UNDERSTANDING COASTAL GEOLOGIC HAZARDS, SEA LEVEL RISE and CLIMATE CHANGE in THE NORTHEASTERN US

Congressional Hazards Caucus Briefing – Washington, DC

18 November 2009

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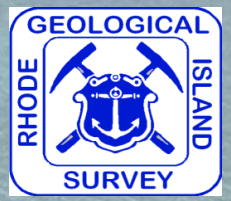
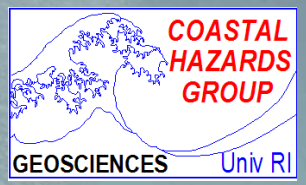




The Sea Is Rising – But…..

When Contemplating Northeastern US Coastal Geologic Hazards

One Must Consider:

- **Extratropical Cyclones (“Nor’easters”)**
- **Hurricanes (Tropical Cyclones)**
- **and ……. Sea Level Rise**

When Contemplating Northeastern US Coastal Geologic Hazards

Which Give Rise to these Processes:

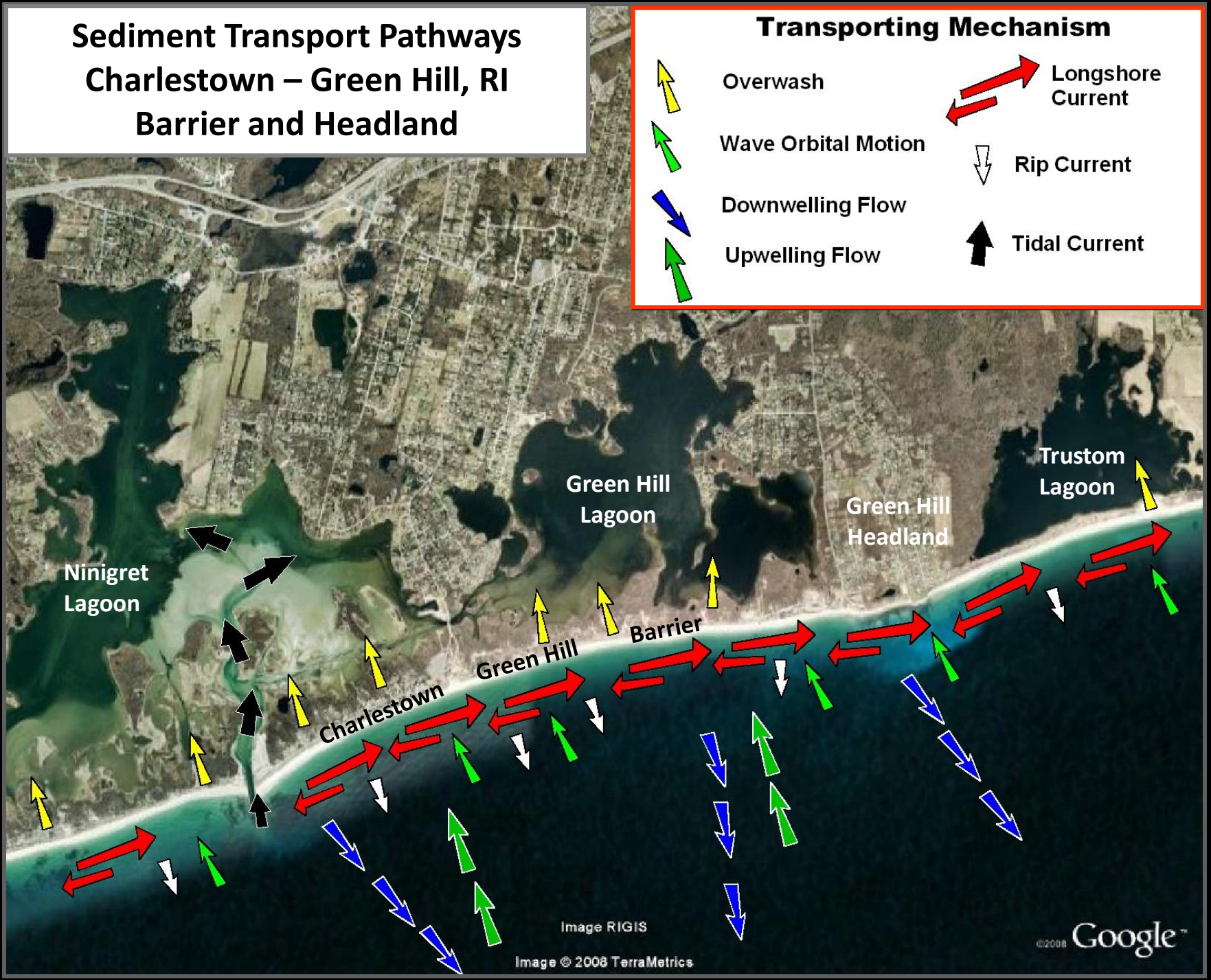
- **Frontal Erosion – from Breaking Waves and Swash**
- **Storm-Surge Overwash**
- **Elevated MHHW into the Future**

When Contemplating Northeastern US Coastal Geologic Hazards

The Scale of Processes are:

- **Breaking Waves –**
  1 to 3+ meters at shoreline
- **Storm-Surge Overwash –**
  30 cm to 3+ m water depth across shore zone
- **Sea-Level Rise –**
  2.7-3.3 mm/year at present;
  could increase to 1-1.5 cm/yr

Sediment Transport Pathways Charlestown – Green Hill, RI Barrier and Headland



Storms as Modifying Agents in the Coastal Environment

Are Governed By:

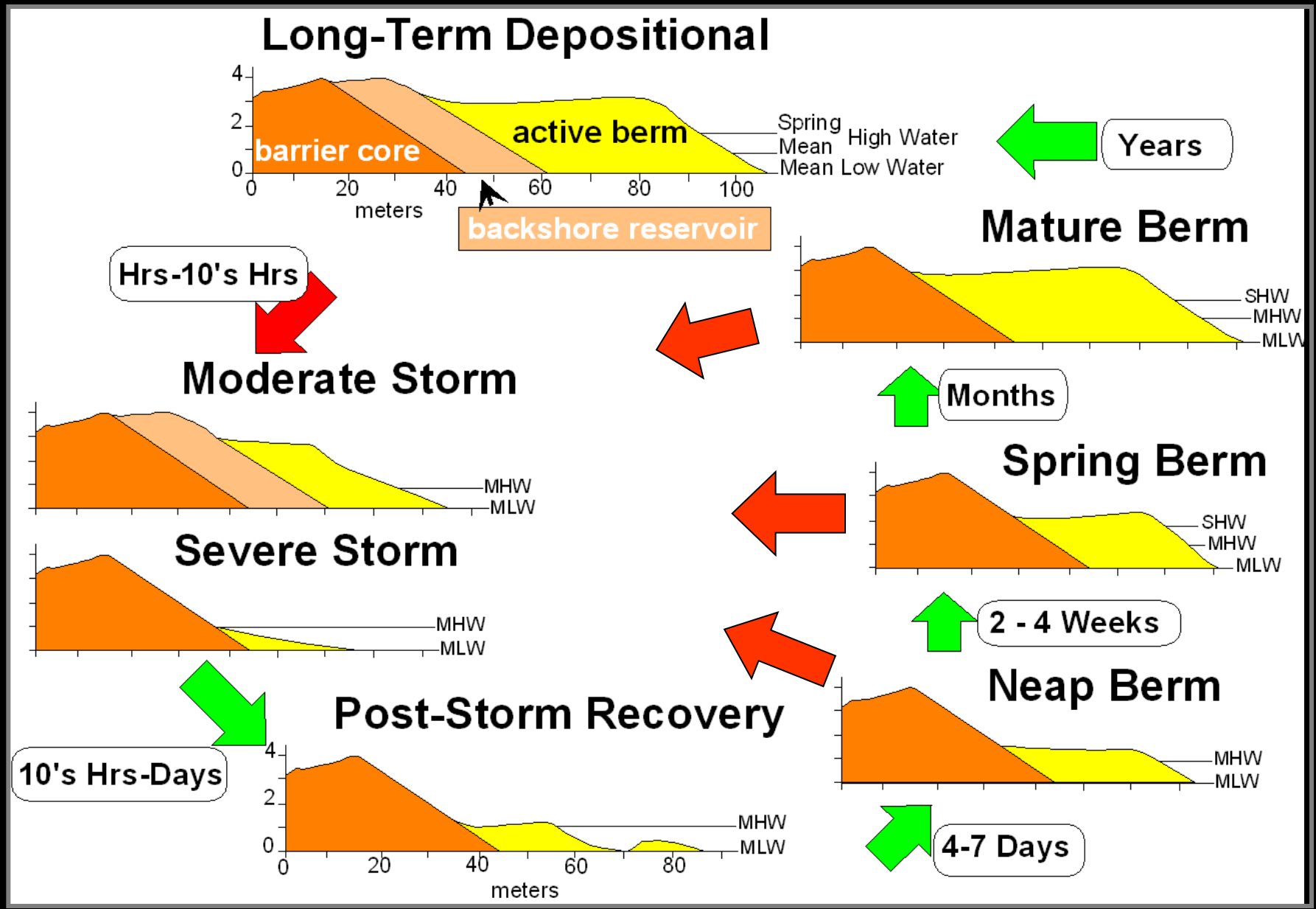
- Size and Intensity of the Storm
- Speed of Storm Passage
- Tidal Phase – Spring-Neap, High-Low
- Path of Storm with Respect to Orientation of Shoreline
- Time Interval between Storms

