

Recent Inlet Geomorphology and Coastal Processes

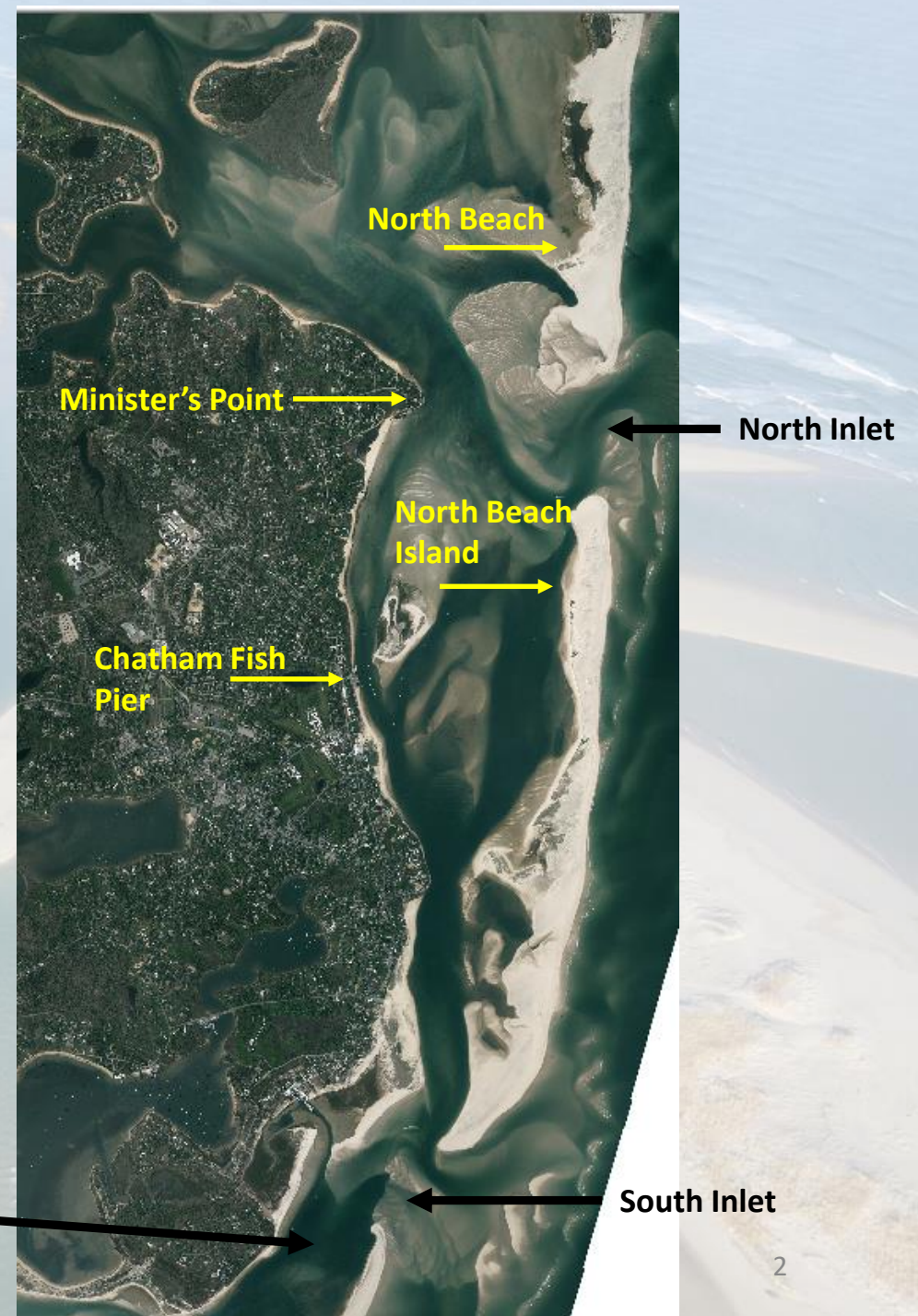
February 28, 2019

John Ramsey, P.E.



Project Overview

1. Inlet/Channel Migration Analysis
2. Quantitative Analysis of Coastal Processes
3. Initial Engineering Analysis to Screen Alternatives
4. Prioritize Shore Protection and Management Strategies



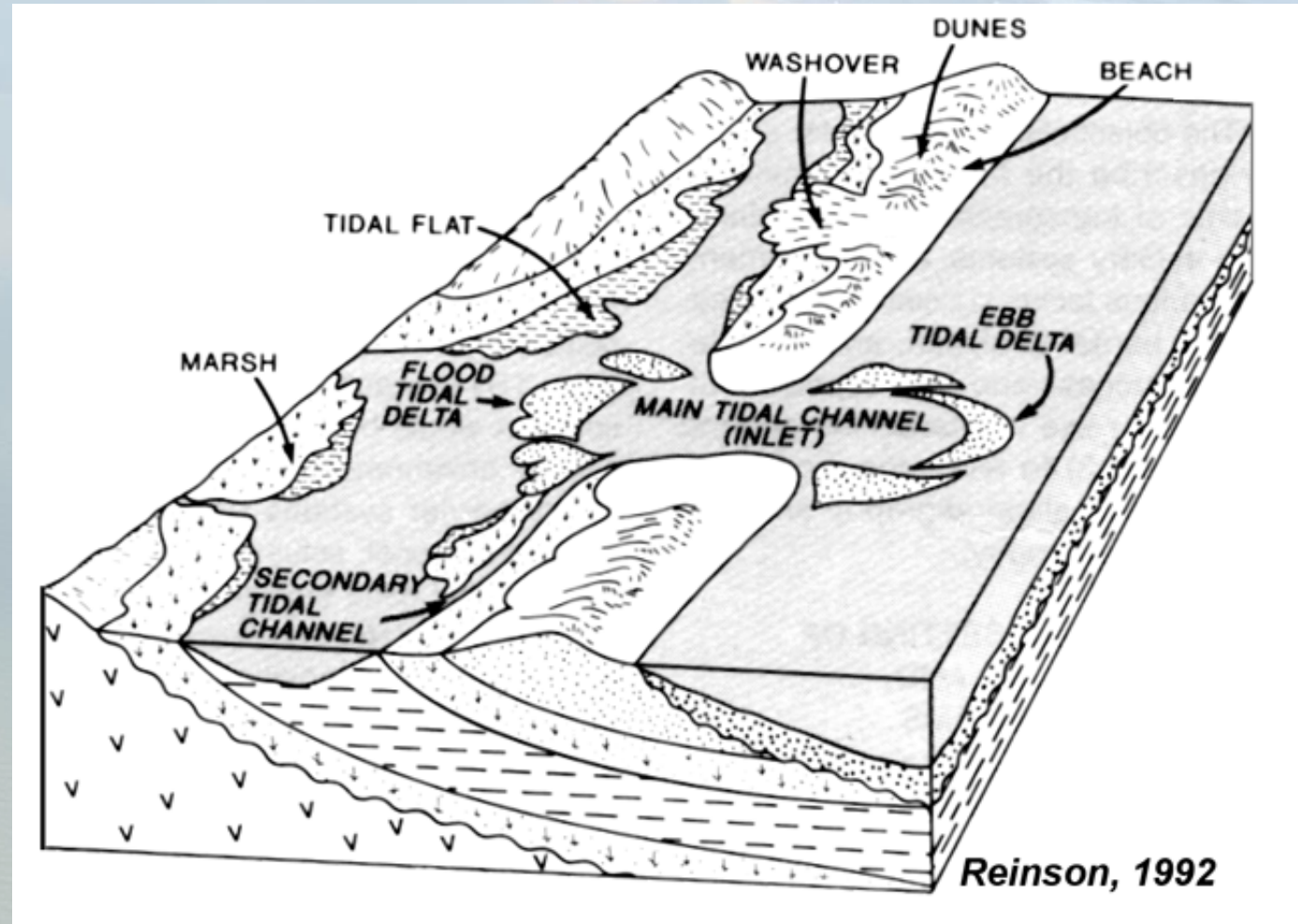
Outline

1. Dynamic Barrier Island Systems
2. Modeled Current Velocity
3. Water Elevation and Current Speed
4. Tidal Flow Patterns
5. Wave Patterns



Barrier Island Systems: A Primer

- Barrier Islands develop parallel to mainland
- Separated from land by a small body of water
- Connected to the ocean via tidal channels/inlets

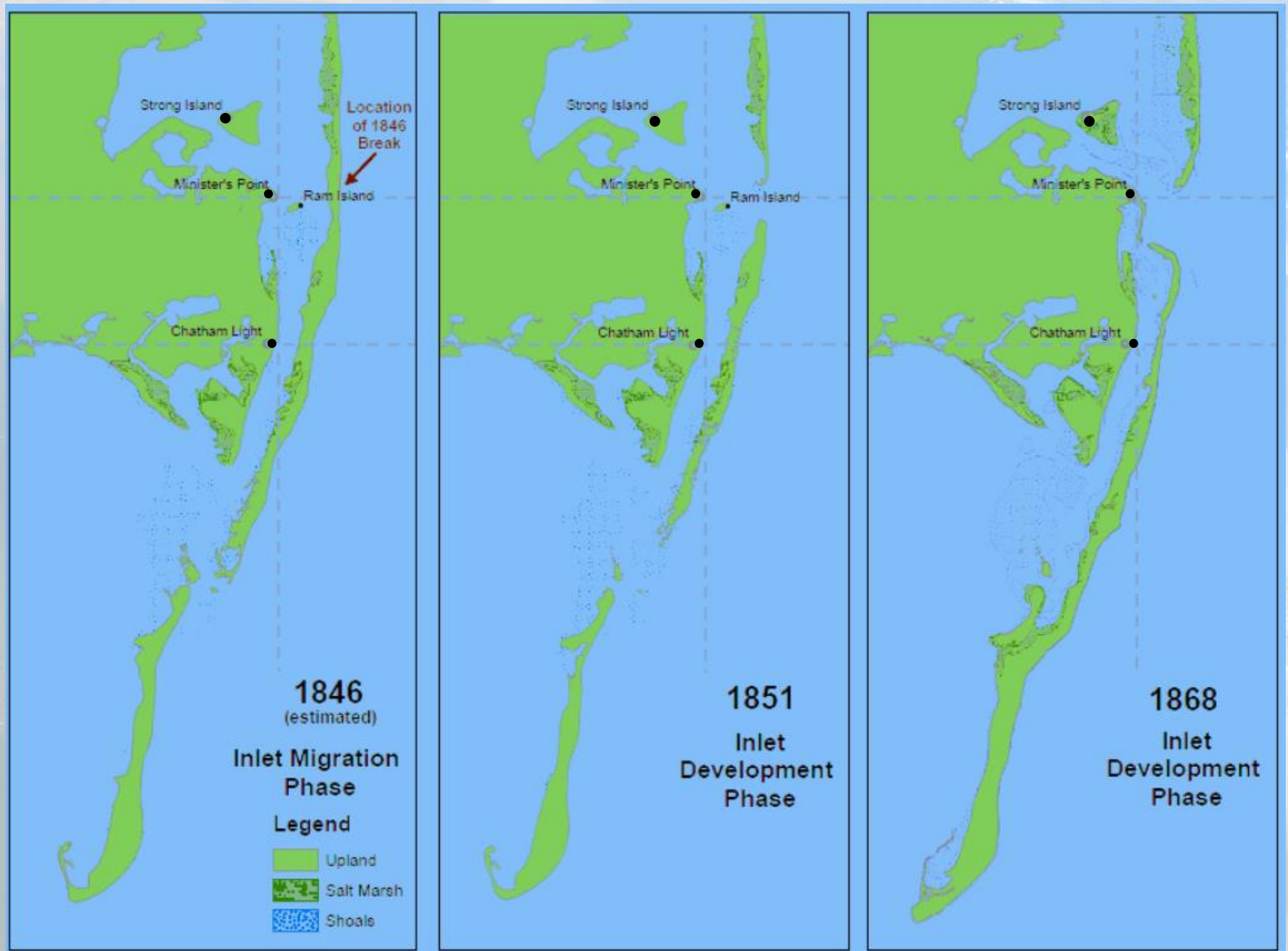


We've Been Here Before...

Strong Island

Minister's Point

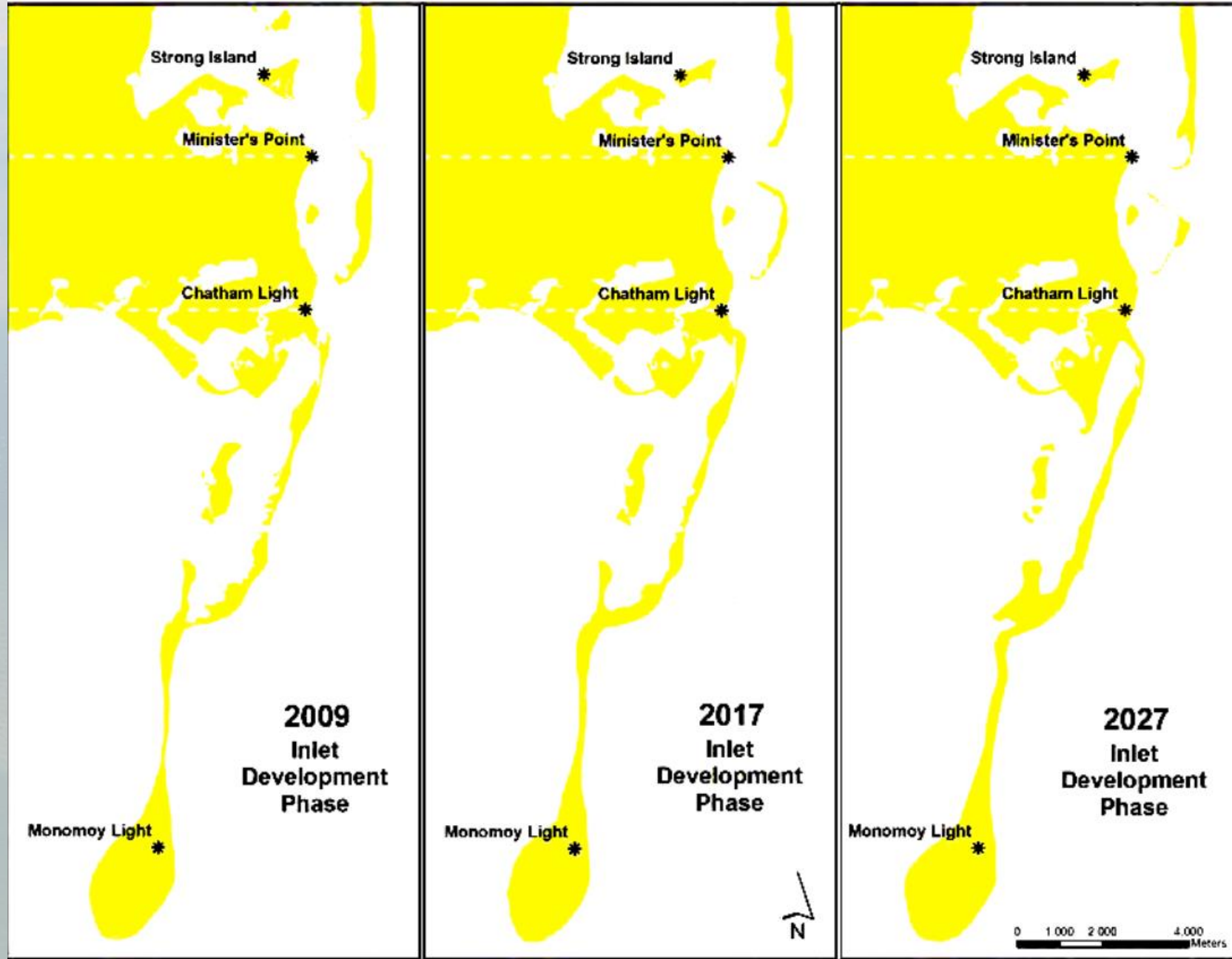
Chatham Light



From Giese et al 2009



We've Been Here Before...

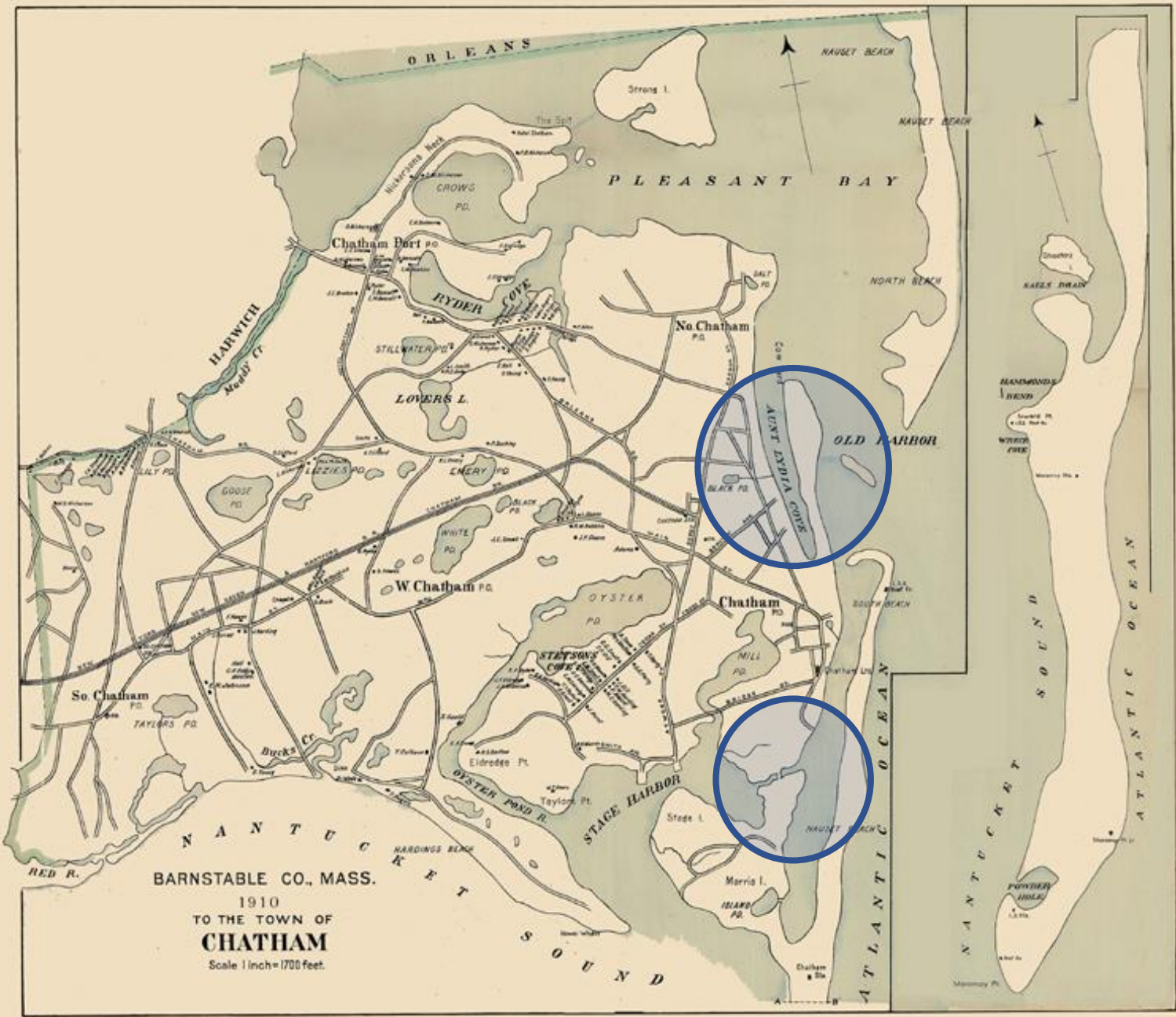


From Giese et al 2009

The Estuary in 1910

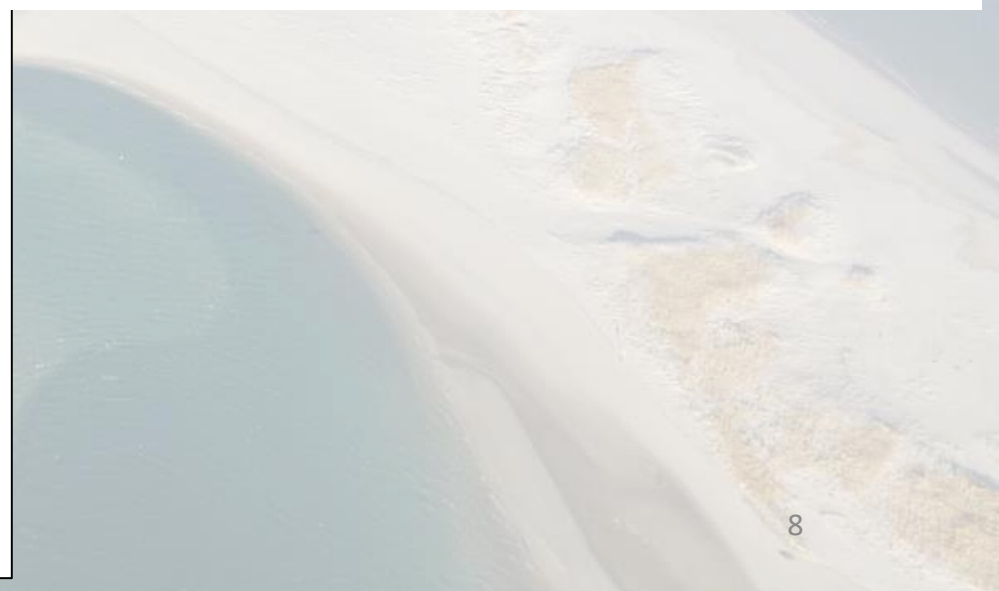
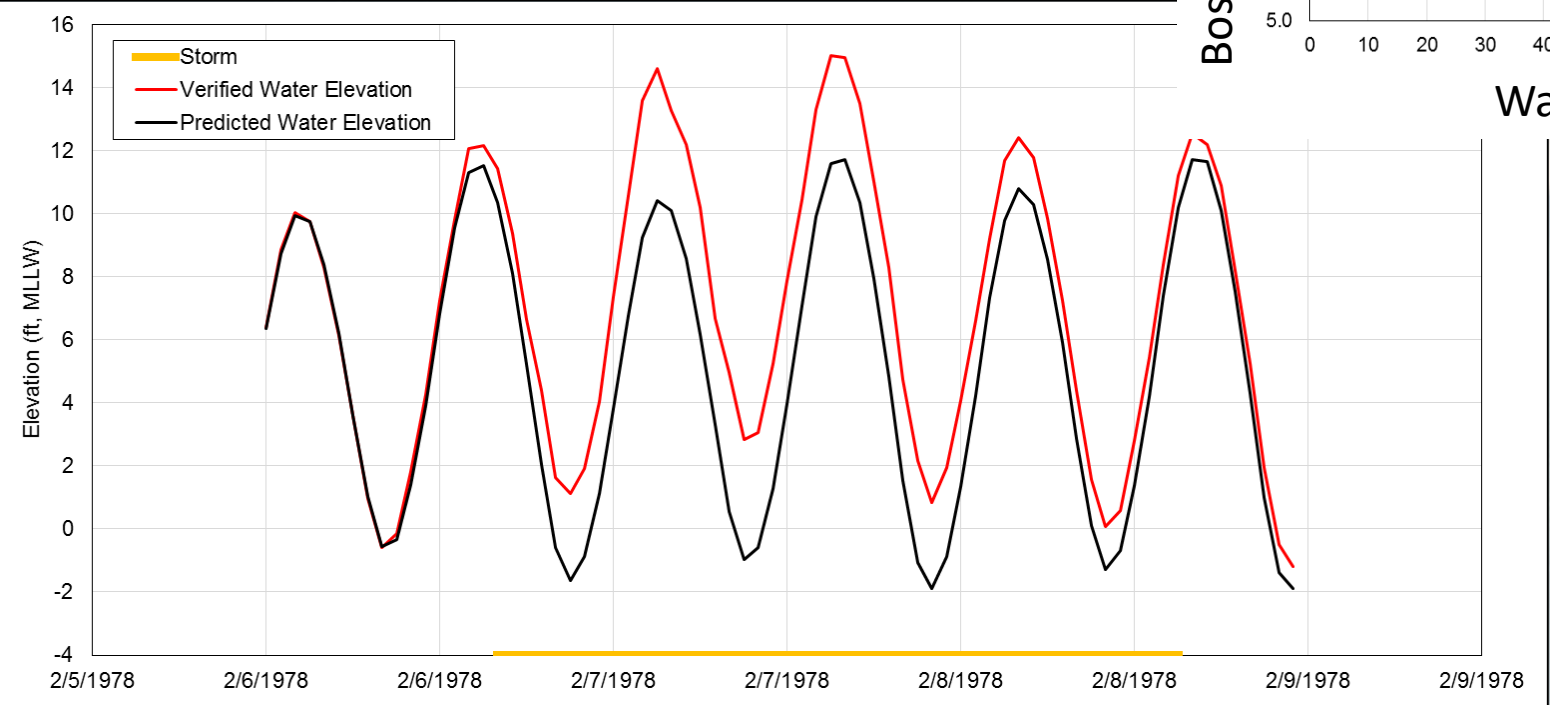
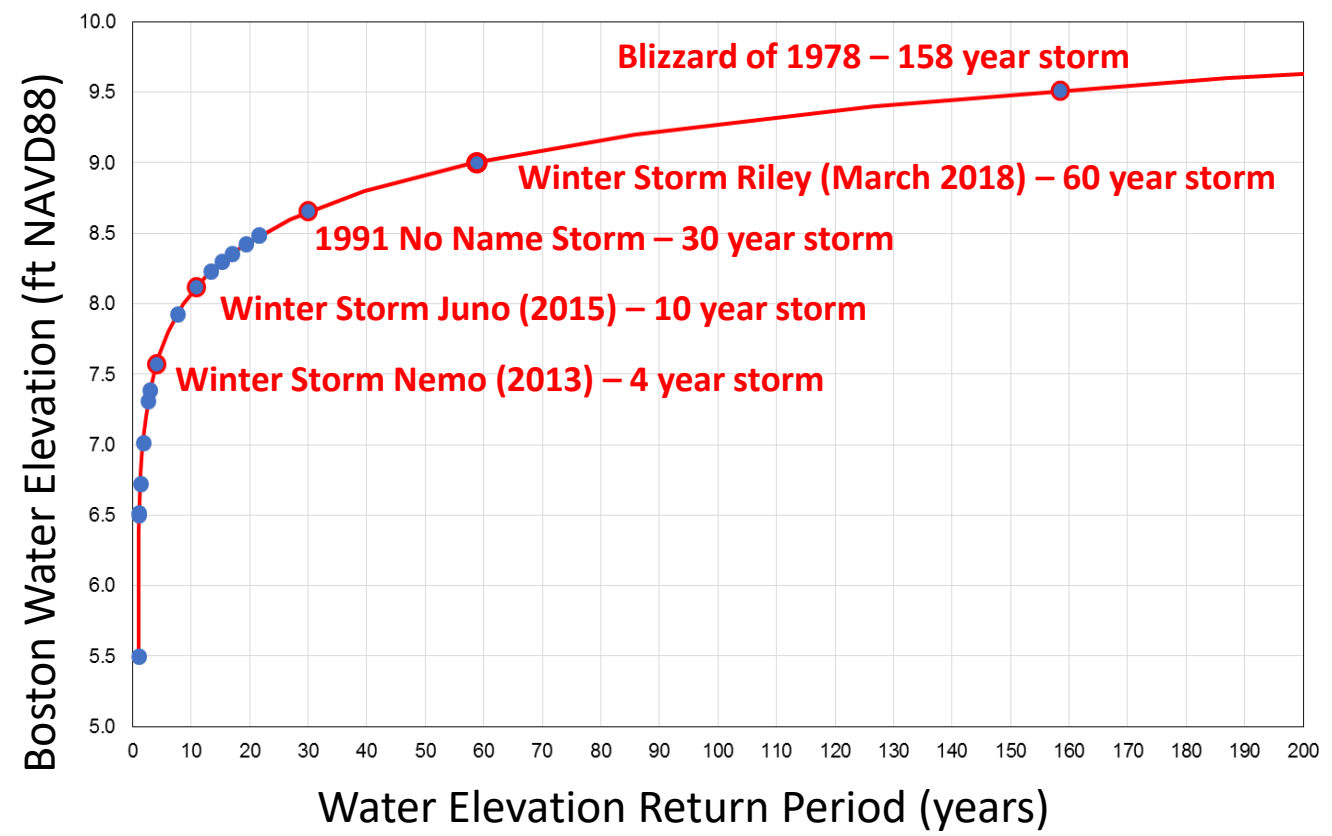
Aunt Lydia's Cove and the initial formation of Tern Island

