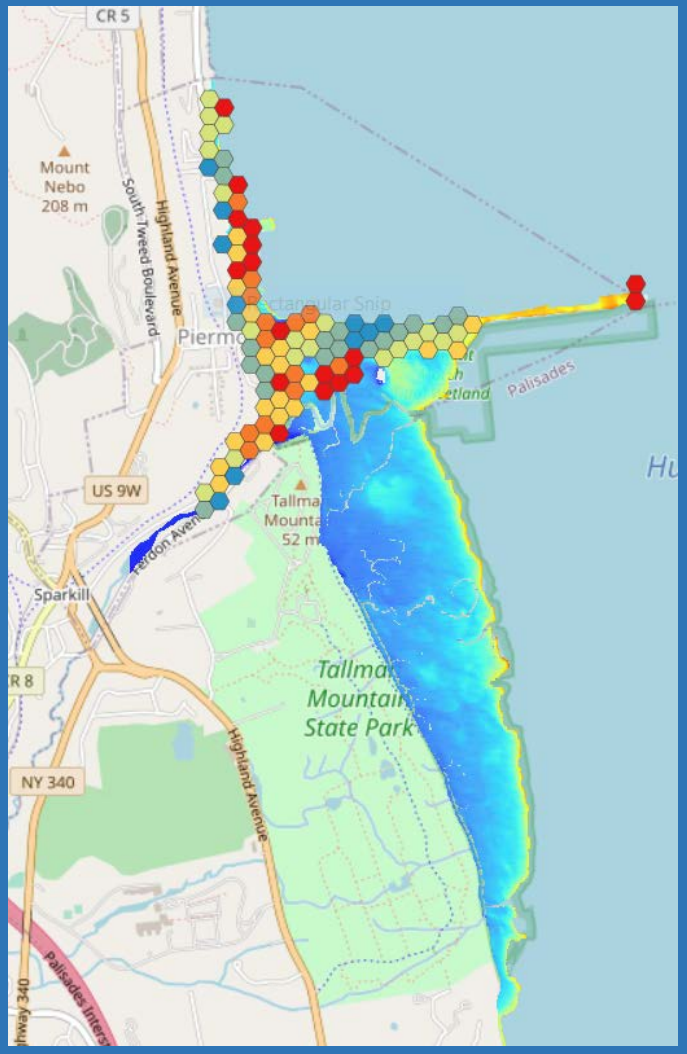




18 inches of SLR wave and height







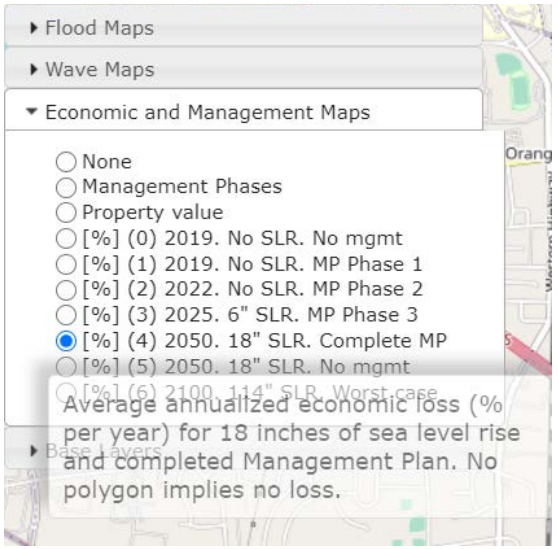
18 inches SLR economic analysis

Wave height (ft)

- 0.25
- 0.50
- 0.75
- 1.00
- 1.25
- 1.50
- 1.75
- 2.00
- 2.25
- 2.50
- 2.75
- 3.00
- 3.25
- 3.50
- 3.75

Avg annualized loss, %

- 0.0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6



Using the Web Tool

- Contact me at nmitchell@piermont-ny.gov and PWRC will schedule a call to train you how to use the tool.

PWRC has compiled a collection of web based SLR impact mapping tools and flood awareness resources.

We are here to support our residents learning how to utilize these resources

Piermont Waterfront Resiliency Commission