Hayes and Boothroyd, 1969, 1986

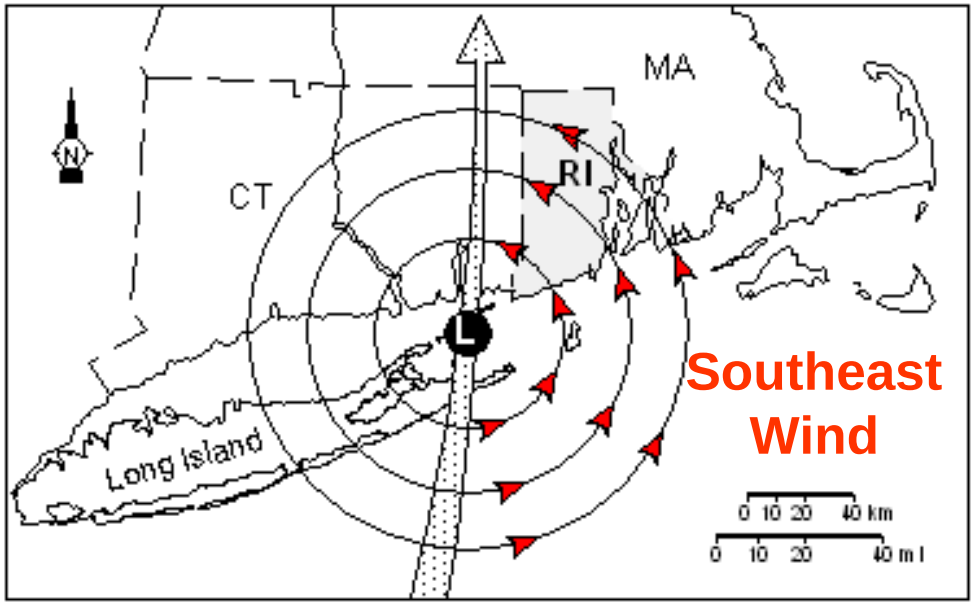
Beach Cycles – RI Shore

COASTAL HAZARDS GROUP
GEOSCIENCES Univ RI

Boothroyd and Galagan, 1999



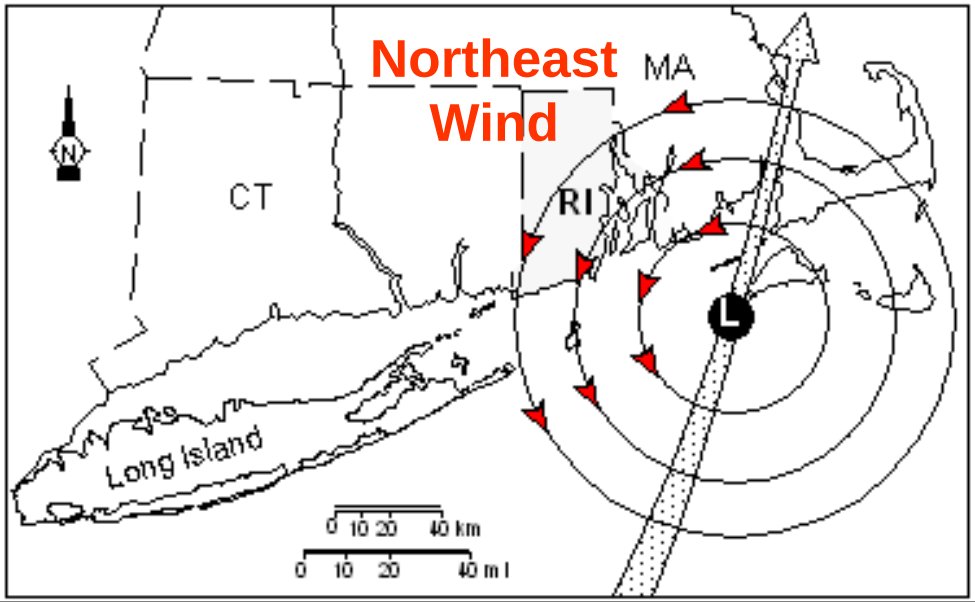
HURRICANE and EXTRATROPICAL STORM PATHS and ASSOCIATED WIND PATTERNS



