COASTAL GEOLOGIC HAZARDS and CLIMATE CHANGE

Global Warming's Impact on Narragansett Bay

United States Senate Committee on Environment and Public Works Field Briefing

21 August 2008

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The Sea May Be Rising - But

When Contemplating Rhode Island Coastal Geologic Hazards

One Must Consider:

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

When Contemplating Rhode Island Coastal Geologic Hazards

Which Give Rise to these Processes:

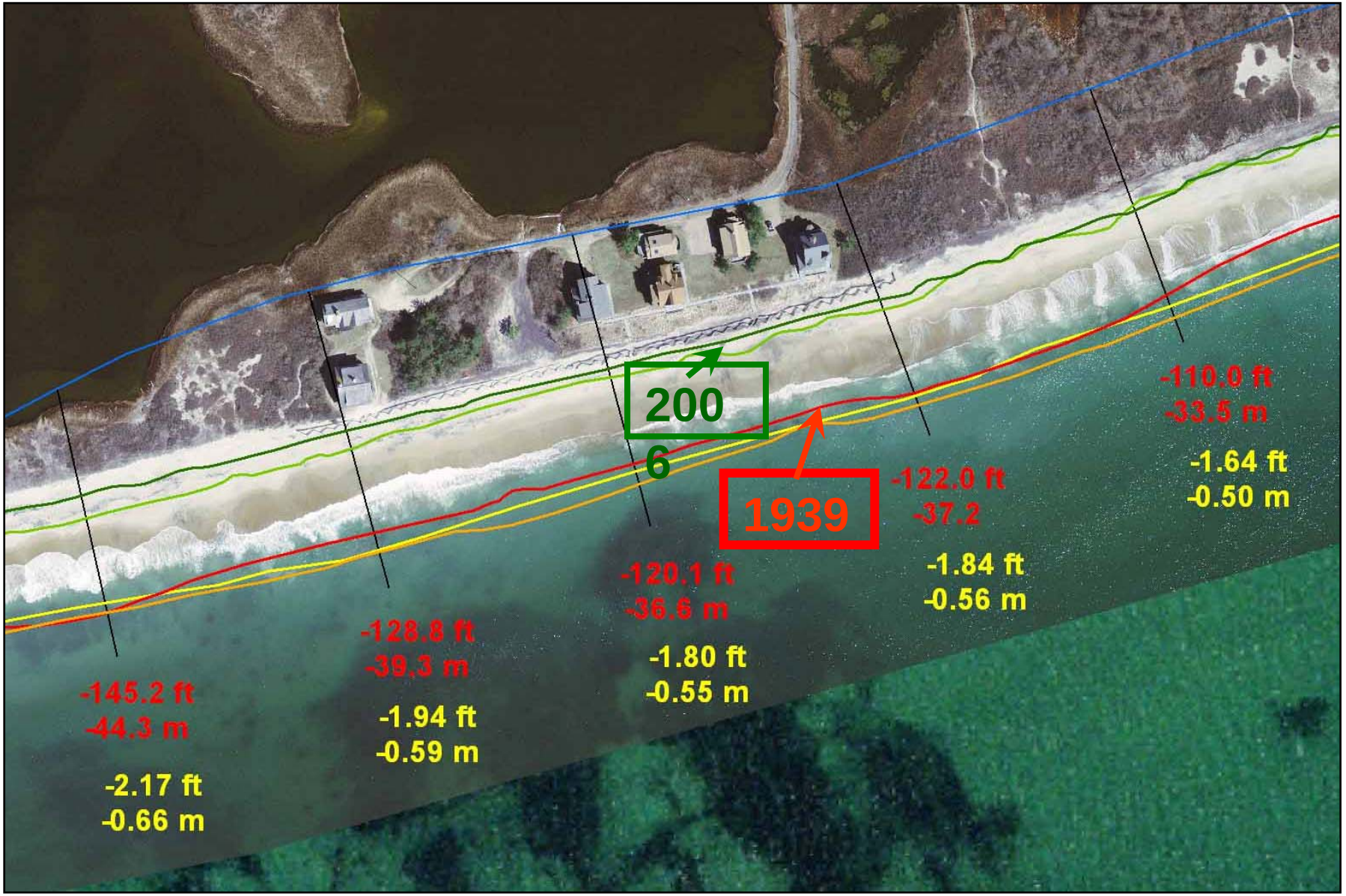
- **Frontal Erosion – from Breaking Waves and Swash**
- **Storm-Surge Overwash**
- **Elevated MHHW into the Future**

When Contemplating Rhode Island Coastal Geologic Hazards

The Scale of Processes are:

- **Breaking Waves – 3 to 10 feet at shoreline**
- **Storm-Surge Overwash – 1 to 10 feet water depth across shore zone**
- **Sea-Level Rise – 0.13 inches per year at present**

Frontal Erosion 1939-2006 - Browning Cottages

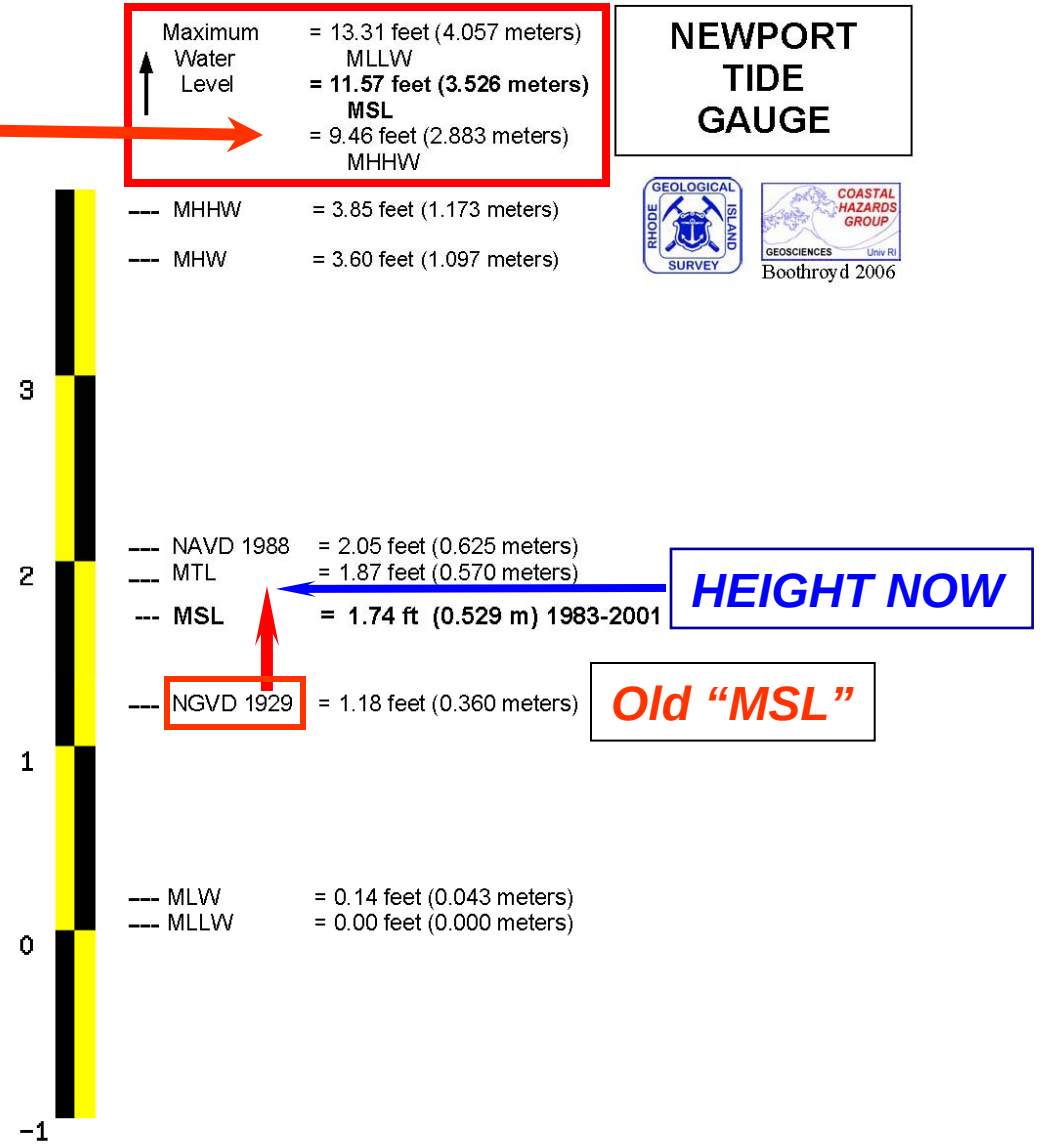


Frontal Erosion - Browning Cottages

BA Oakley

How High will the Water Be?