Connection between Stage and Chatham Harbors



Perspective on Storms

Return Period
Duration
Storm Surge

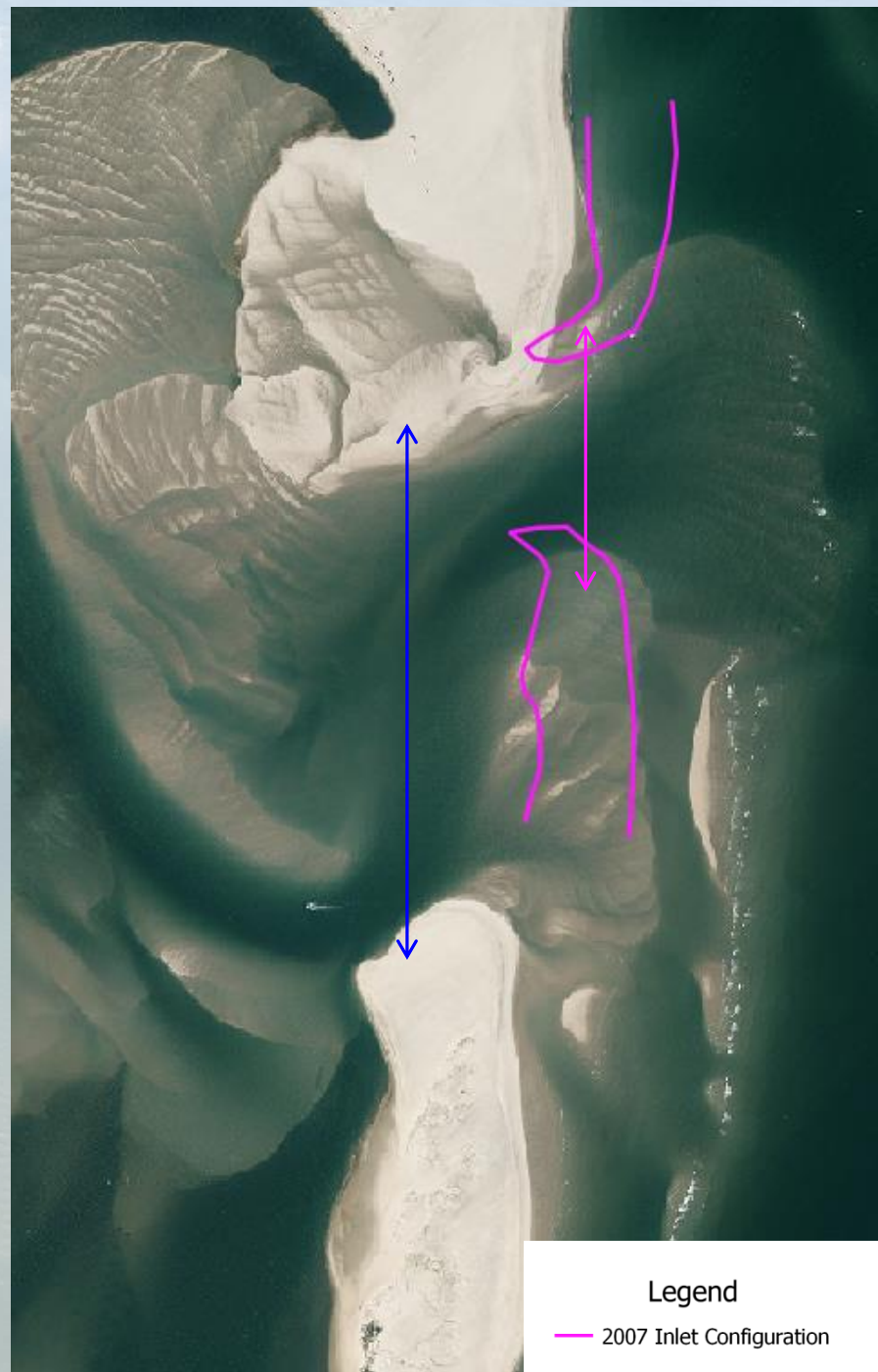


North Inlet Physical Changes

North Inlet Formation
"Patriot's Day" Storm in April
2007

2018 Inlet Width = ~2,475 ft
(almost ½ mile)

2007 Inlet Width = ~1,200 ft



Chatham: A Dynamic Barrier Island System

Short-Term Changes

- Days-Years
- System responds to tidal currents, wave action, and storms

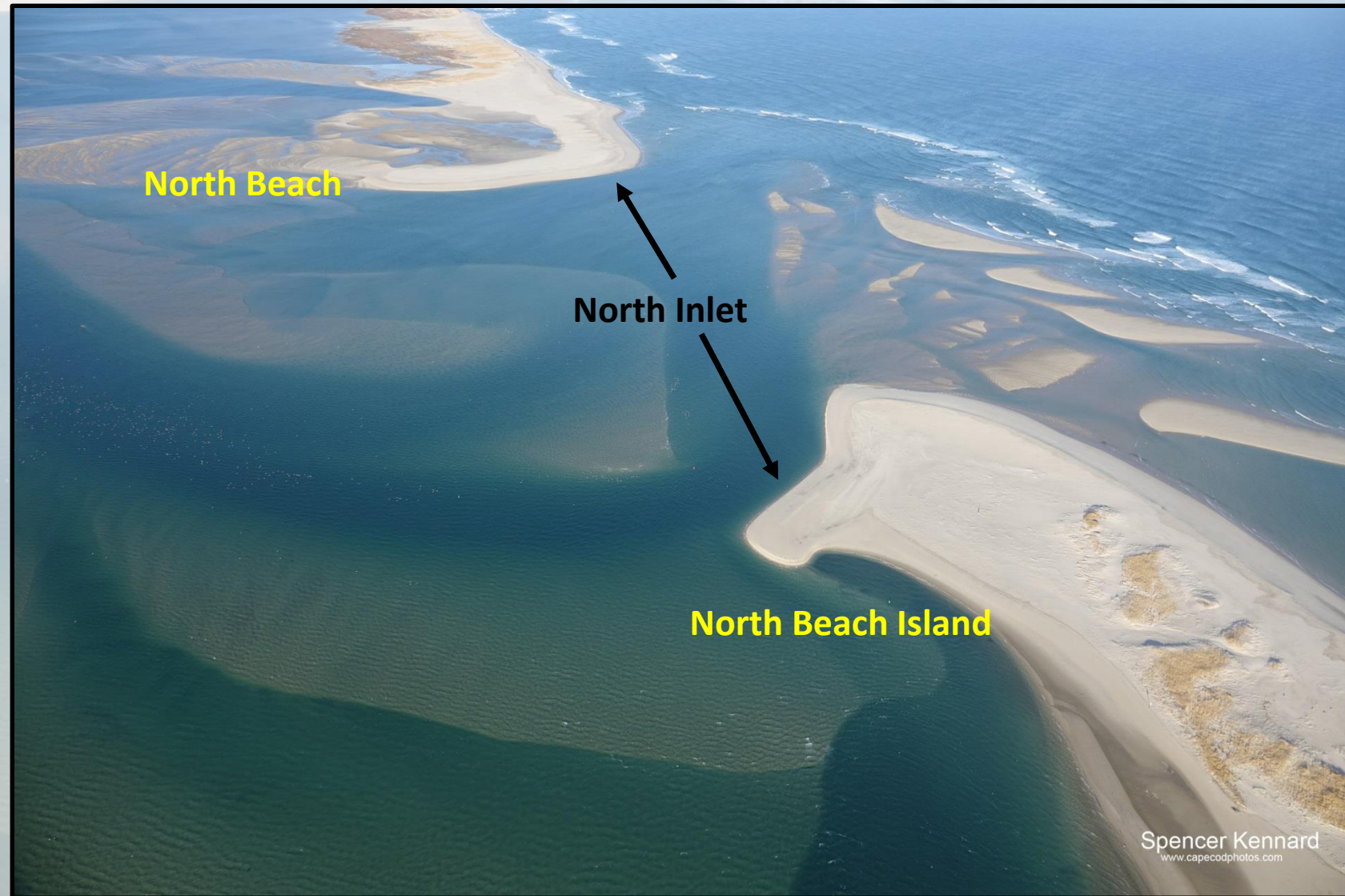
Long-Term Changes

- Years-Decades
- System responds to sea level changes and climate patterns



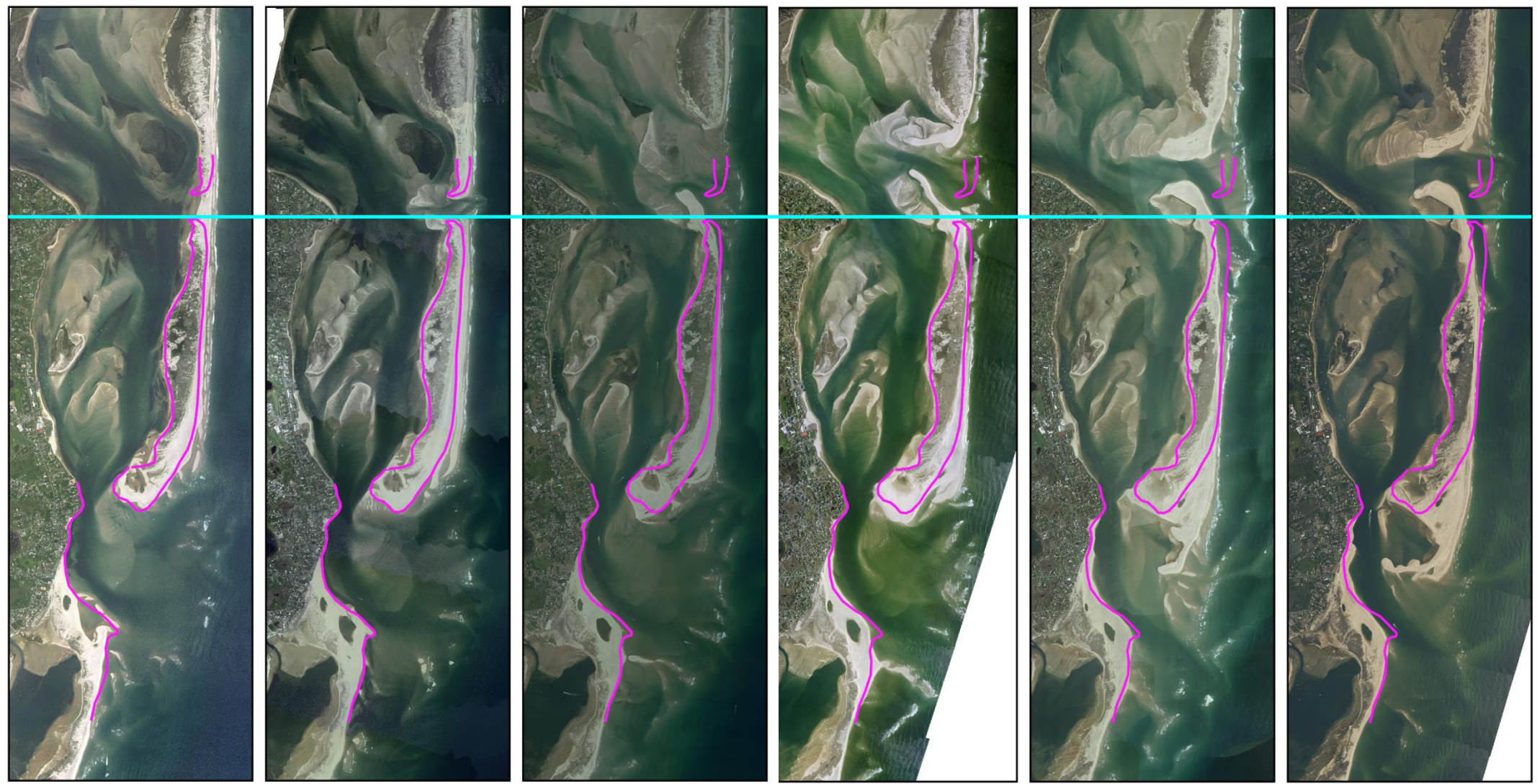
Examples of Short Term Changes

- **Shifting shoals**
- **Breaching**
- **Sediment Transport**



Spencer Kennard
www.capecodphotos.com

Inlet Southern Migration is Evident in Aerial Imagery



2006

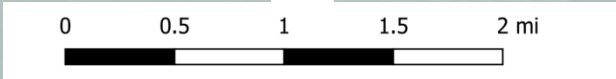
2007

2008

2009

2011

2012

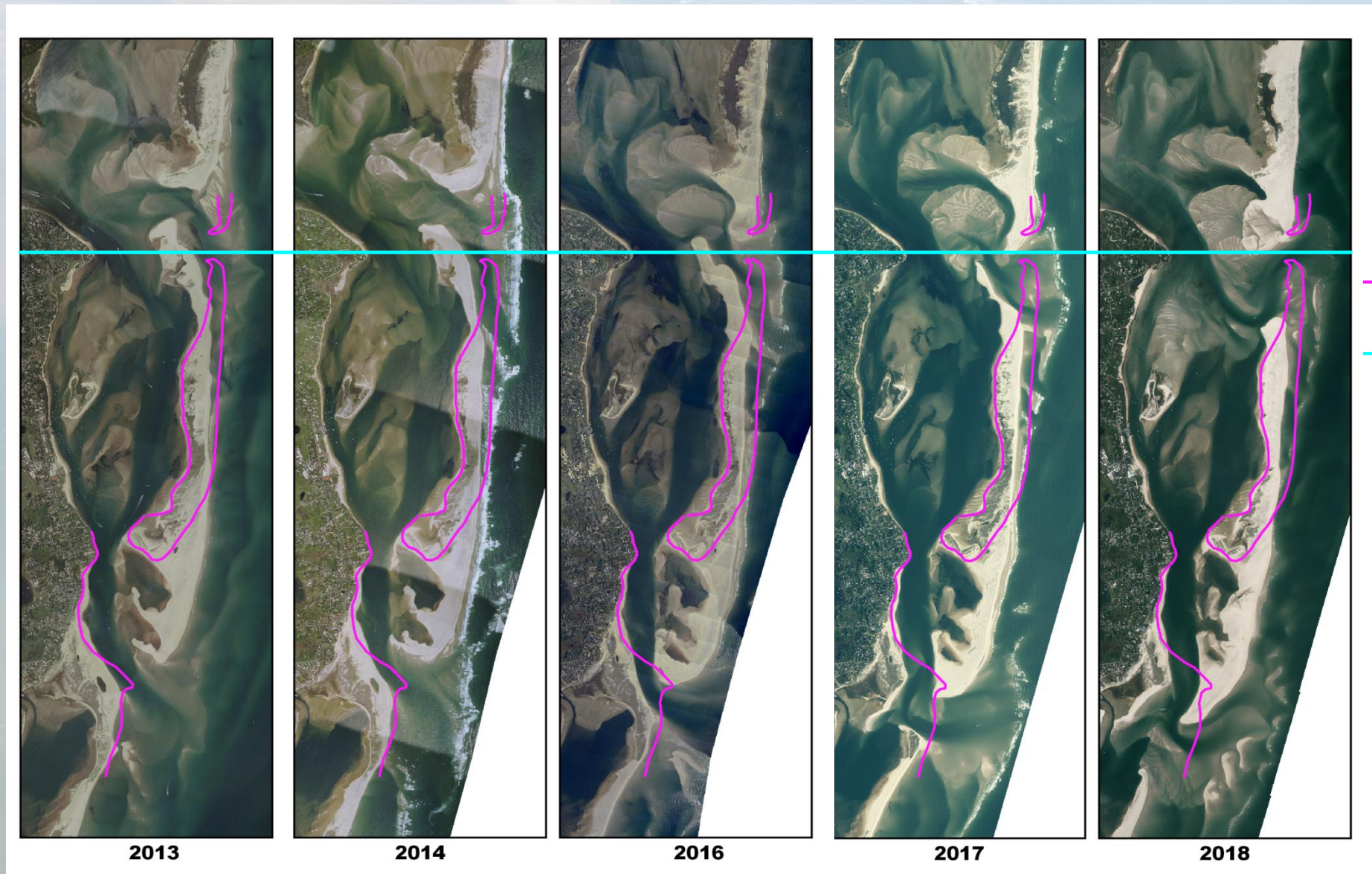


Legend

- 2007 LiDAR High Water Line
- Minister's Point Line of Reference

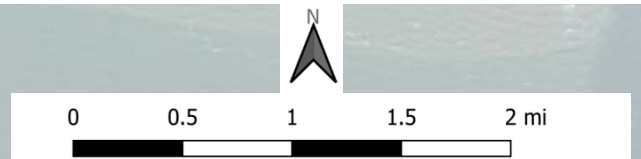


Aerial Imagery Cont'd



Legend

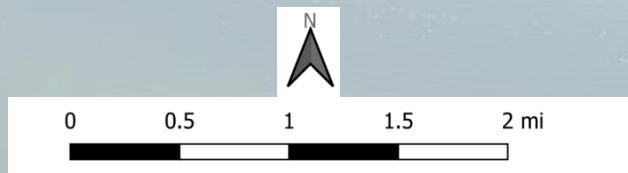
- 2007 LiDAR High Water Line
- Minister's Point Line of Reference



Inlet Configuration: 2007 vs. 2018

Legend

- 2007 LiDAR High Water Line
- Minister's Point Line of Reference



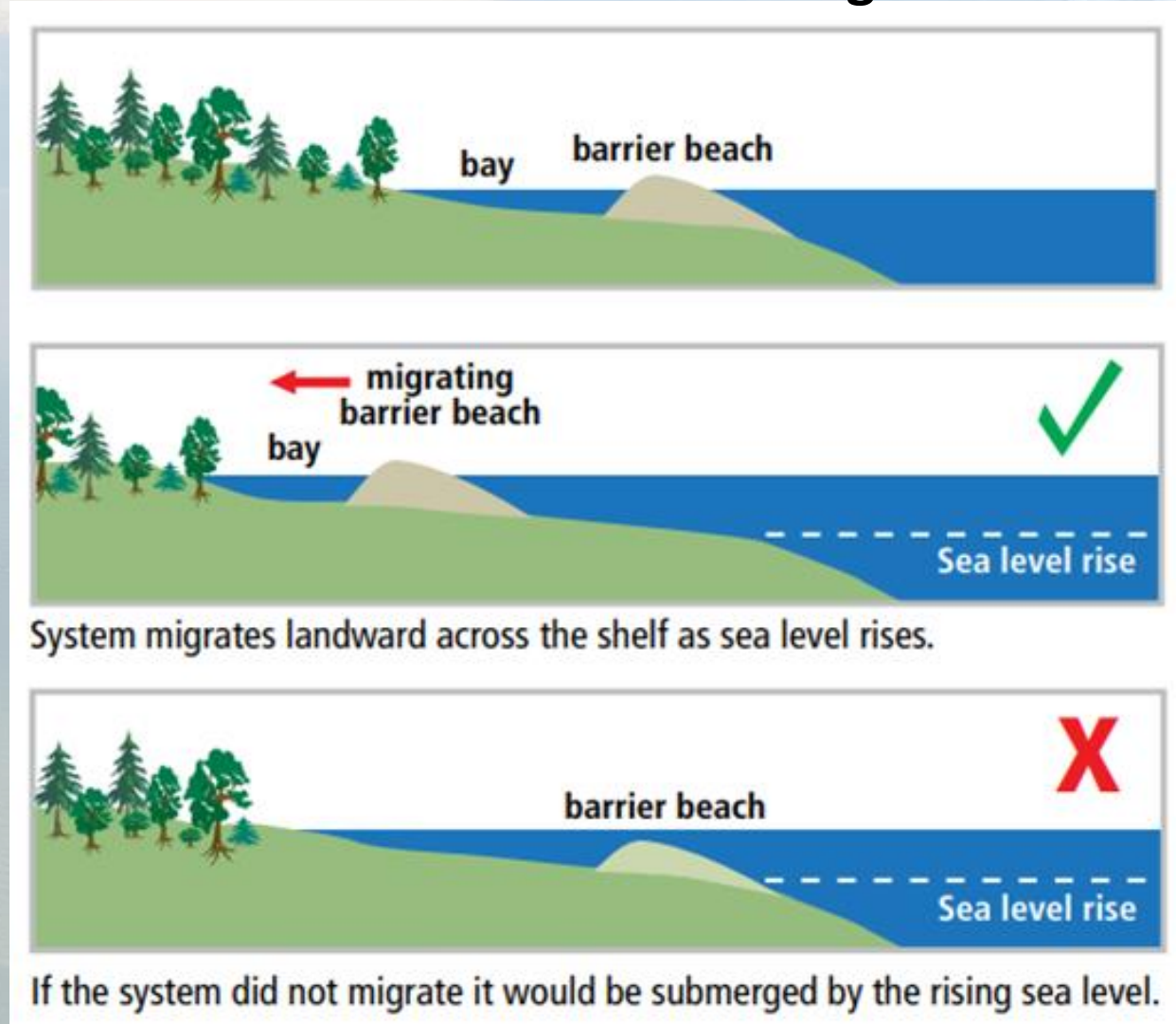
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2018