PASSAGE TO THE WEST

- Maximum Onshore Wind
- Severe Storm-Surge Flooding

Sou'easters



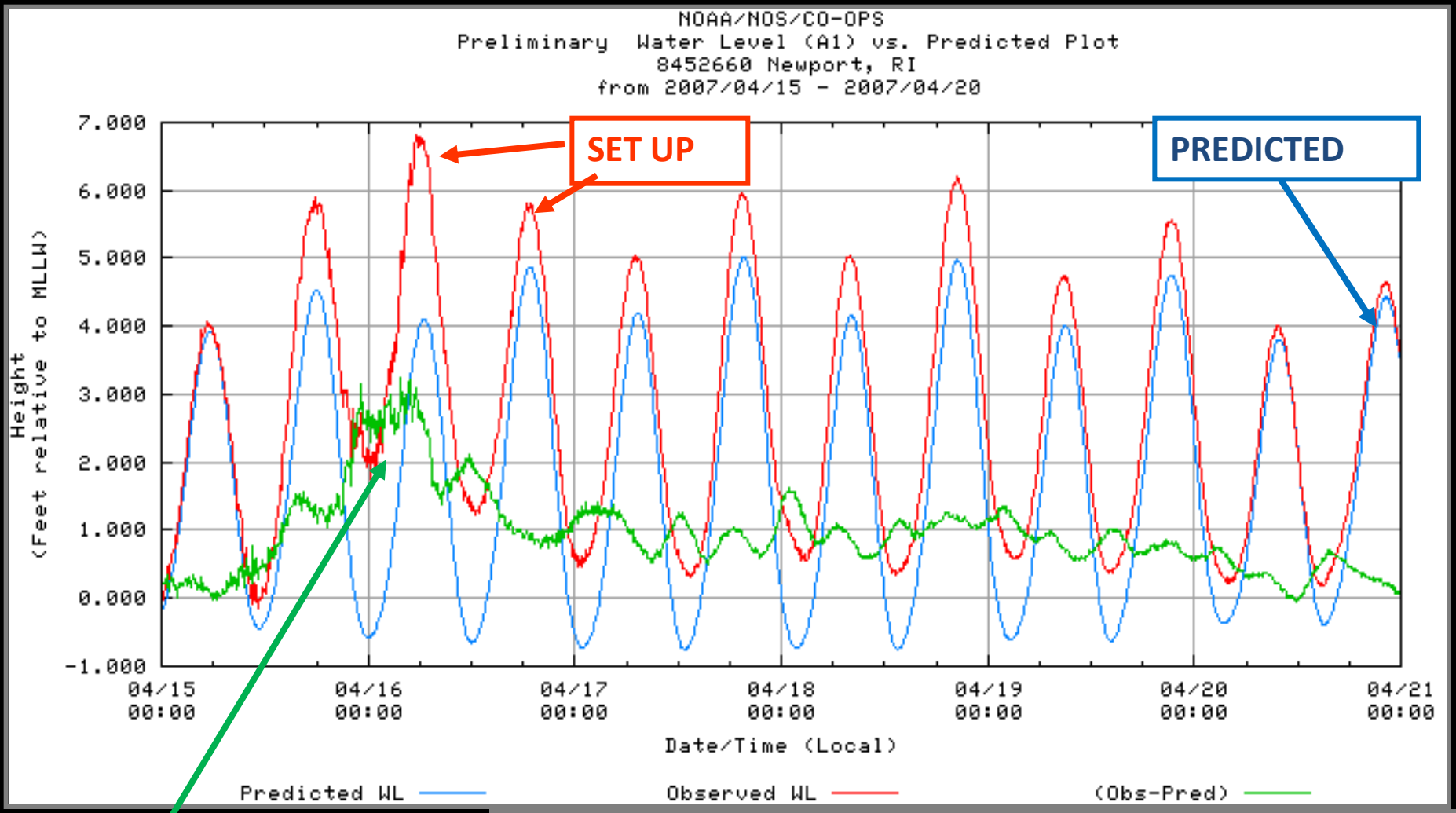
PASSAGE TO THE EAST

- Offshore Wind
- Minimum Storm-Surge Flooding

Nor'easters

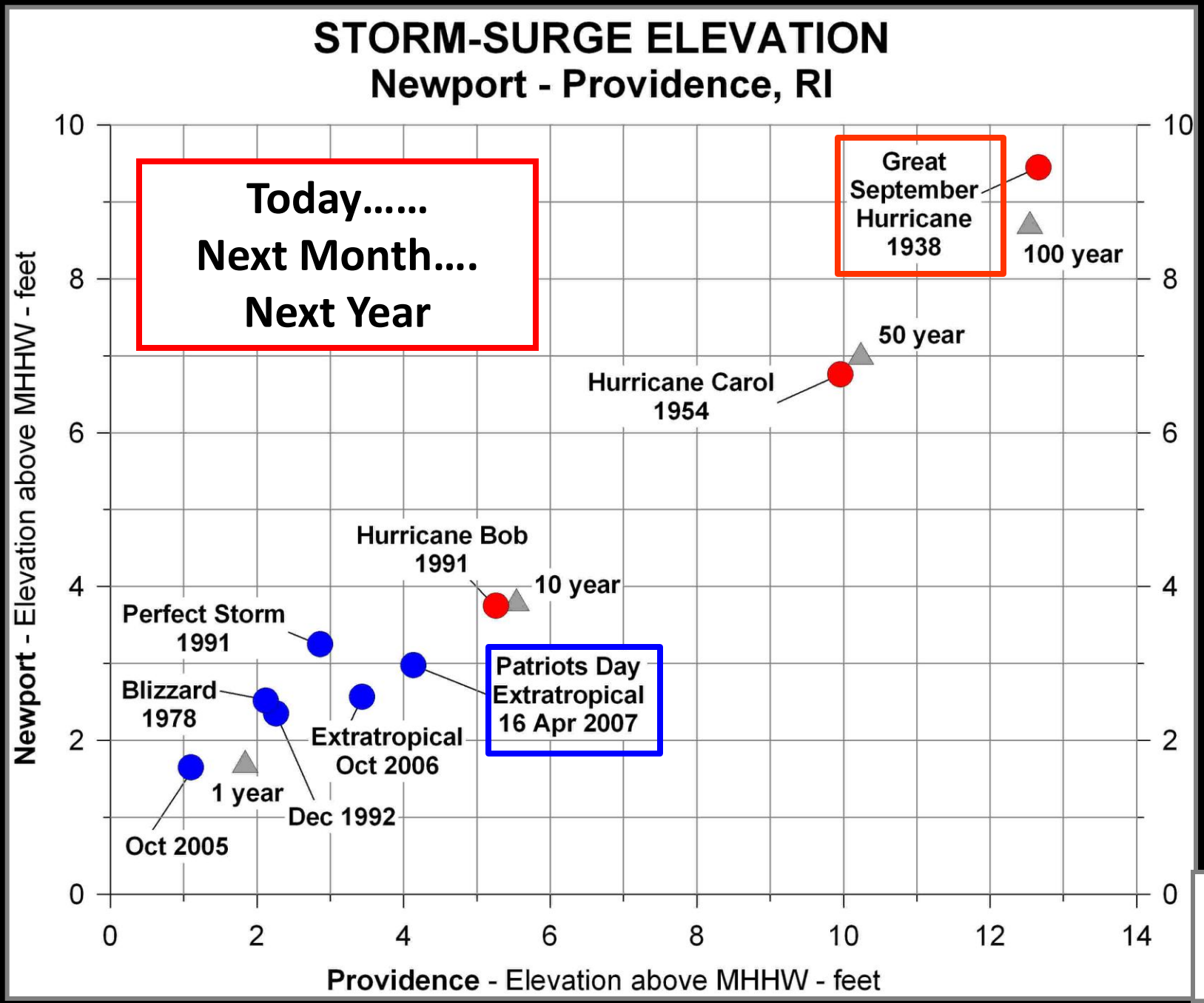
From Wright and Sullivan, 1982

Patriots Day Extratropical Storm – April 2007
Newport, RI Tide Gauge



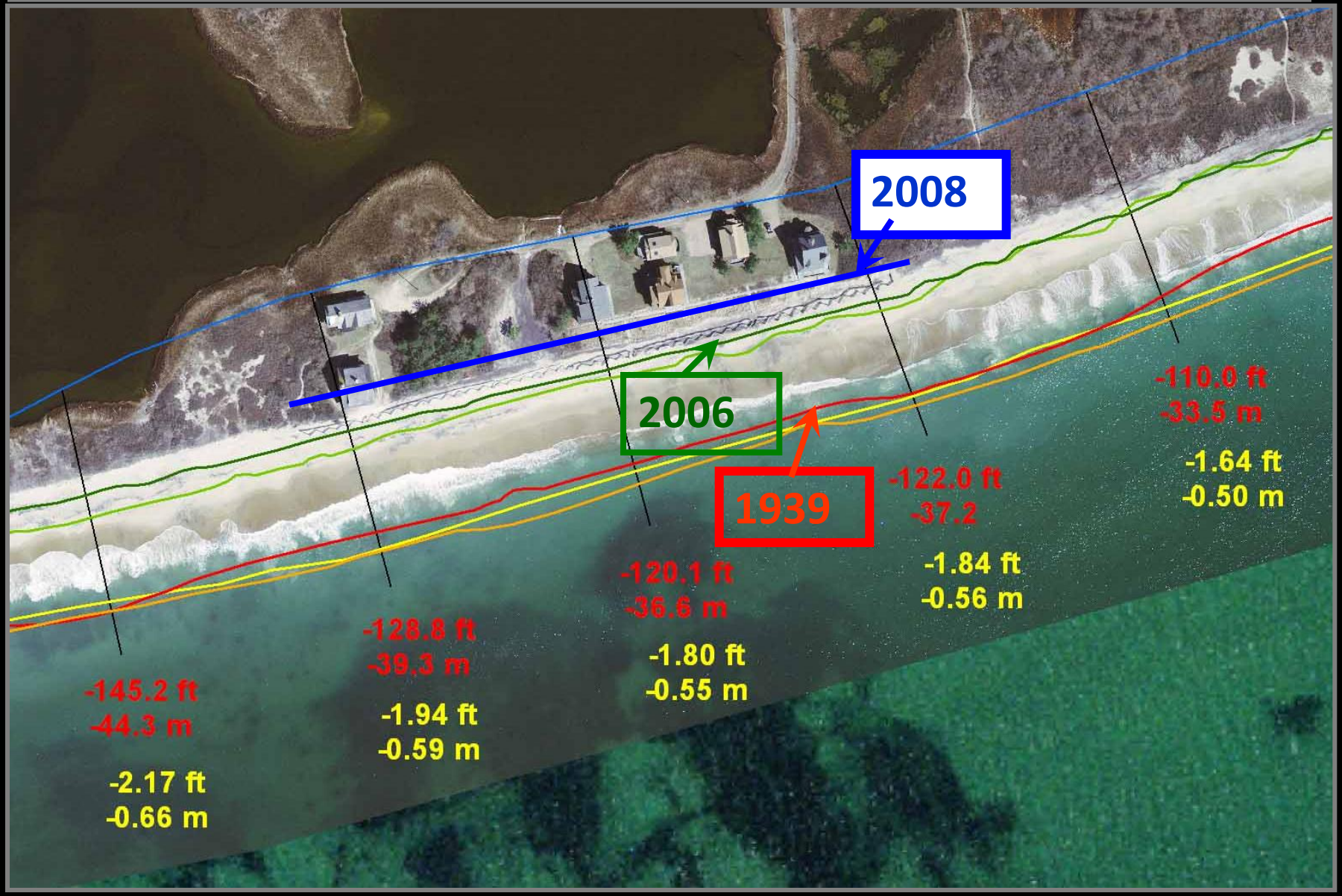
STORM SURGE

http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=8452660%20Newport,%20RI&type=Tide+Data



Adapted from NOAA; USACE 1988; Hehre 2007

Frontal Erosion 1939-2008 -
Browning Cottages, Moonstone Barrier, RI



Frontal Erosion - Browning Cottages, Moonstone Barrier, RI - 1972

CRMC Archives

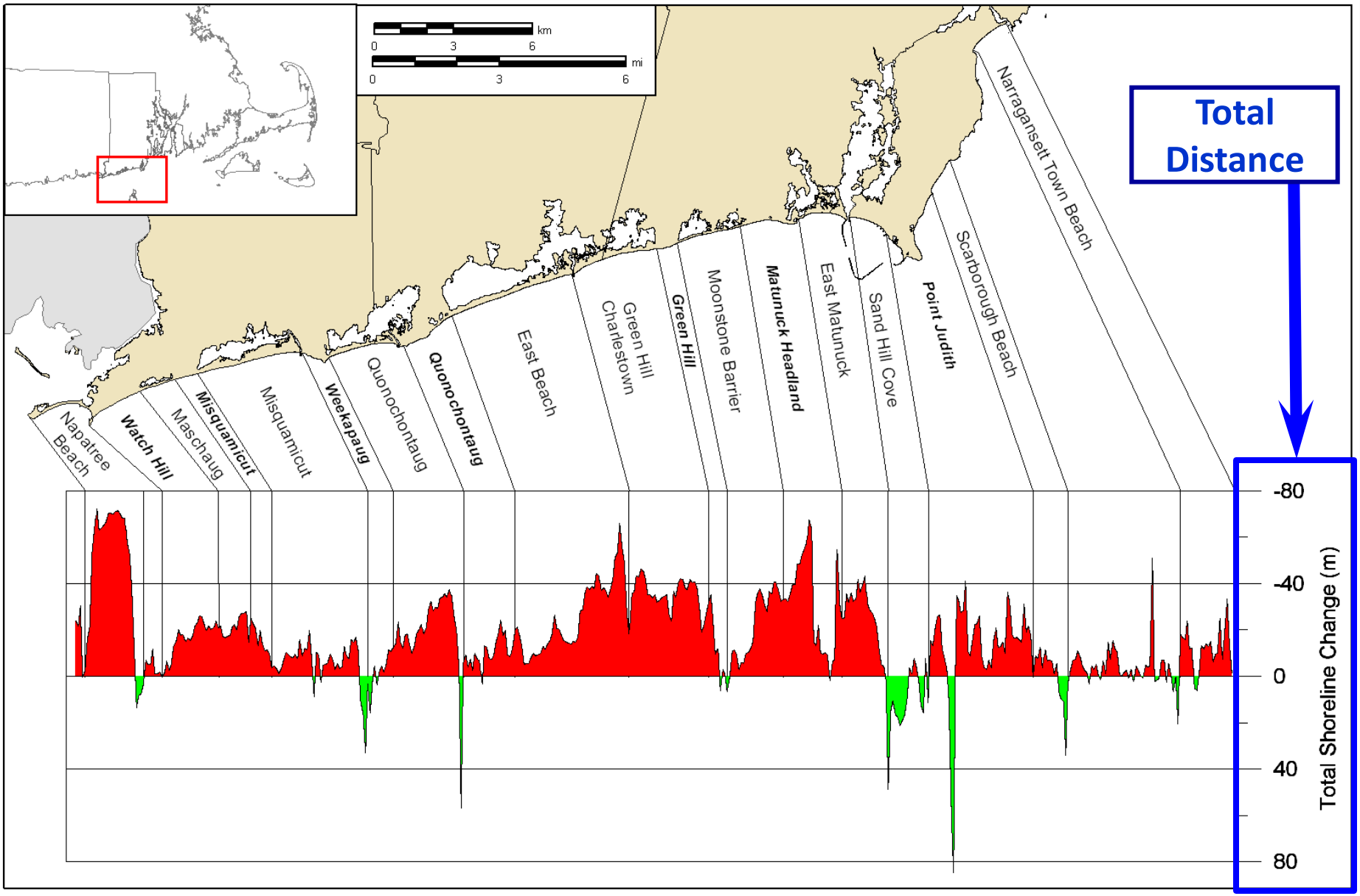
Frontal Erosion - Browning Cottages, Moonstone Barrier, RI – March 2002

