SENSING STORM SURGE

A citizen science approach to measuring storm surge-estuarine interaction in three Maine communities

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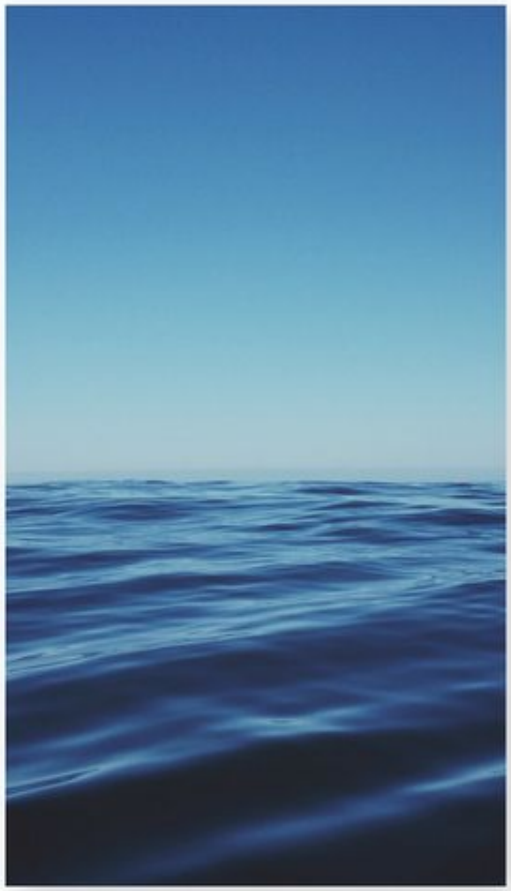


SESSION OVERVIEW

- Project personnel
- Study methods + timeline
- Story of two storms + data sharing

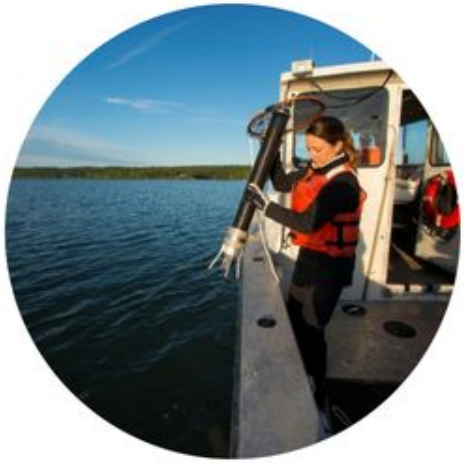
Short Intermission

- Challenges + difficulties
- Implications for climate change adaptation + coastal development

Networking, questions, etc.

WHO'S WHO

DR. LAURA RICKARD



DR. KIMBERLY HUGUENARD

ABBY ROCHE

PRESTON SPICER

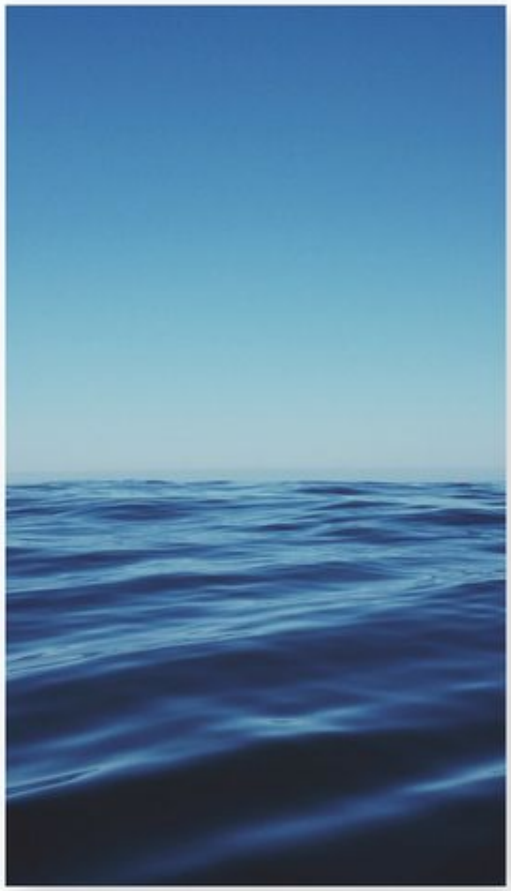
KEVIN DUFFY

KYAH LUCKY

DYLAN SCHLICHTING

DR. LINDA SILKA

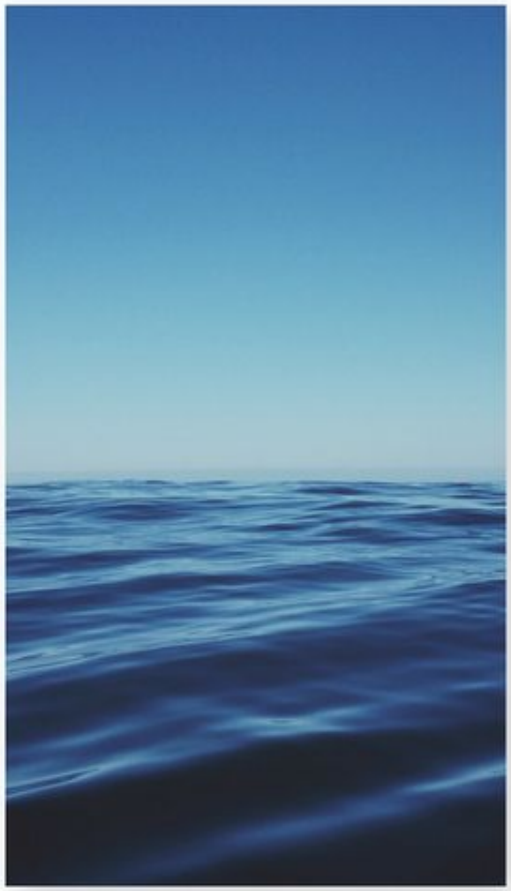
… and our citizen scientists!



ICE-BREAKER

Where are you from?

Visit: www.menti.com
Use code: **70 14 83**



ICE-BREAKER

What brings you here today?

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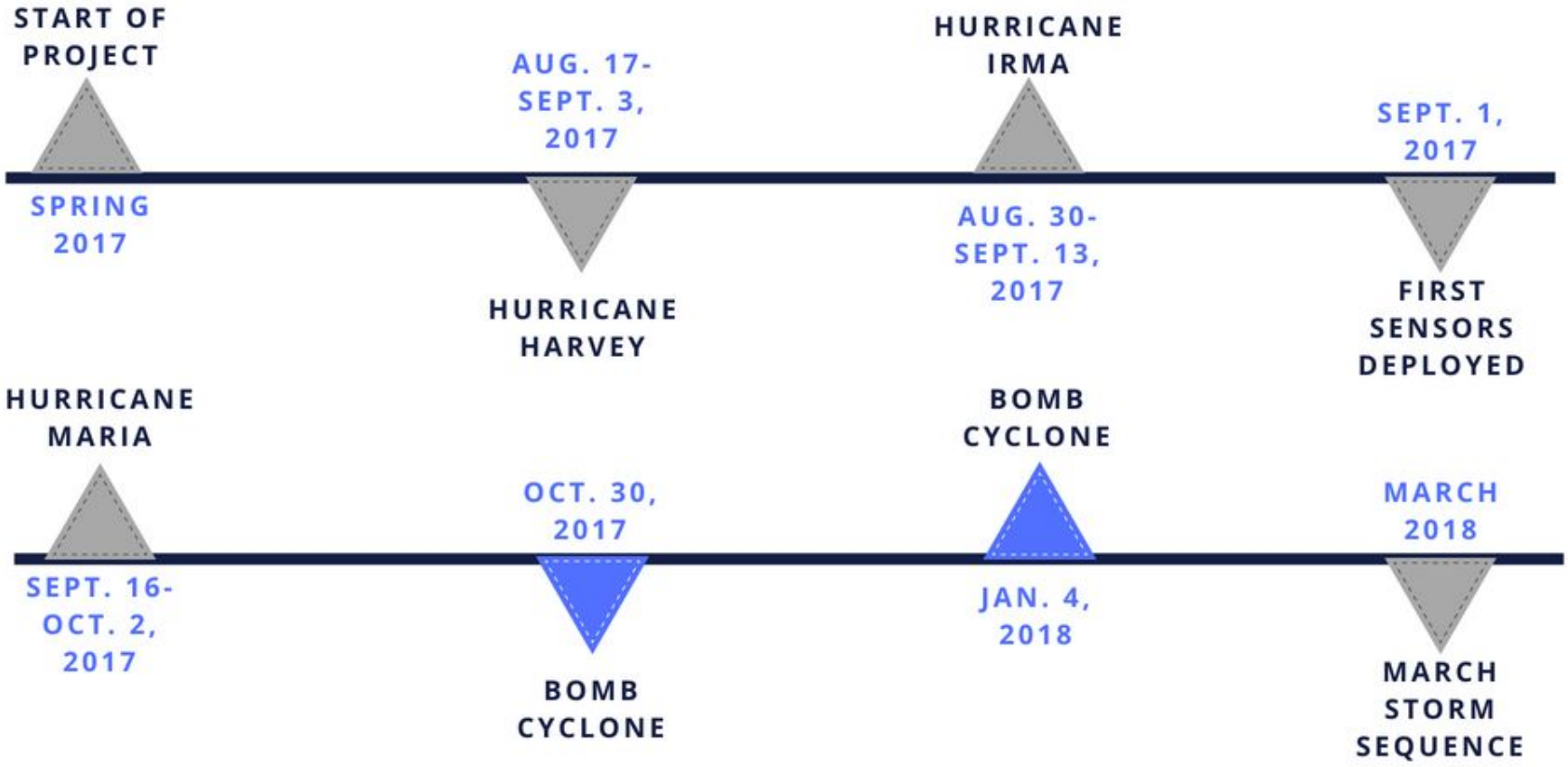
PROJECT TIMELINE