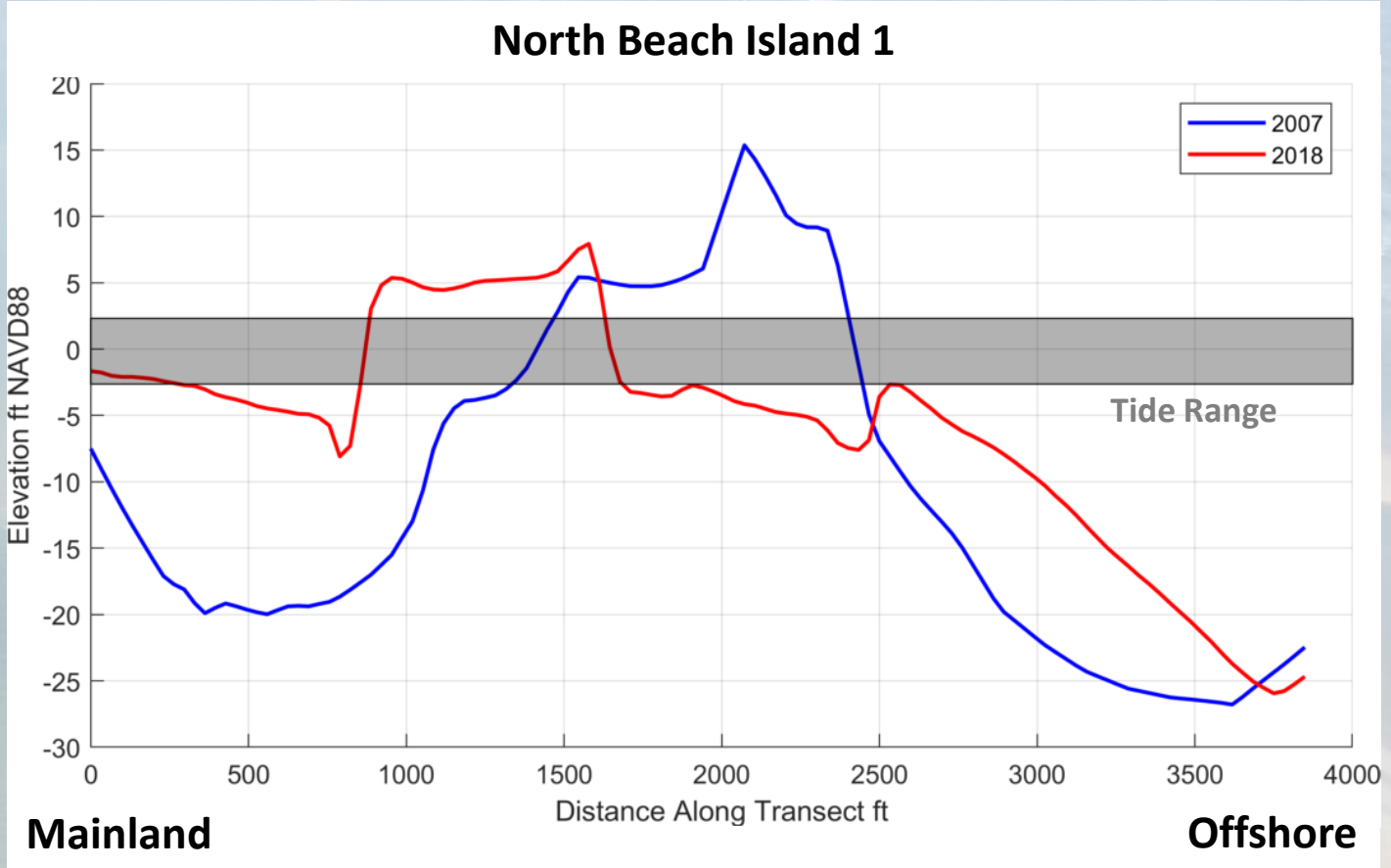


Long-Term Change: Barrier Beach Landward Migration



From Woods Hole Seagrass Program 2015

Landward Migration is Evident in LiDAR Datasets

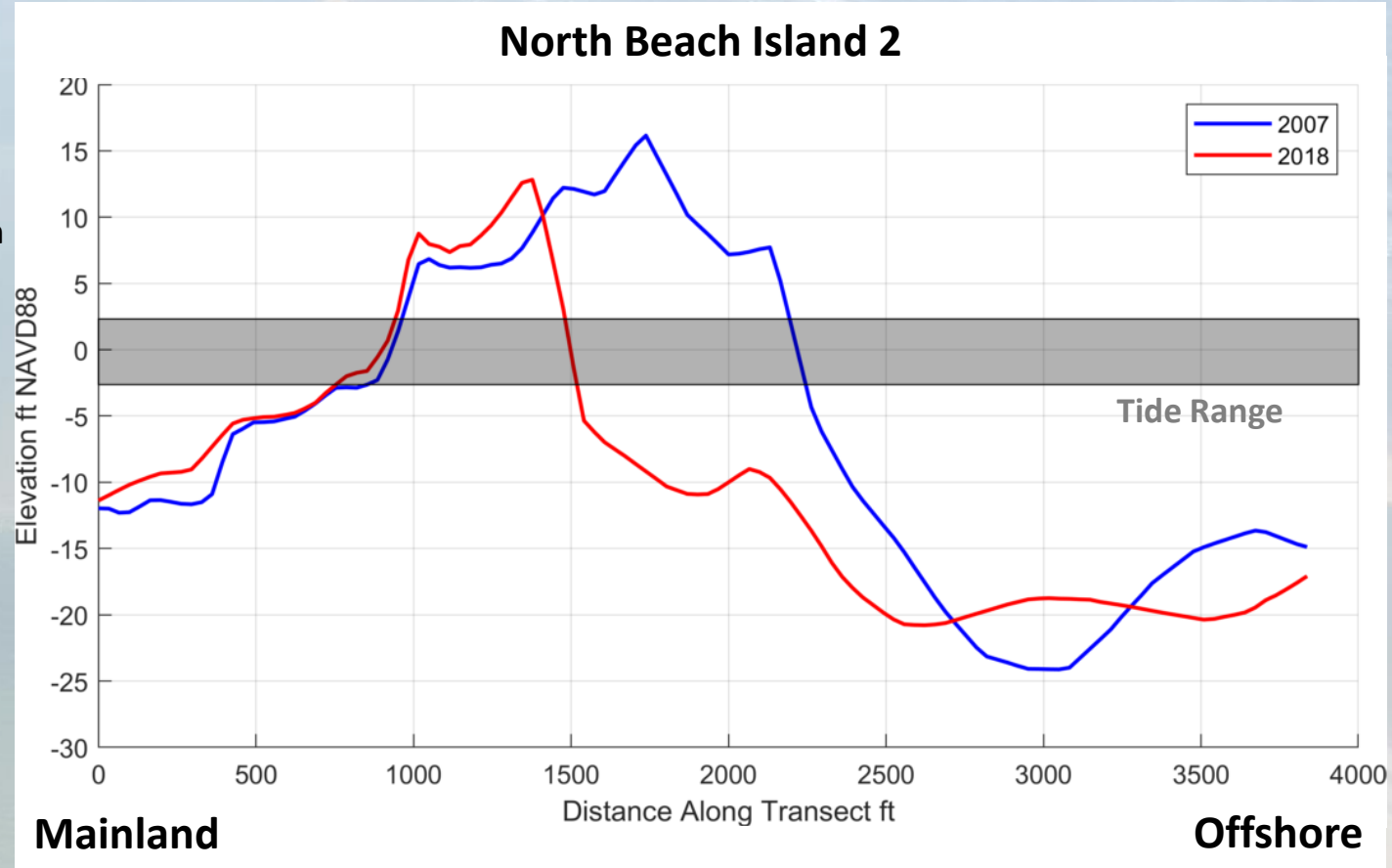


Fools Inlet



South Inlet

Oceanside Erosion is Evident in LiDAR Datasets

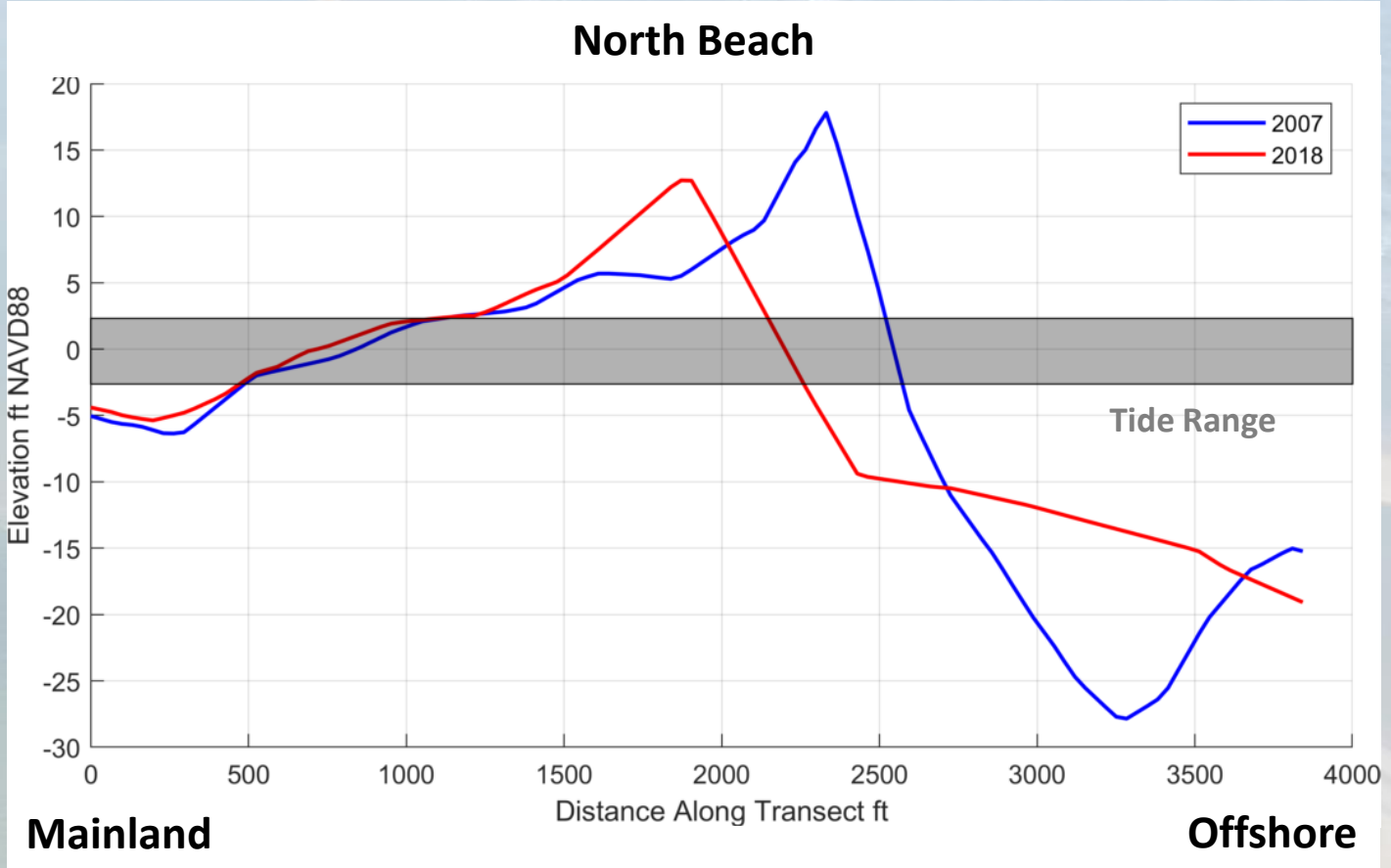


Fools Inlet



South Inlet

Landward Migration is Evident in LiDAR Datasets

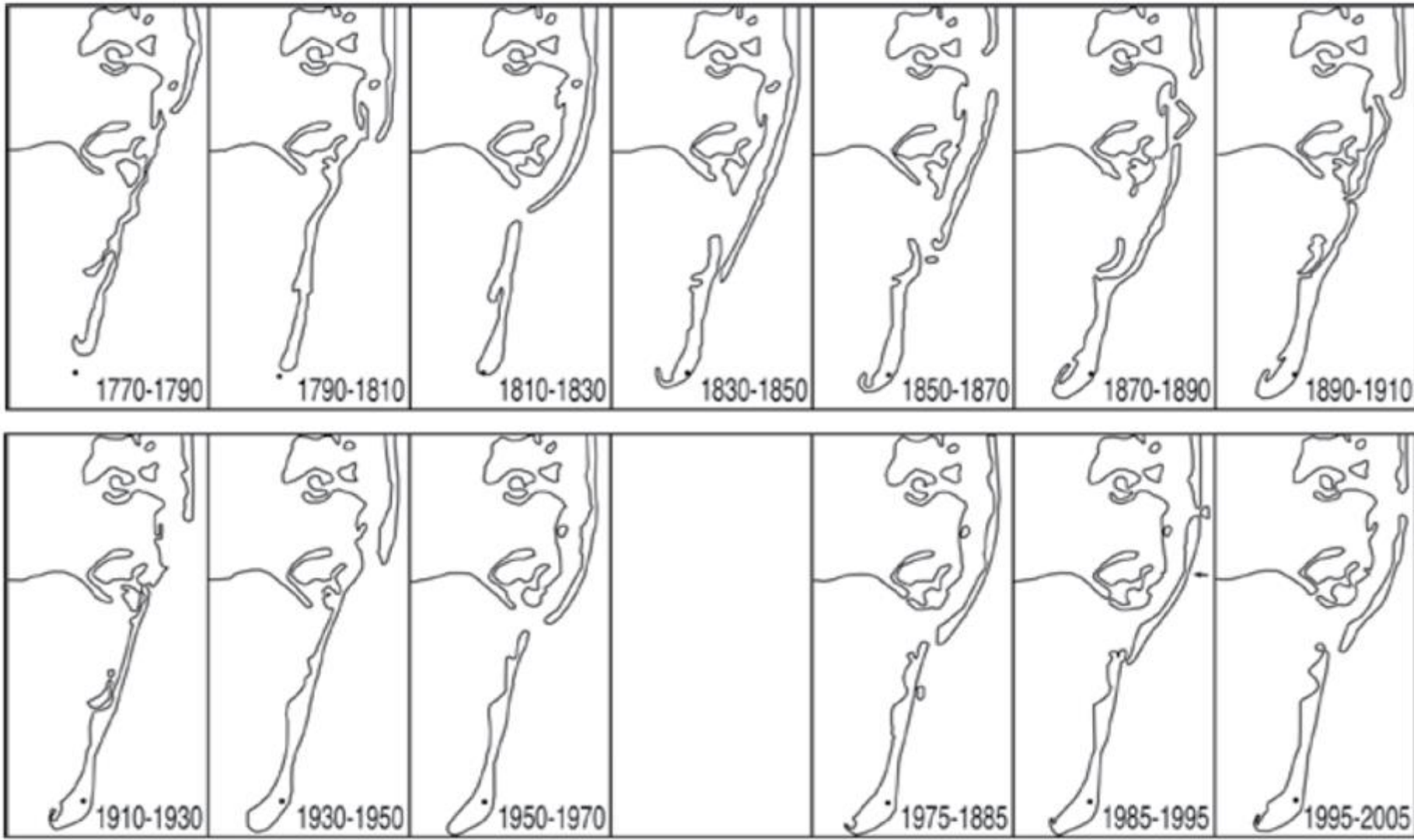


Fools Inlet



South Inlet

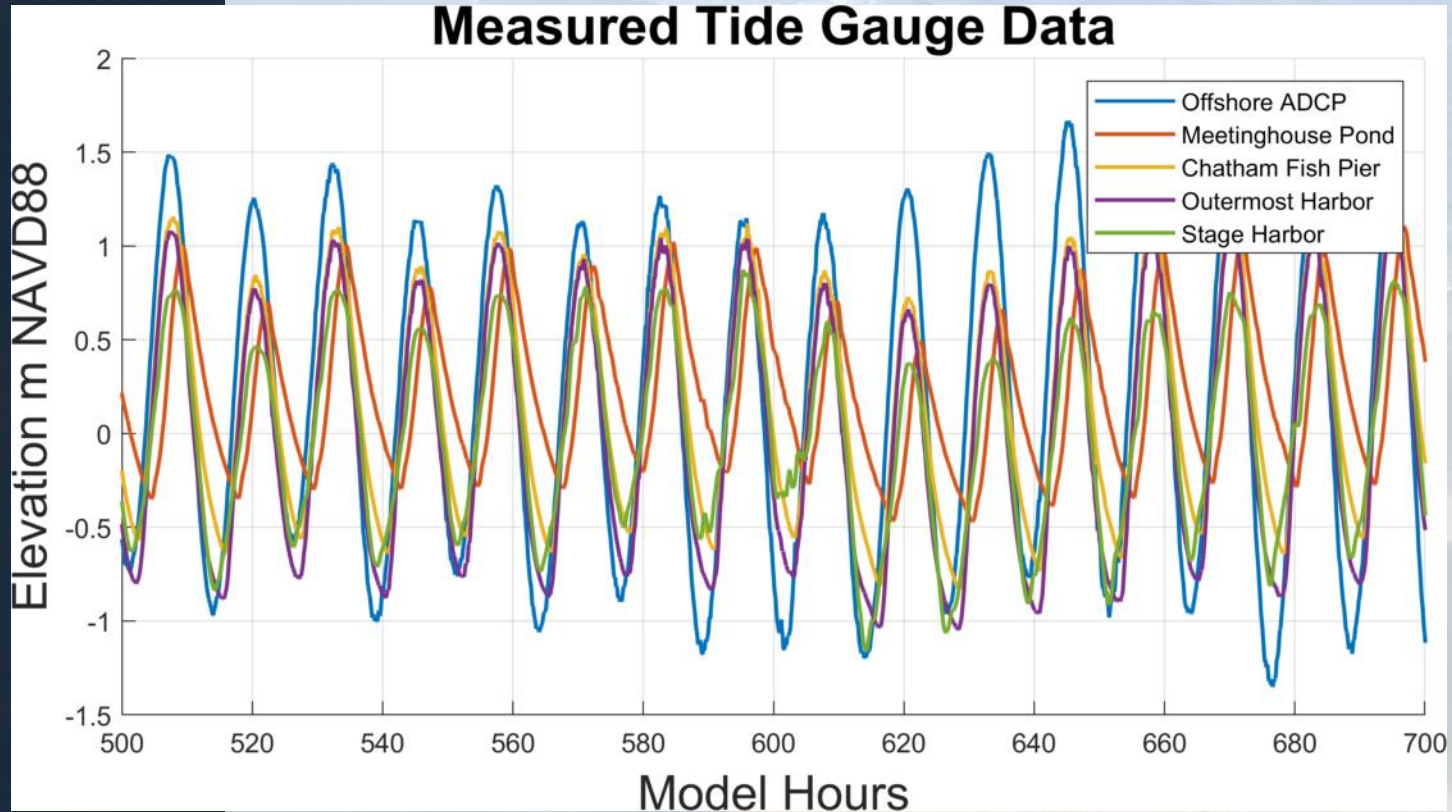
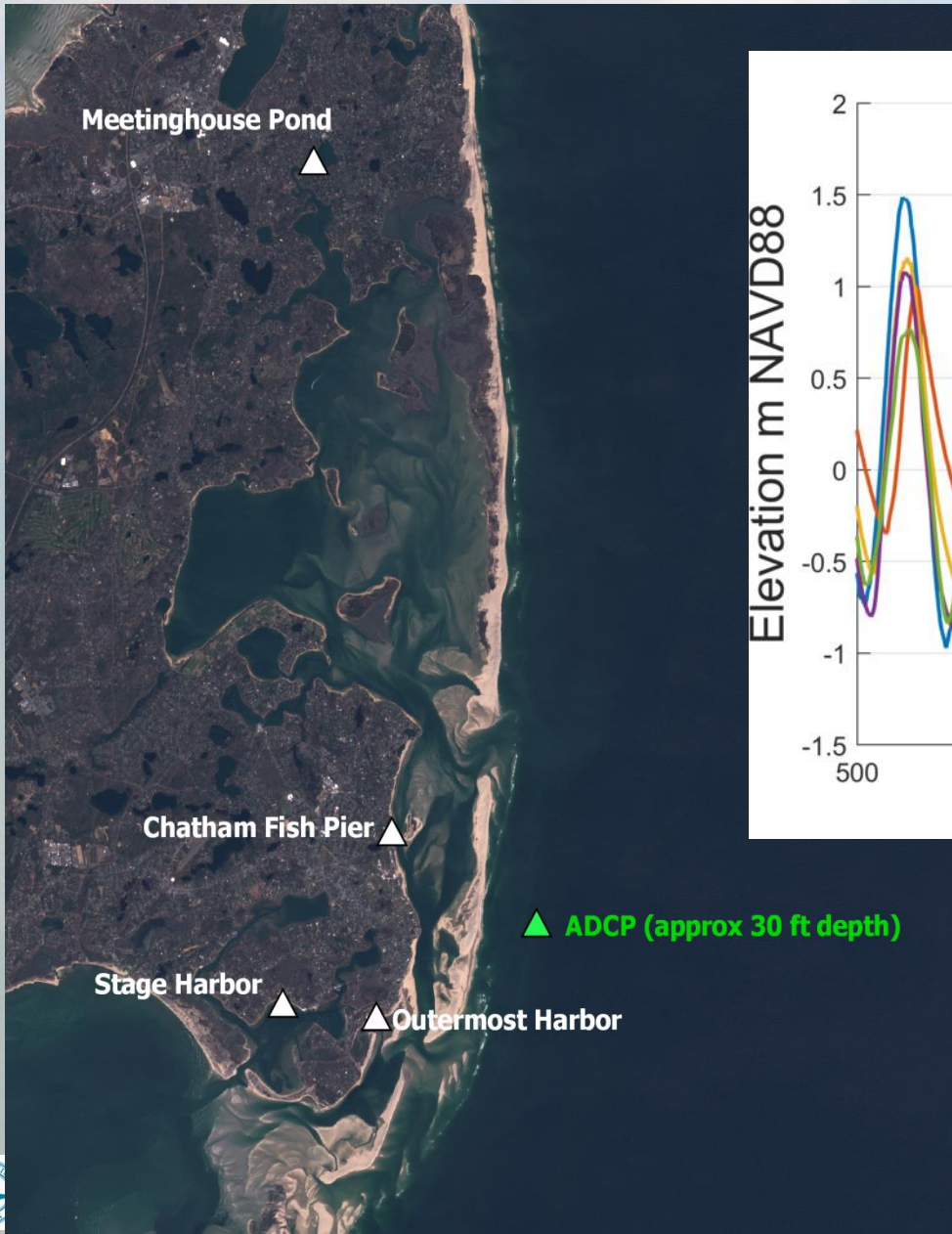
Long-Term Change: Inlet Southern Migration



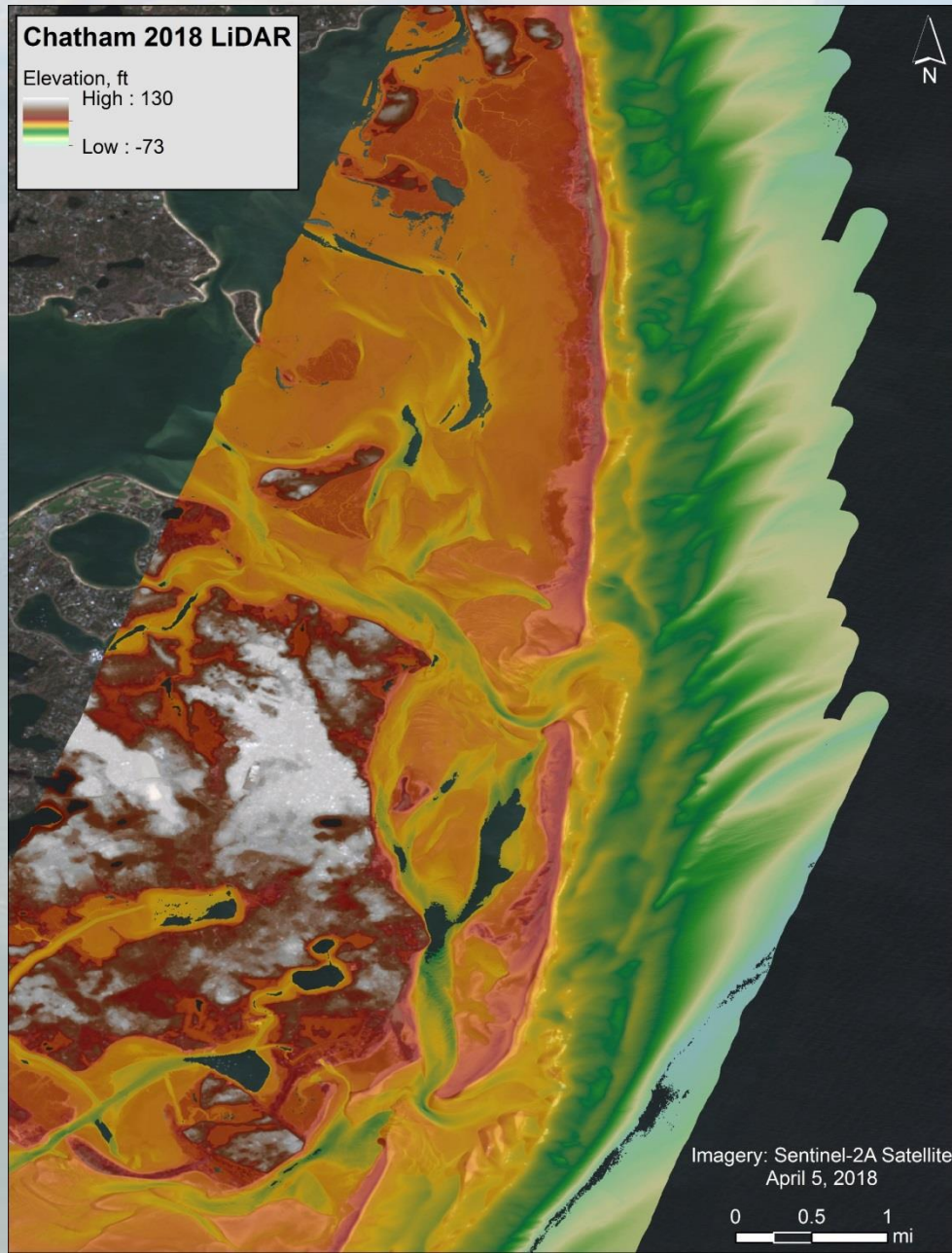
Historical changes in the Nauset Beach-Monomoy barrier system illustrated by generalized 20-year diagrams from 1770-1790 to 1950-2005 (from Giese, 1988).