Frontal Erosion - Browning Cottages, Moonstone Barrier, RI – Dec 2002

Frontal Erosion - Browning Cottages, Moonstone Barrier, RI - 2007

Frontal Erosion - Browning Cottages, Moonstone Barrier, RI - 2007

Total Shoreline Change – Southern RI 1939-2004

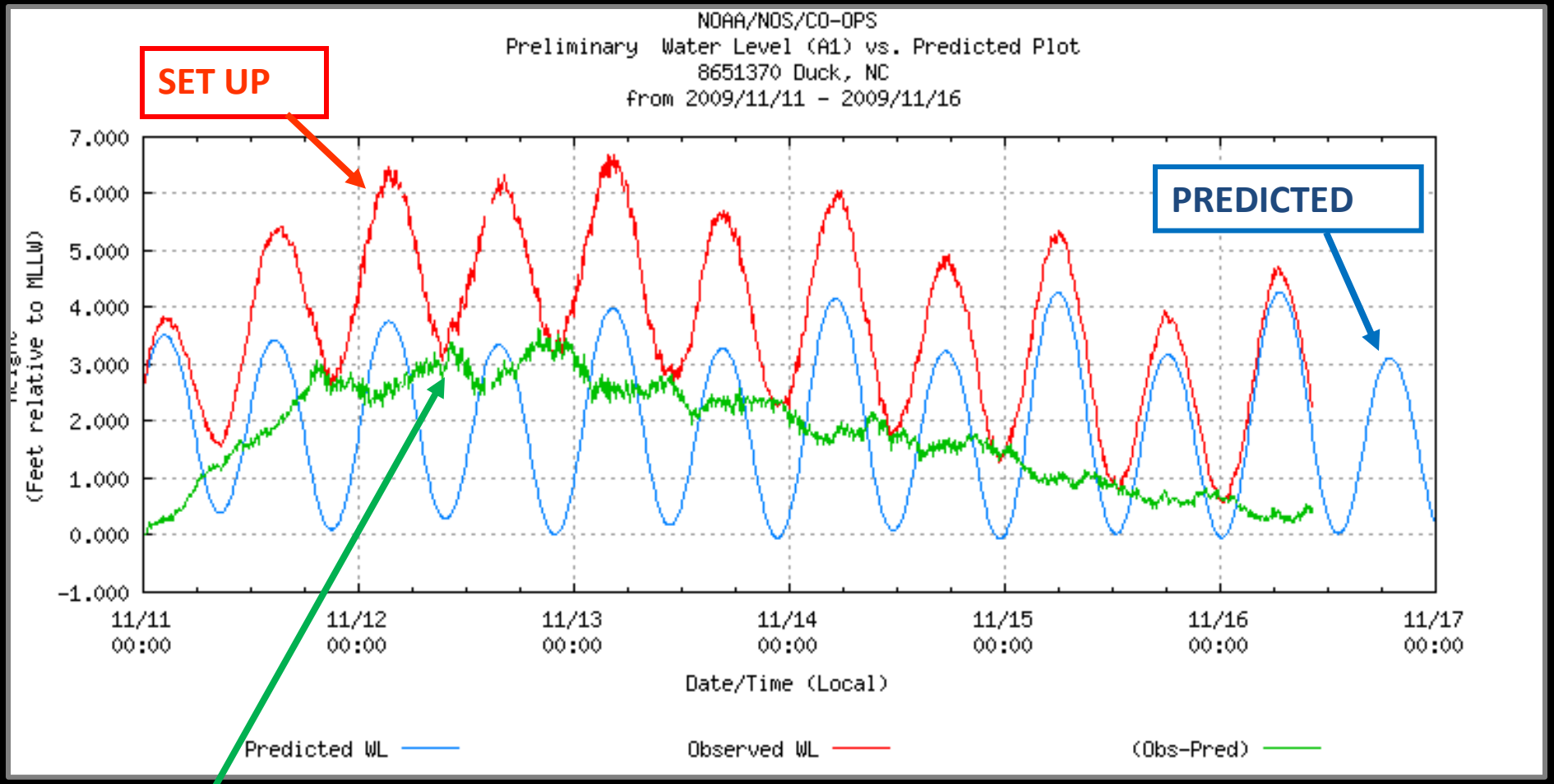


Charlestown Beach, RI – Overwash Processes

11 Dec 1992

Charlestown Barrier, RI – Hurricane Bob 1991
Washover Fans

November 2009 Extratropical Storm
Duck, NC Tide Gauge



http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=8651370%20Duck,%20NC&type=Tide+Data