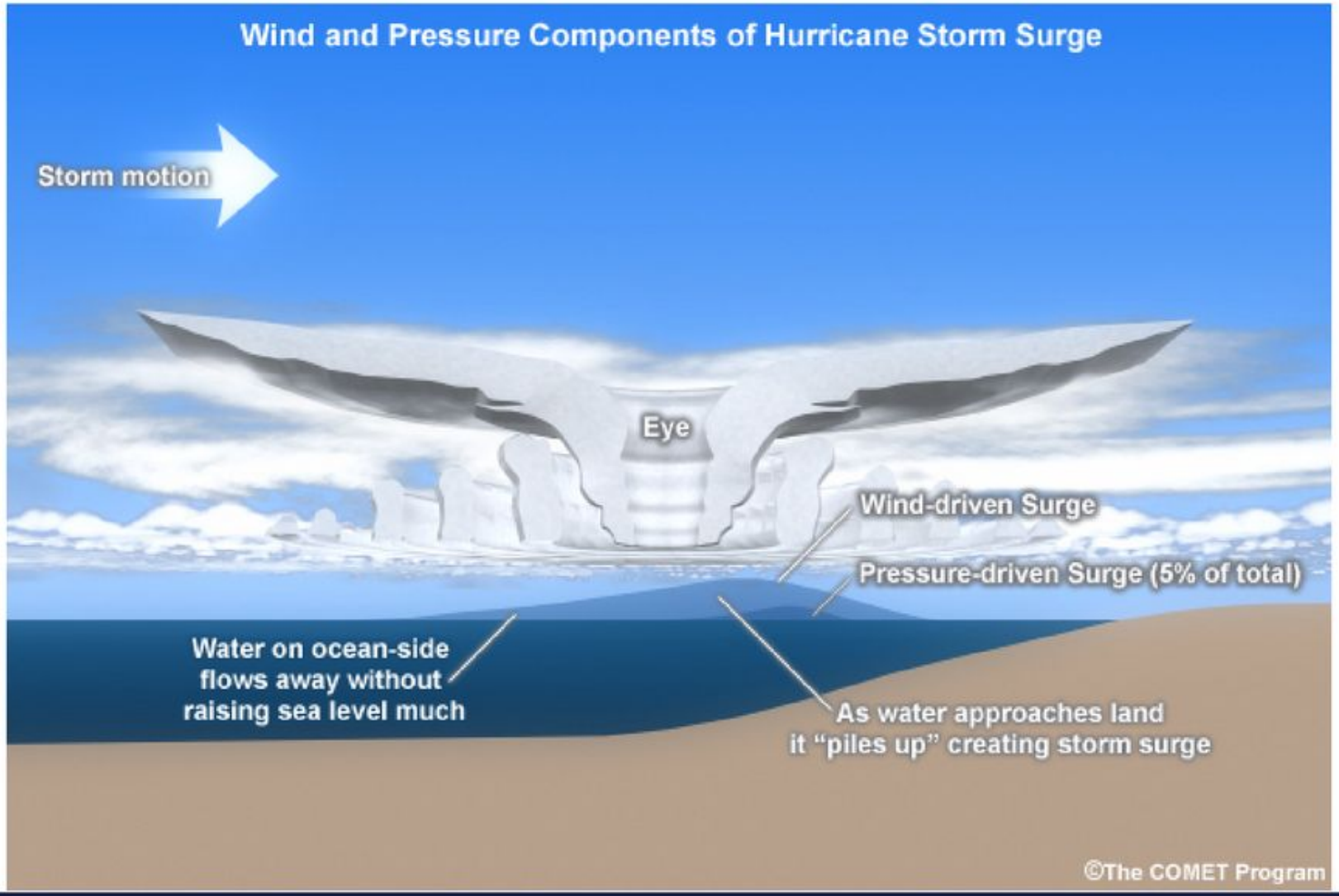
STORM SURGE

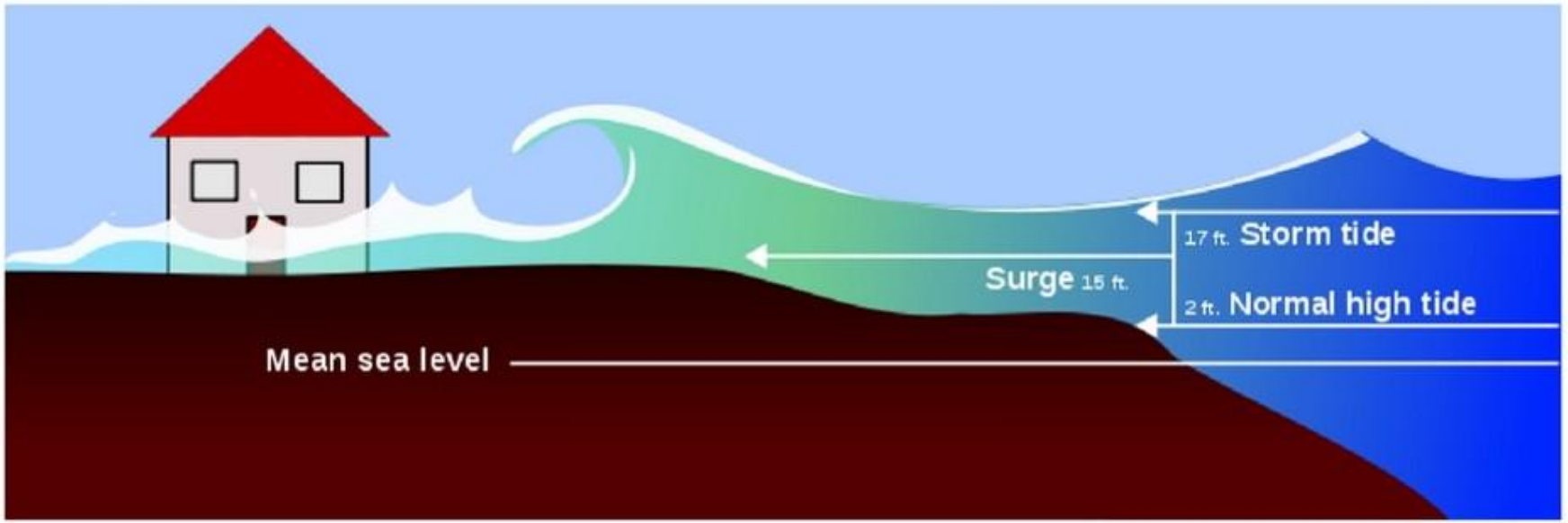
BACKGROUND

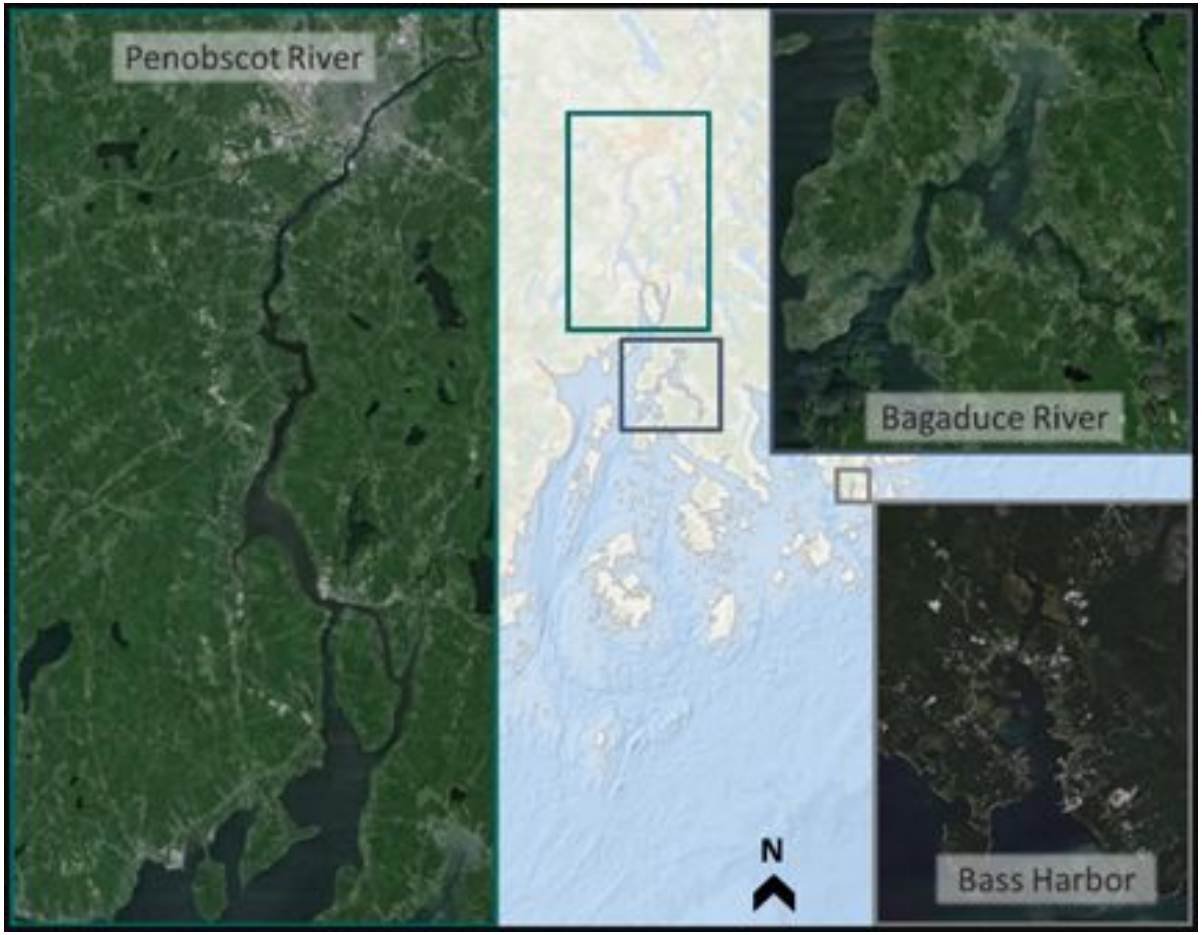
- Storm surge a growing concern in Maine communities
- Frequency of extreme storms is increasing .