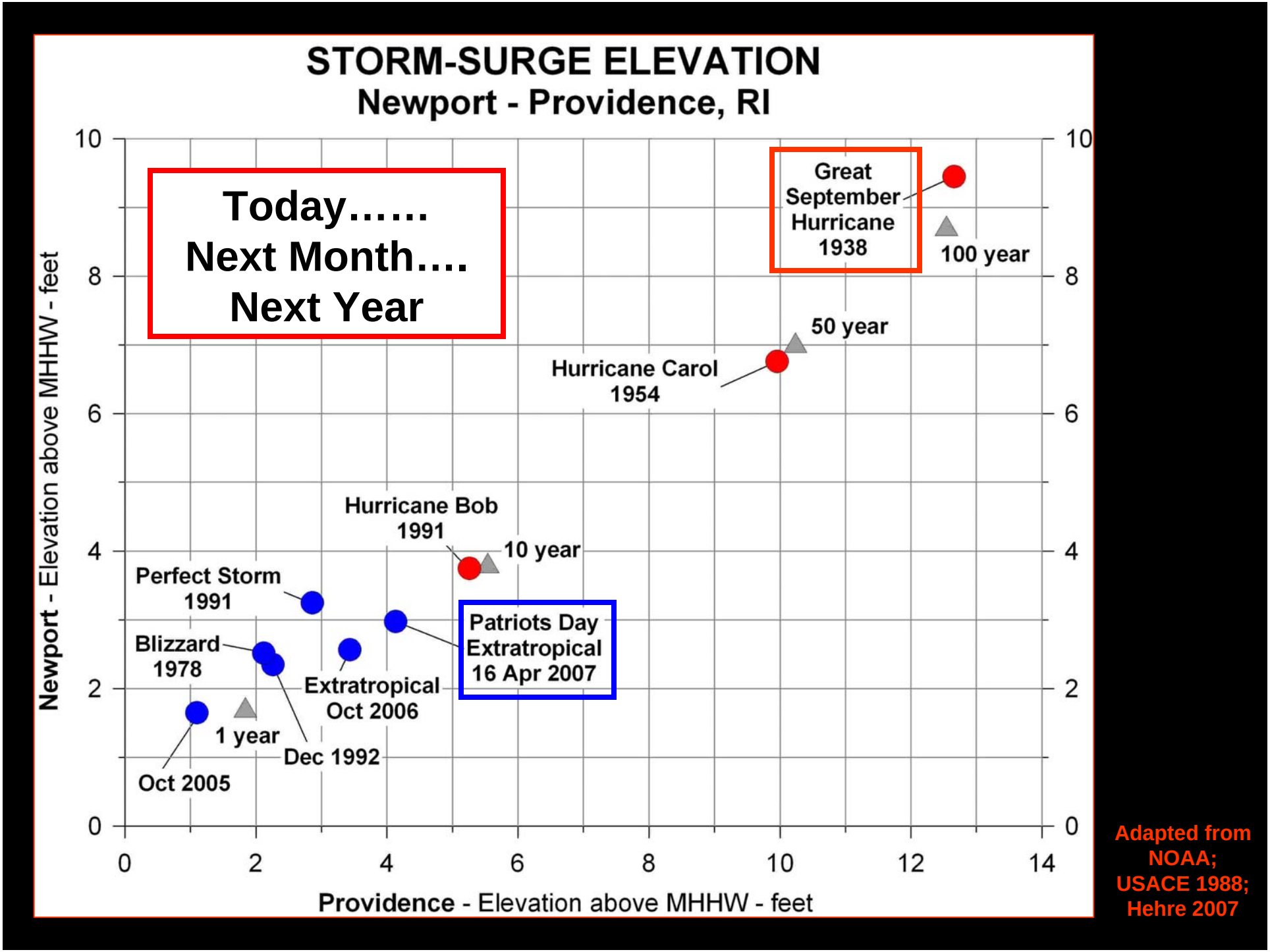
Tidal Datums Newport



The NAVD 1988 and NGVD 1929 elevations related to MLLW were computed from Bench Mark, 845 2660 TIDAL 6, at the station.

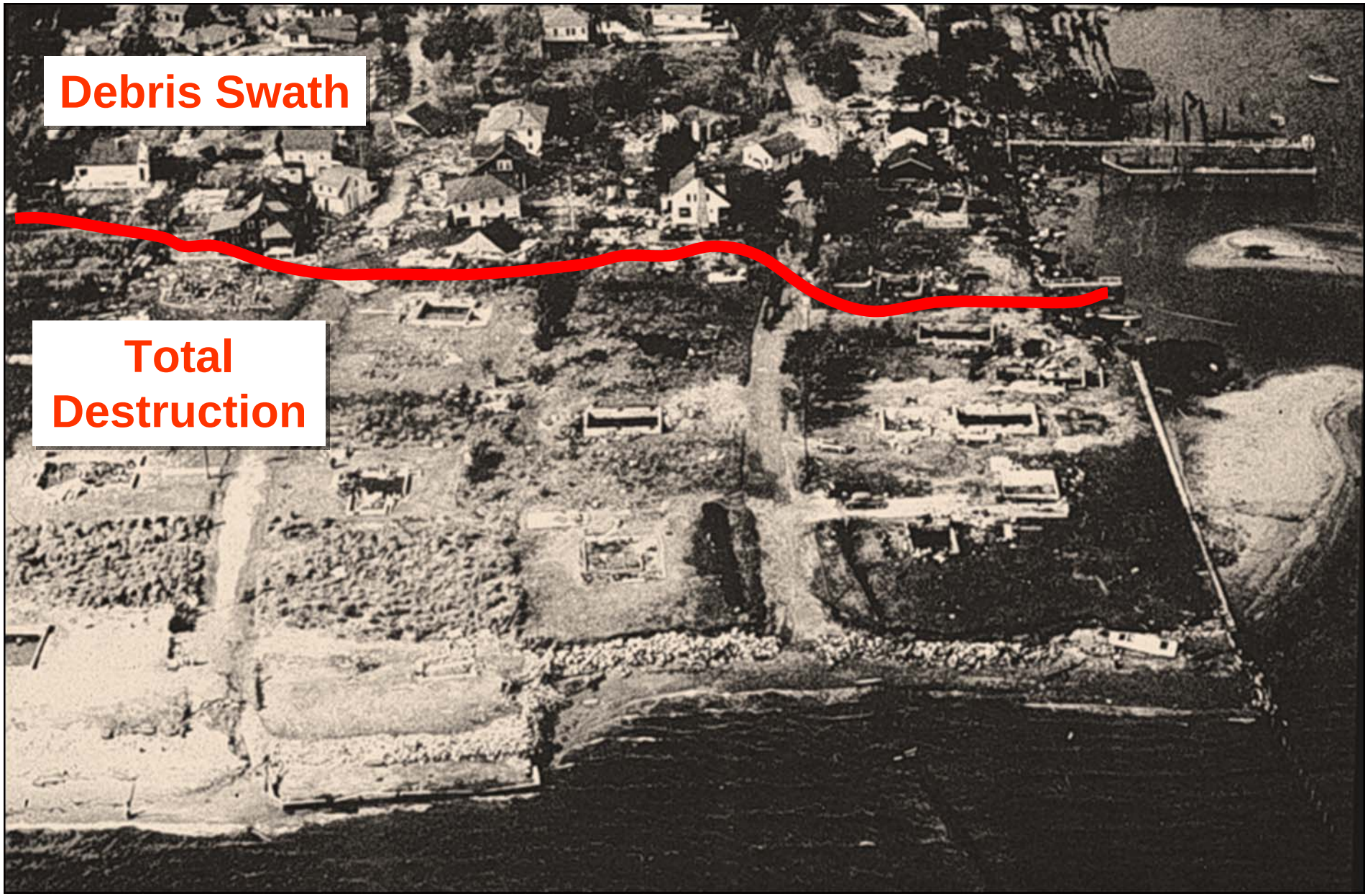
Displayed tidal datums are MEAN HIGHER HIGH WATER (MHHW), MEAN HIGH WATER (MHW), MEAN TIDE LEVEL (MTL), MEAN LOW WATER (MLW), AND MEAN LOWER LOW WATER (MLLW) referenced on 1983-2001 Epoch.

Adapted from: www.ngs.noaa.gov/newsys-cgi-bin/ngs_opsd.prl?PID=LW0493&EPOCH=1983-2001



Adapted from NOAA; USACE 1988; Hehre 2007

Oakland Beach – Warwick - 1954

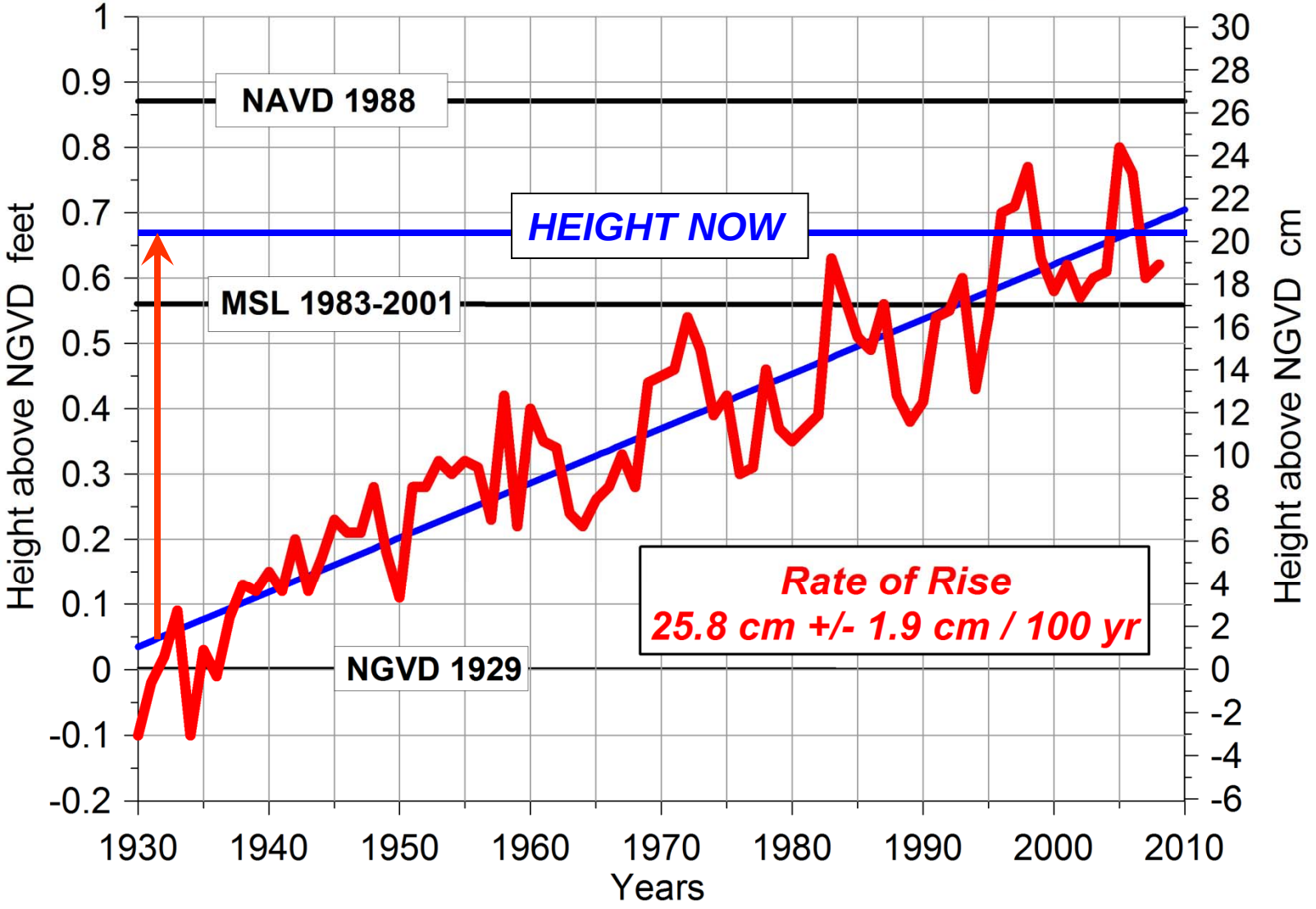


Providence Journal 1954

Misquamicut – US 1A – Westerly
Debris Swath

Increased Storm Frequency and Intensity??