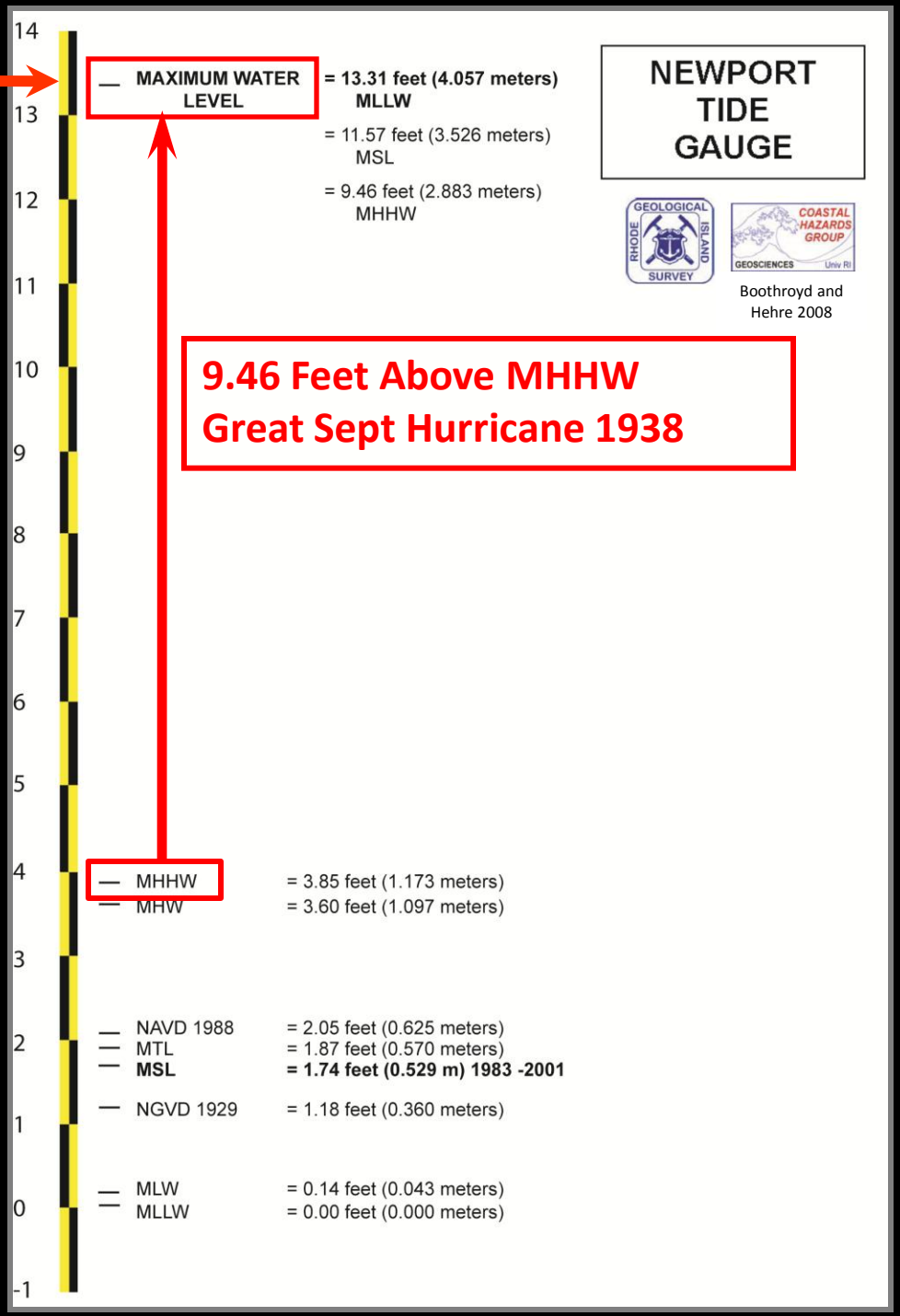
Kitty Hawk, NC – Overwash - Nov 2009

South Nags Head, NC – Overwash - Nov 2009

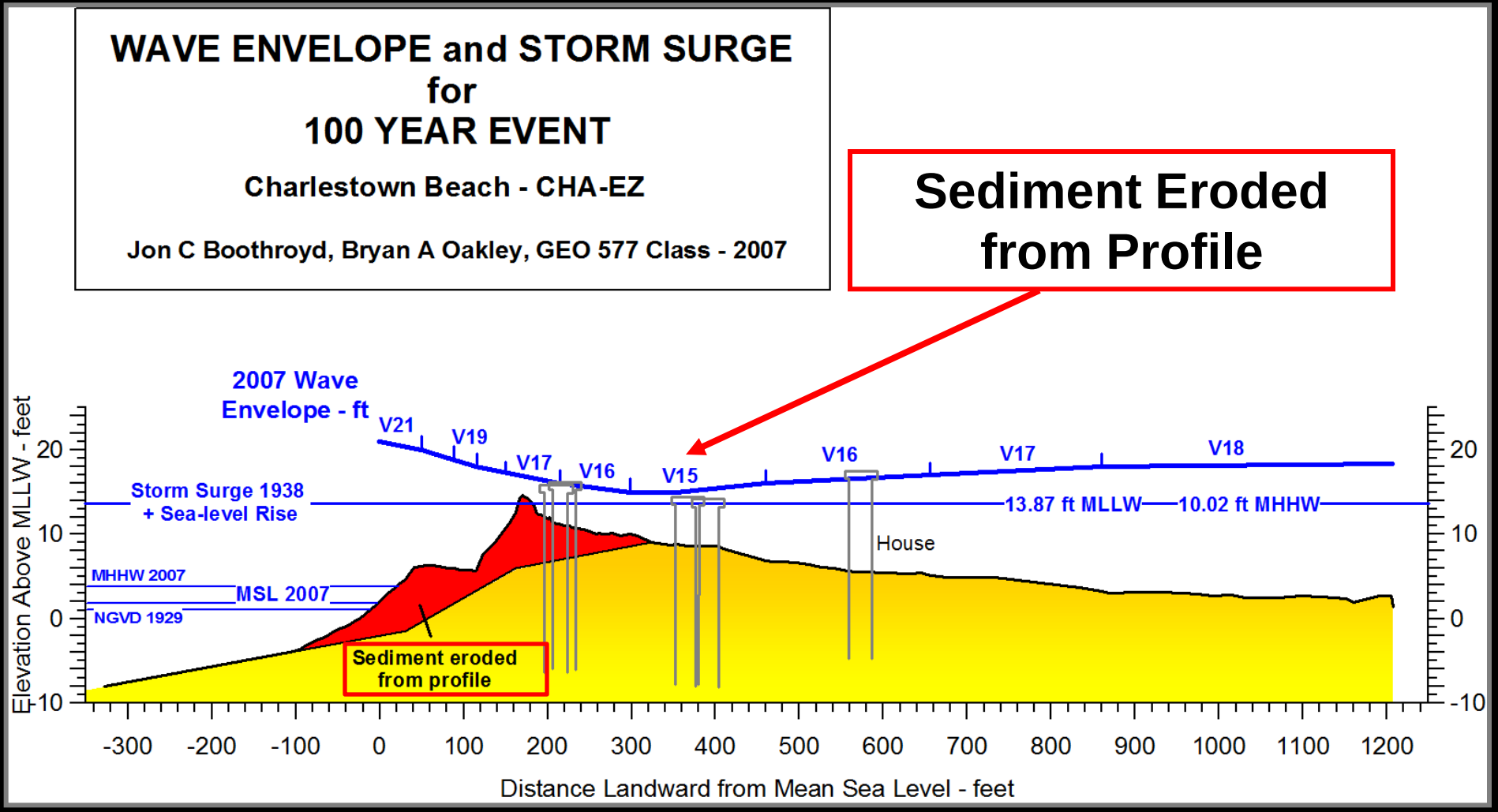
The Problem of Built Infrastructure

How High will the Water Be?