February 1976 Bomb Cyclone	
Lowest Pressure	964 mb
Expected Pressure Surge	49 cm
Max. Sustained Wind	20.5 m/s (46 mph)
Average Wind Direction	From SSW
Time of Max. Surge	2 hrs before hightide

Photos courtesy of Bangor Daily News


Wind and Pressure Components of Hurricane Storm Surge
Storm motion
Eye
Wind-driven Surge
Pressure-driven Surge (5% of total)
Water on ocean-side flows away without raising sea level much
As water approaches land it "piles up" creating storm surge
©The COMET Program

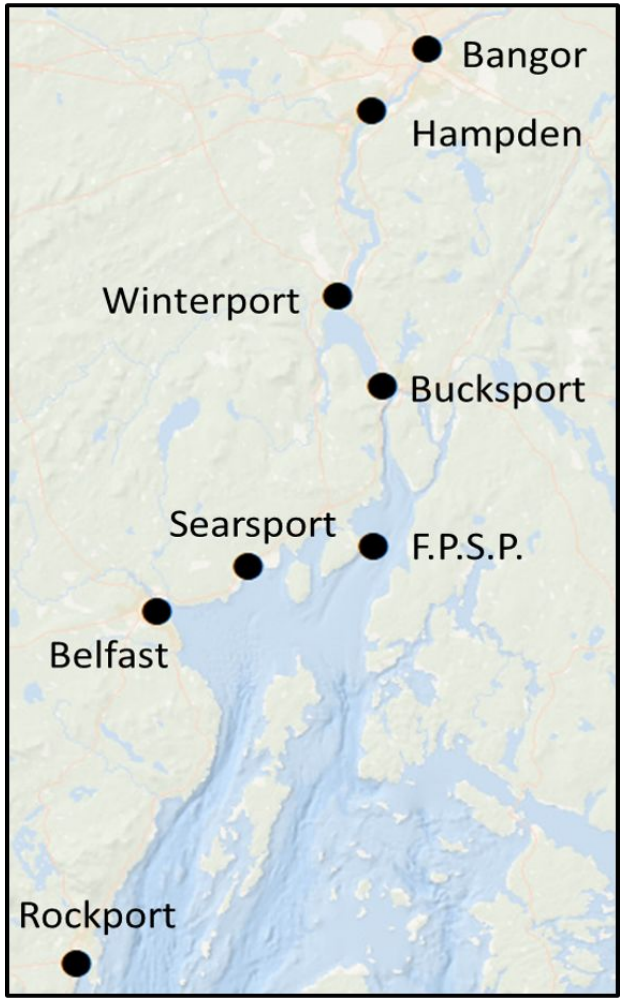

17 ft. Storm tide
Surge 15 ft.
2 ft. Normal high tide
Mean sea level

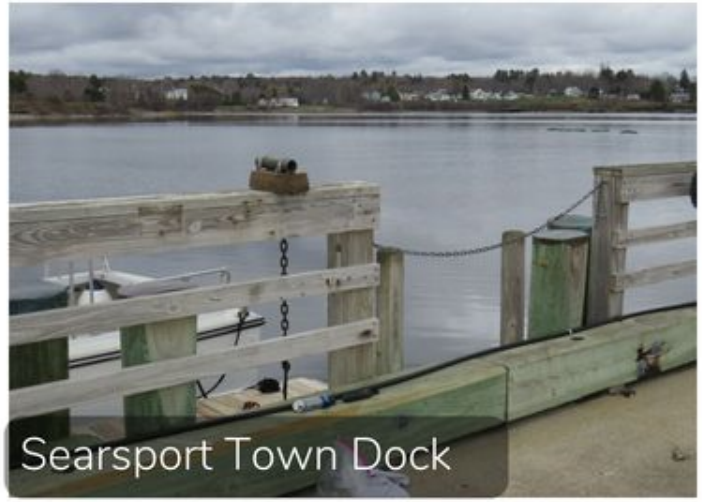


Penobscot:
Converging, long, north-south orientation, deep system, freshwater input