HISTORIC SEA-LEVEL RISE - Newport, RI



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

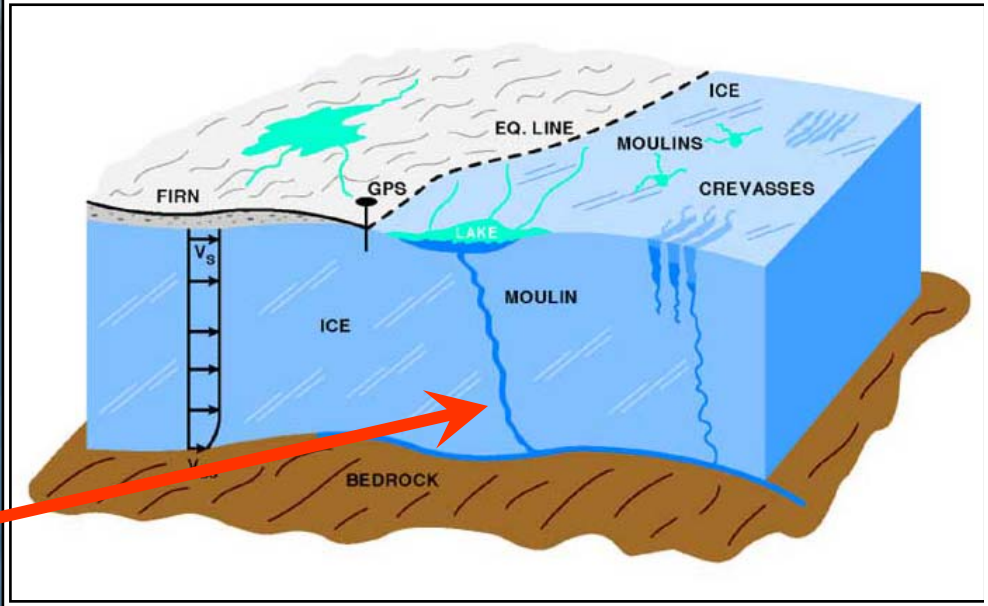
GEOLOGICAL RHODE ISLAND SURVEY

COASTAL HAZARDS GROUP GEOSCIENCES Univ RI

Boothroyd 2008

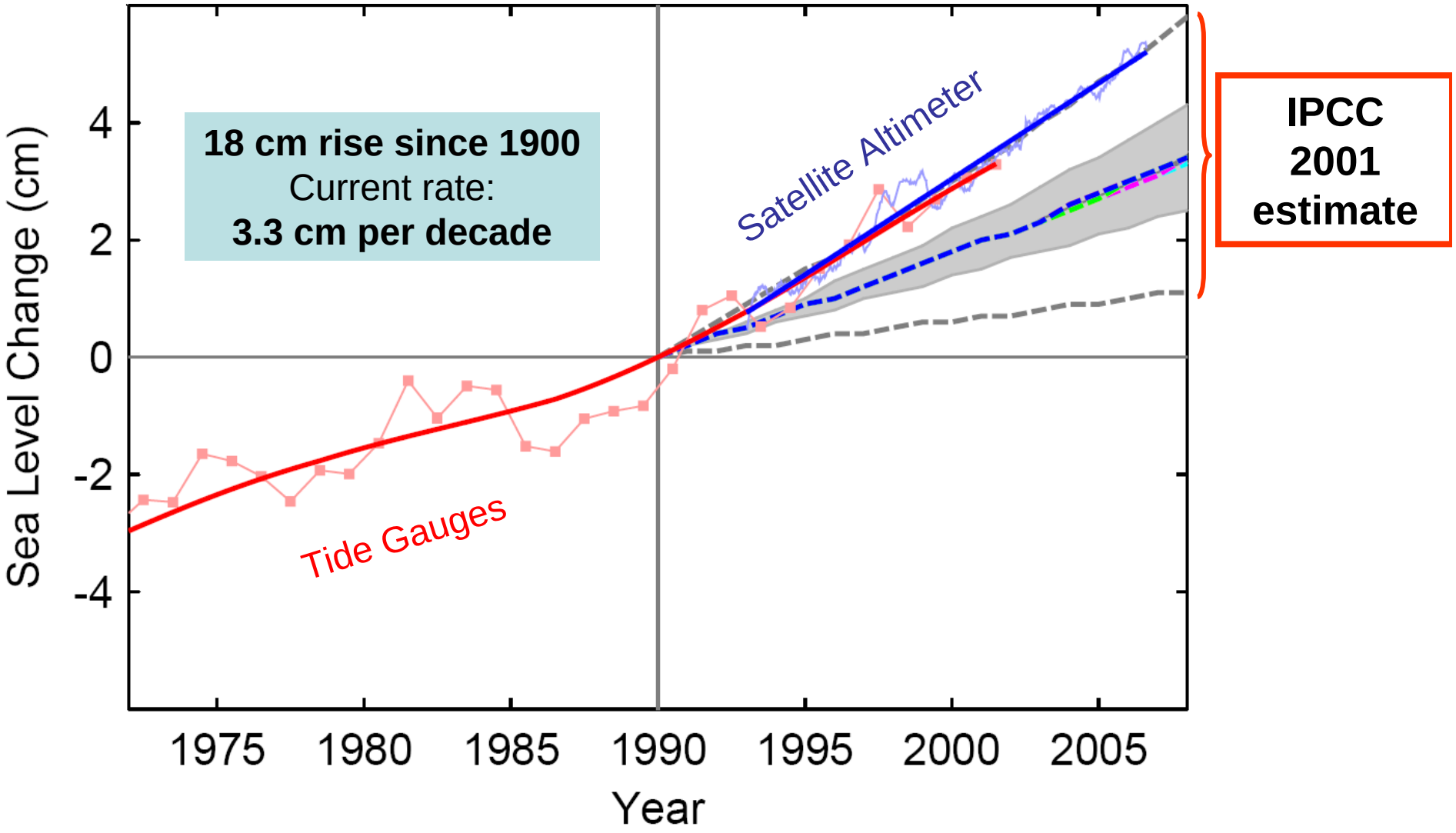
Greenland
Outlet Glaciers
Change to Polythermal