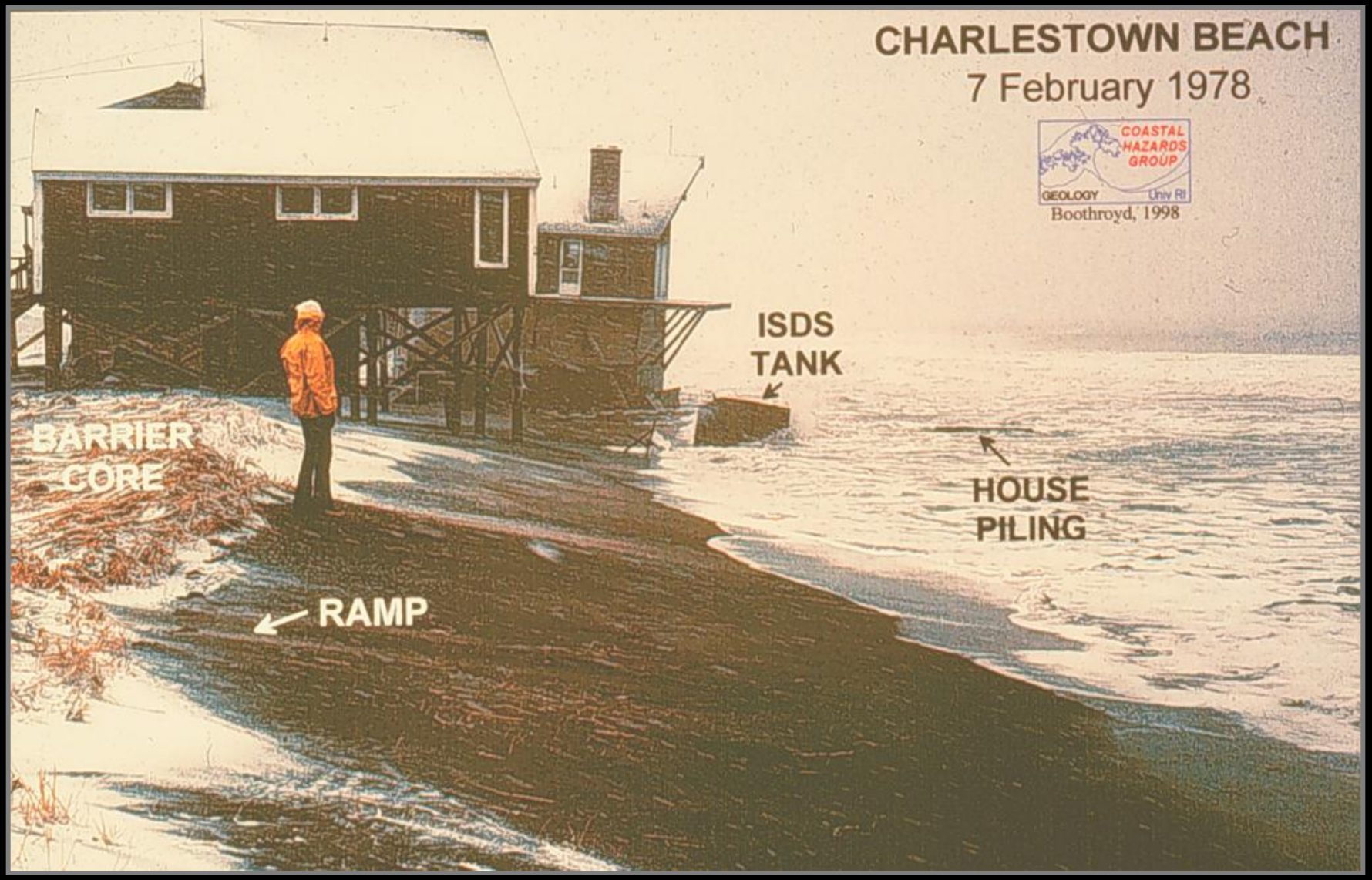
Tidal Heights Newport, RI



Erosion Configuration – Charlestown Barrier, RI



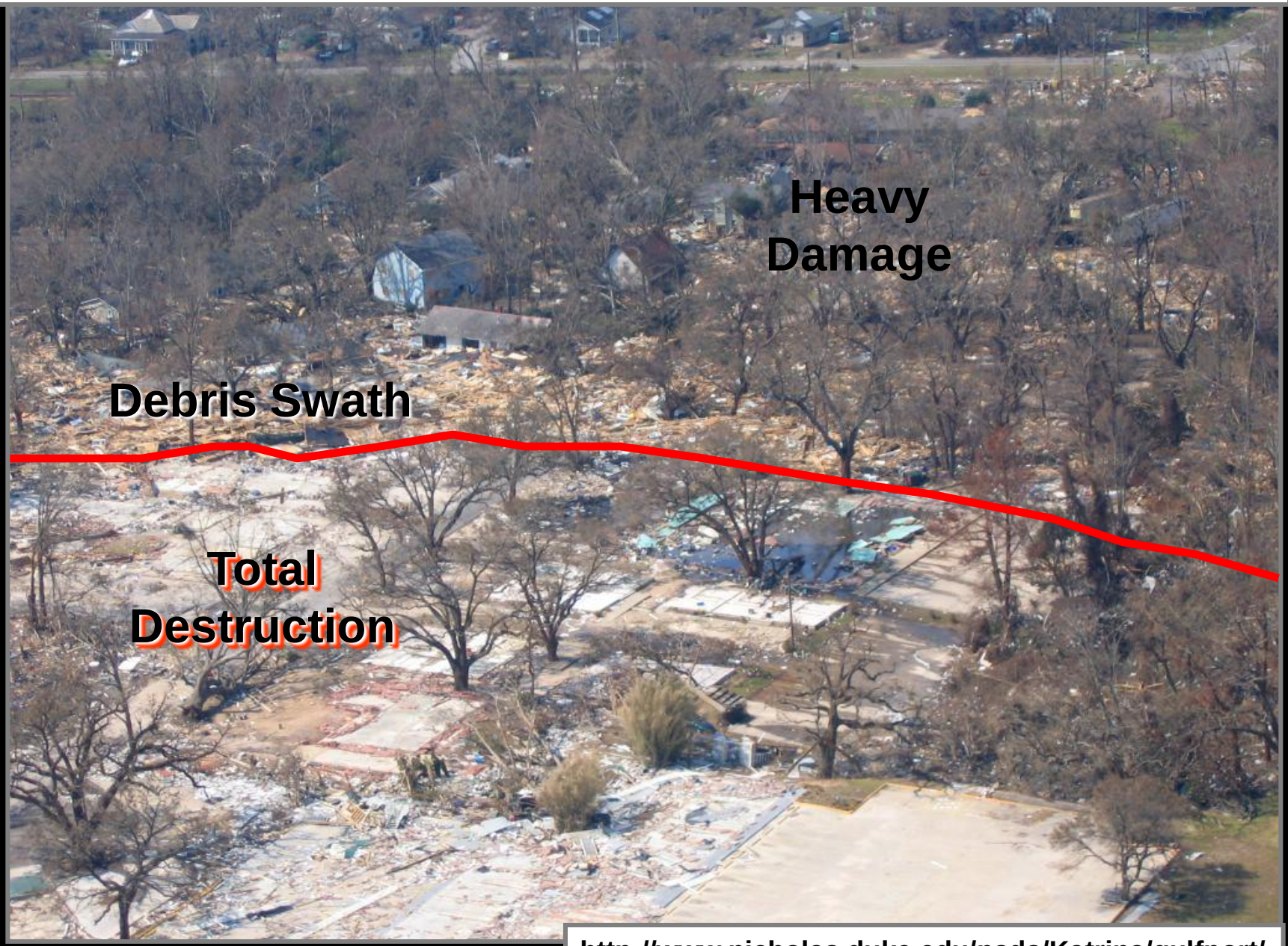
Charlestown Beach, RI – Blizzard 1978 – Erosion Configuration – No Berm



Charlestown Barrier, RI – 100 Year Storm Surge

RE Hehre

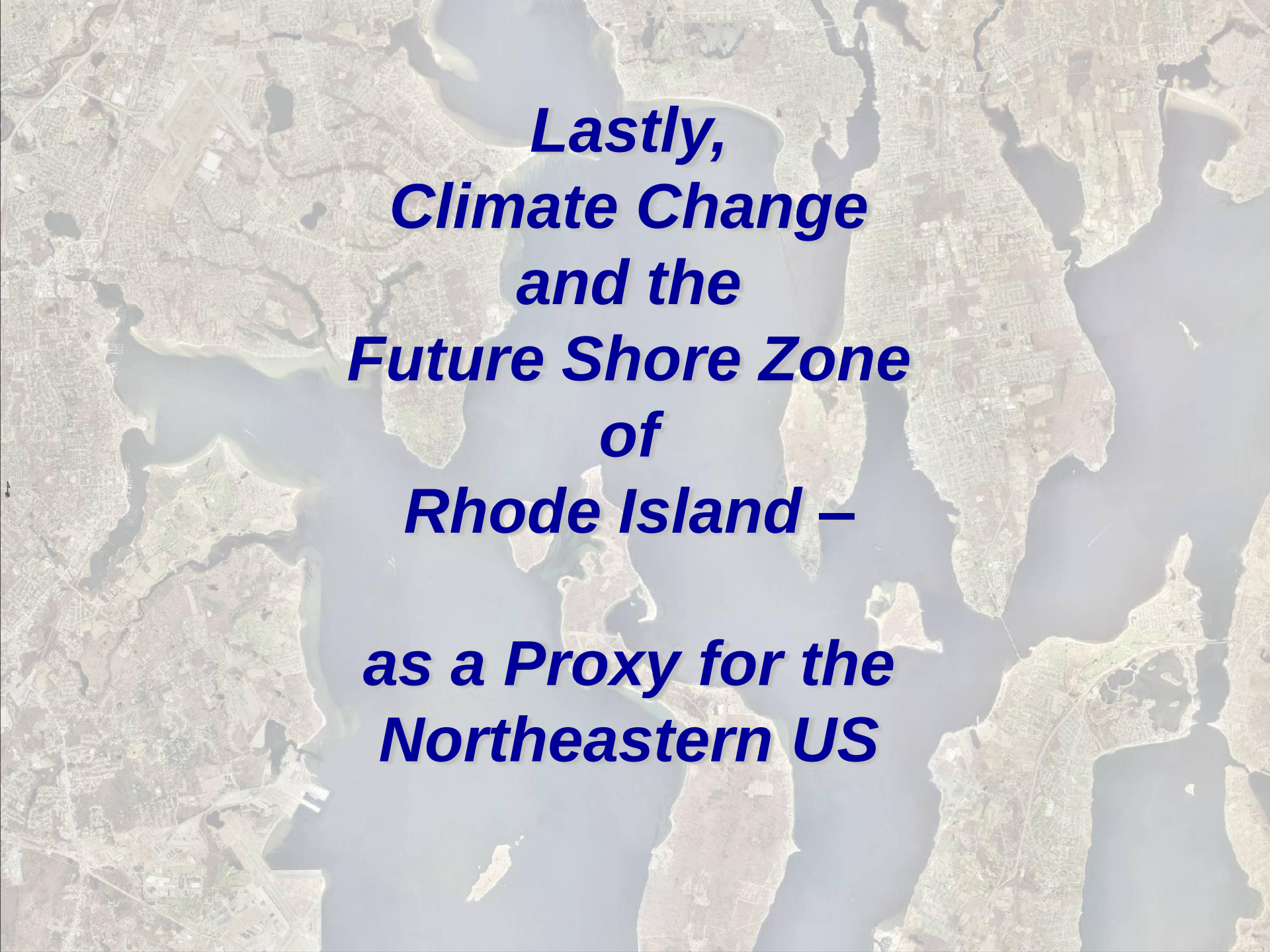
Gulfport, MS – Katrina - 2 Sept 2005 – Debris Swaths



http://www.nicholas.duke.edu/psds/Katrina/gulfport/

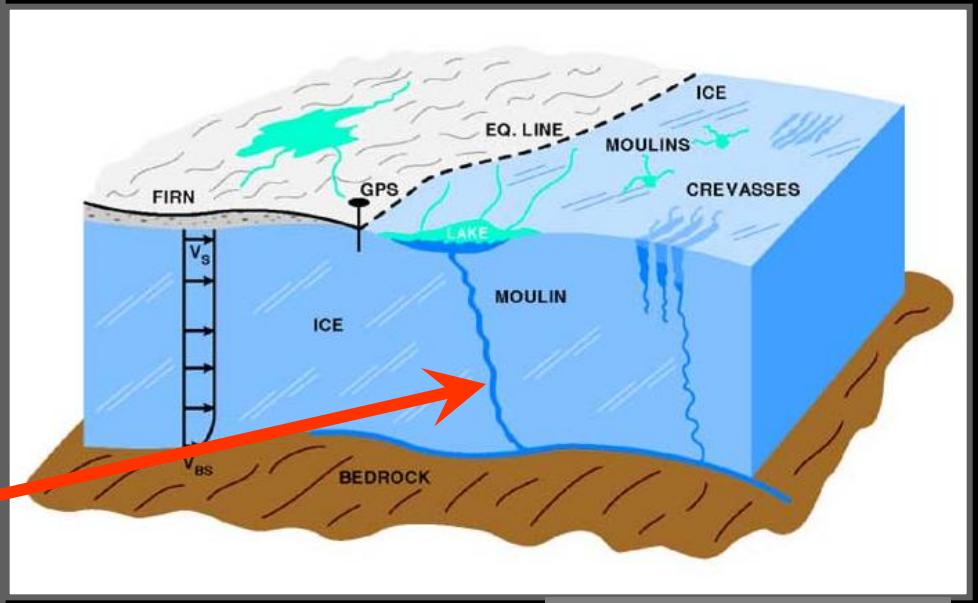
Misquamicut Barrier – Westerly, RI
Upland Debris Swath – Great Sept Hurricane 1938

Increased Storm Frequency and Intensity??