Bagaduce:
L-shaped, shallow, constrictions (reversing falls), tidal flats

Bass Harbor/SW Harbor:
Small, converging, north-south orientation, salt marsh

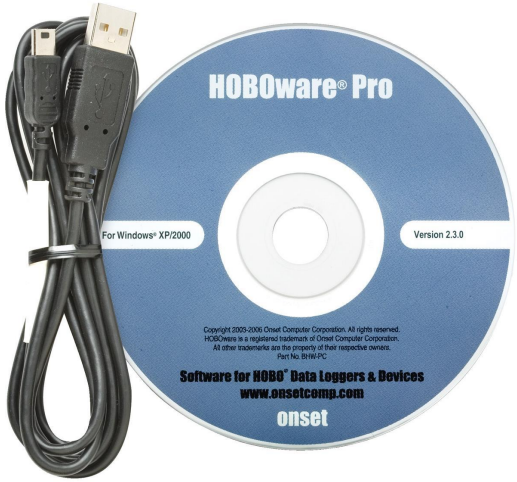

Bangor
Hampden
Winterport
Bucksport
Searsport
F.P.S.P.
Belfast
Rockport

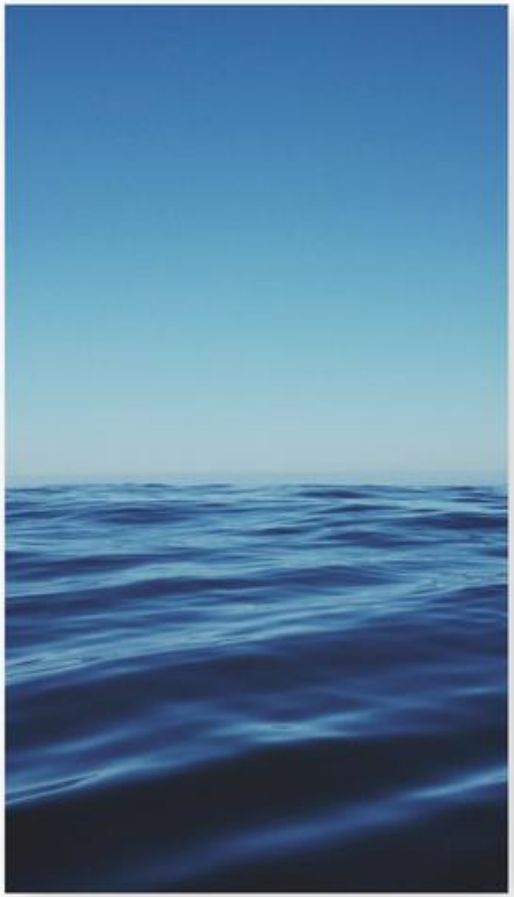

Searsport Town Dock


Bucksport location


Rockport location

INTRODUCTION TO THE PROJECT





Recollections of “bomb cyclone” weather events

Visit: www.menti.com
Use code: **44 63 73**

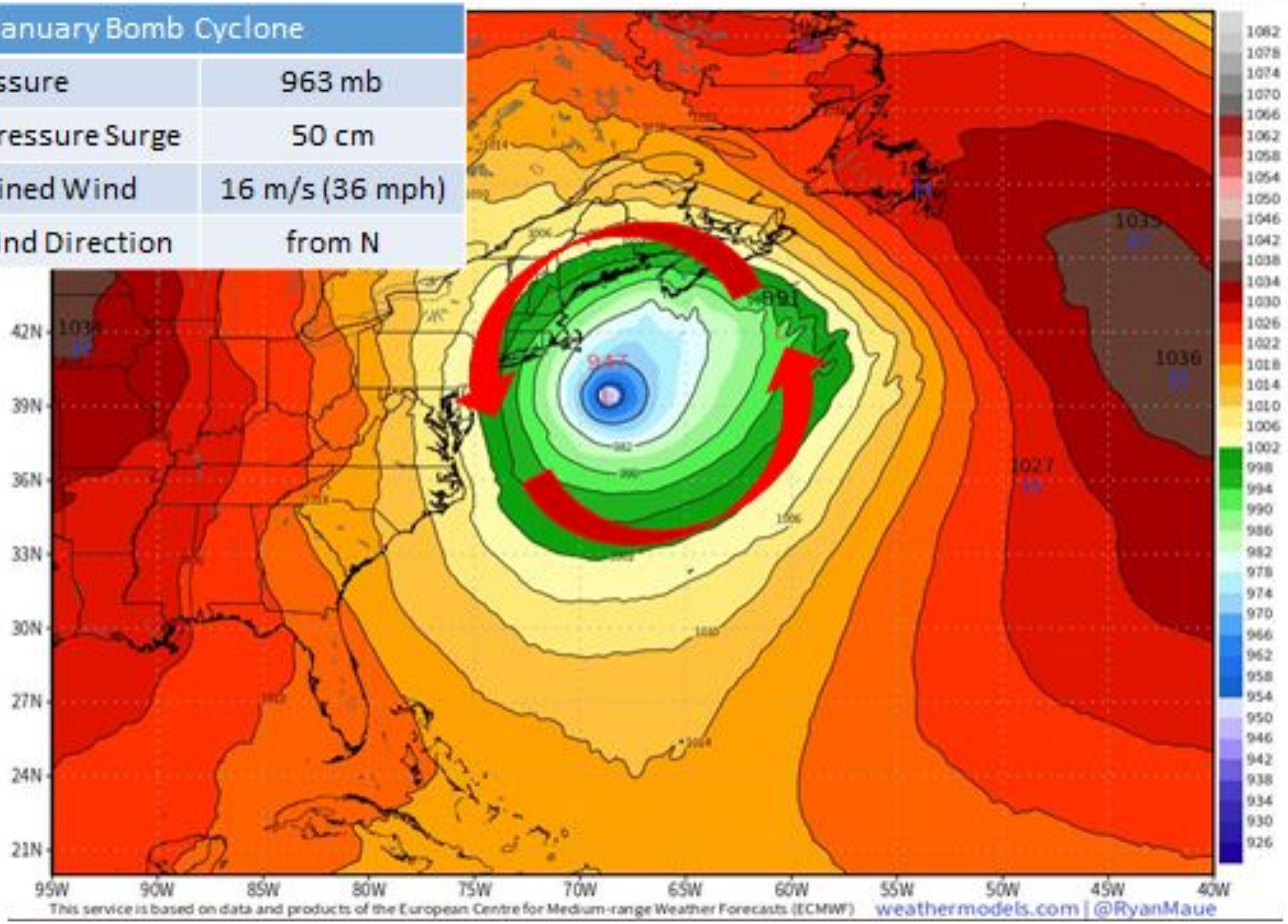
STORY OF TWO STORM EVENTS

PRESENTATION OF THE DATA

Name	Water Level Data									
Penobscot	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Bucksport				15-Nov	x	x	x	x	x	17-May
Searsport				21-Nov	6-Dec		2/5 to 2/27	3/12 to 3/27	4/10 to 4/25	5/1 to 5/16
Rockport			11-Oct	9-Nov						
Fort Point SP				4-Nov	x	x	x	x	29-Apr	
Hampden		20-Sep	20-Oct	4-Nov	x	1-Jan	20-Feb	x	18-Apr	
Winterport								3-Mar	29-Apr	
Bangor				4-Nov	16-Dec					
Belfast				4-Nov	x	x	x	x	29-Apr	
Bagaduce										
B3		17-Sep	x	4-Nov						
B4		17-Sep	x	x	16-Dec		24-Feb	26-Mar		
B1	22-Aug	x	x	x	x	x	x	x	x	14-May
B5		17-Sep	x	x	16-Dec	16-Jan	x	x	x	16-May
B2			12-Oct	x	x	30-Jan	2-Feb	x	x	26-May
B6						10-Jan	x	x	2-Apr	
Bass Harbor										
Thurston's Lobster Pound	18-Aug	x	x	x	x	x	x	31-Mar		
Tremont School		4-Sep	x	x	x	x	x	x	29-Apr	
Underwood Wharf	26-Aug	x	x	x	x	x	x	x	x	5-May
Seafood Ketch		17-Sep	x	x	x	x	x	x	30-Apr	
Tremont Dock	31-Aug	x	x	x	x	x	x	x	30-Apr	
Adam's Bridge				3-Nov	12/3 then 12/7	6-Jan				
Southwest Harbor										
Manset Town Dock			3-Oct	x	x	x	x	x	30-Apr	
Dysart's Marina		17-Sep	x	x	x	x	x	31-Mar		
Somesville Landing									4/9 to 4/24	5/9 to 5/24

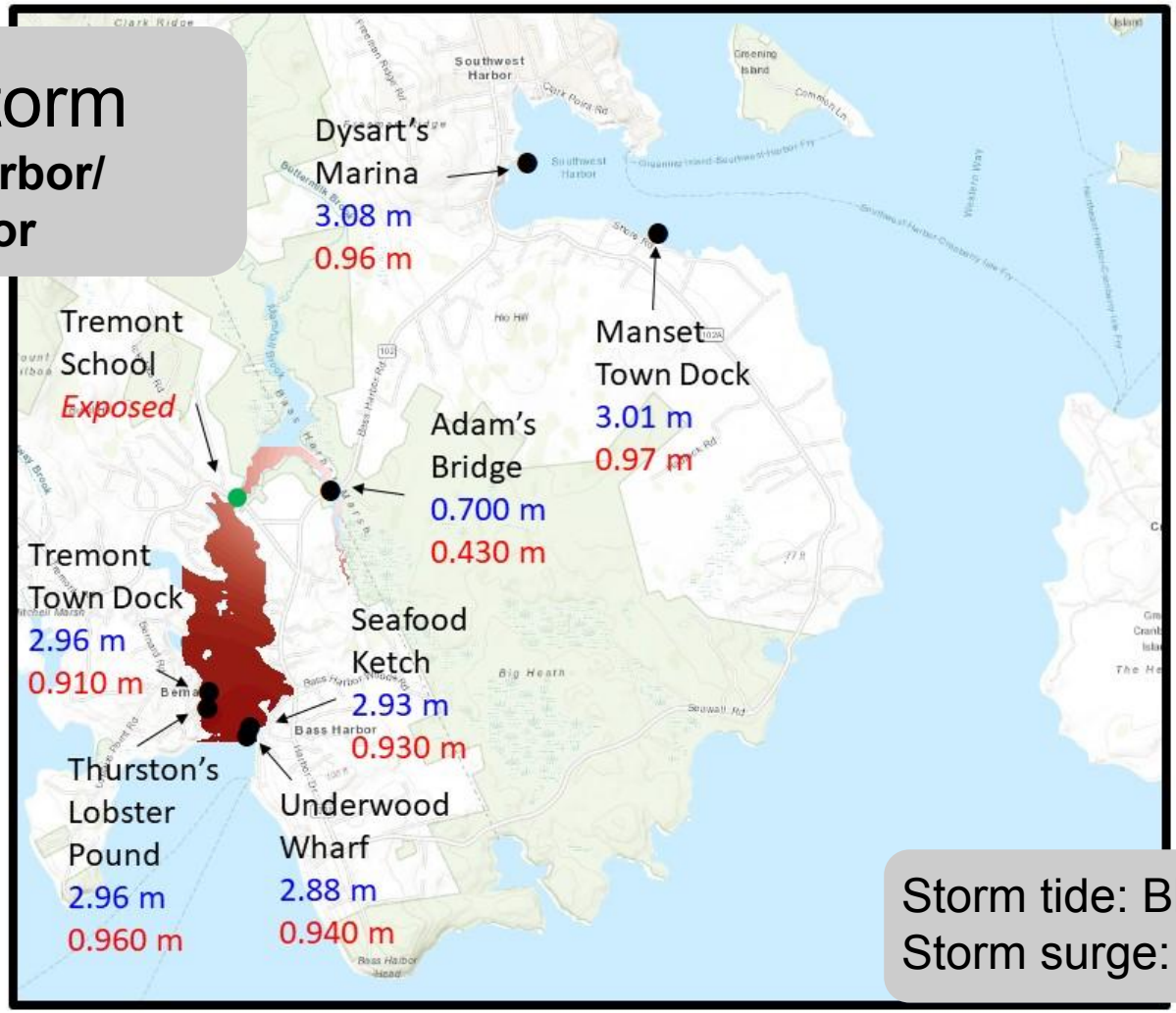
STORY OF TWO STORM EVENTS

January Bomb Cyclone	
Lowest Pressure	963 mb
Expected Pressure Surge	50 cm
Max. Sustained Wind	16 m/s (36 mph)
Average Wind Direction	from N