A Key to Future
Sea-Level Rise



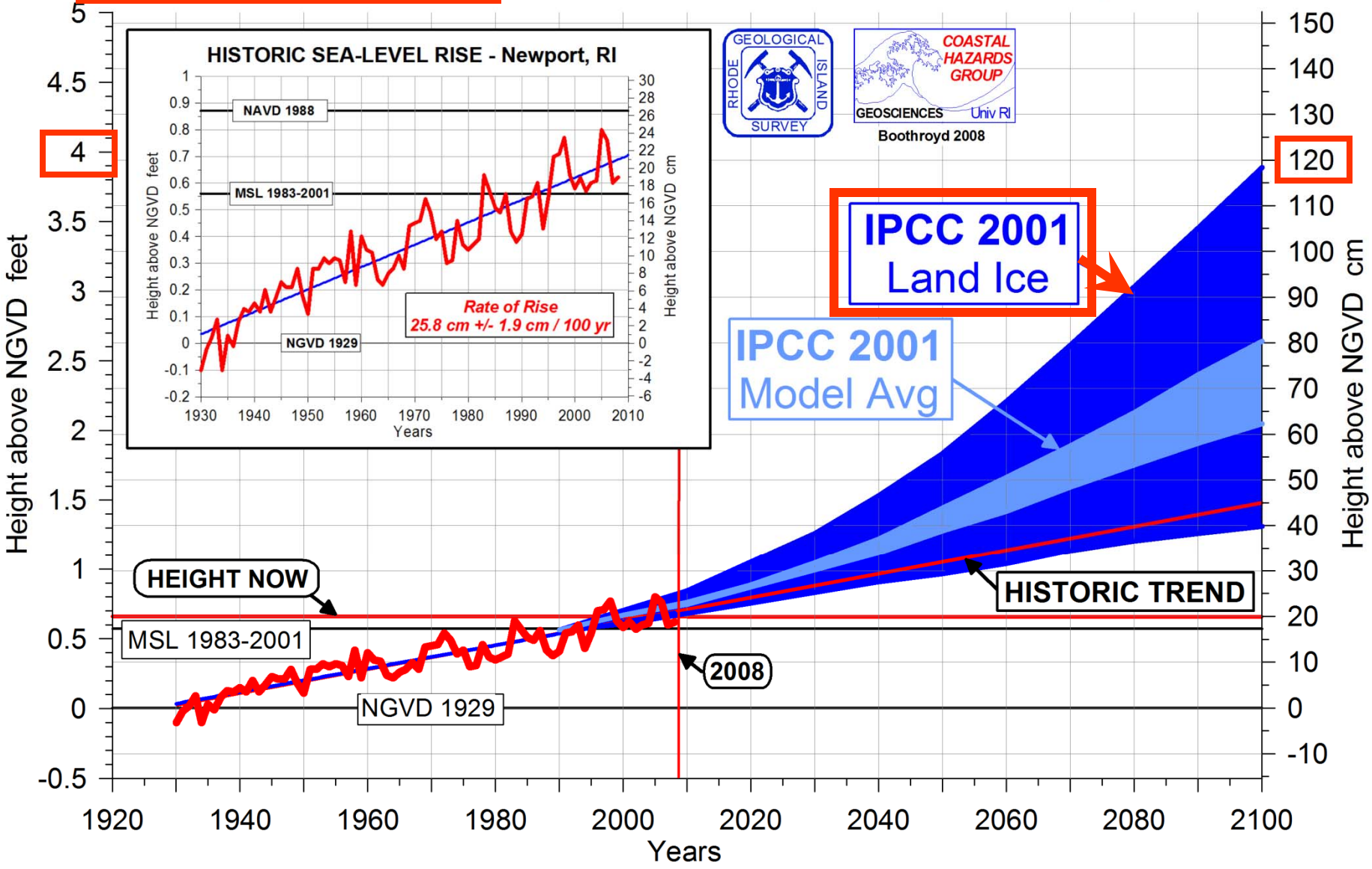
Brathwaite, 2002

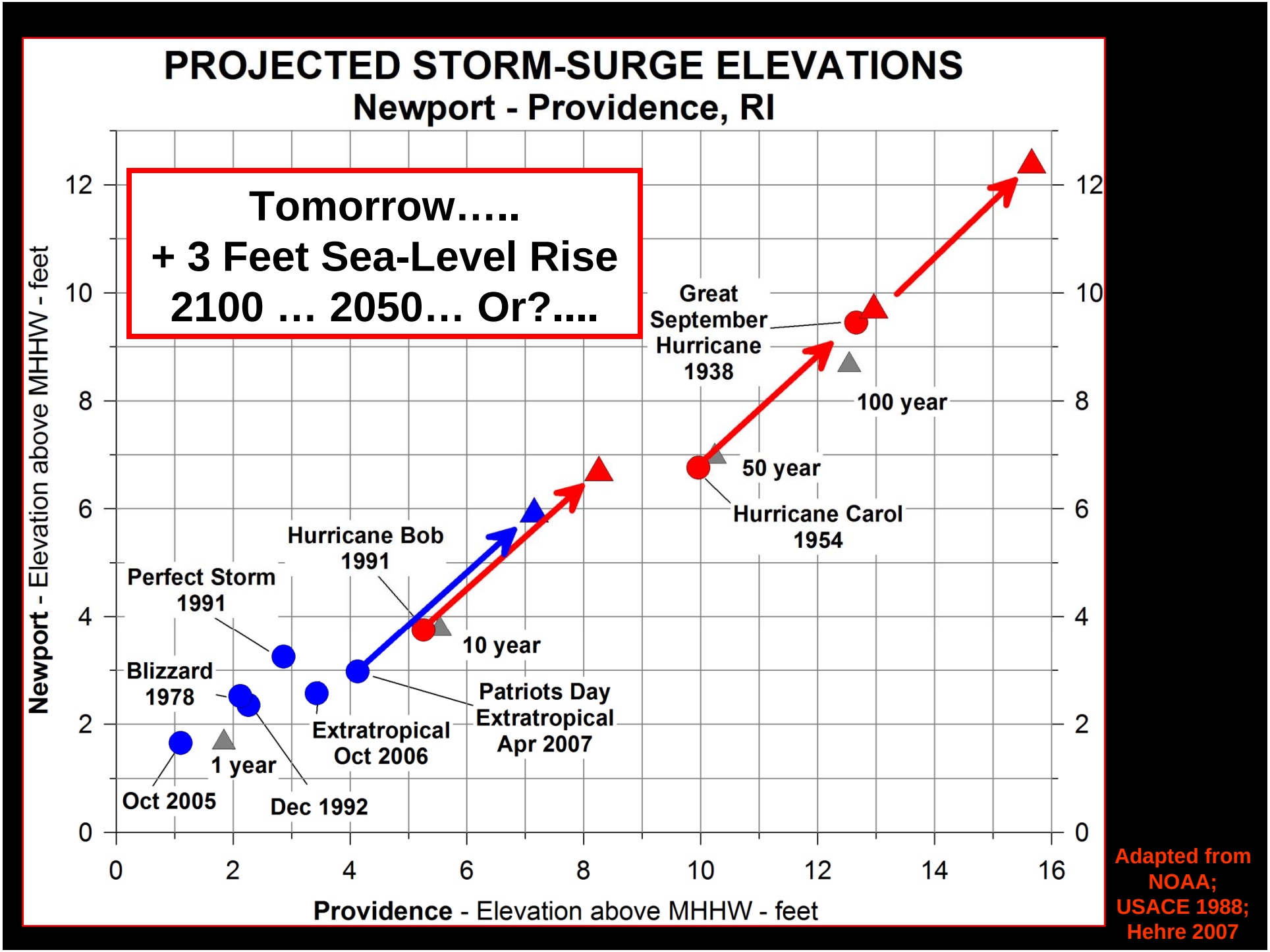
Observed Global Sea Level Rise ... Accelerating



Rahmstorf, Cazenave, Church, Hansen, Keeling, Parker and Somerville (Science 2007)

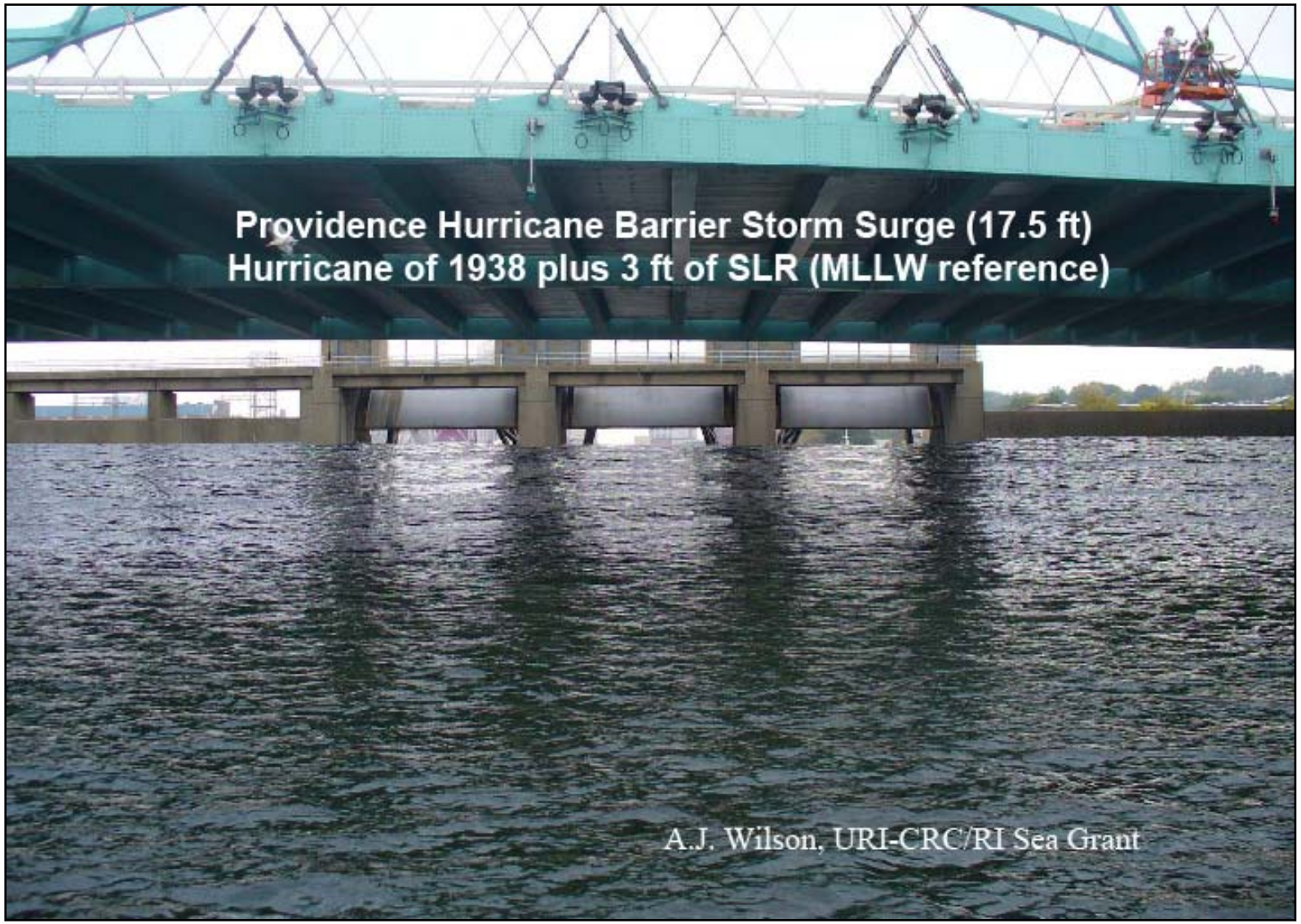
ACCELERATED SEA-LEVEL RISE - Newport, RI




PROJECTED STORM-SURGE ELEVATIONS
Newport - Providence, RI
Tomorrow…..
+ 3 Feet Sea-Level Rise
2100 … 2050… Or?....
Great September Hurricane 1938
100 year
50 year
Hurricane Carol 1954
Hurricane Bob 1991
Perfect Storm 1991
10 year
Blizzard 1978
Patriots Day Extratropical Apr 2007
Extratropical Oct 2006
1 year
Oct 2005
Dec 1992
Newport - Elevation above MHHW - feet
Providence - Elevation above MHHW - feet
0
2
4
6
8
10
12
14
16
Adapted from NOAA; USACE 1988; Hehre 2007