Data Collection - Tides



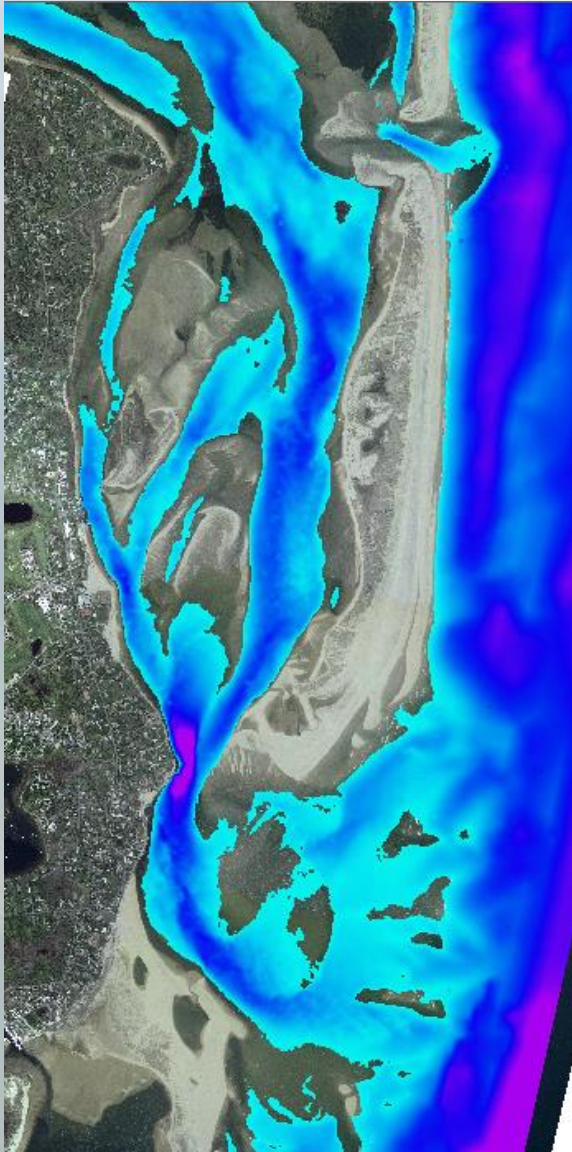
Updated LiDAR Survey 2018 - USACE



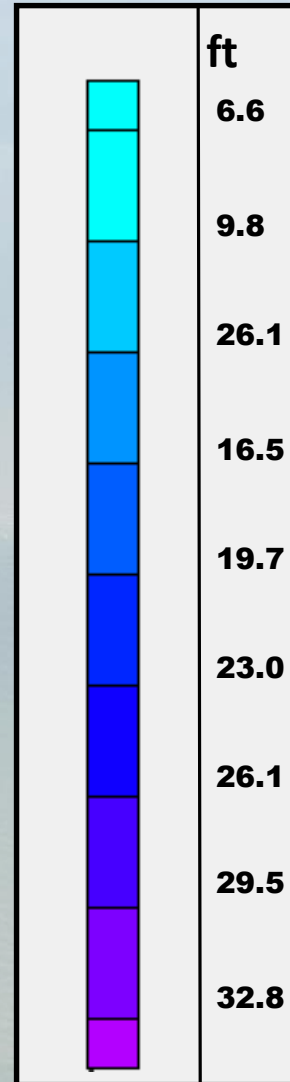
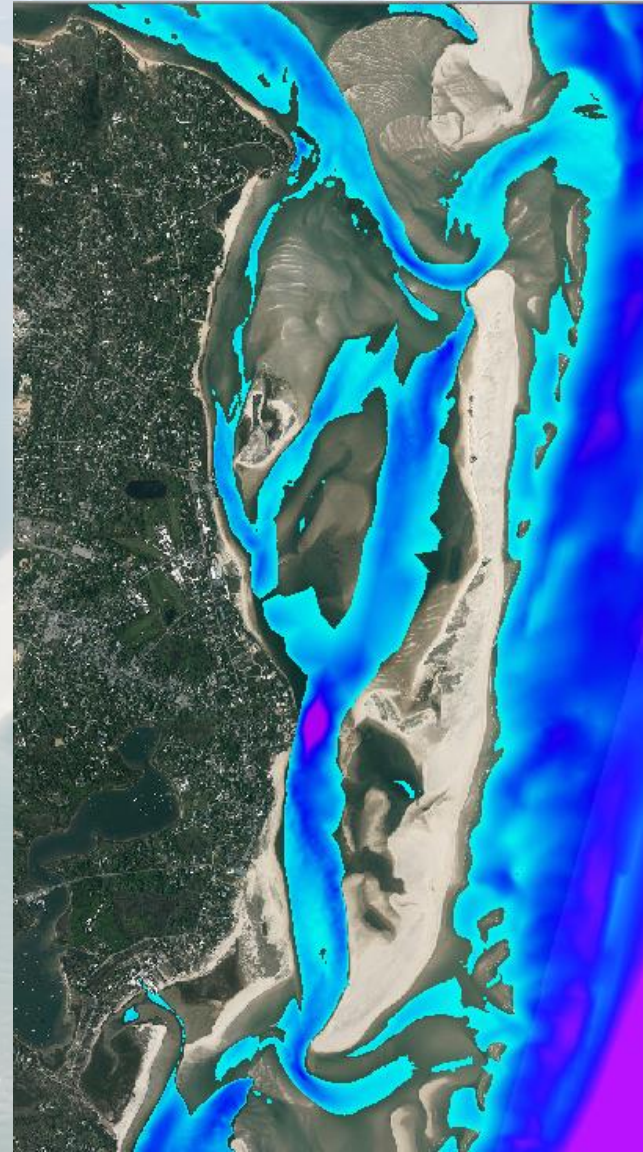
This could then be compared to the 2007 LiDAR data

Water Depth of Channels Deeper Than 6.6 feet (2 meters)

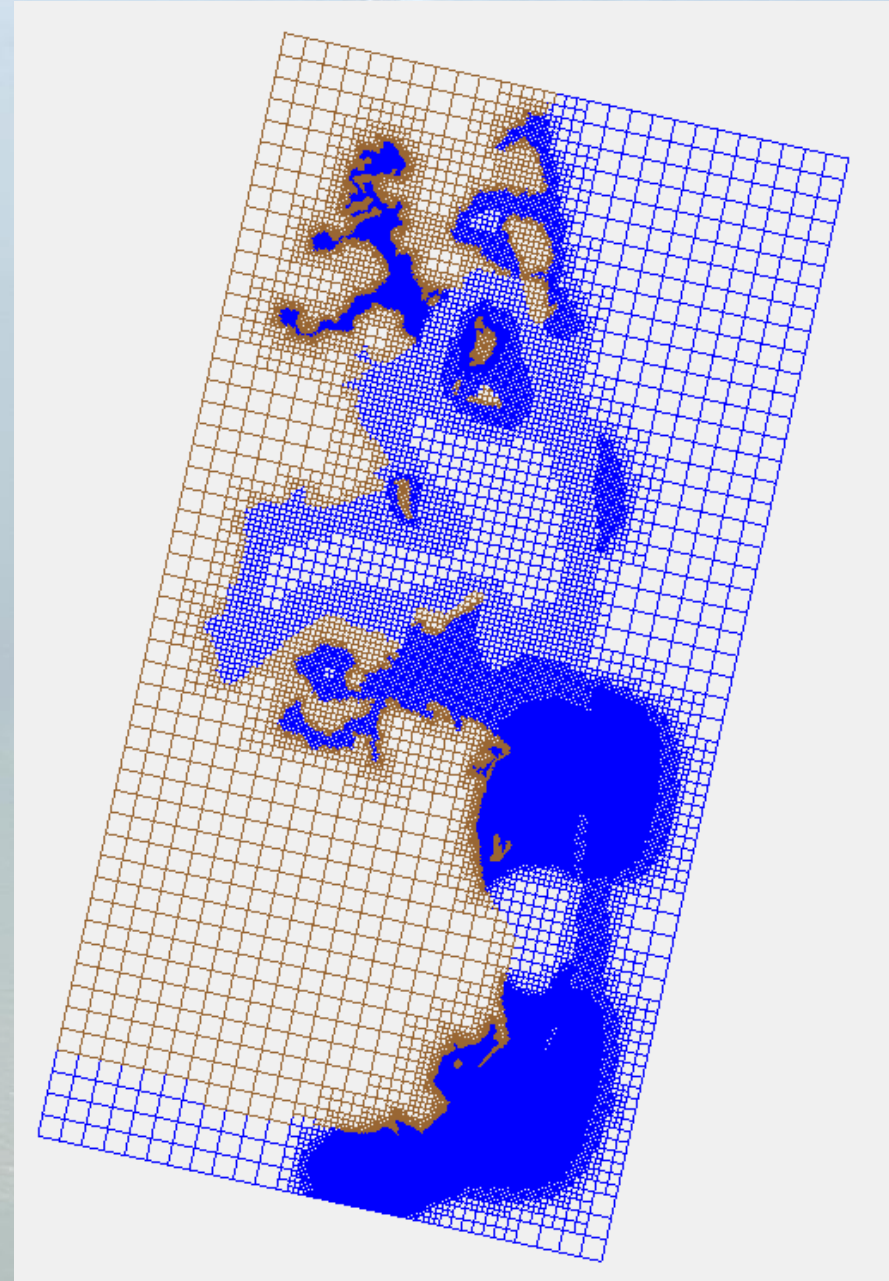
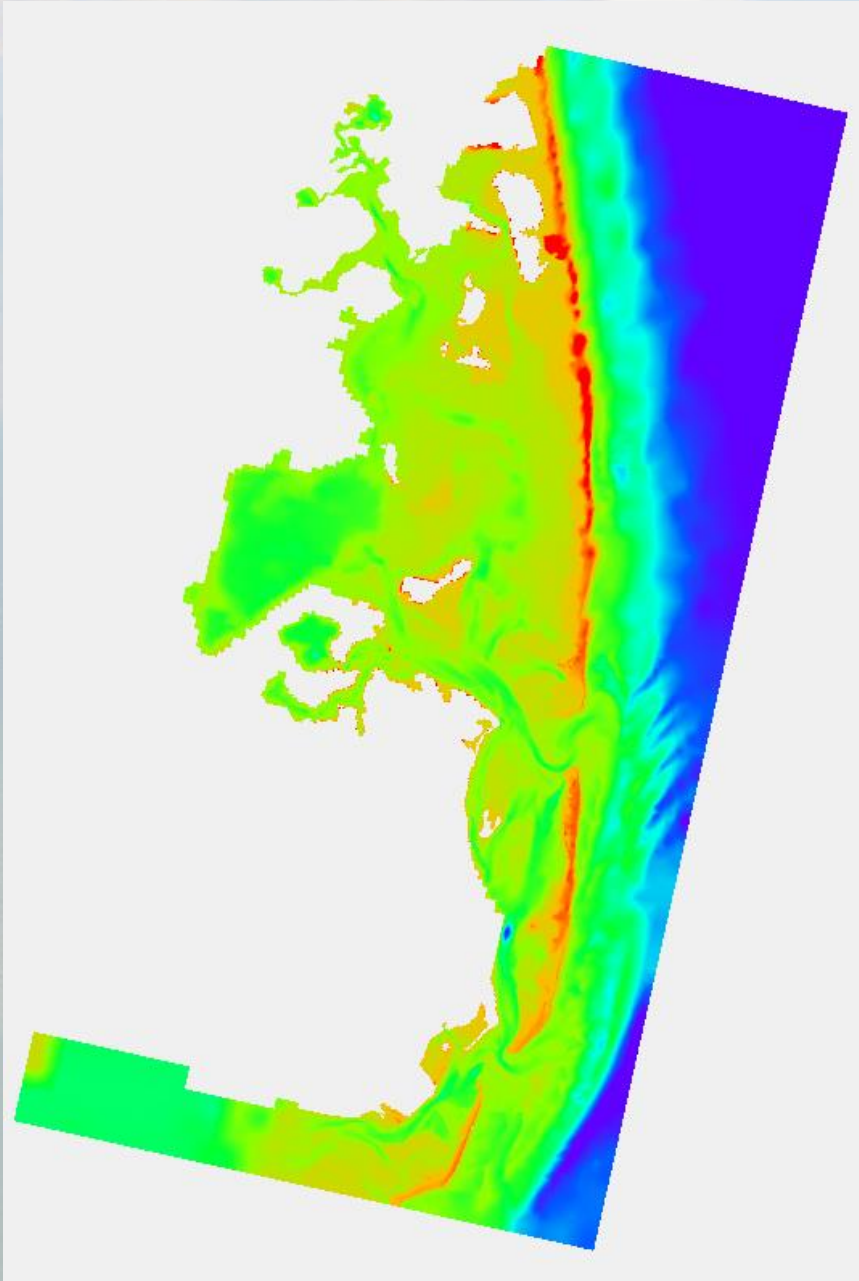
2007



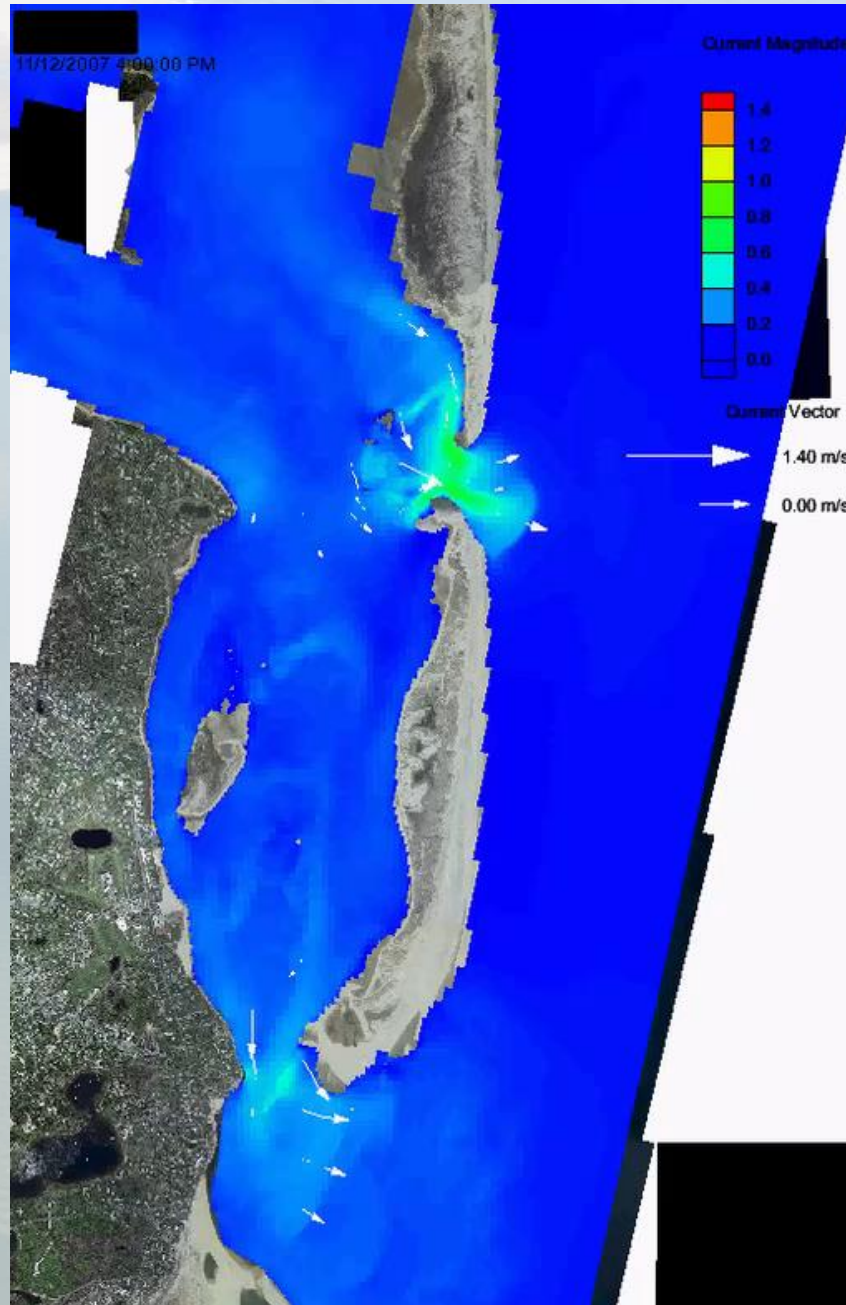
2018



Modeling

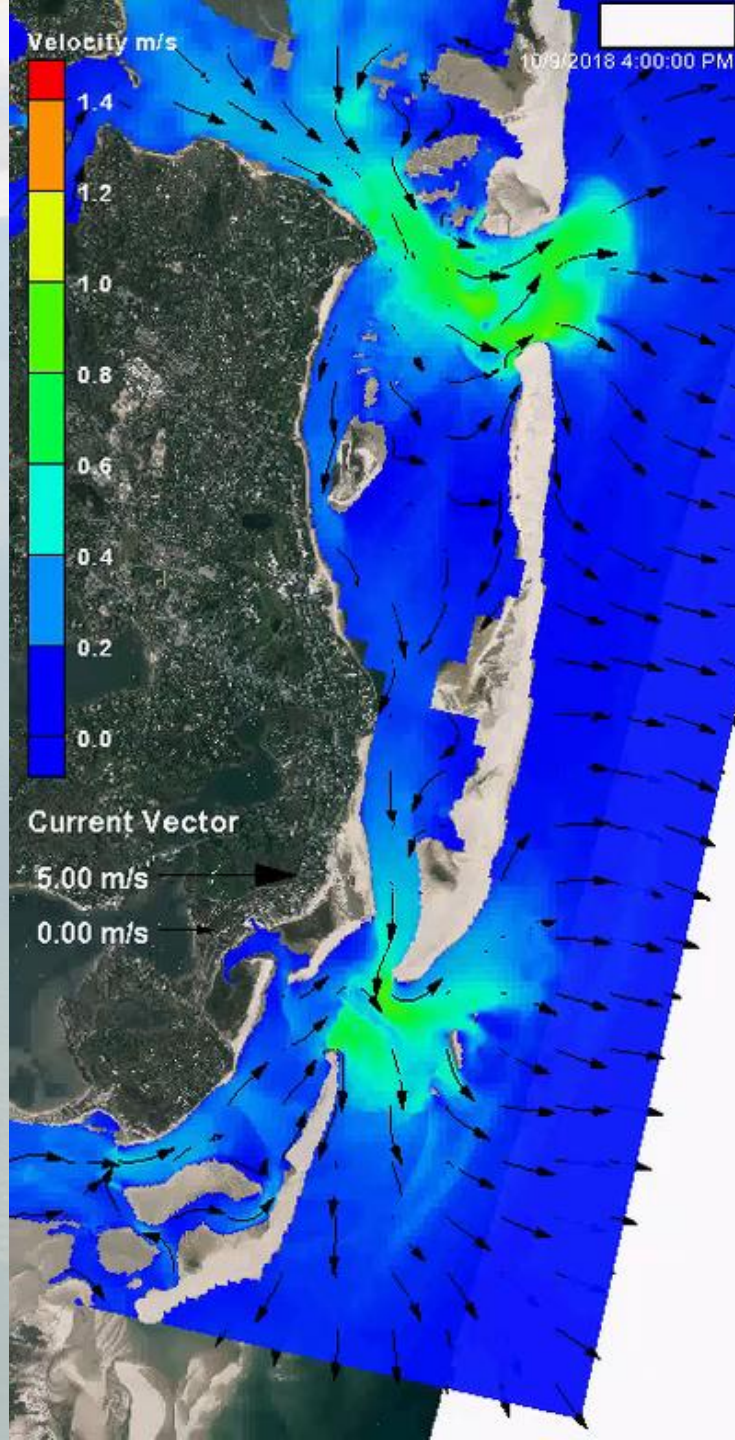


2. Modeled Current Velocity



2007 Inlet Configuration

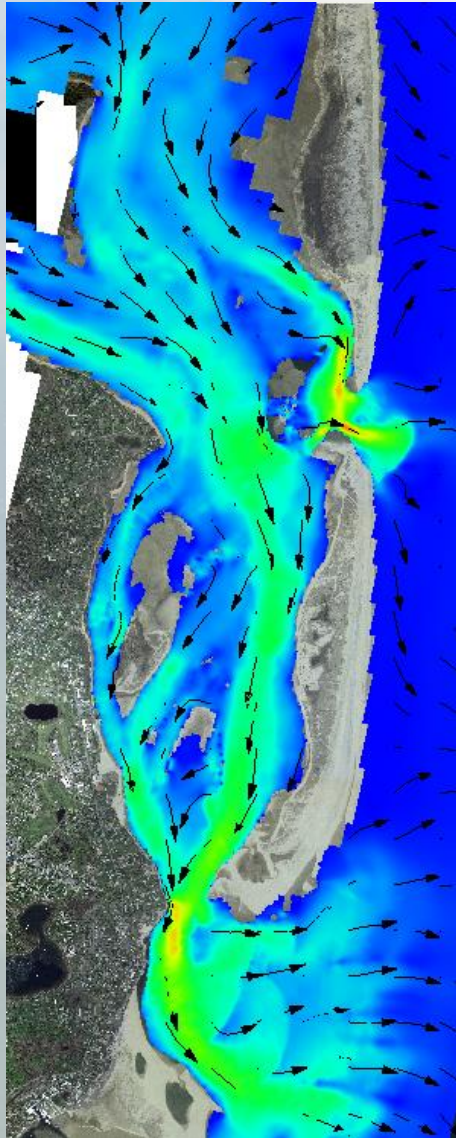
Modeled Current Velocity



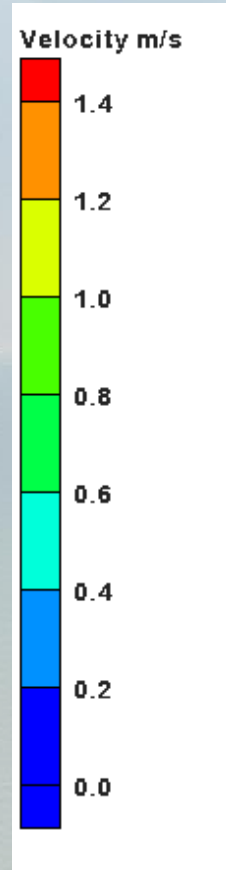
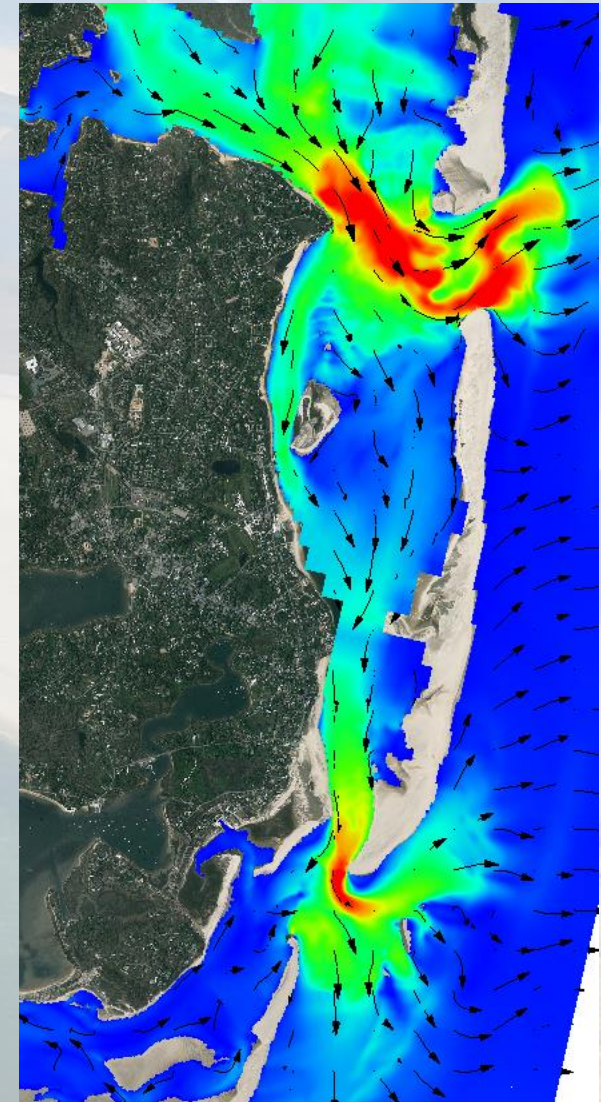
2018 Inlet Configuration

Max Ebb Comparison

2007

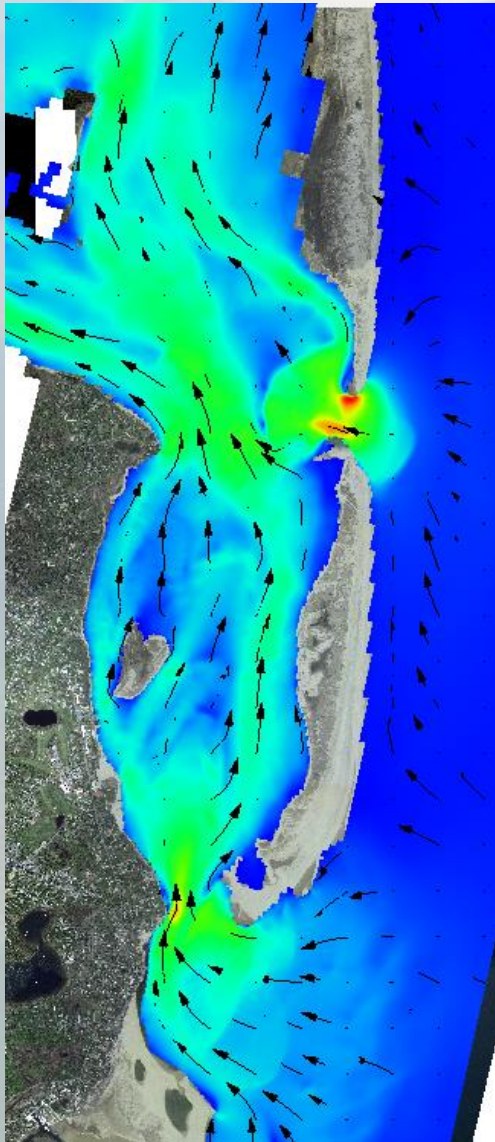


2018

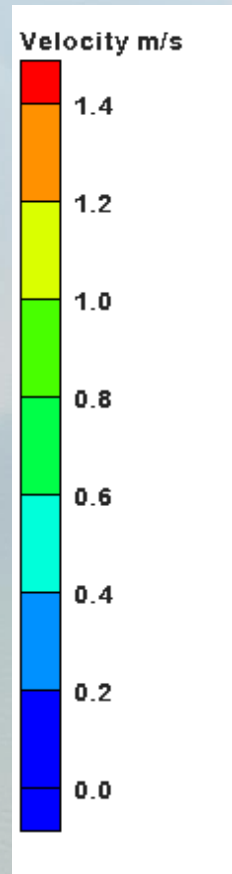
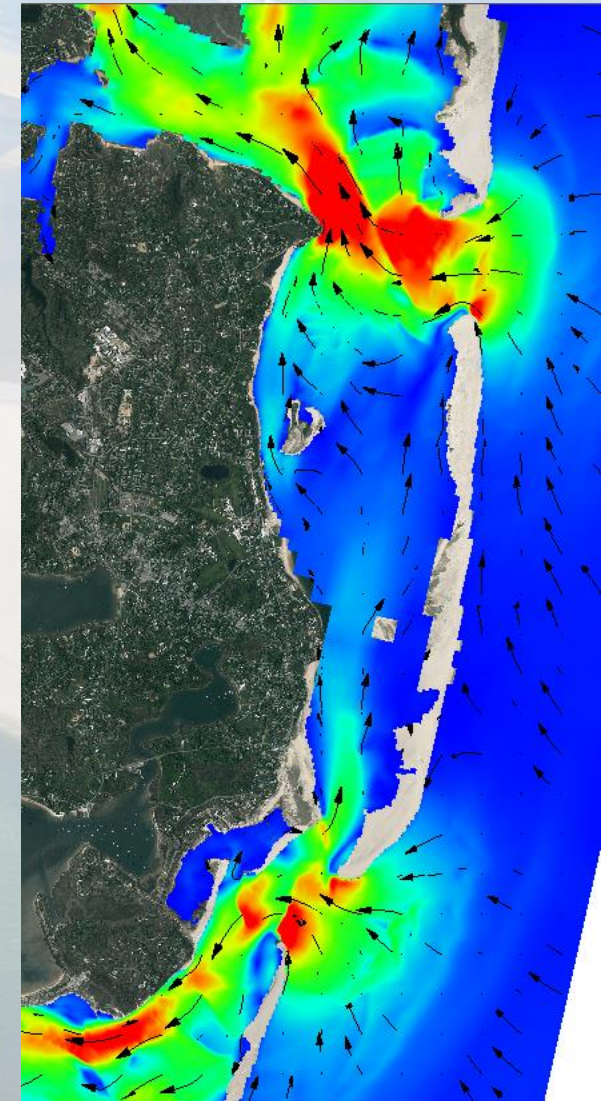