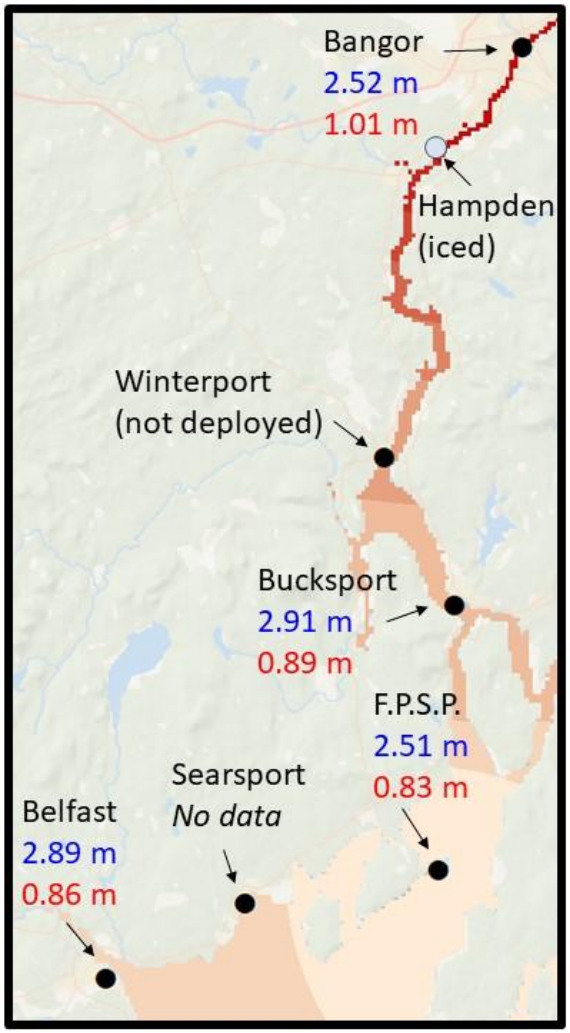
Jan. 4th storm

Southwest Harbor/ Bass Harbor



Jan. 4th storm

Penobscot River

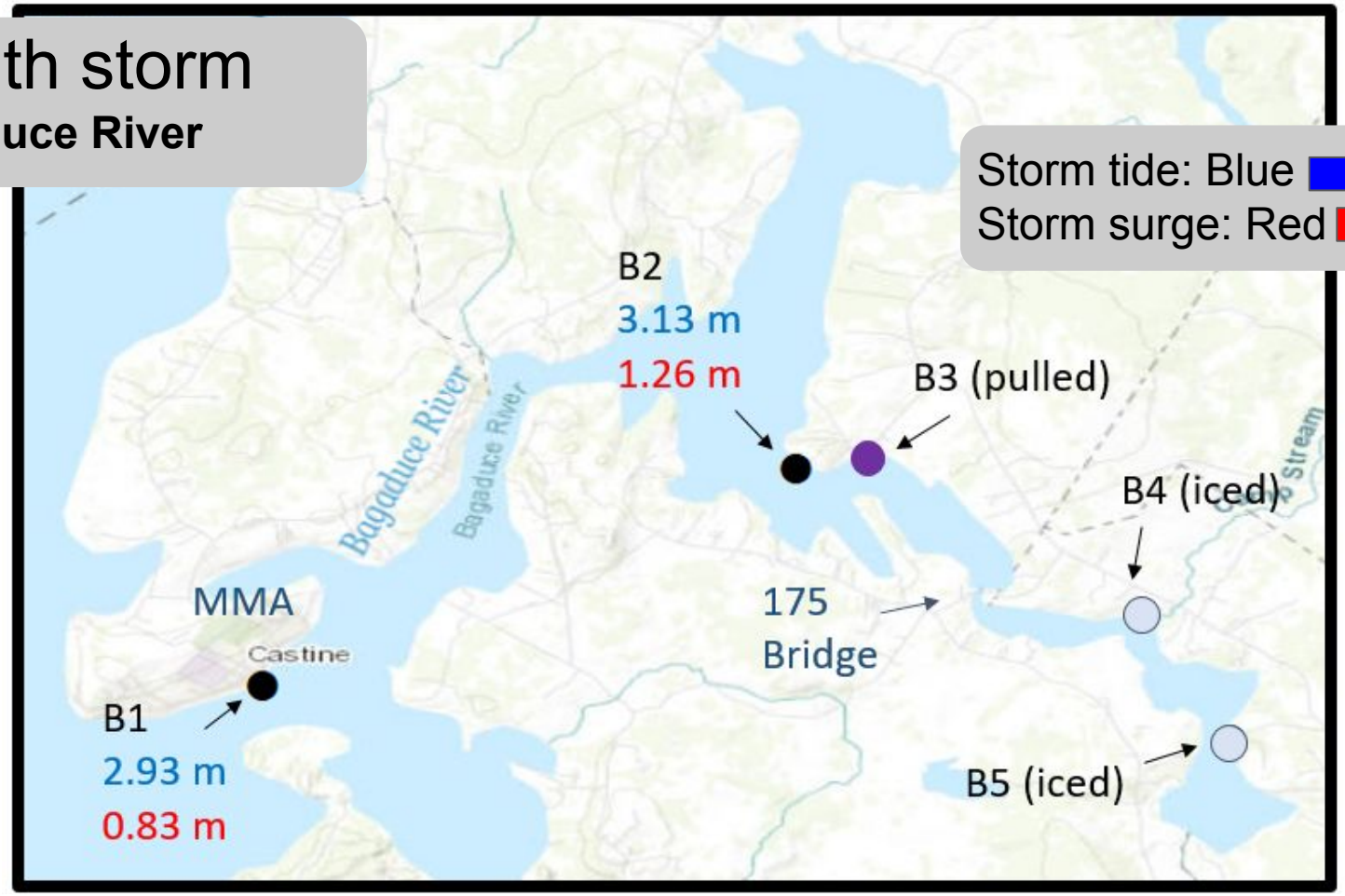


Storm tide: Blue

Storm surge: Red

Jan. 4th storm

Bagaduce River



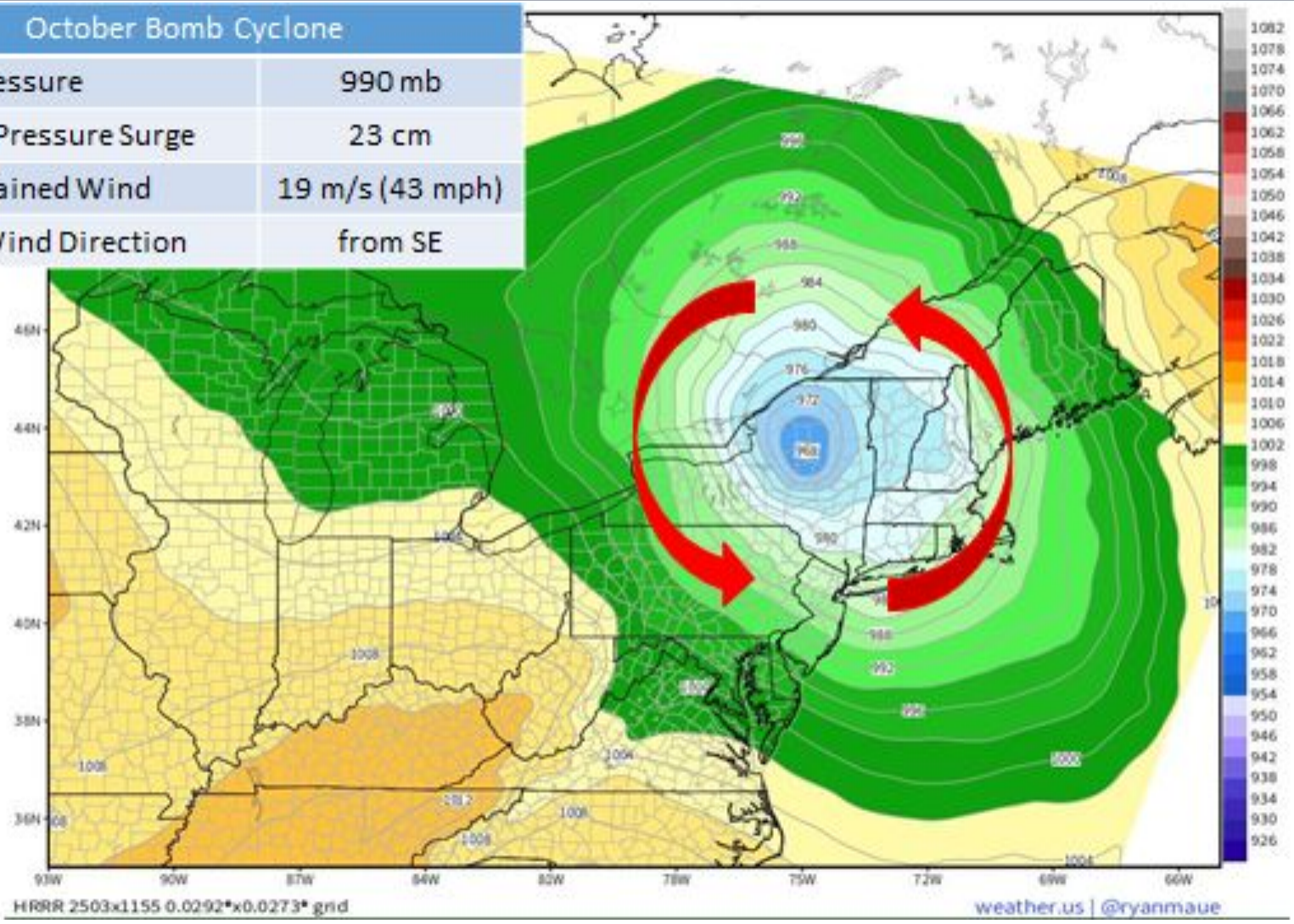
Summary:

January Bomb Cyclone	
Lowest Pressure	963 mb
Expected Pressure Surge	50 cm
Max. Sustained Wind	16 m/s (36 mph)
Average Wind Direction	from N
Time of Max. Surge	~2.5 hrs after HT

- Penobscot: surge slightly **increases** moving up-estuary
  - Wind working against surge propagation
  - Convergence still allows for slight amplification
- Bagaduce
  - Surge **increases** from narrow channel
  - Uncertainty for this storm after B2
- Bass Harbor
  - **Decrease** in surge moving up estuary from shallow depth and restriction of bridge
- Southwest Harbor
  - **Increase** in surge relative to Bass Harbor from narrower Western Way