100-Year Storm-Surge Inundation - Providence

+ 3 Feet Sea-Level Rise

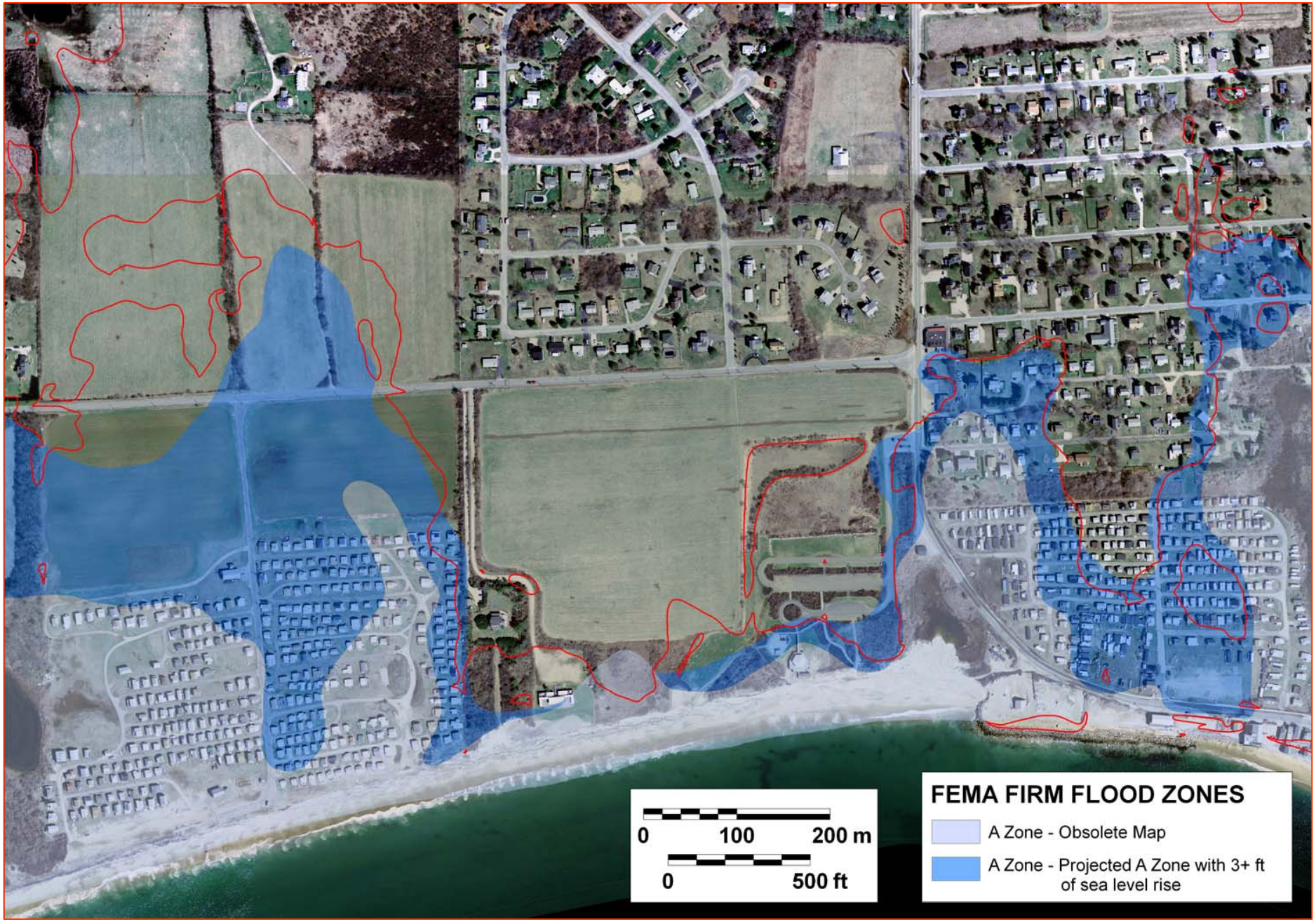


M Spaulding, AJ Wilson 2007

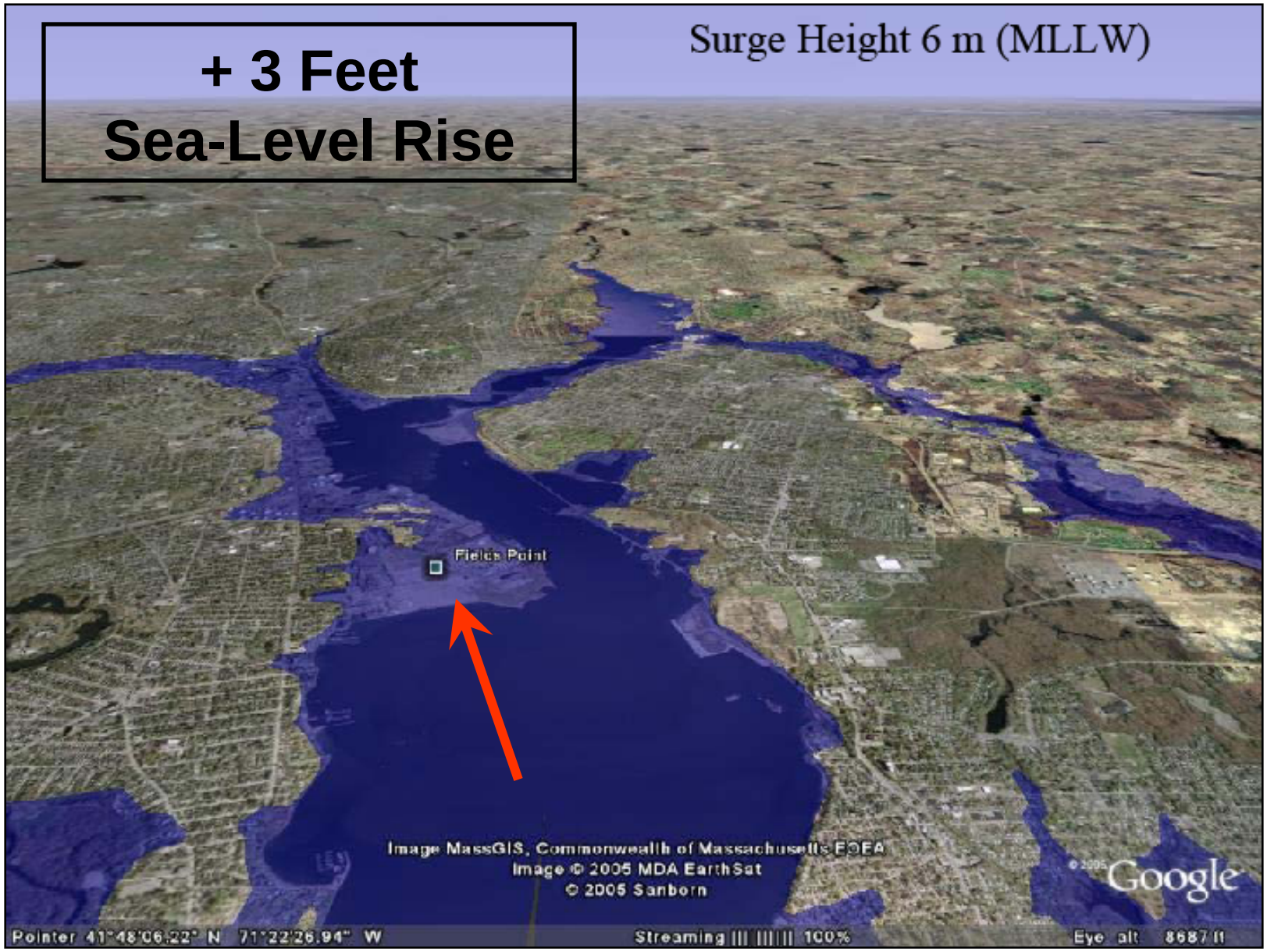
Middlebridge, South Kingstown – A Common View of the Future