Max Flood Comparison

2007



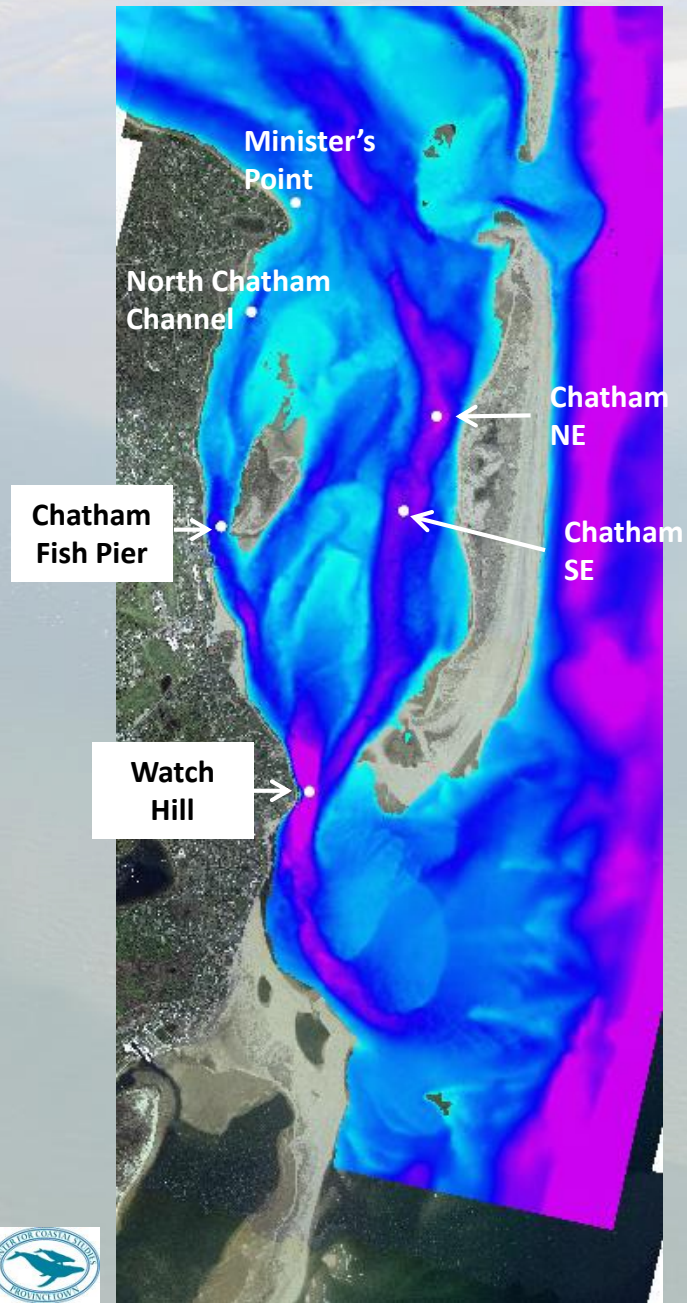
2018



3. Water Elevation and Current Speed Comparisons

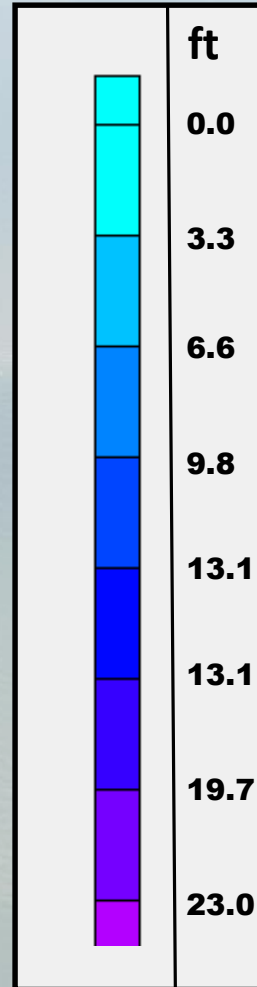


2007

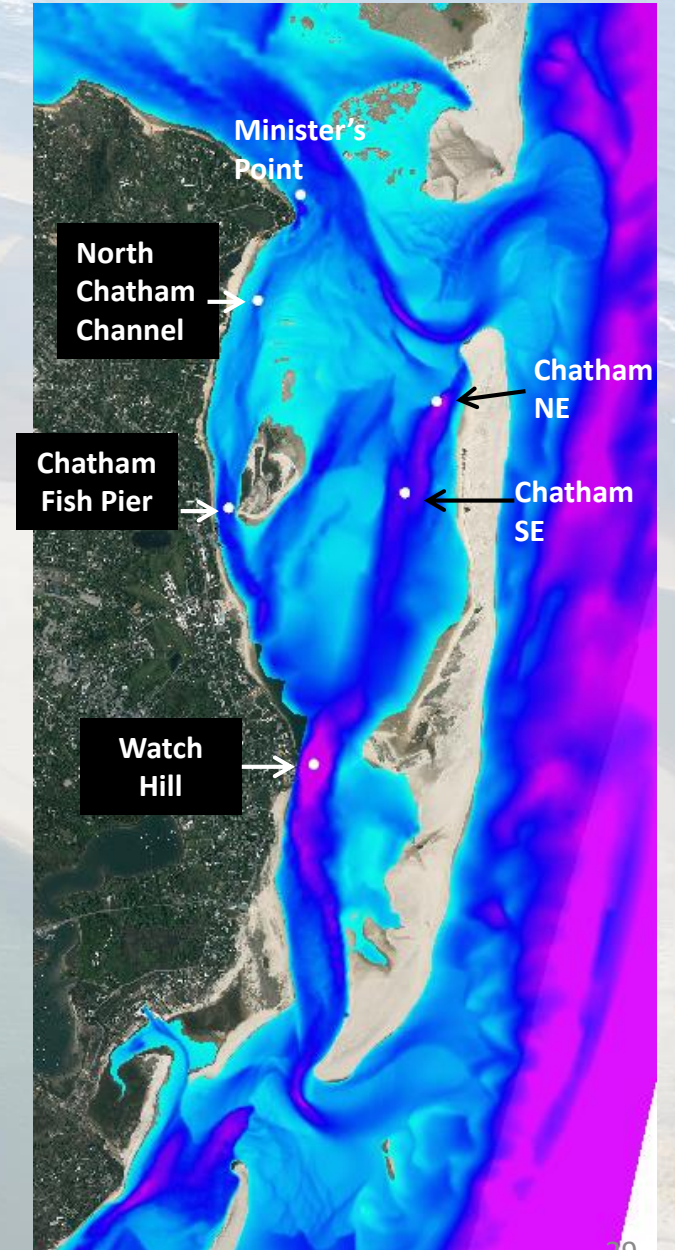


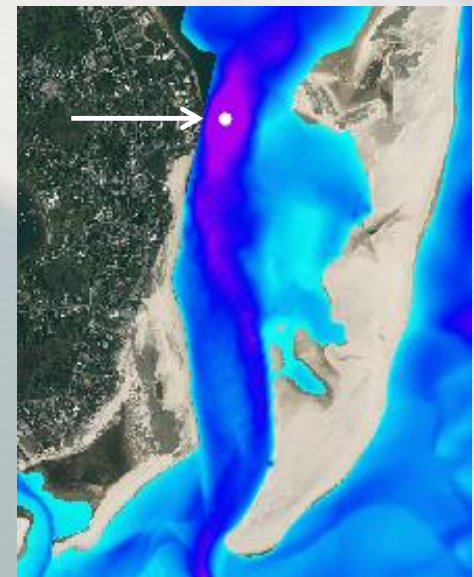
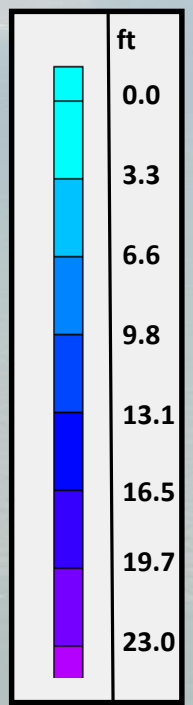
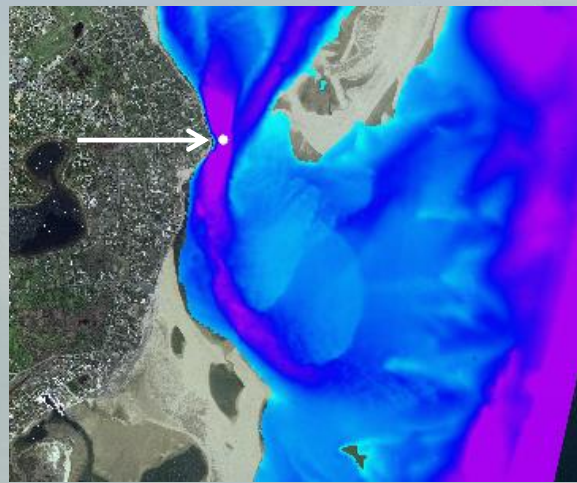
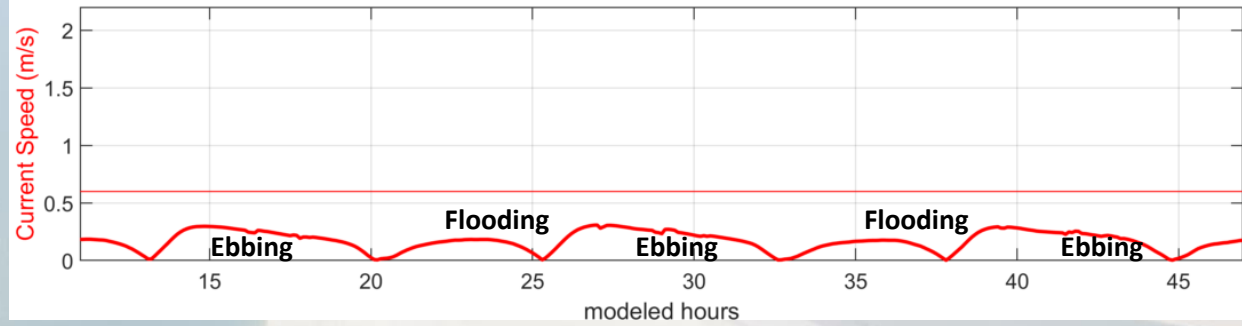
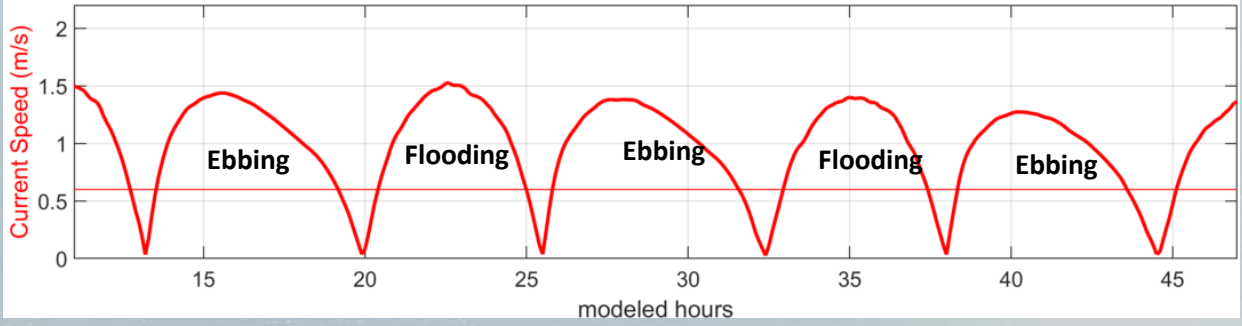
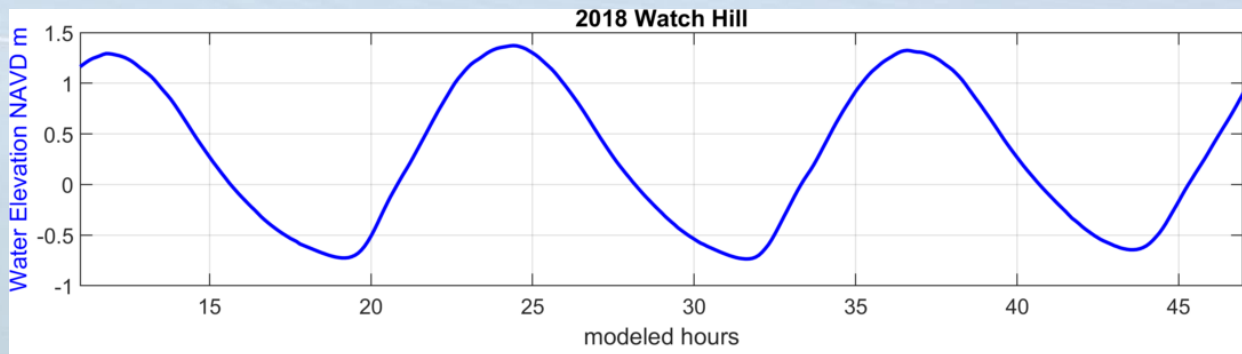
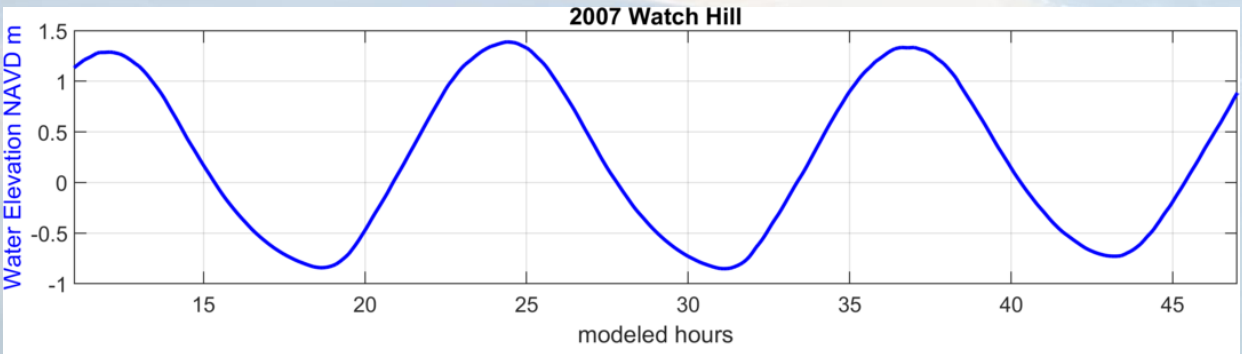
Channel Changes

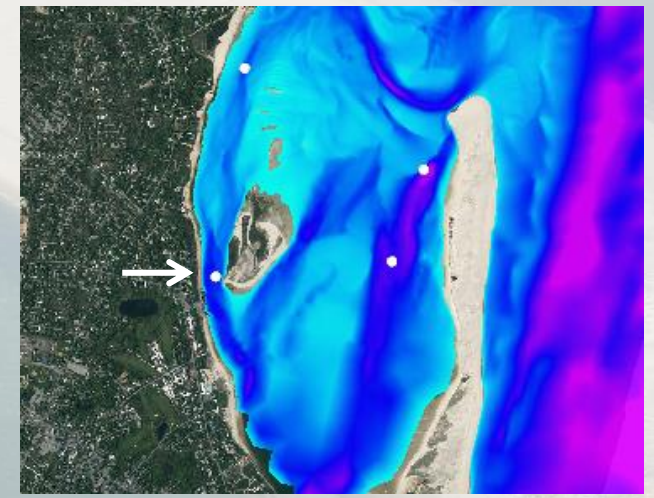
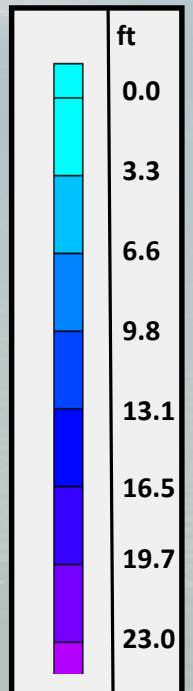
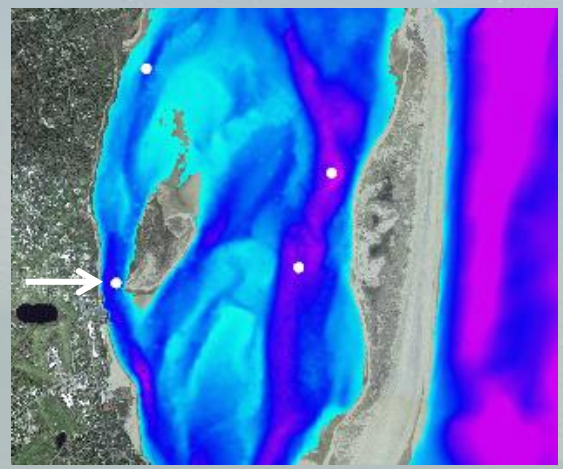
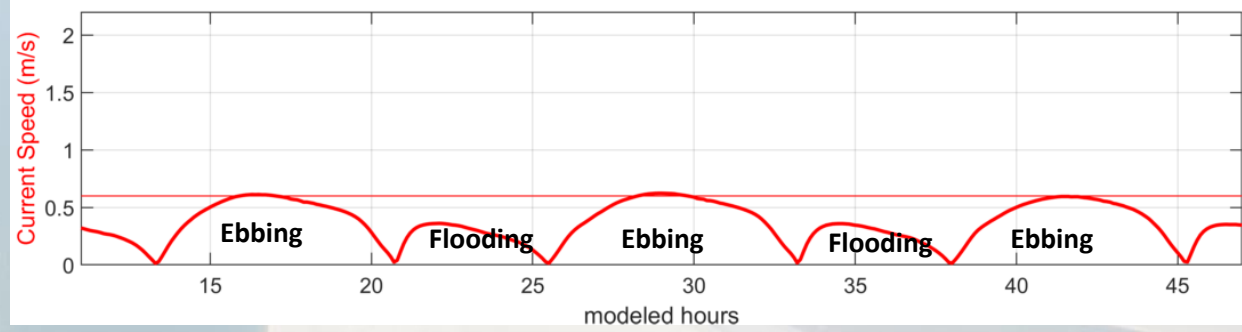
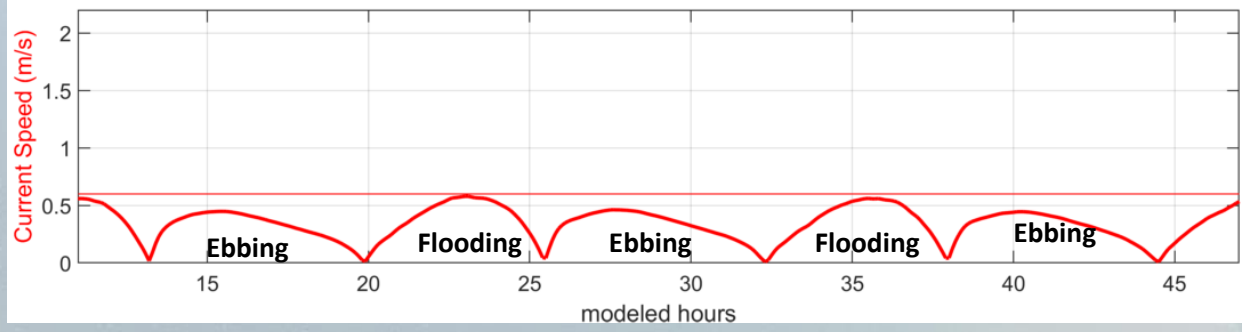
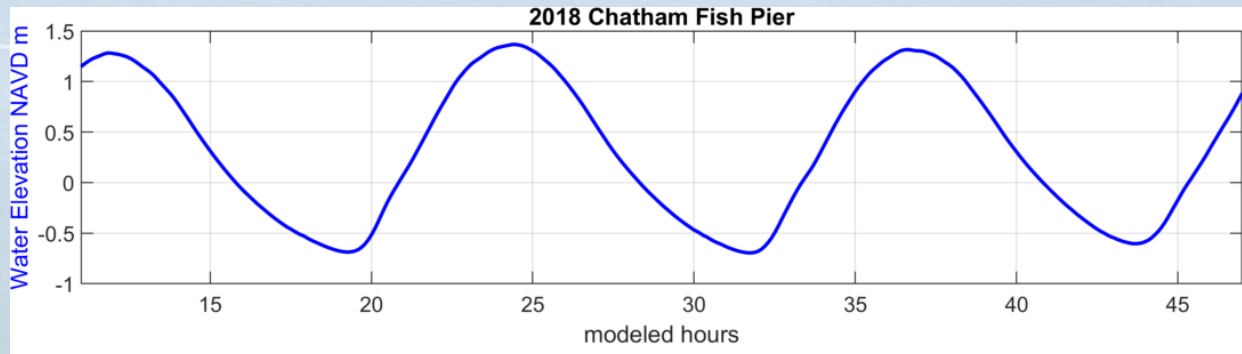
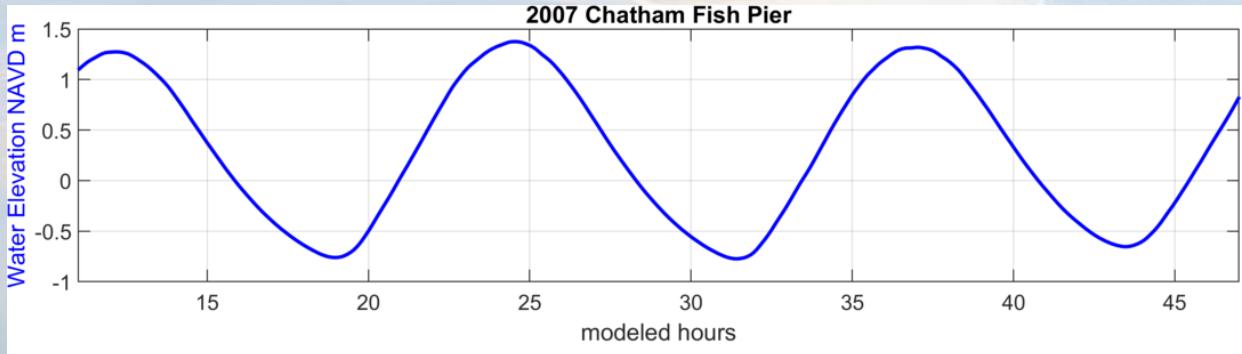
Water Depth
NAVD88