Lastly,
Climate Change
and the
Future Shore Zone
of
Rhode Island –
as a Proxy for the
Northeastern US

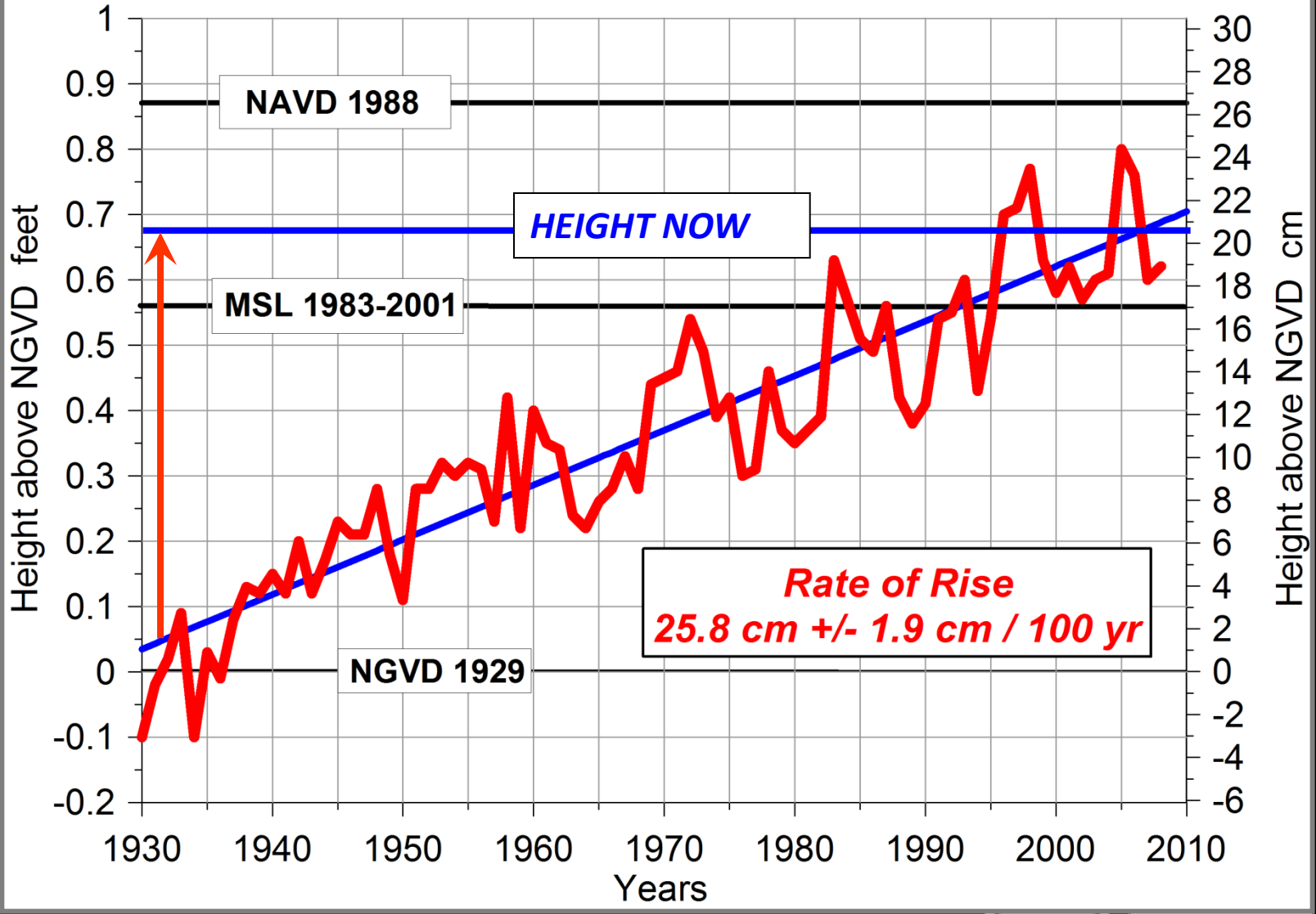
Greenland Outlet Glaciers - Change from Polythermal to Warm Based

A Key to Future Sea-Level Rise



Brathwaite, 2002

HISTORIC SEA-LEVEL RISE - Newport, RI

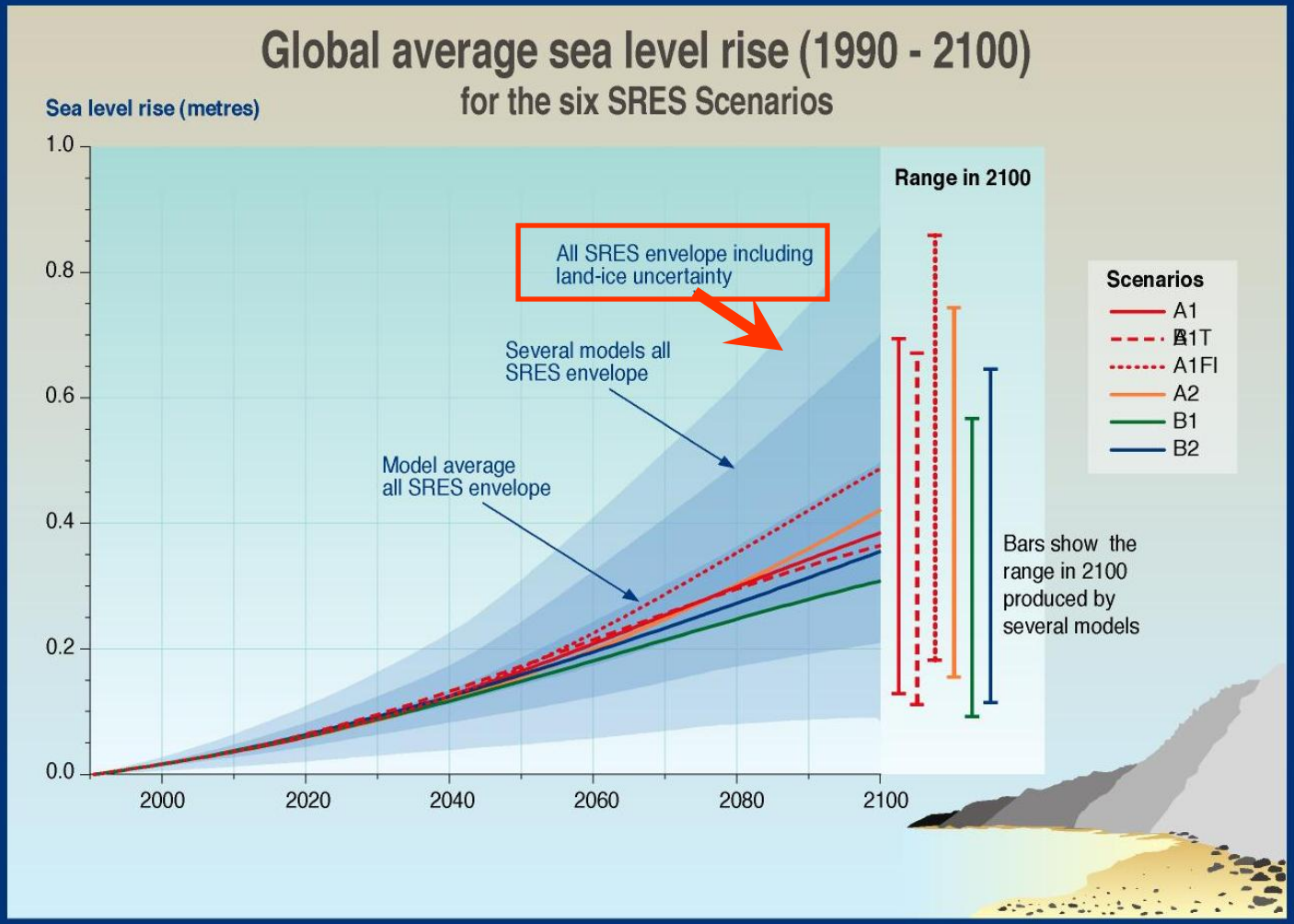


Adapted from: http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=8452660%20Newport,%20RI

GEOLOGICAL SURVEY RHODE ISLAND

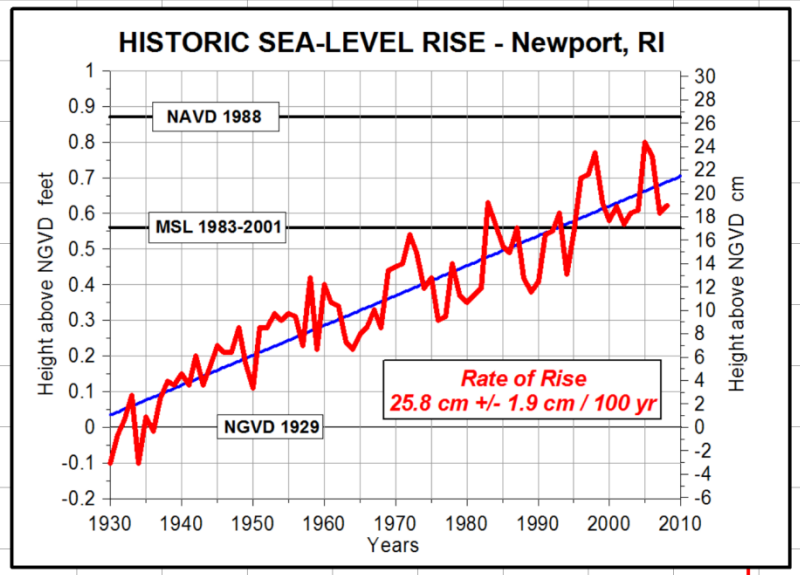
COASTAL HAZARDS GROUP GEOSCIENCES Univ RI