End of Presentation

100-Year Storm-Surge Inundation - Matunuck

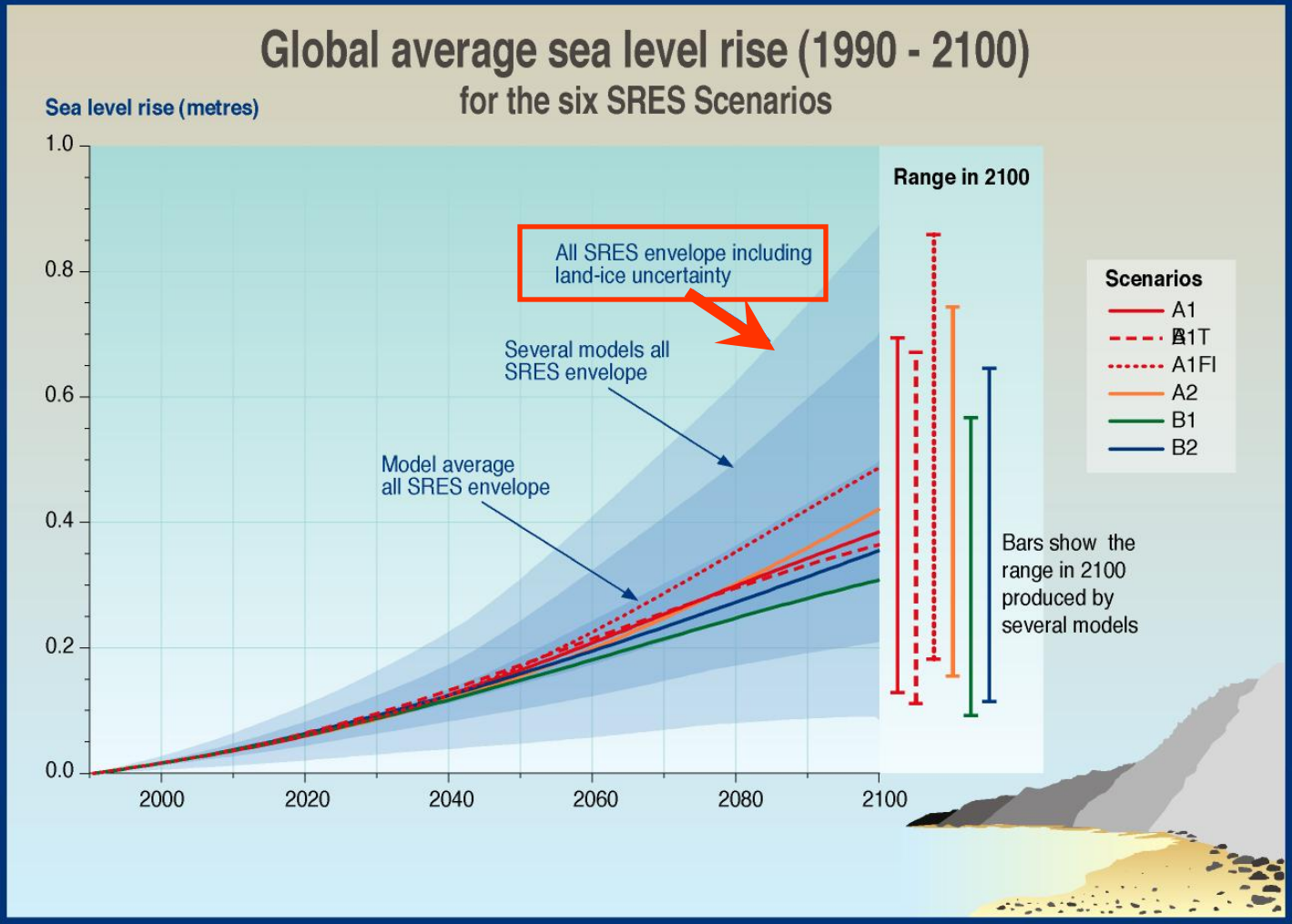


100-Year Storm-Surge Inundation - Providence

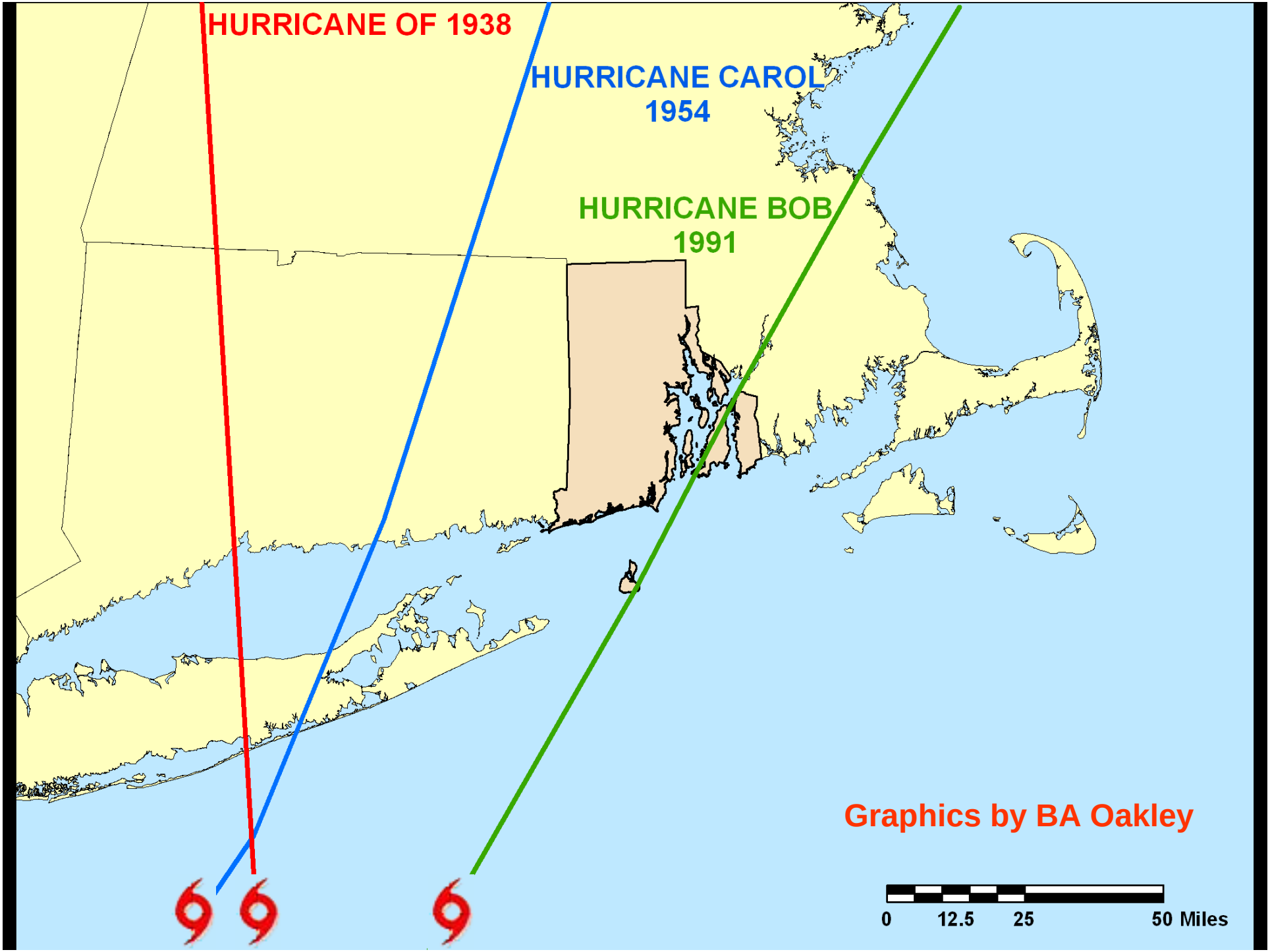


M Spaulding, K Knee 2007

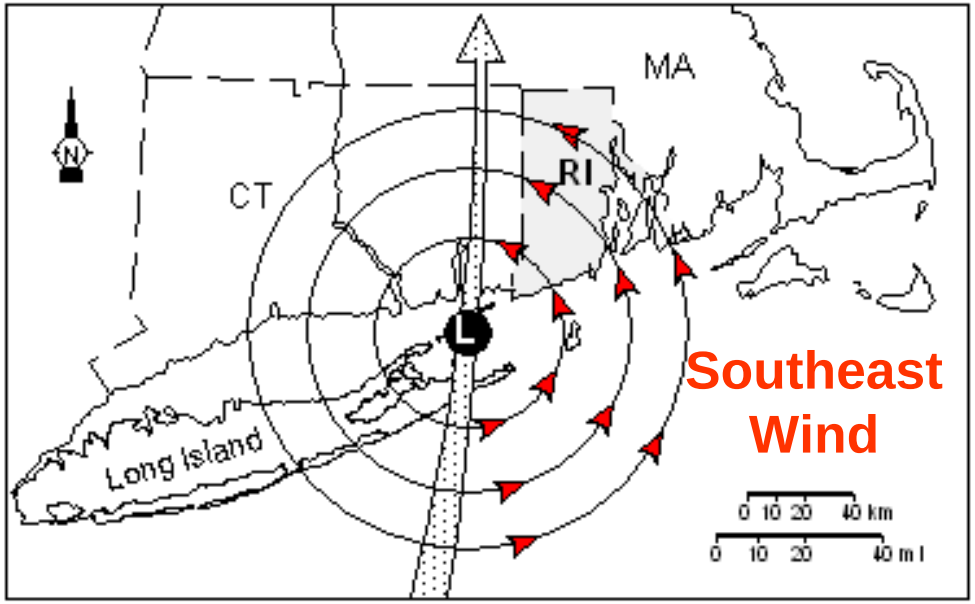
IPCC Scenarios 2001



WG1 TS FIGURE 24

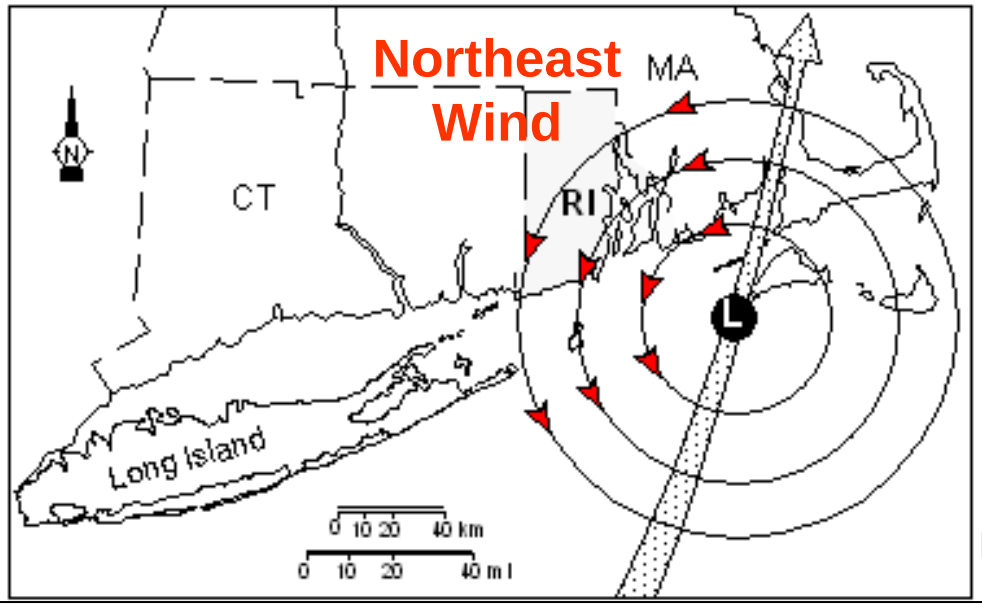

HURRICANE OF 1938
HURRICANE CAROL
1954
HURRICANE BOB
1991
Graphics by BA Oakley
0
12.5
25
50 Miles