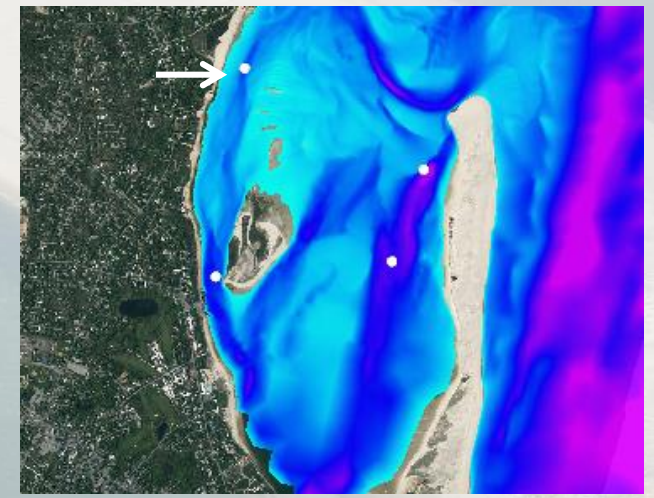
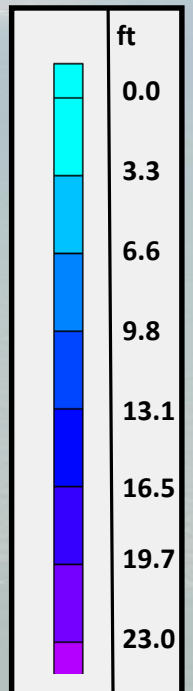
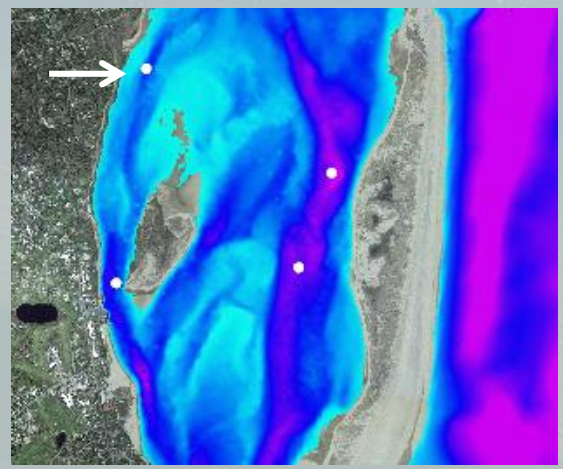
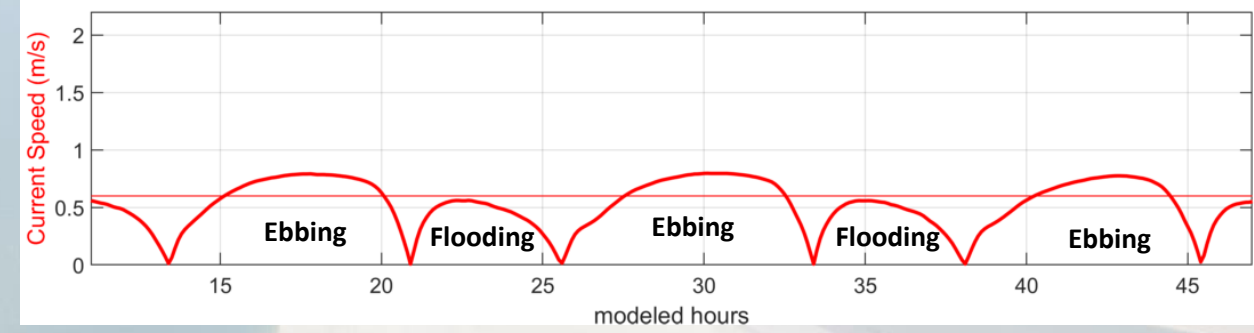
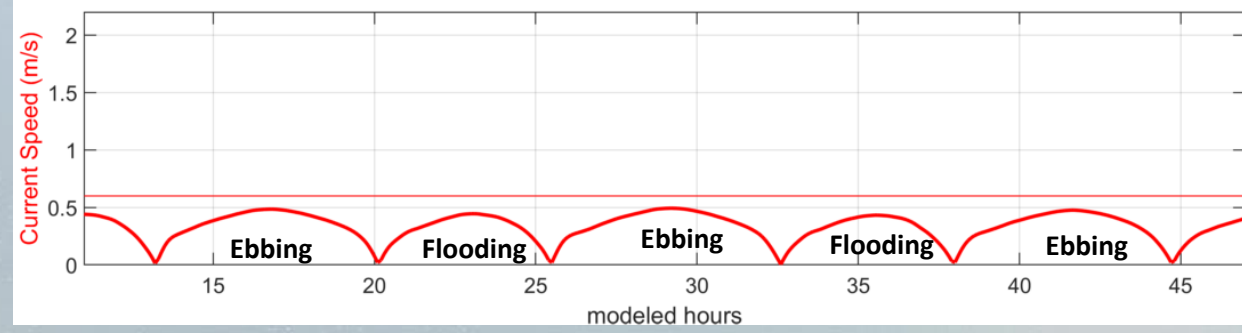
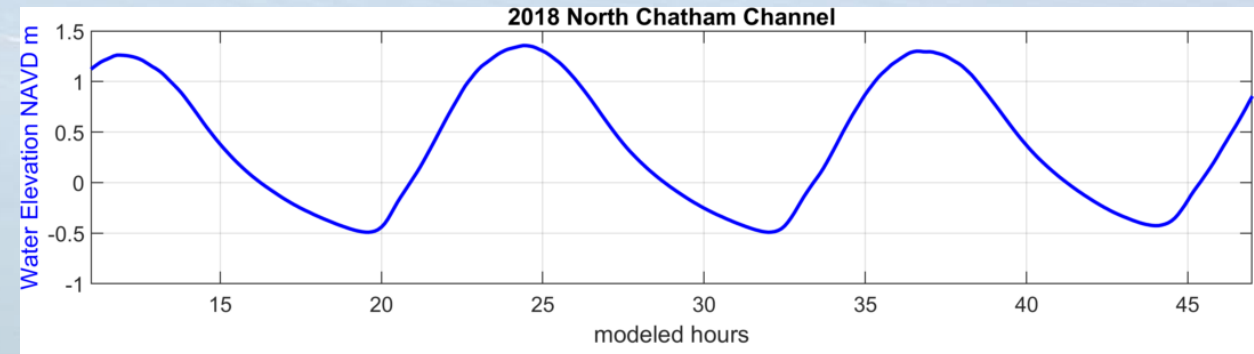
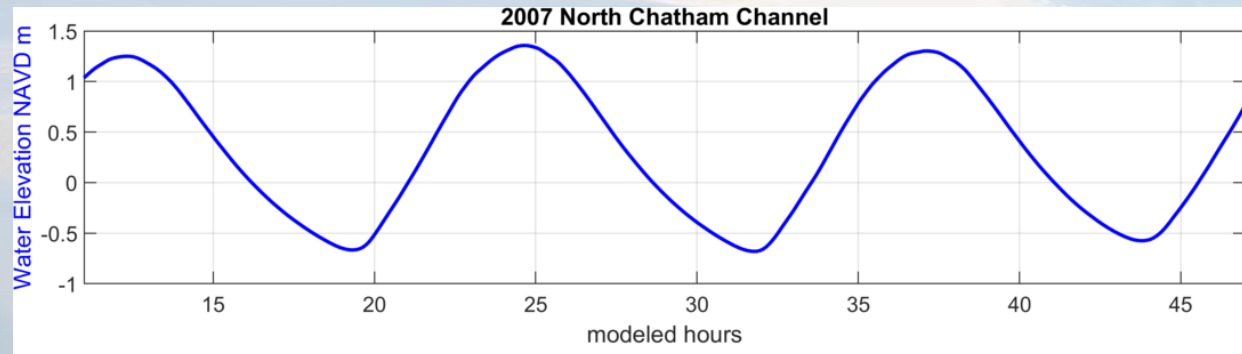


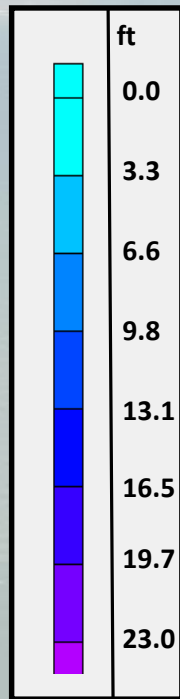
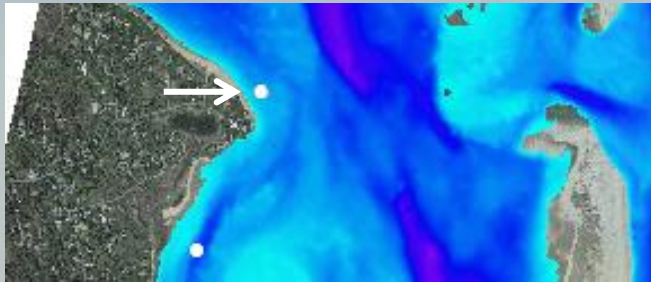
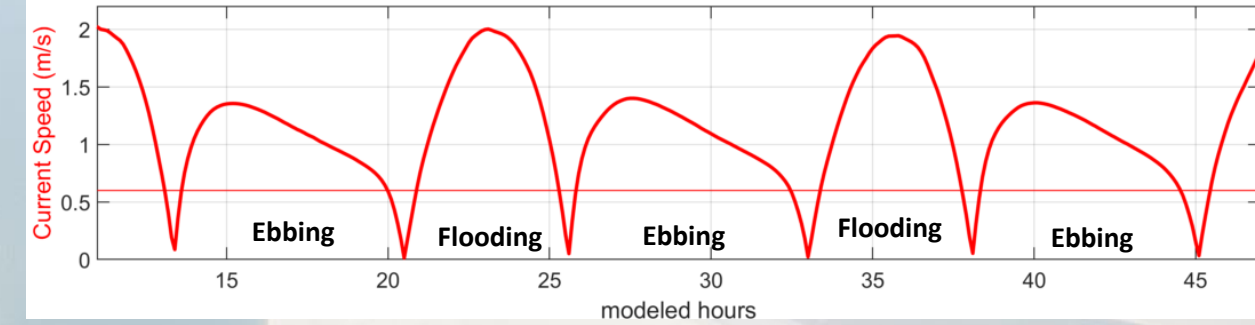
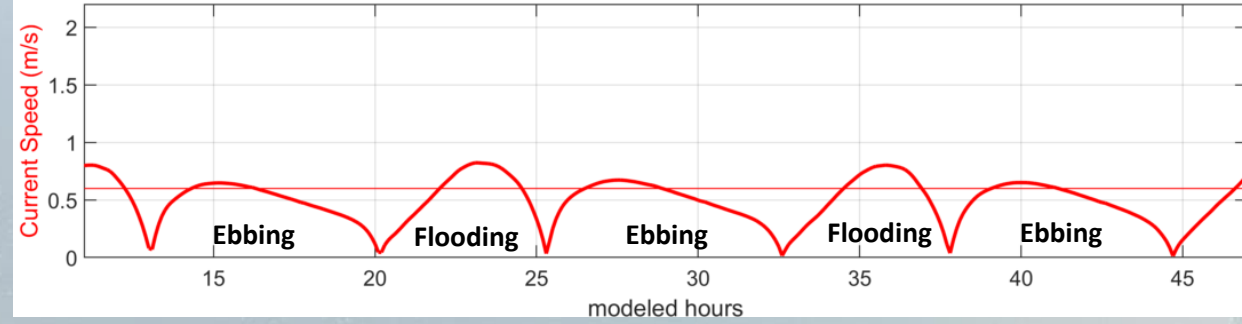
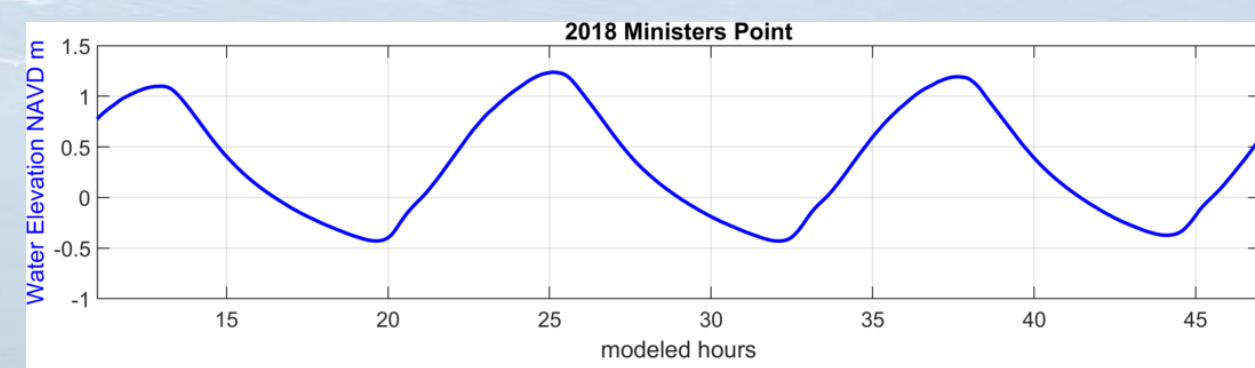
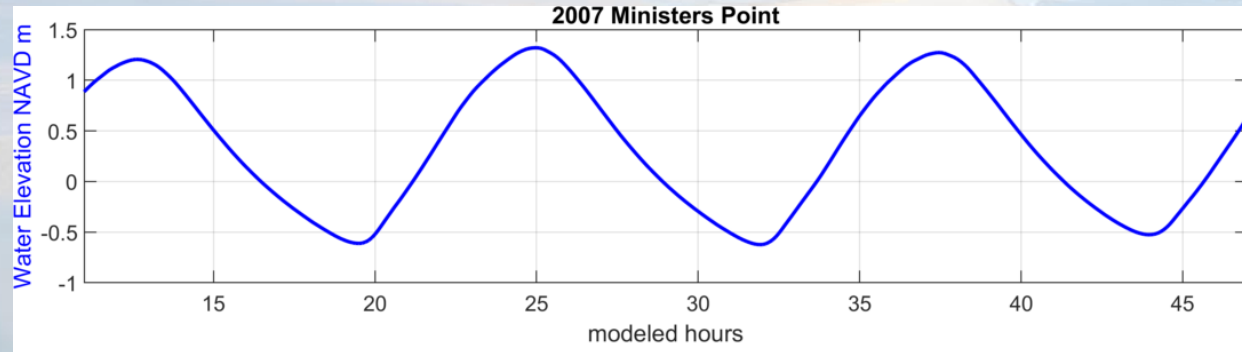
2018

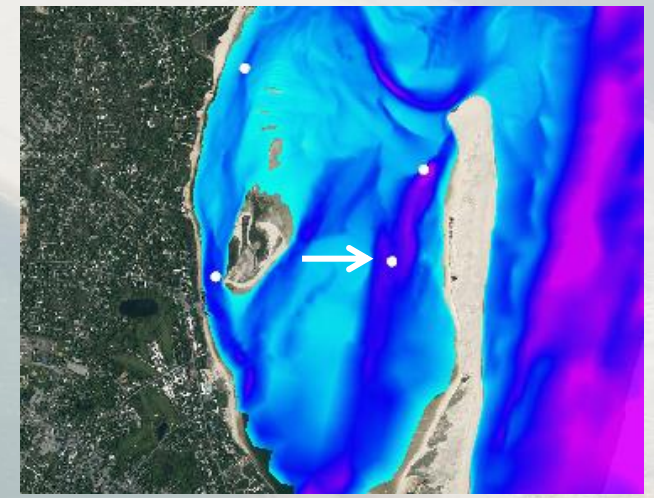
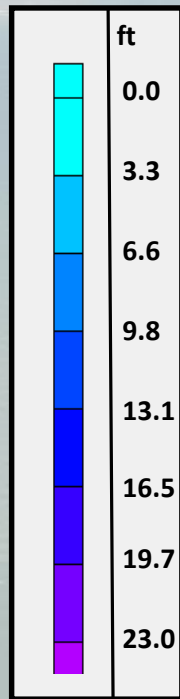
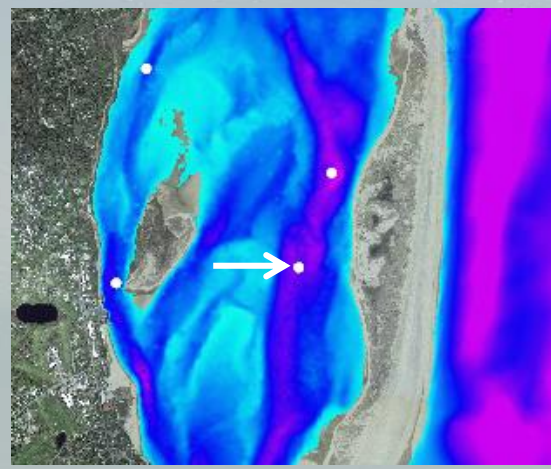
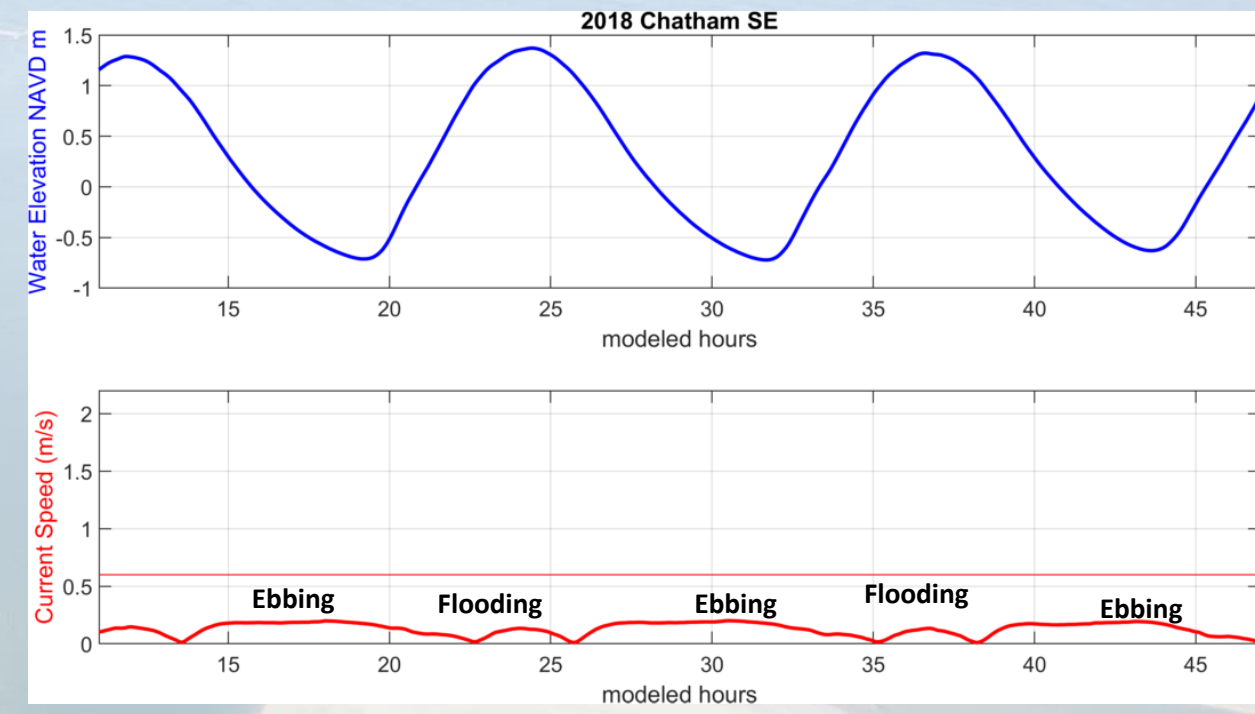
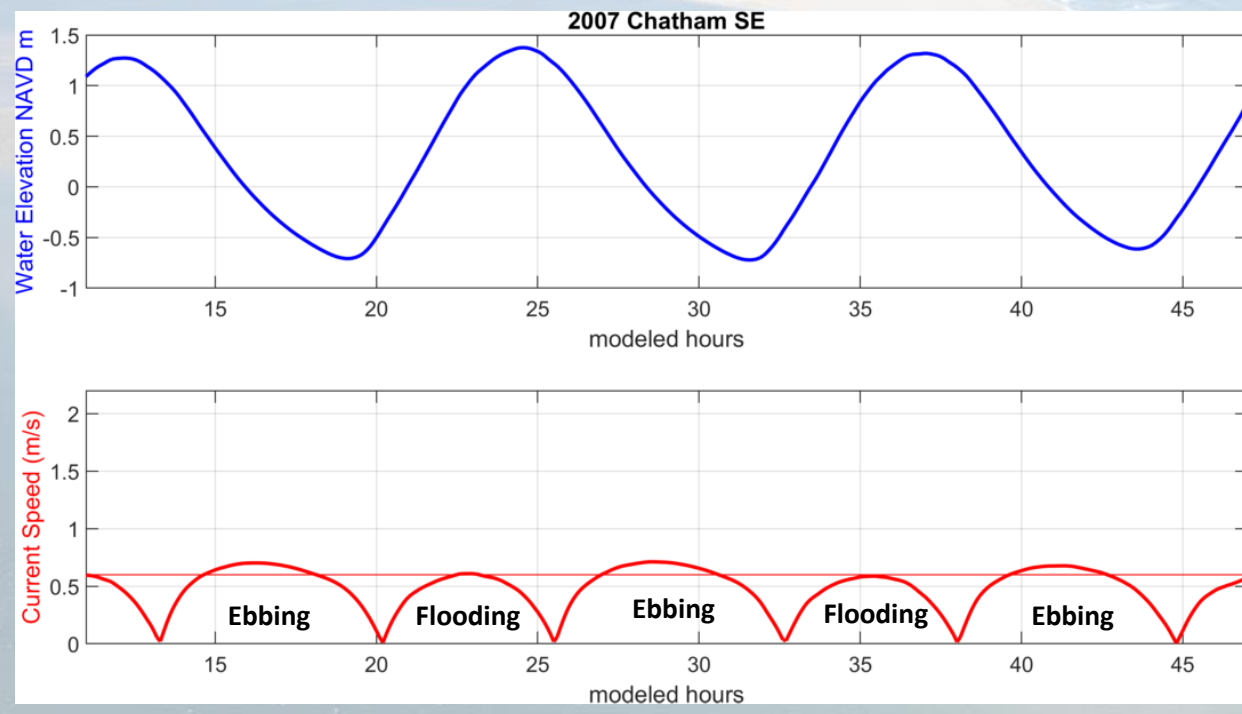


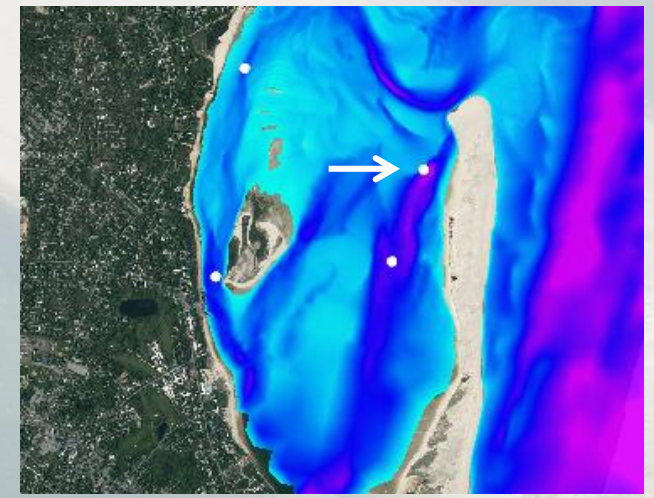
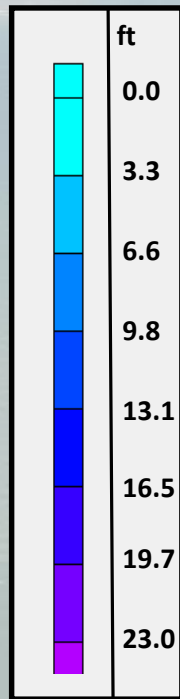
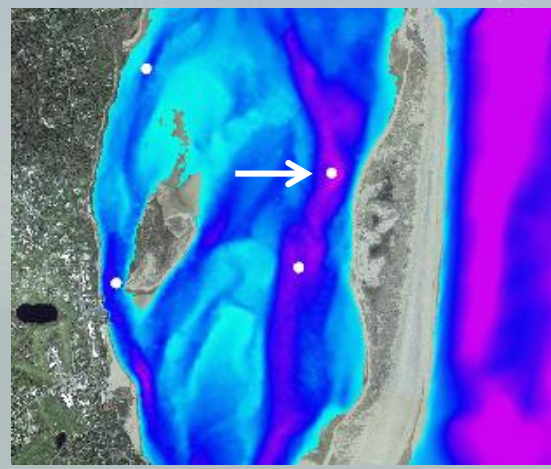
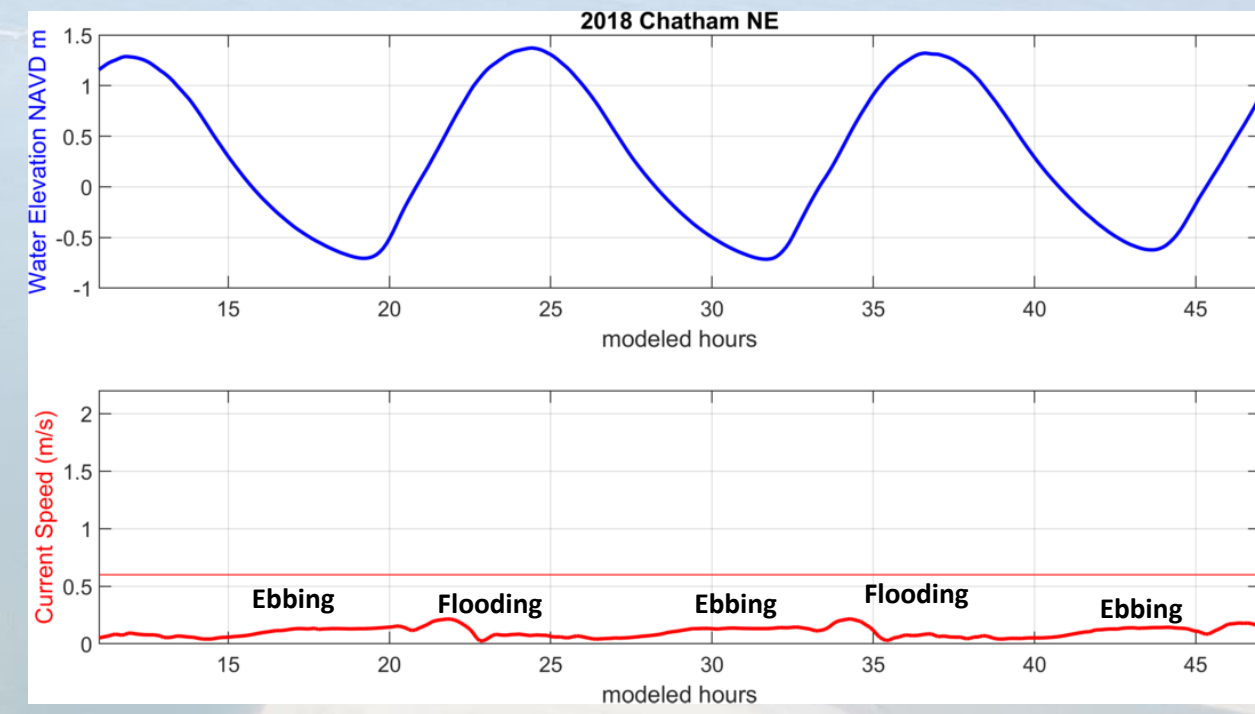
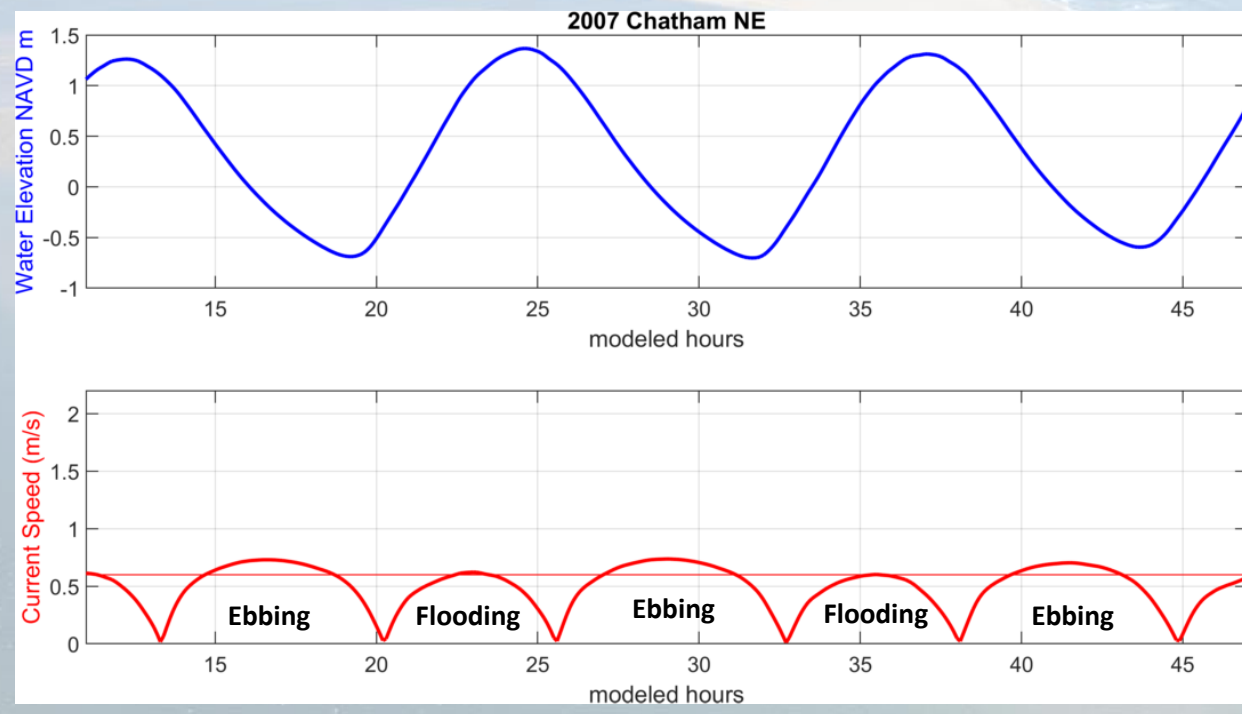