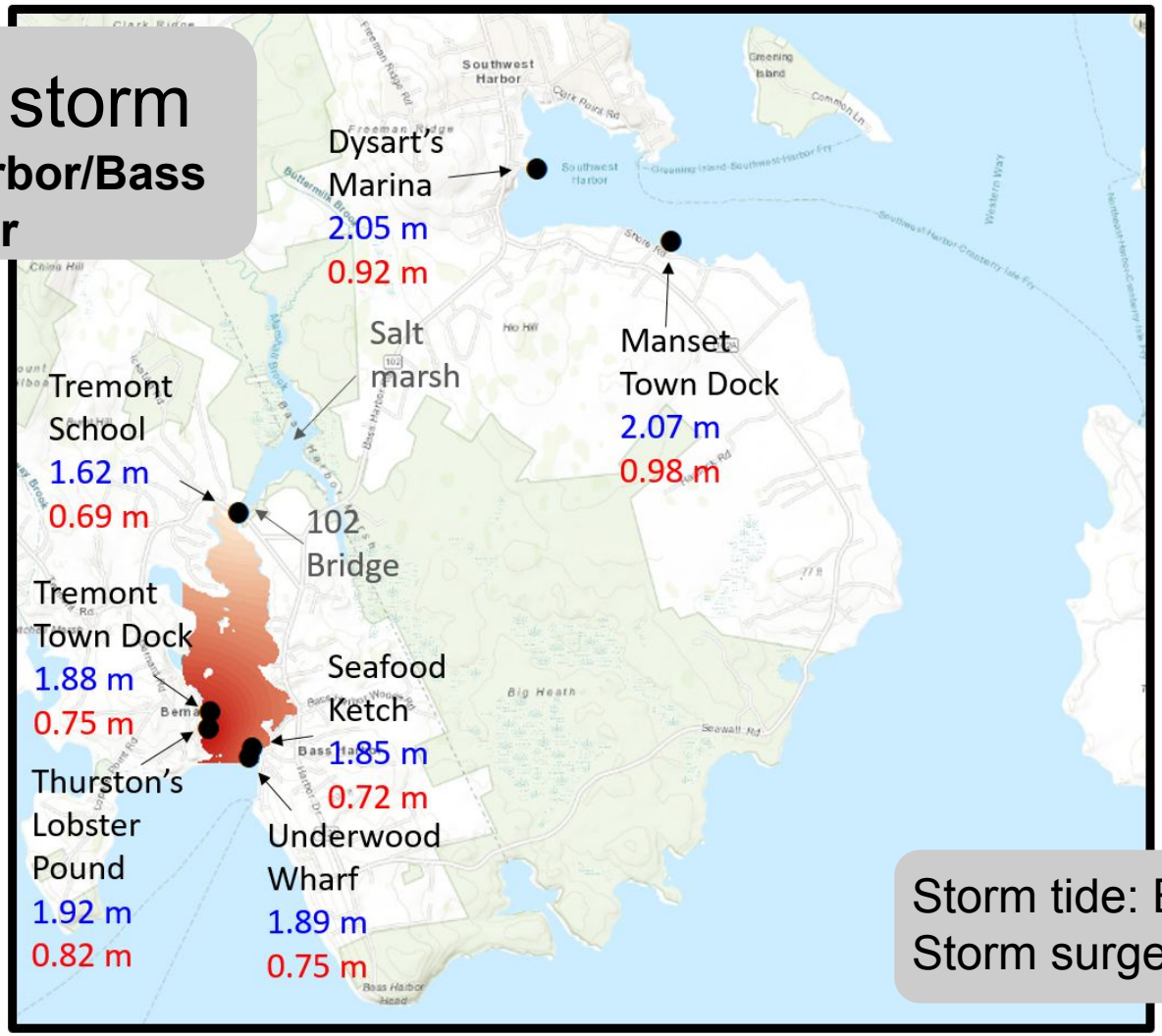
STORY OF TWO STORM EVENTS

October Bomb Cyclone	
Lowest Pressure	990 mb
Expected Pressure Surge	23 cm
Max. Sustained Wind	19 m/s (43 mph)
Average Wind Direction	from SE



Oct. 30th storm

Southwest Harbor/Bass Harbor



Oct. 30th storm

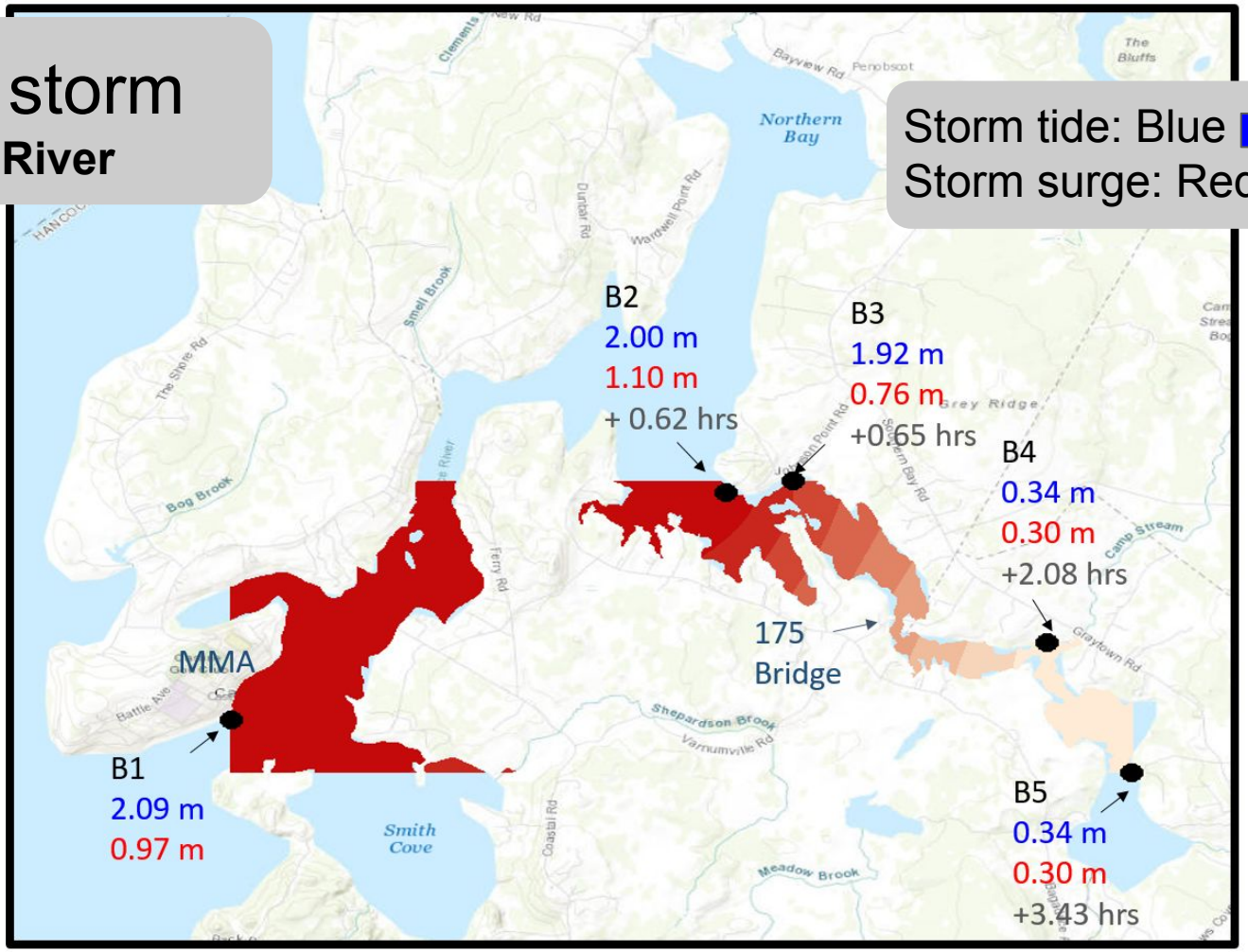
Penobscot River

Storm tide: Blue

Storm surge: Red

Oct. 30th storm

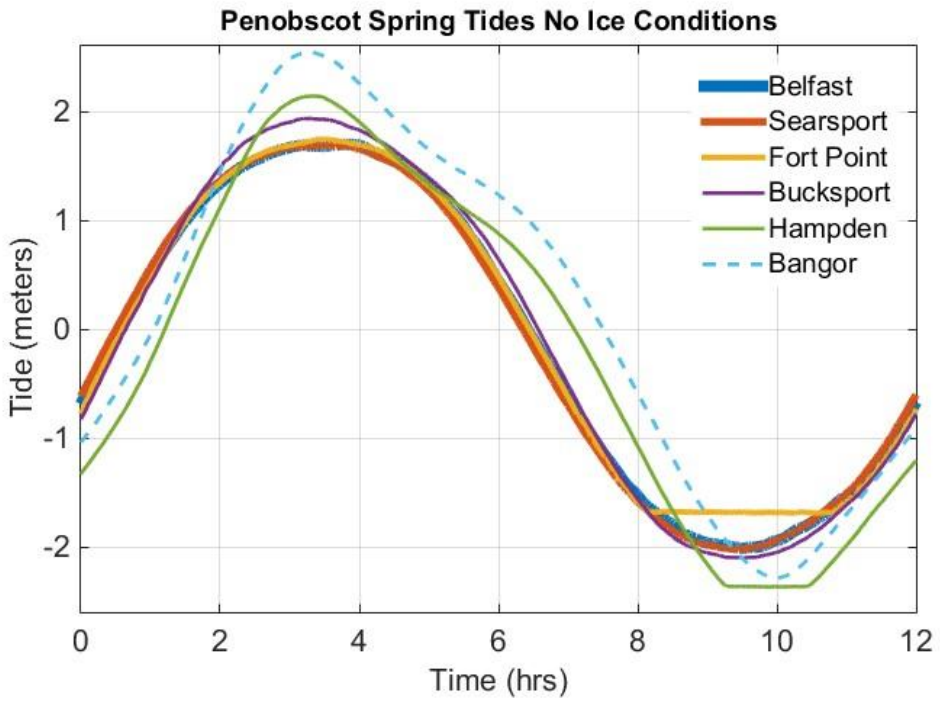
Bagaduce River



Summary:

October Bomb Cyclone	
Lowest Pressure	990 mb
Expected Pressure Surge	23 cm
Max. Sustained Wind	19 m/s (43 mph)
Average Wind Direction	from SE
Time of Max. Surge	~30 min after HT

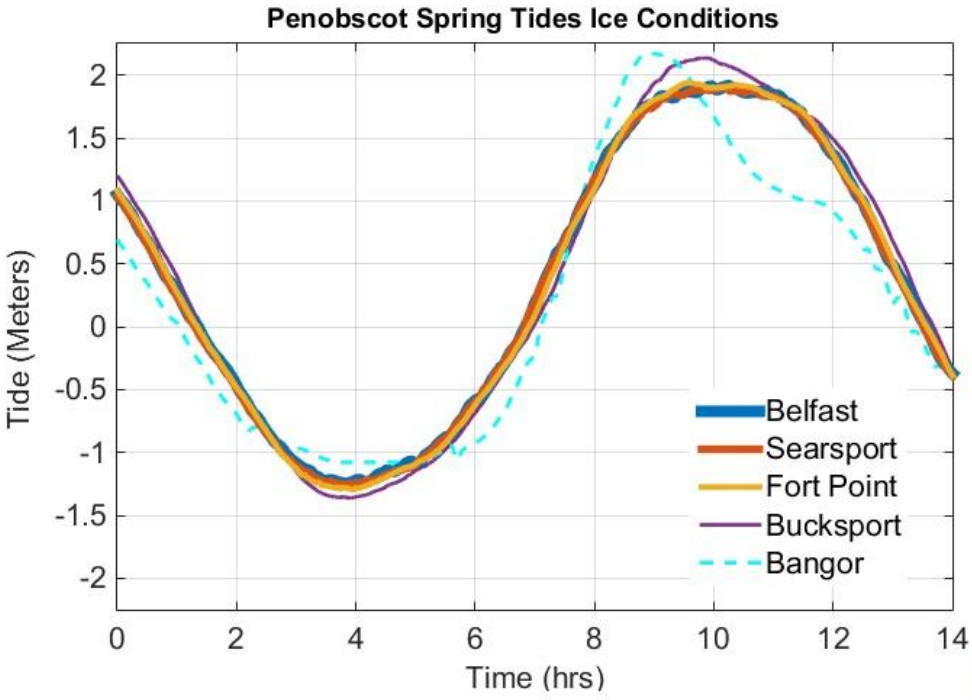
- Penobscot: significant **increase** moving up estuary
  - Wind working with surge propagation…generally wind enhanced surge
  - Larger surge than January storm…from wind
- Bagaduce, Bass Harbor, Southwest Harbor
  - Similar patterns compared to January storm for B1 to B2
  - Then surge **decrease** from shallower channel and restriction of reversing falls
- Bagaduce, Bass Harbor, Southwest Harbor
  - Coastal values all smaller
- Main Message
  - Storm path really important



Typical Tidal Ranges

	Spring (m)	Neap (m)
Belfast	3.69	2.55
Searsport	3.69	2.56
Fort Point	-	2.59
Bucksport	4.03	2.67
Hampden	-	2.98
Bangor	4.83	2.98

PRESENTATION OF THE DATA



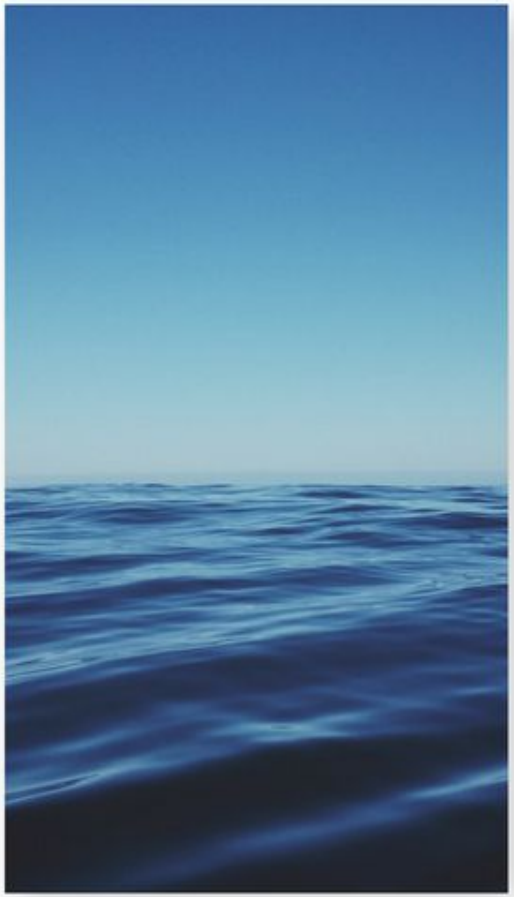
Typical Tidal Ranges

	Spring (m)	Neap (m)
Belfast	3.16	2.67
Searsport	3.16	2.67
Fort Point	3.23	2.74
Bucksport	3.50	2.86
Bangor	3.30	1.30

INTERMISSION

[5 MINUTES]

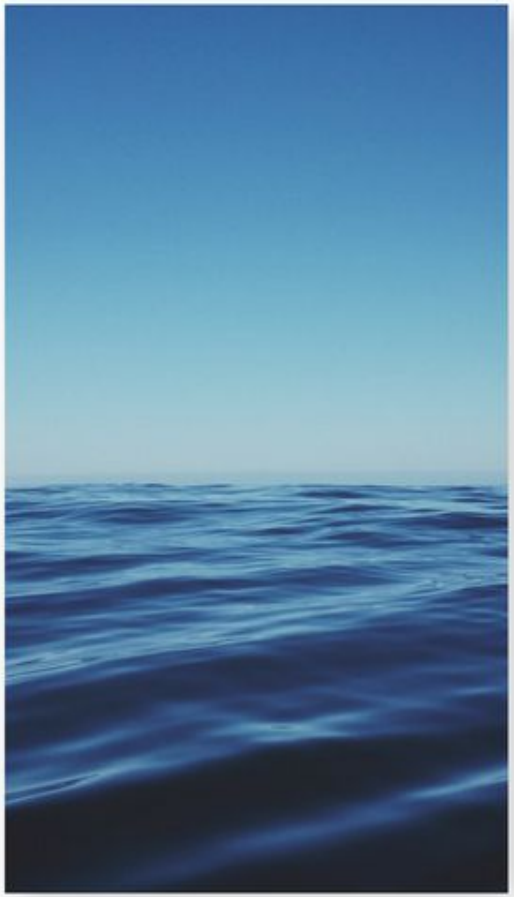
CHALLENGES & DIFFICULTIES



Citizen scientist challenges and difficulties

Icing over of equipment

“..and then the ice freezing over. So it was the weather that really impeded us in doing it correctly. We just couldn't pull the sensor out of the ice.“

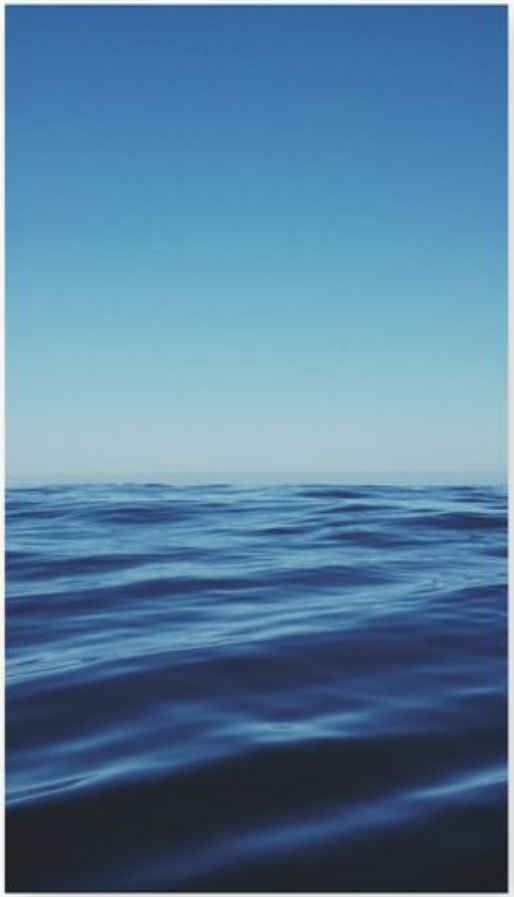


Citizen scientist challenges and difficulties

Community building with other citizen scientists

"(I was) hoping to connect with new people through it, and locally that hasn't been the case. I know that there's another data logger just up the road from me, but besides one other person in the study I haven't communicated with any of those people."