HURRICANE and EXTRATROPICAL STORM PATHS and ASSOCIATED WIND PATTERNS



PASSAGE TO THE WEST

- Maximum Onshore Wind
- Severe Storm-Surge Flooding

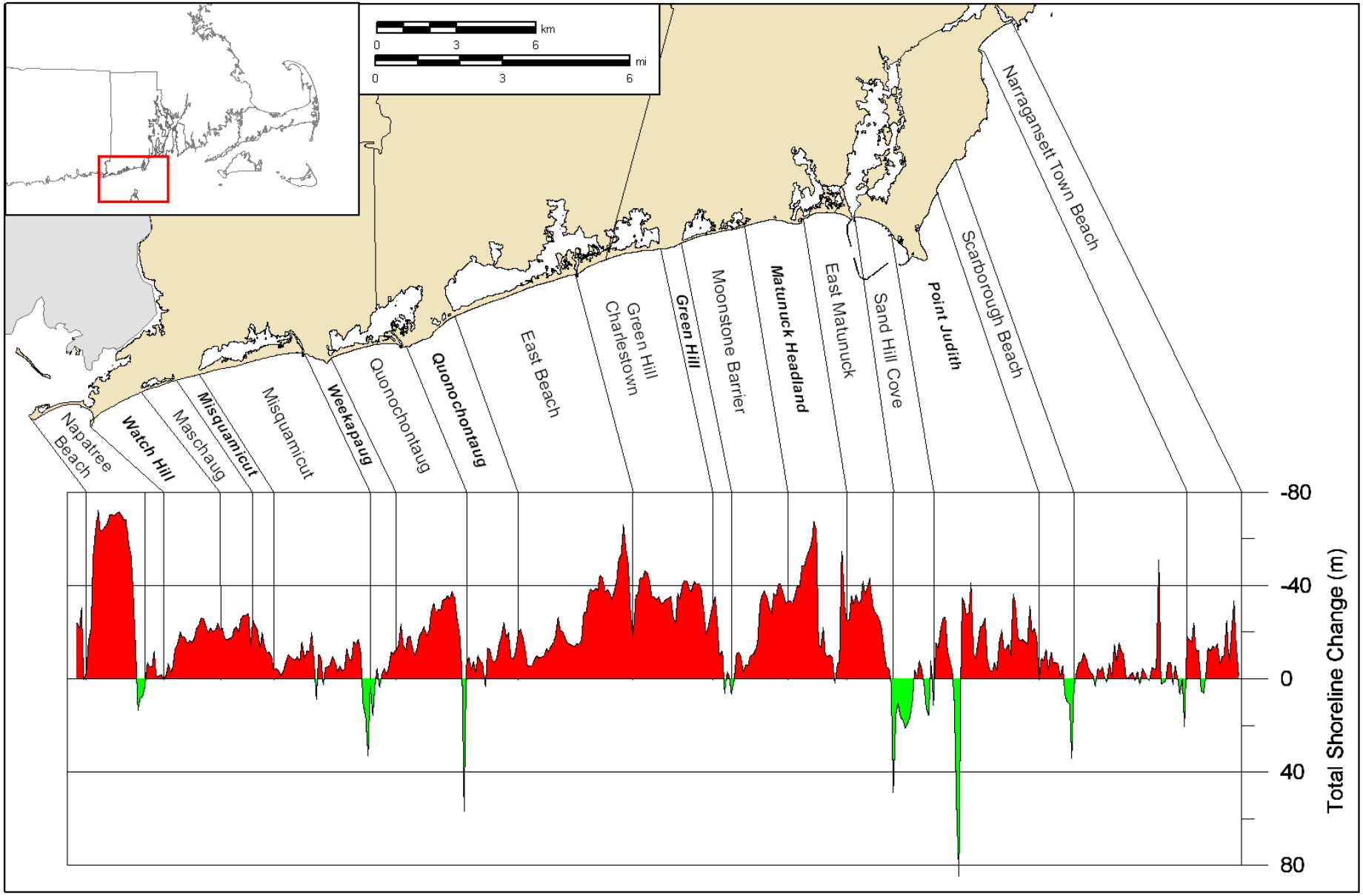


PASSAGE TO THE EAST

- Offshore Wind
- Minimum Storm-Surge Flooding

From Wright and Sullivan, 1982

TOTAL SHORELINE CHANGE - 1939 TO 2004/2006



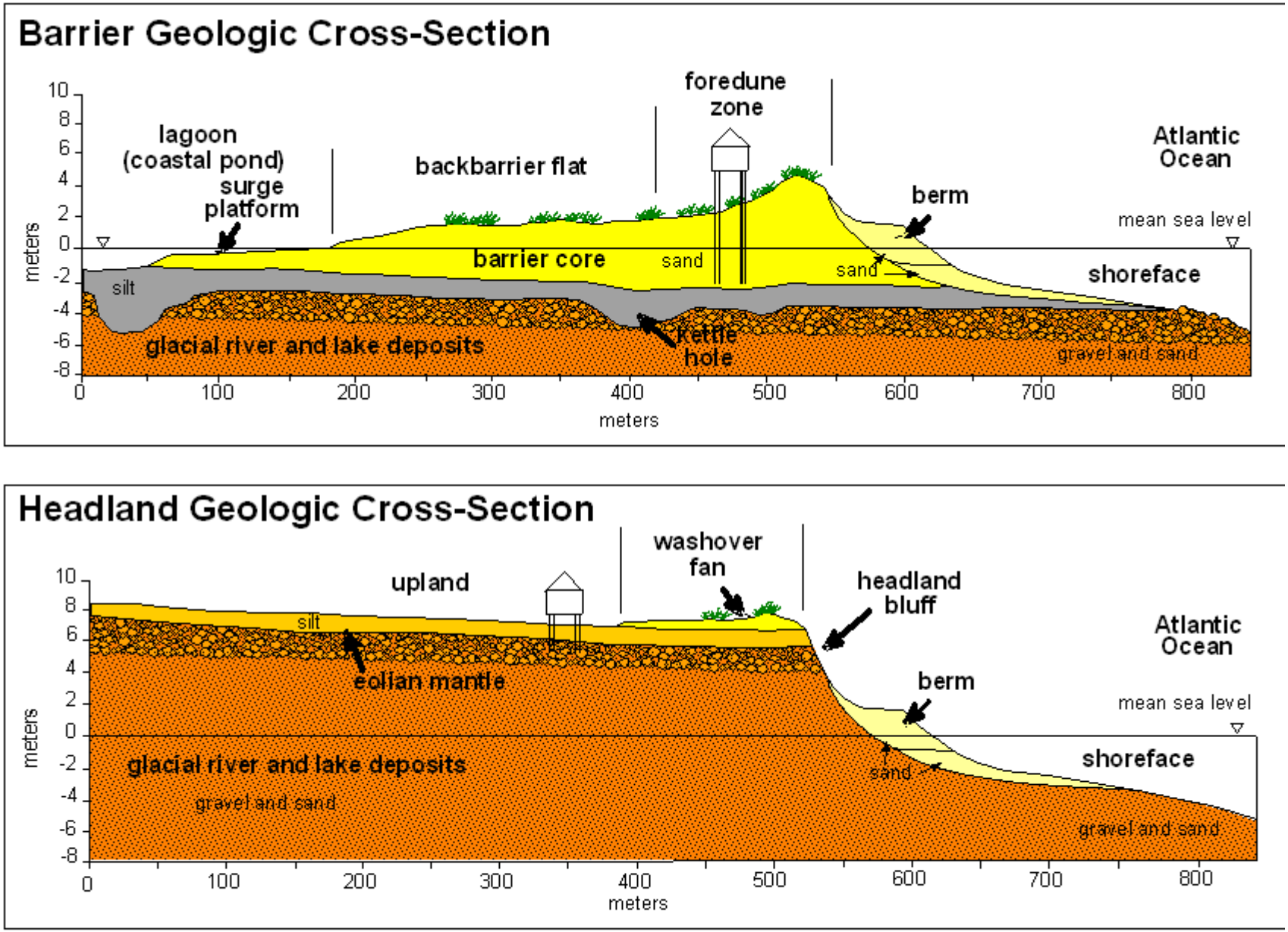
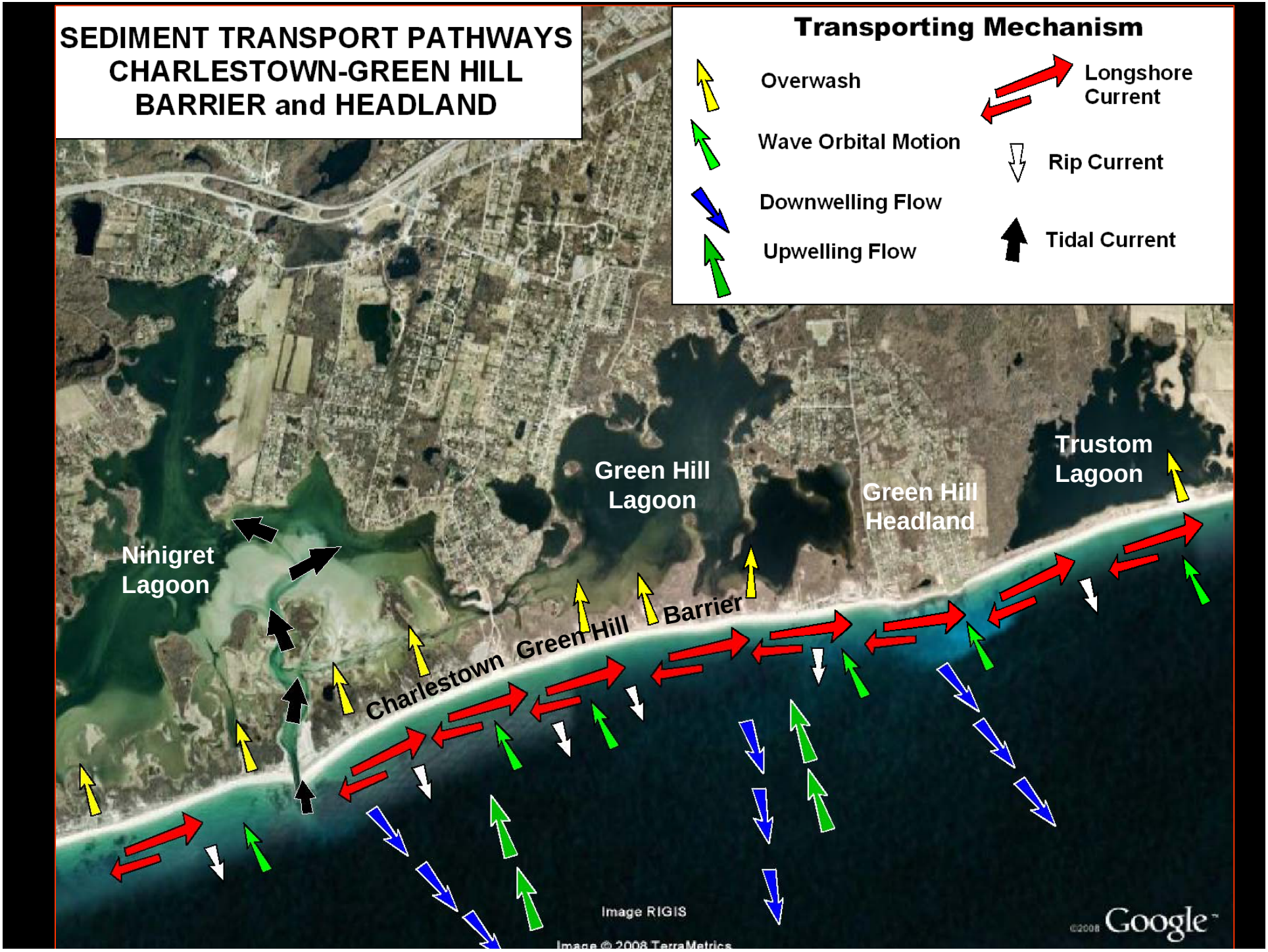


Figure 4-2

CHARLESTOWN BEACH

RE Hehre


SEDIMENT TRANSPORT PATHWAYS
CHARLESTOWN-GREEN HILL
BARRIER and HEADLAND
Transporting Mechanism
Overwash
Wave Orbital Motion
Downwelling Flow
Upwelling Flow
Longshore Current
Rip Current
Tidal Current
Ninigret Lagoon
Green Hill Lagoon
Green Hill Headland
Trustom Lagoon
Charlestown Green Hill Barrier
Image RIGIS
Image © 2008 TerraMetrics
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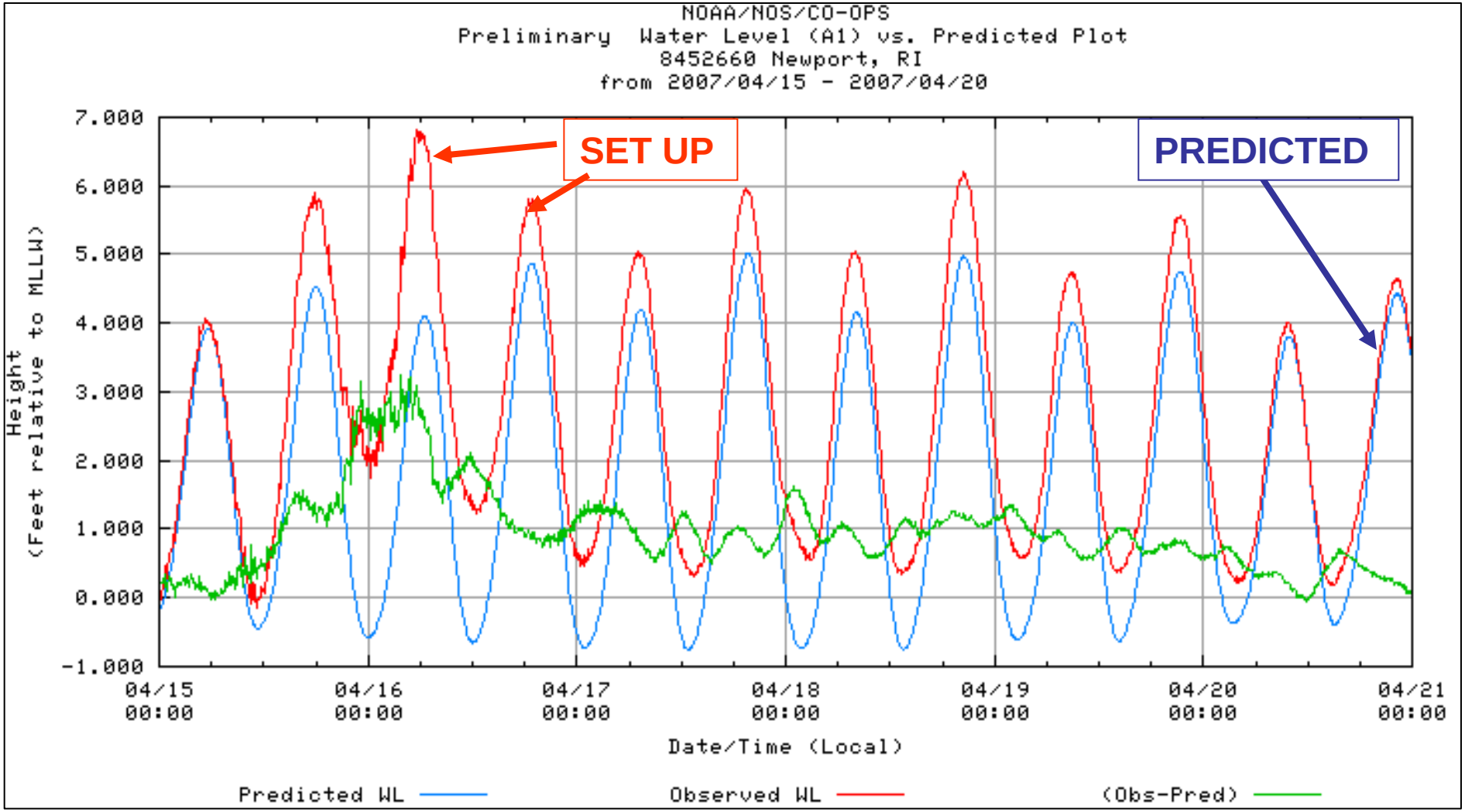
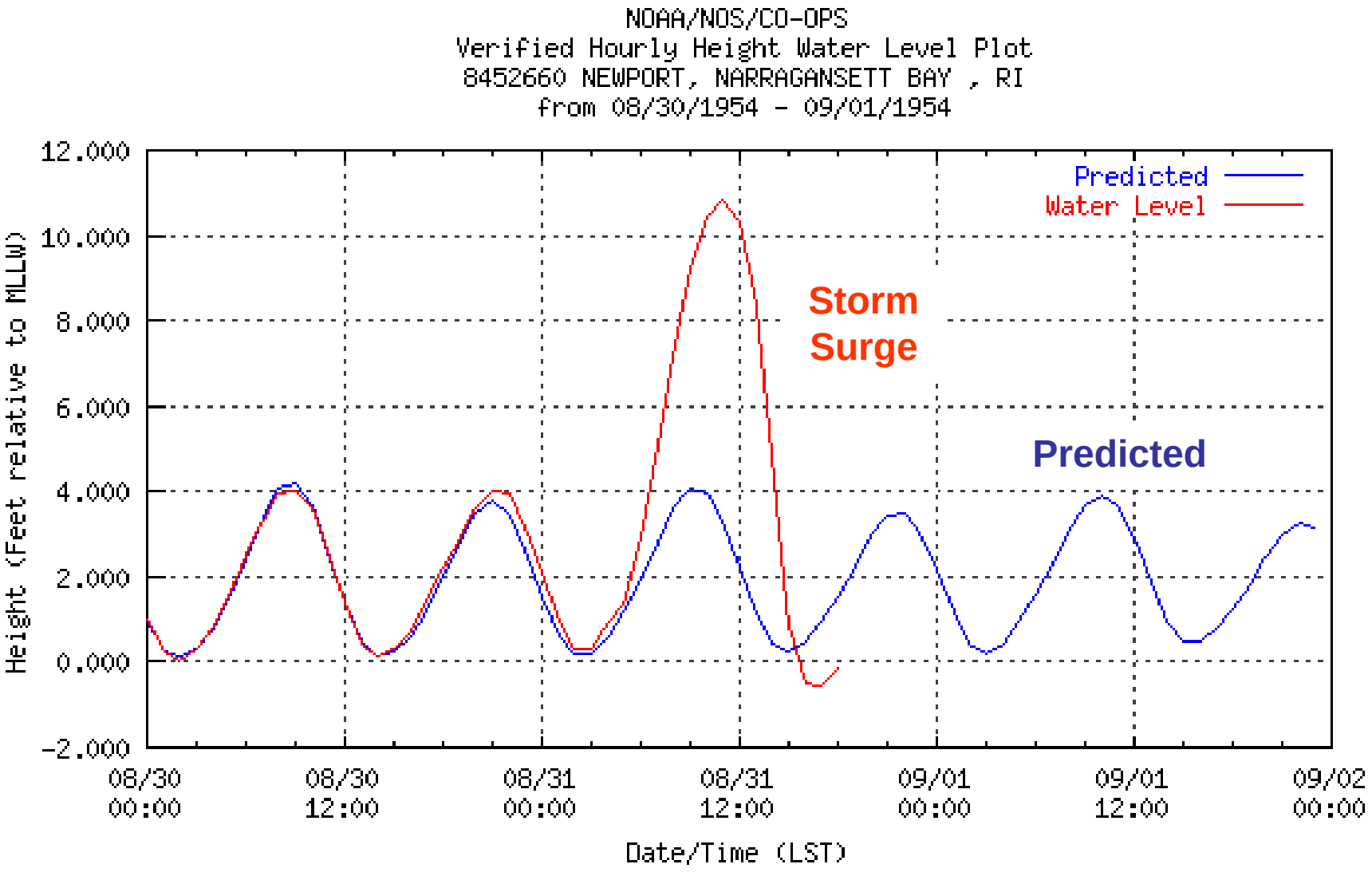
Patriots Day Extratropical Storm – April 2007