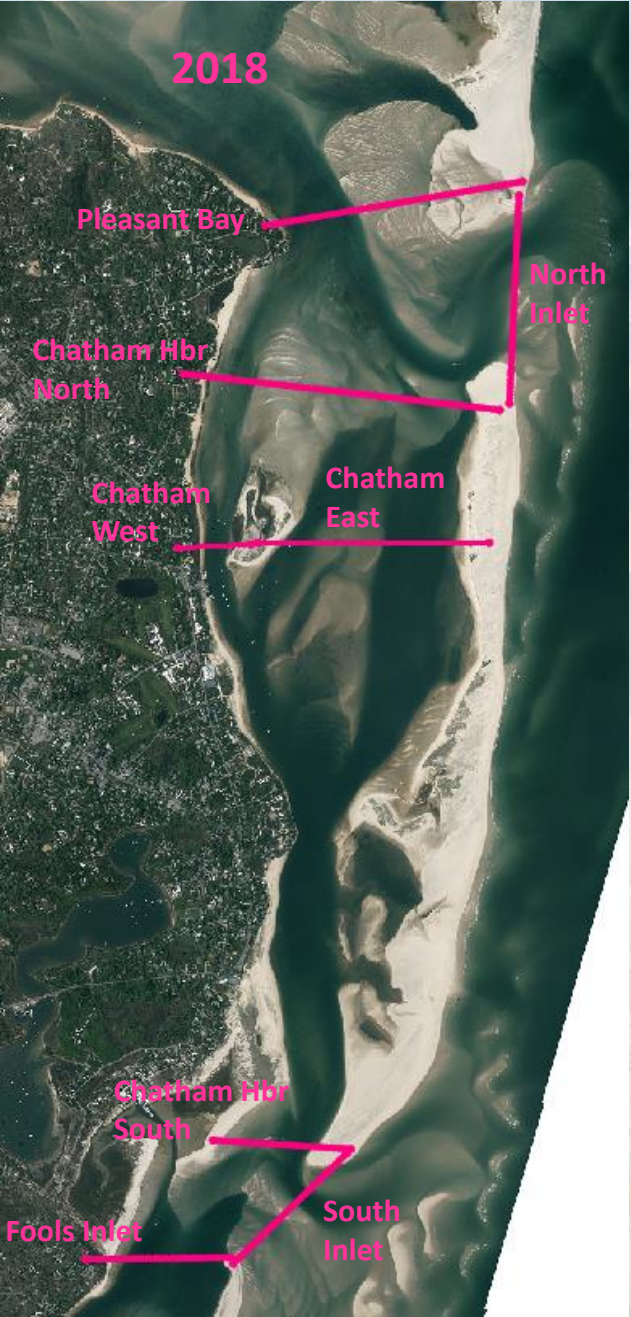
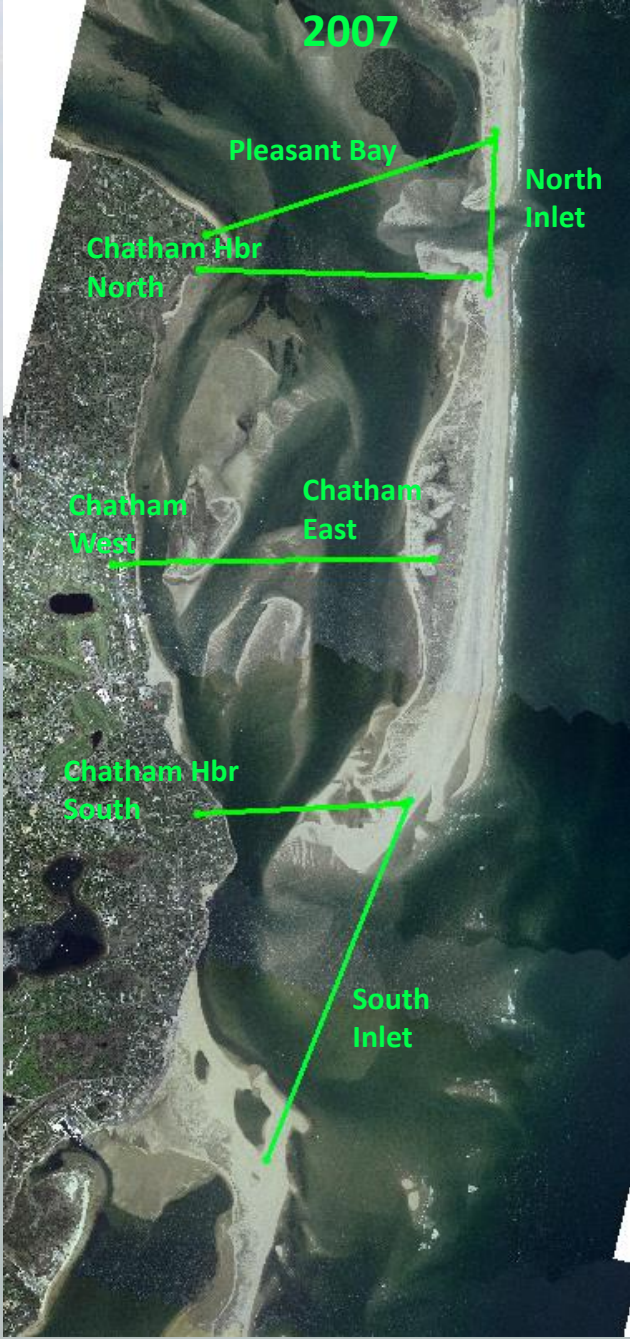




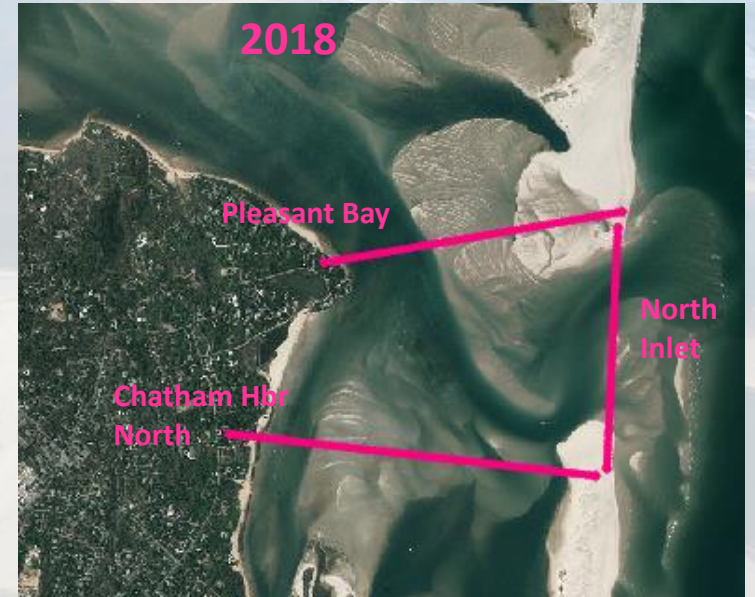




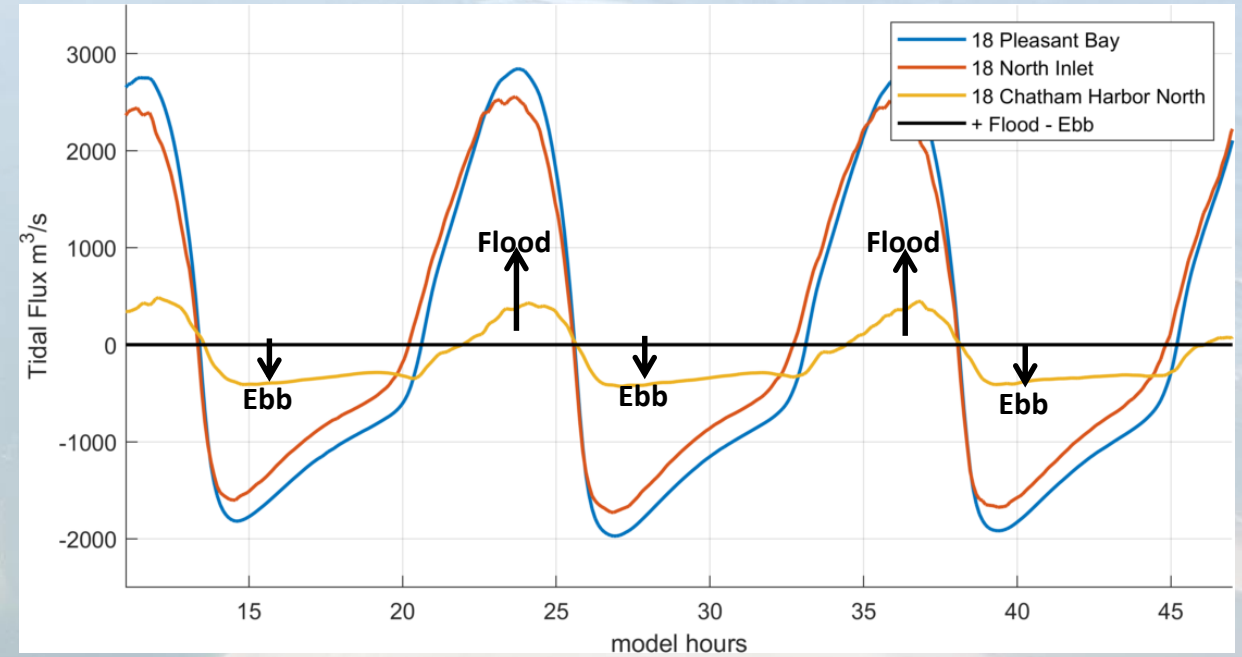
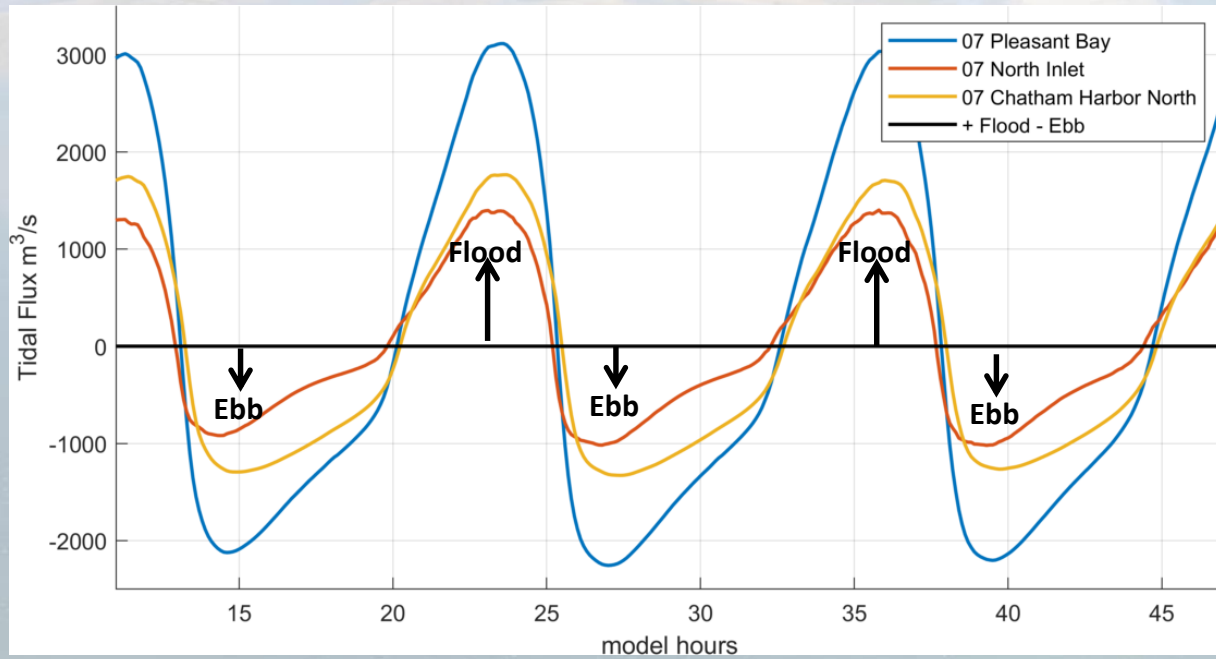
4. Tidal Flow Comparisons



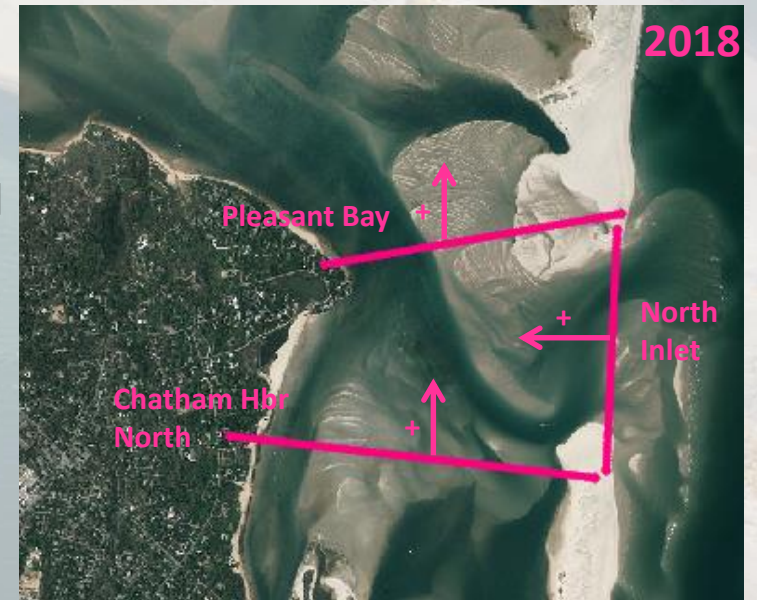
Northern Tidal Flow



4. Tidal Flow



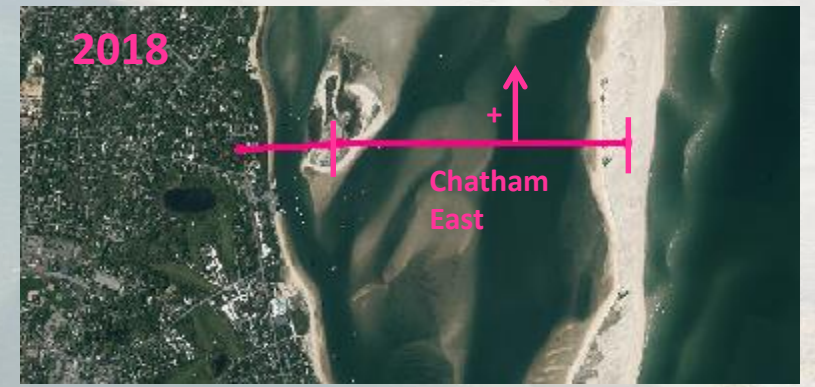
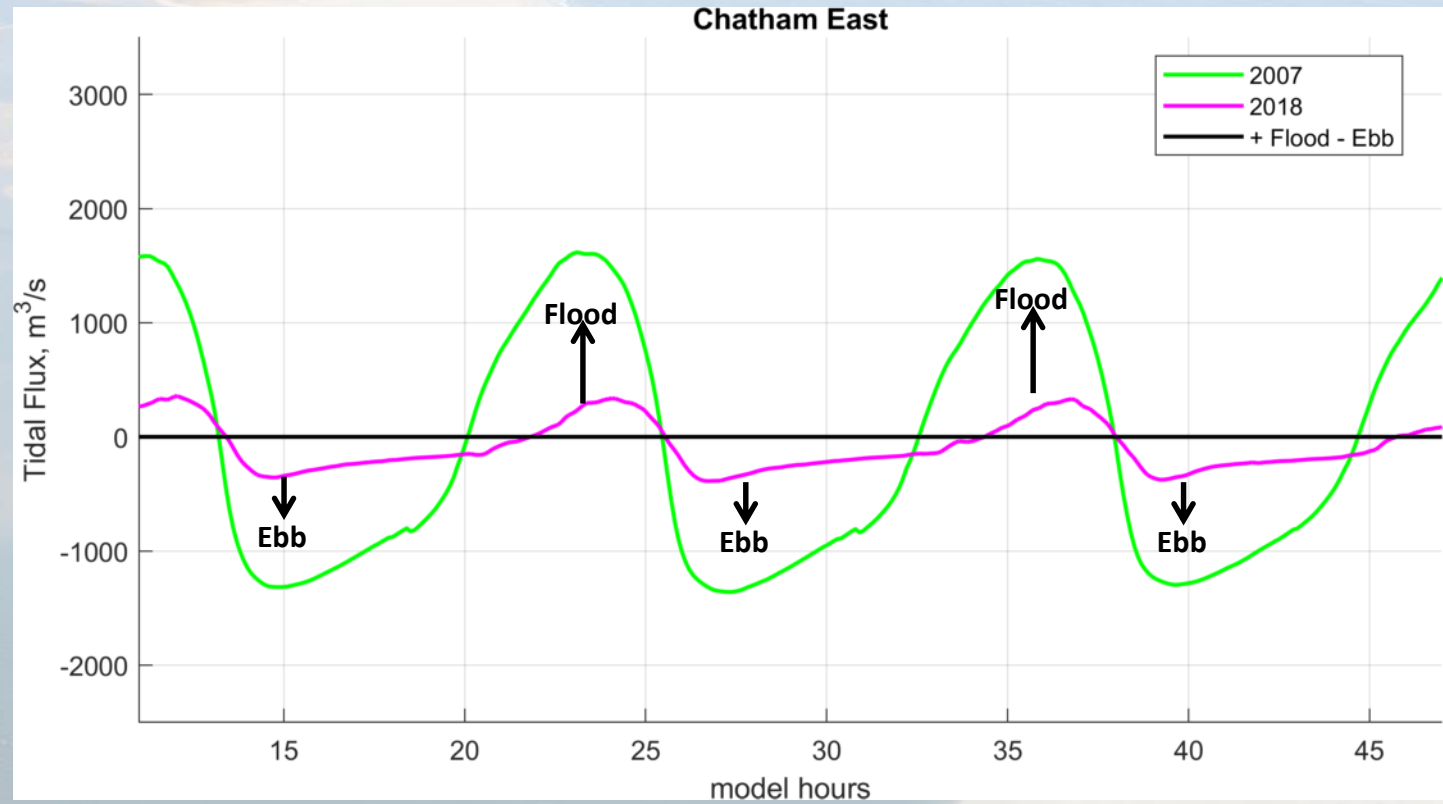
- Flood directed north (Into Pleasant Bay)
- Dramatic decrease of flow in and out of Chatham Harbor in 2018 as compared to 2007
- Increase in flow in and out of North Inlet in 2018 as compared to 2007