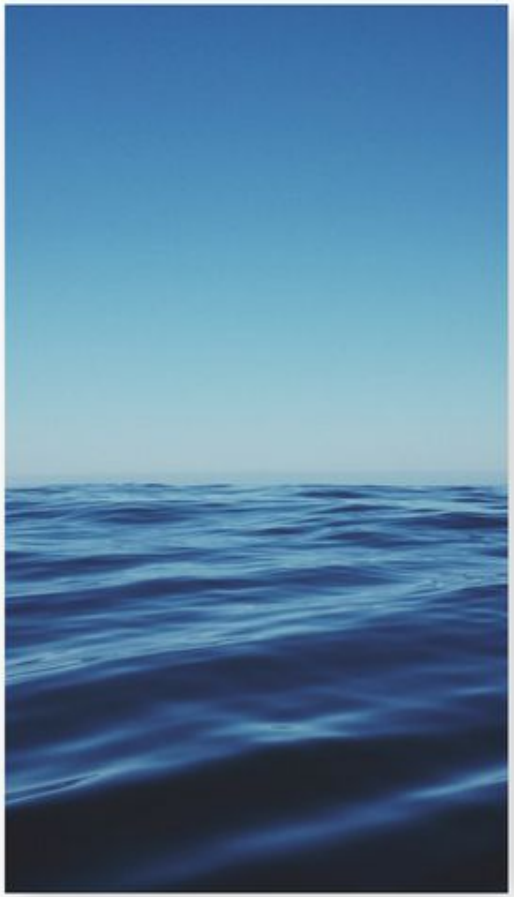
"I think that we would of or I would of enjoyed contacting other people and not just feeling on my own. That's one thing. I think creating a team in an area who have a common interest would be more effective in a way then this one on one thing."



Citizen scientist challenges and difficulties

Data collection frequency

"..because it's so infrequent, when you're doing it once a month you don't get really good and right in the hang of it so much as if you were doing it every day or every week or something...so it doesn't become like second nature because there's a big interval in between you gotta remind yourself what to do."



Citizen scientist challenges and difficulties

Periodic check-ins and updates

“ (a suggestion) would be to see some simple graphs of the trends that are the product of the data you’re collecting rather than waiting for some longer time. Like you’re collecting it but unless you go in and you were to make your own graphs and things – you can see the day to day kinda ups and downs if you open the data flies. But pulling out some of the patterns that are emerging during the data collection time from different sites would be interesting and engaging I think for all the participants. So you’re not working in isolation and not knowing even perhaps what your own data looks like.”

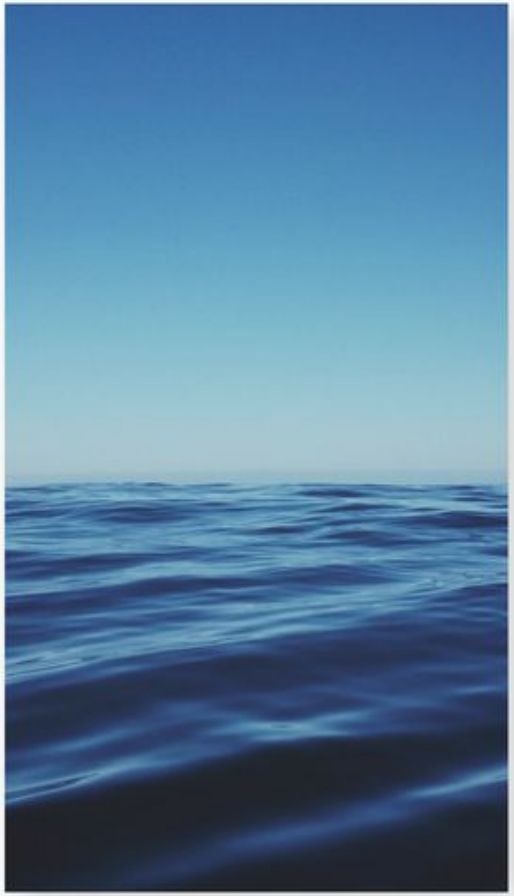
STORM SURGE IN ESTUARIES

What we have learned

- Storm path and timing with tide is critical
- Importance of accurate storm forecasting for flood advisories inland versus coastal
- Need for hydrodynamic modeling to inform future coastal adaptation

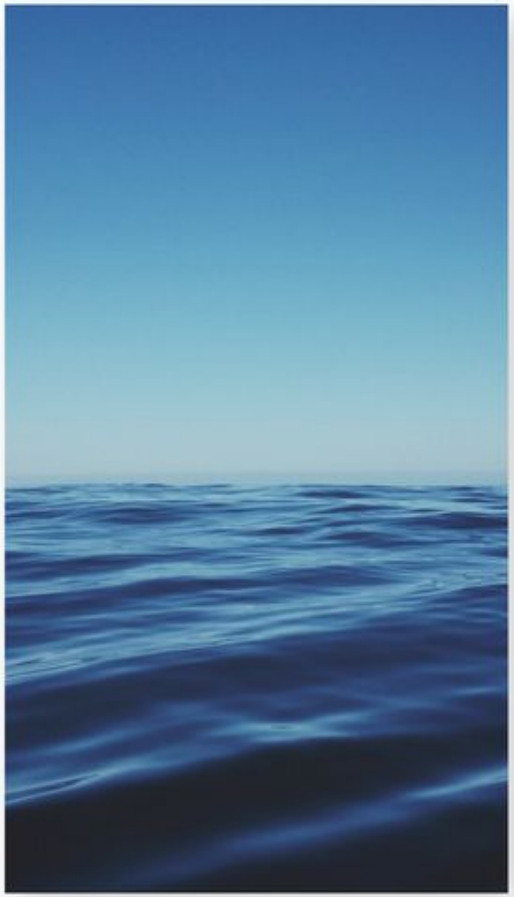
Why is this important for Maine?

- Coastal infrastructure
- Coastal economic development
- Climate change adaptation



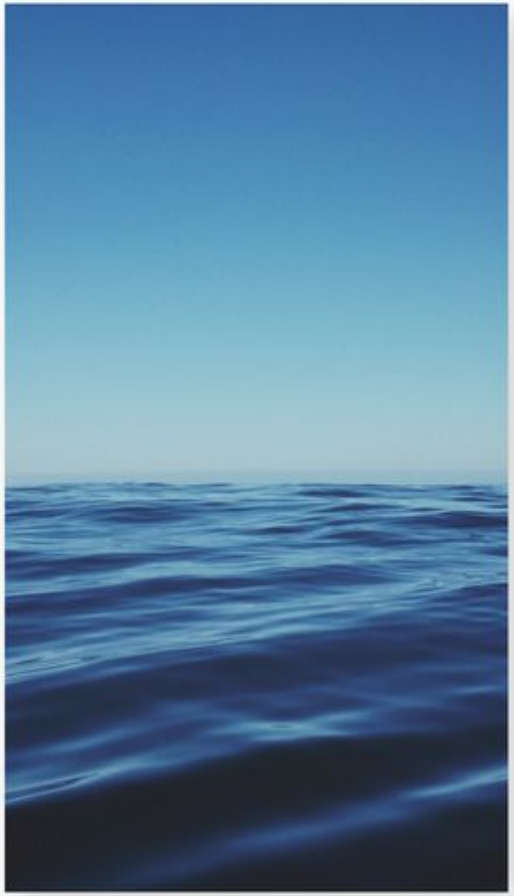
What's next?

- Electronic technical report
- Data in shareable form
- Scientific publications
- Opportunities for expansion and funding in the future



Where do we go from here?

- Who should receive these data?
- What future research or studies or analysis are needed?



RELEVANT ORGANIZATIONS

National

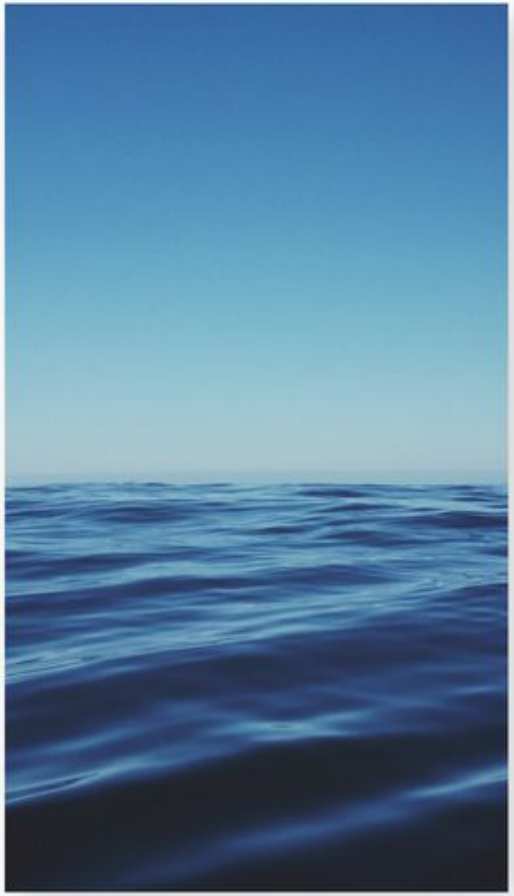
National Weather Service, National Park Service, National Oceanic and Atmospheric Administration

State

Downeast Conservation Network, Maine Geological Survey, Maine Coastal Program, Natural Resources Council of Maine, Maine Coast Heritage Trust, Island Institute, Maine Sea Grant, Maine EPSCoR, Maine DOT

Local

Belfast Bay Watershed Coalition, Lower Penobscot Watershed Coalition, Belfast Climate Change Committee, Islesboro Islands Trust, Friends of Sears Island, Penobscot Nation



CONTACT INFORMATION

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@SensingSurge @LNRickard

Interested in becoming a citizen scientist or being interviewed?
Contact us!

SENSING STORM SURGE

A citizen science approach to measuring storm surge-estuarine interaction in three Maine communities

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