STORM SURGE

NOAA/NOS/CO-OPS

Hurricane Carol - 1954



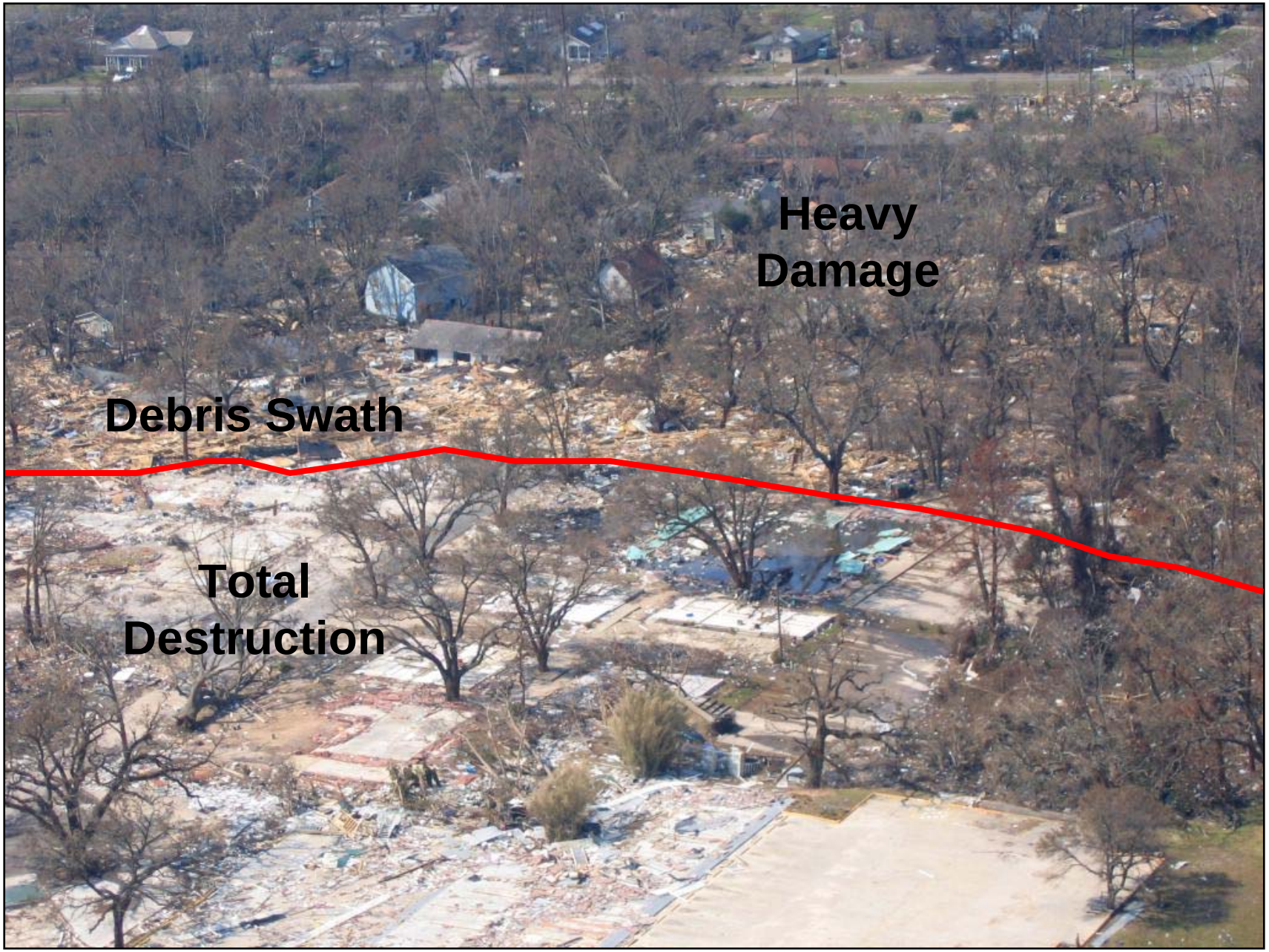
NOAA/NOS/CO-OPS

Dauphin Island, AL

A Model for RI

Katrina
Storm-Surge Channels
and
Back-barrier Marsh
now exposed on the Beach

Gulfport, MS – Katrina - 2 Sept 2005



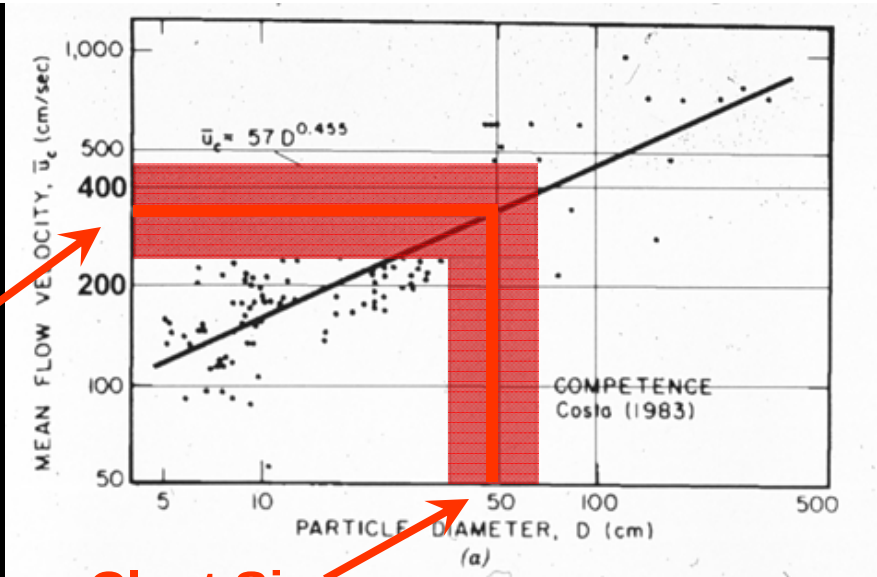
http://www.nicholas.duke.edu/psds/Katrina/gulfport/

The Towers – Narragansett Pier - 1938

Providence Journal, 1938

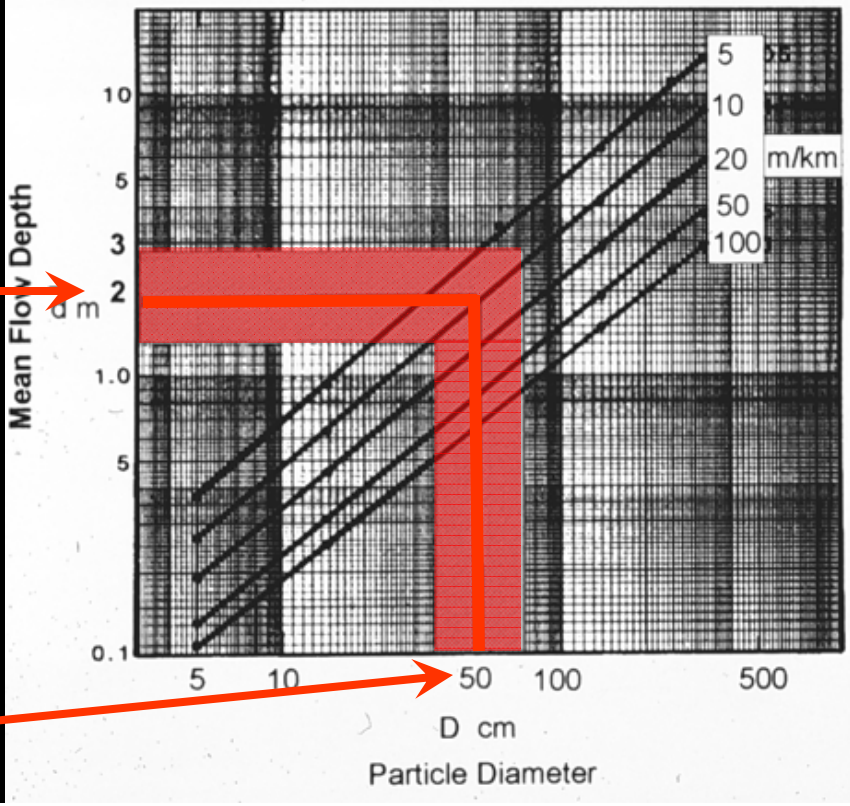
CLAST MOVEMENT DIAGRAMS

Velocity



Clast Size

Depth



Clast Size

Costa, 1983