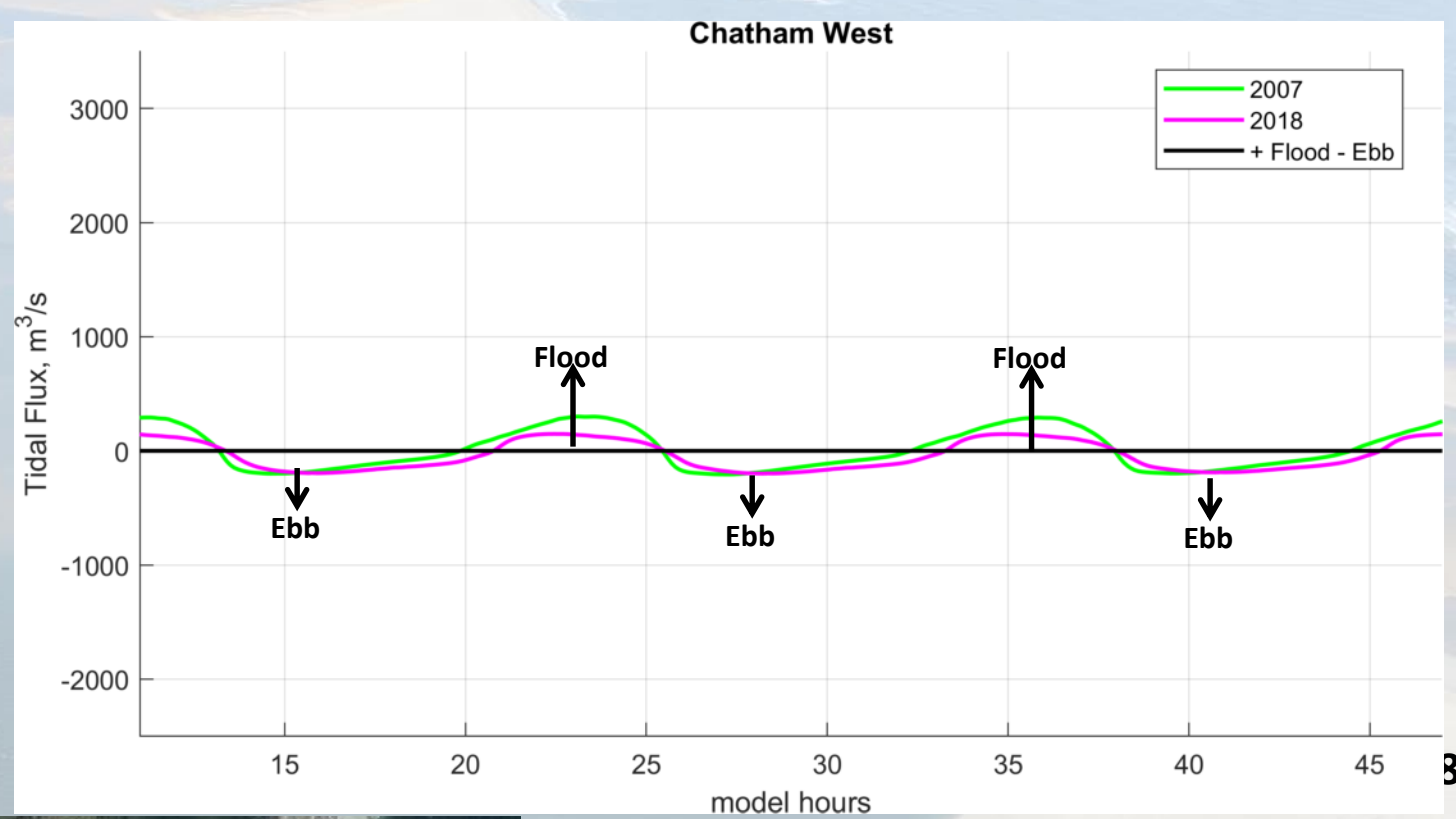
Chatham Harbor Tidal Flow



4. Tidal Flow

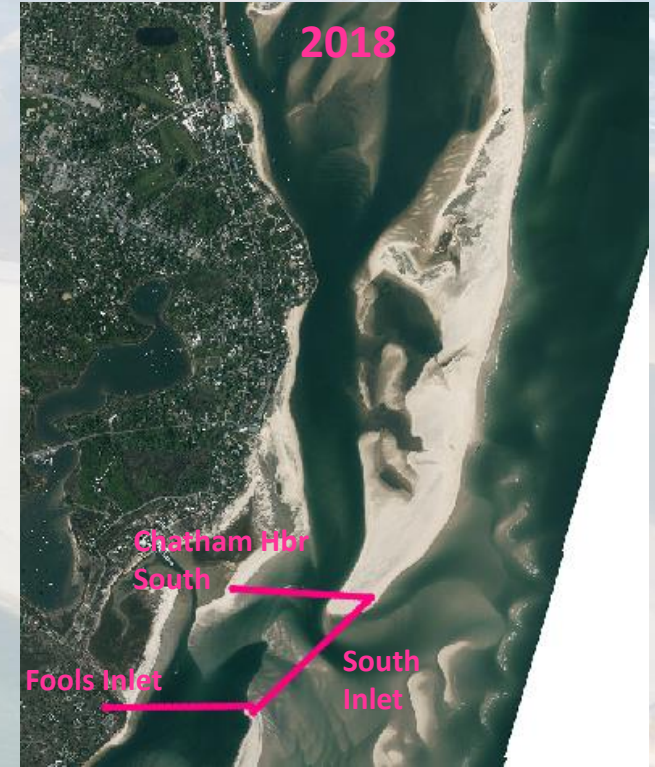


4. Tidal Flow

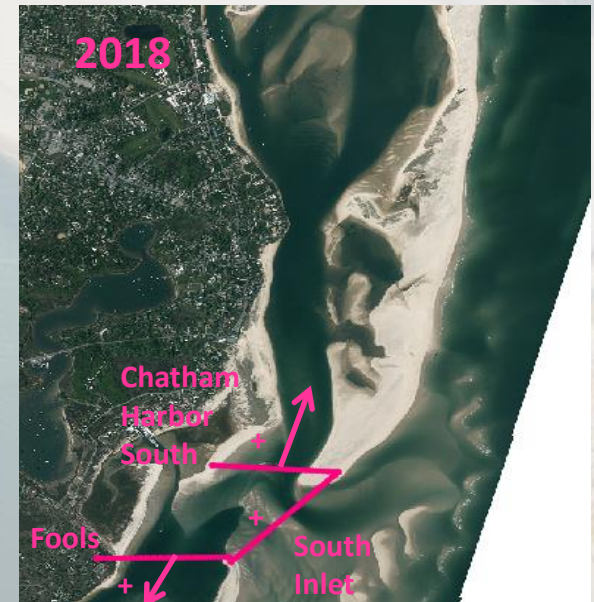
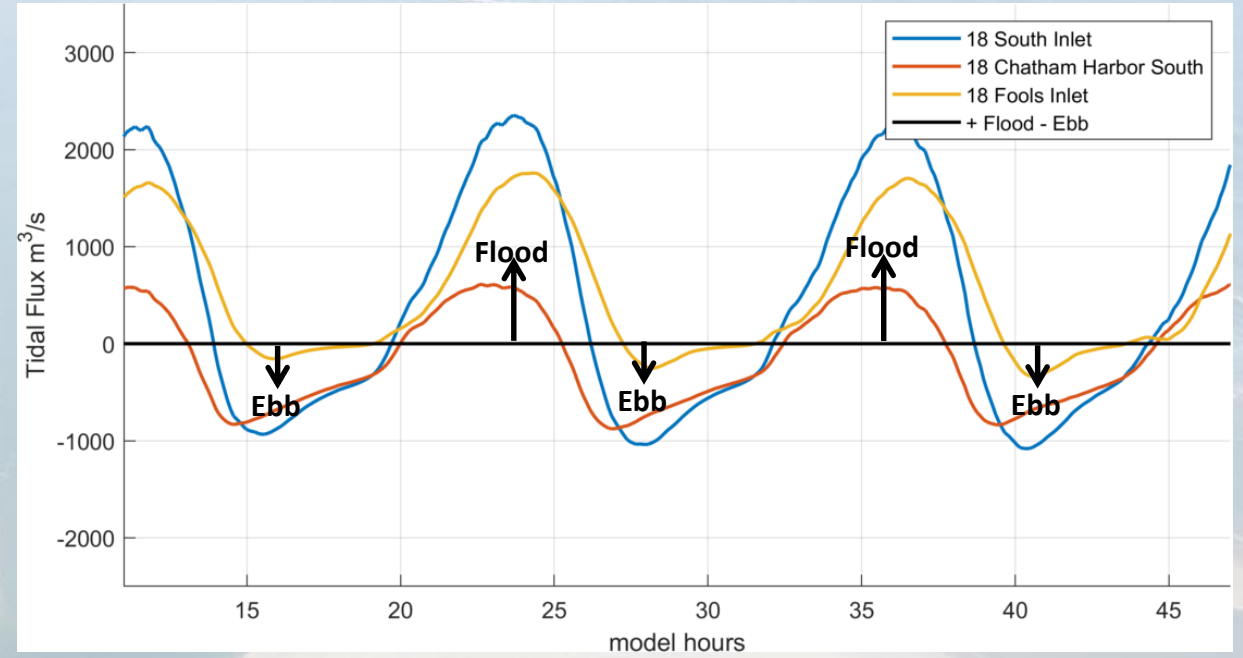
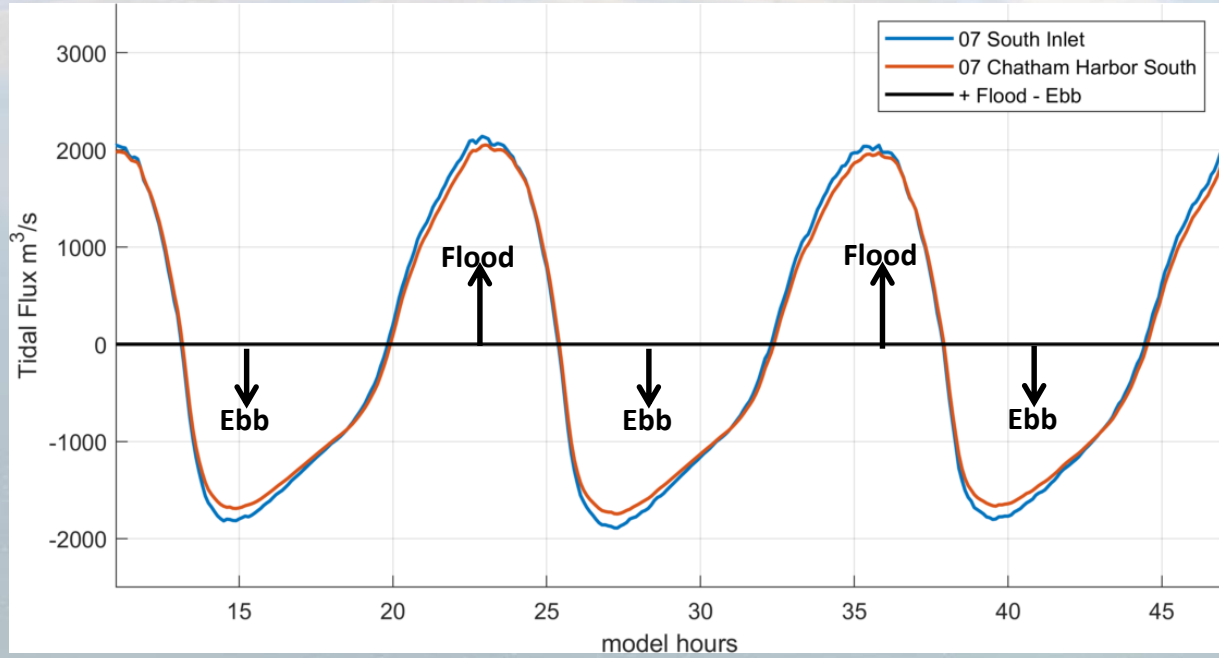




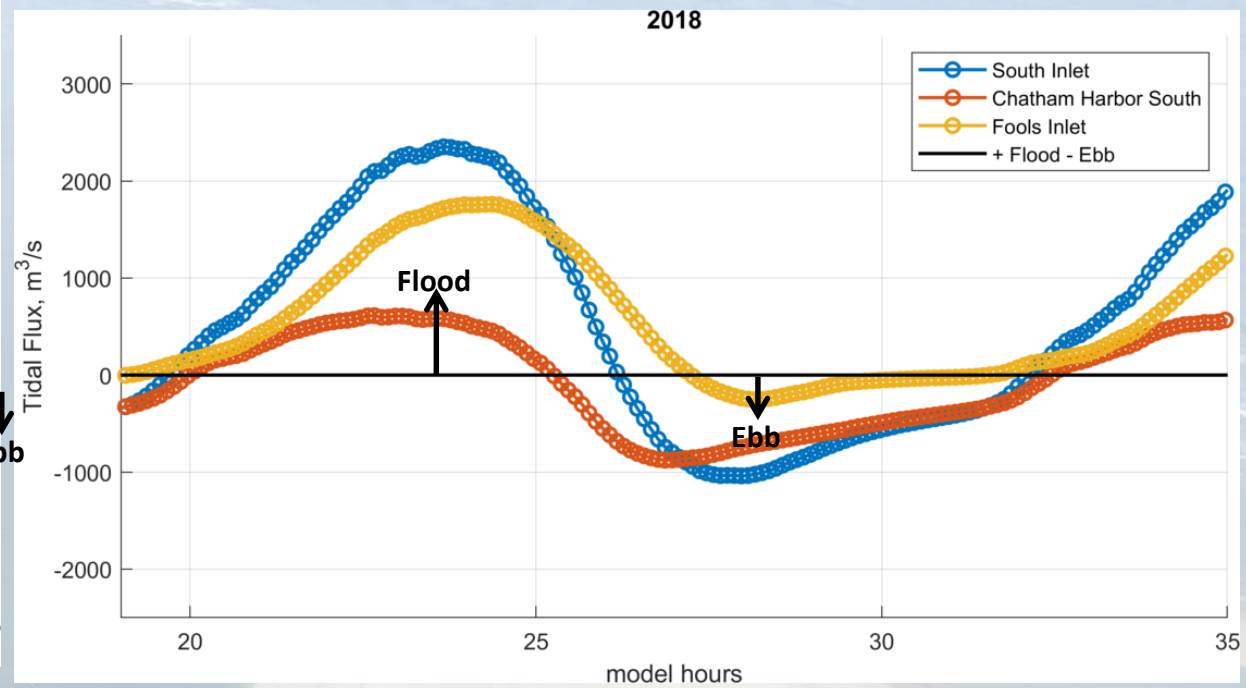
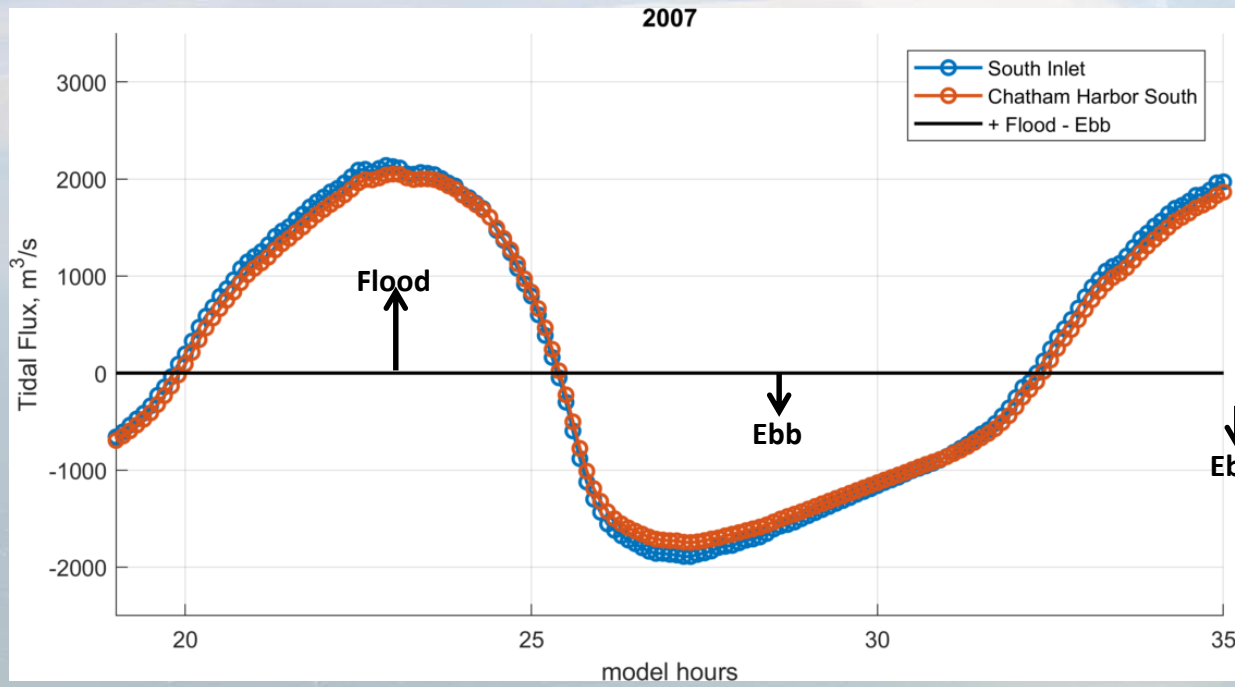
Southern Tidal Flow



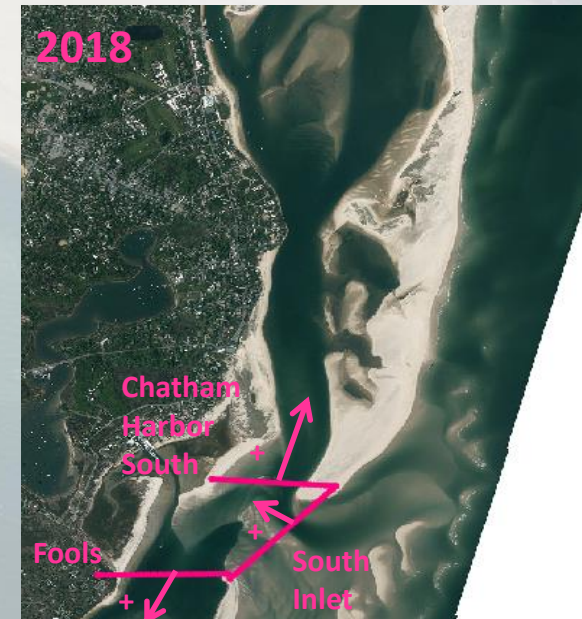
4. Tidal Flow



4. Tidal Flow



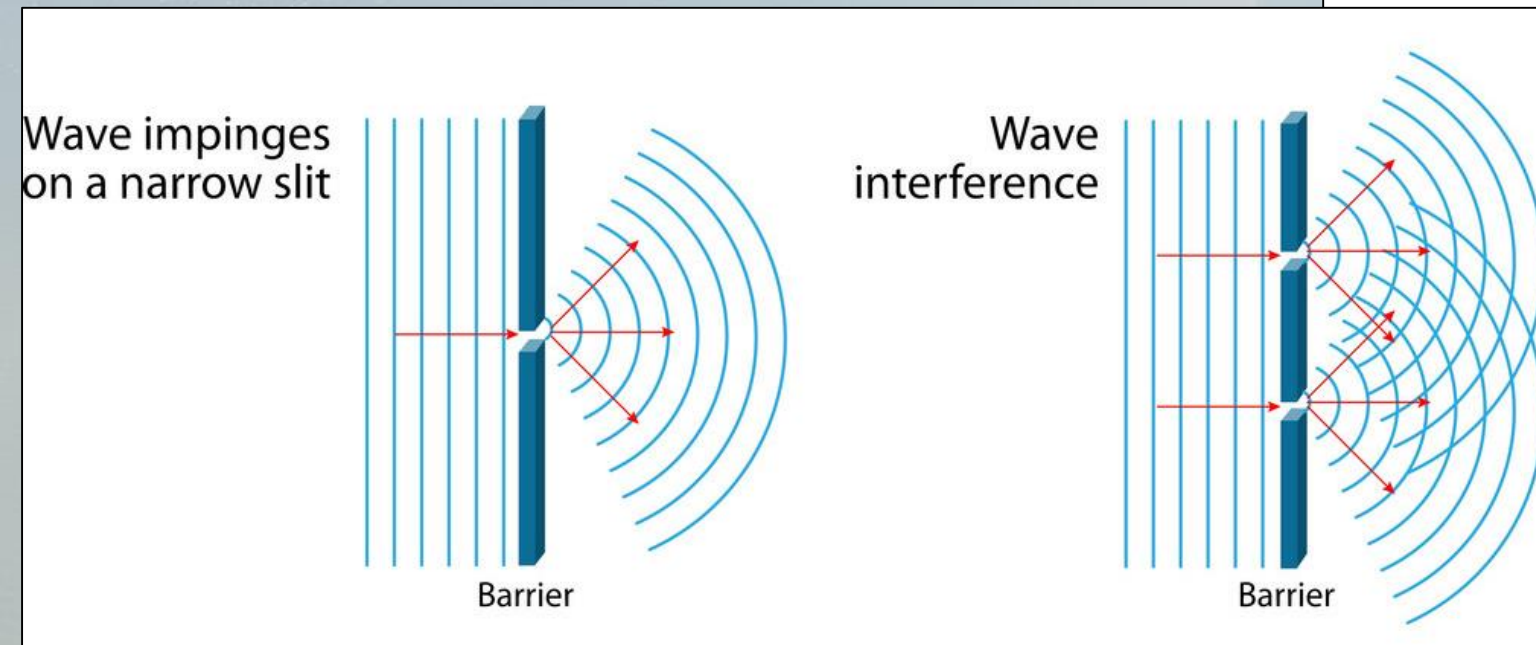
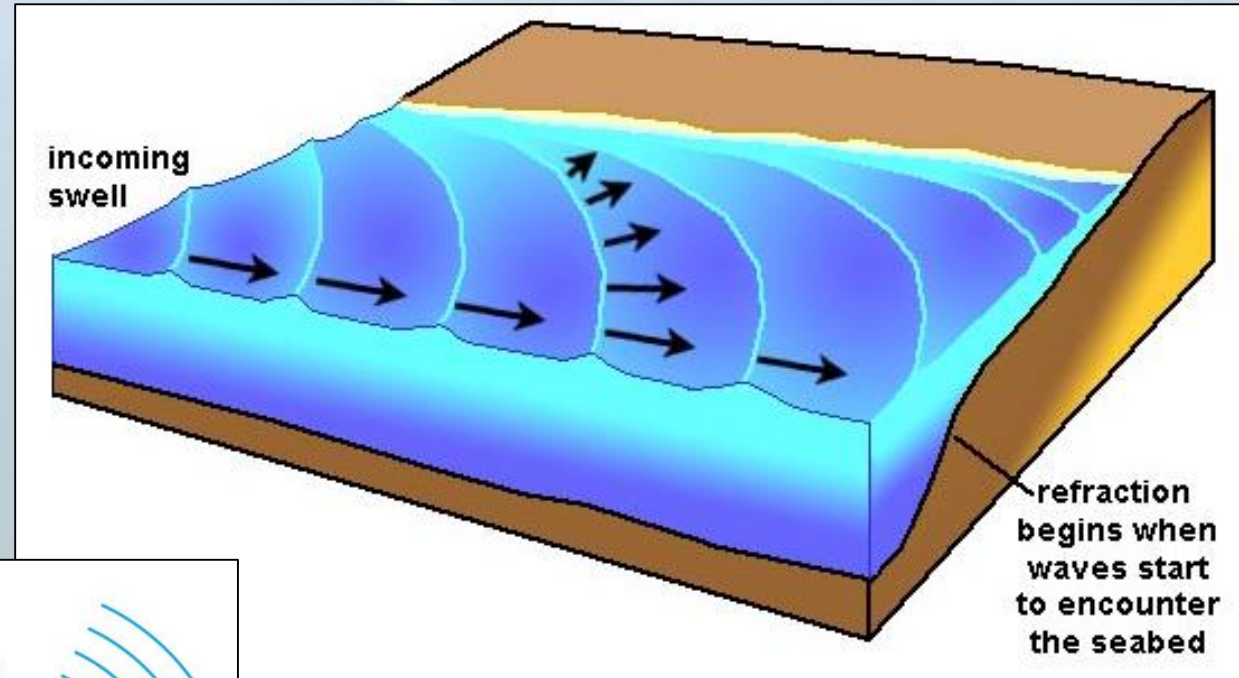
- As tide comes in to South Inlet, majority of it flows in to Fools Inlet, small proportion flows north into Chatham Harbor
- Dramatic decrease of flow in and out of Chatham Harbor in 2018 as compared to 2007



5. Wave Patterns



5. Wave Patterns



5. Wave Patterns



Predominant Offshore Wave Approach



North Inlet

South Inlet

Fools Inlet

2007 Inlets Video










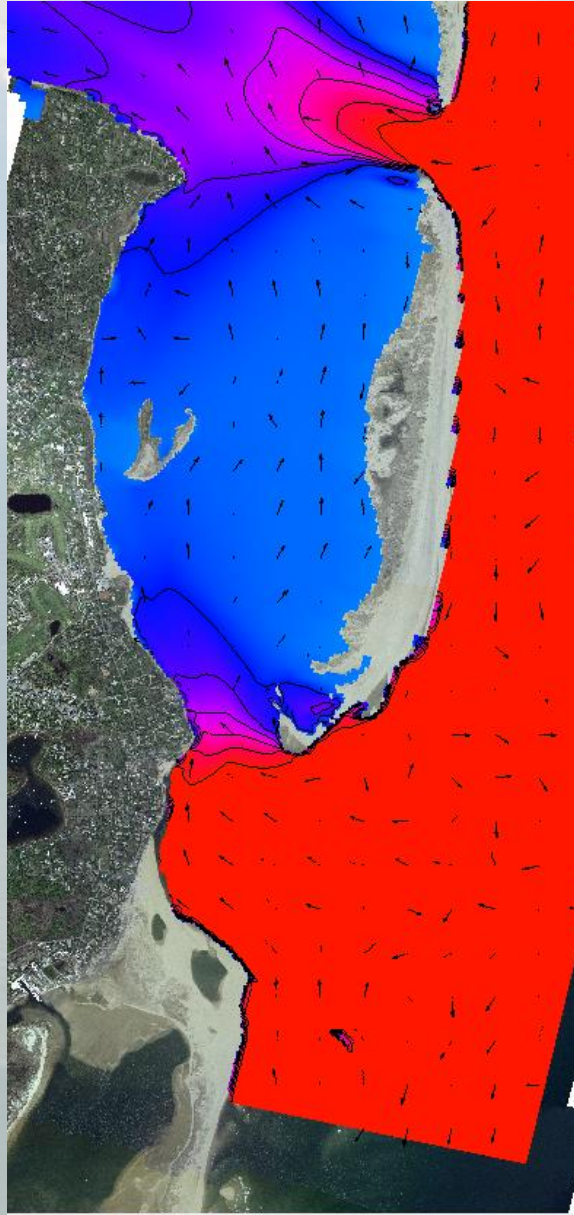
2018 Inlets Video



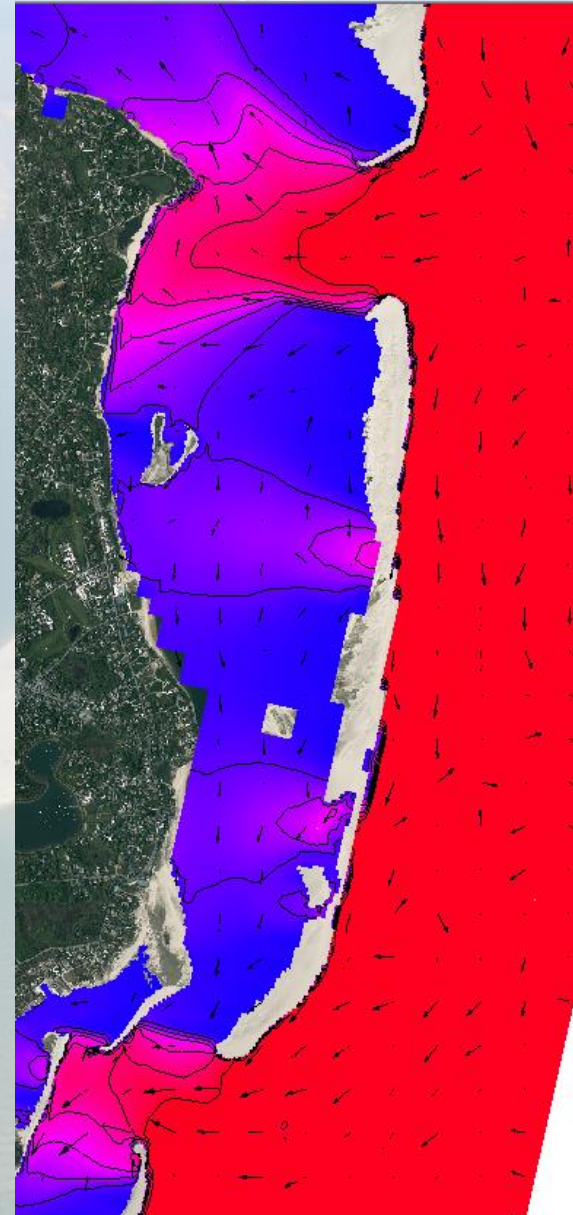
5. Wave Height Comparisons

2007

	m	ft
	1.5	4.8
	1.25	4
	1.0	3.2
	0.75	2.4
	0.5	1.6
	0.25	0.8
	0.0	0



2018





Questions

References

Woods Hole Sea Grant Program. 2015. *The Effect of Sea level Rise on the Barrier Beaches of Cape Cod, Martha's Vineyard, and Nantucket*

Giese, G.S., Mague, S.T., Rogers, S.S., 2009. *A Geomorphological Analysis of Nauset Beach/Pleasant Bay/Chatham Harbor For the purpose of Estimating Future Configurations and Conditions*. Prepared for the Pleasant Bay Alliance Management Alliance. December.

Reinson G.E., 1992. *Transgressive Barrier Island and Estuarine Systems*. In: R. G. Walker and N. P. James, Eds., *Facies Models: Response to Sea Level Change*, Geological Association of Canada, *Geotext 1*, pp. 179-194.