IPCC Scenarios 2001



WG1 TS FIGURE 24

ACCELERATED SEA-LEVEL RISE - Newport, RI



GEOLOGICAL SURVEY RHODE ISLAND

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Boothroyd 2008

IPCC 2001
Land Ice

IPCC 2001
Model Avg

HEIGHT NOW

HISTORIC TREND

MSL 1983-2001

NGVD 1929

2008

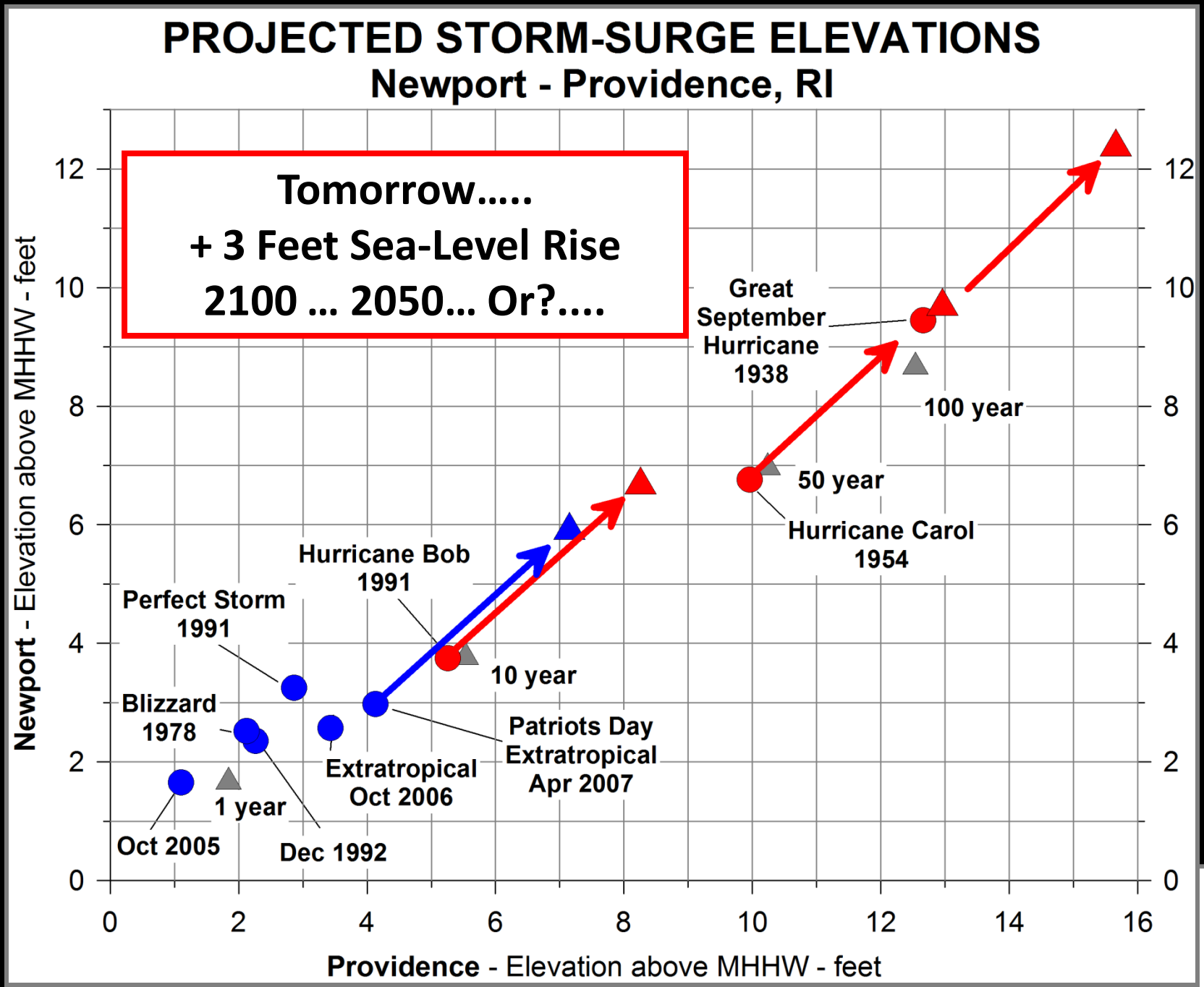
Height above NGVD feet

Height above NGVD cm

Years

PROJECTED STORM-SURGE ELEVATIONS

Newport - Providence, RI



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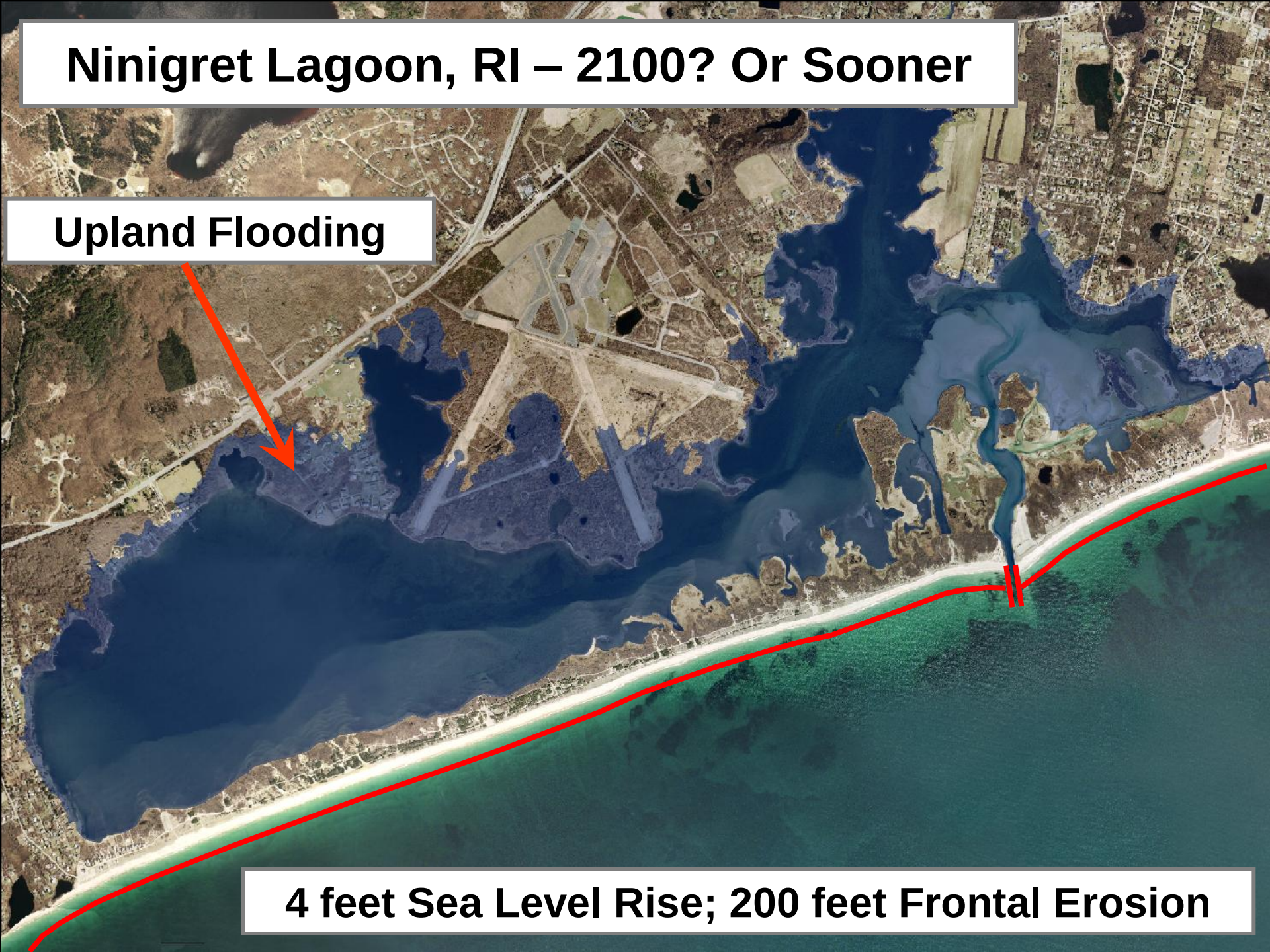
Ninigret Lagoon, RI - 2004


Ninigret Lagoon, RI – 2100? Or Sooner
Upland Flooding
4 feet Sea Level Rise; 200 feet Frontal Erosion

Pettaquamscutt Coastal Lagoon, RI: A Common View of the Future

End of Presentation