

FUTURE COASTAL STORMS

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THEMES

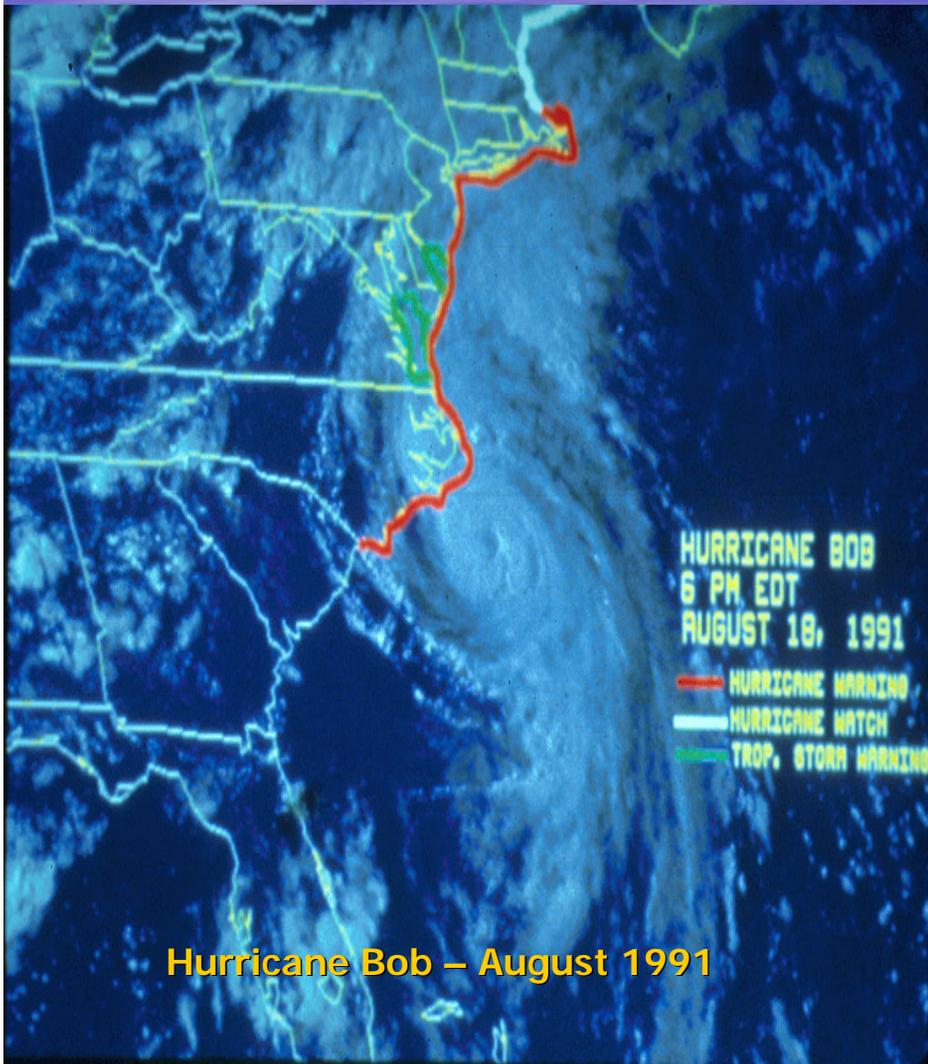
- **History highlights vulnerability of coastline**
- **Impact of Climate change on storms**
 - **Complex issue**
 - **Uncertainty in future storm frequency/intensity**
 - **Sea level rise sets stage for higher impacts**
- **Warning Program is critical**
 - **Today**
 - **Future**

Need to be ready for one of mother nature's bad days!

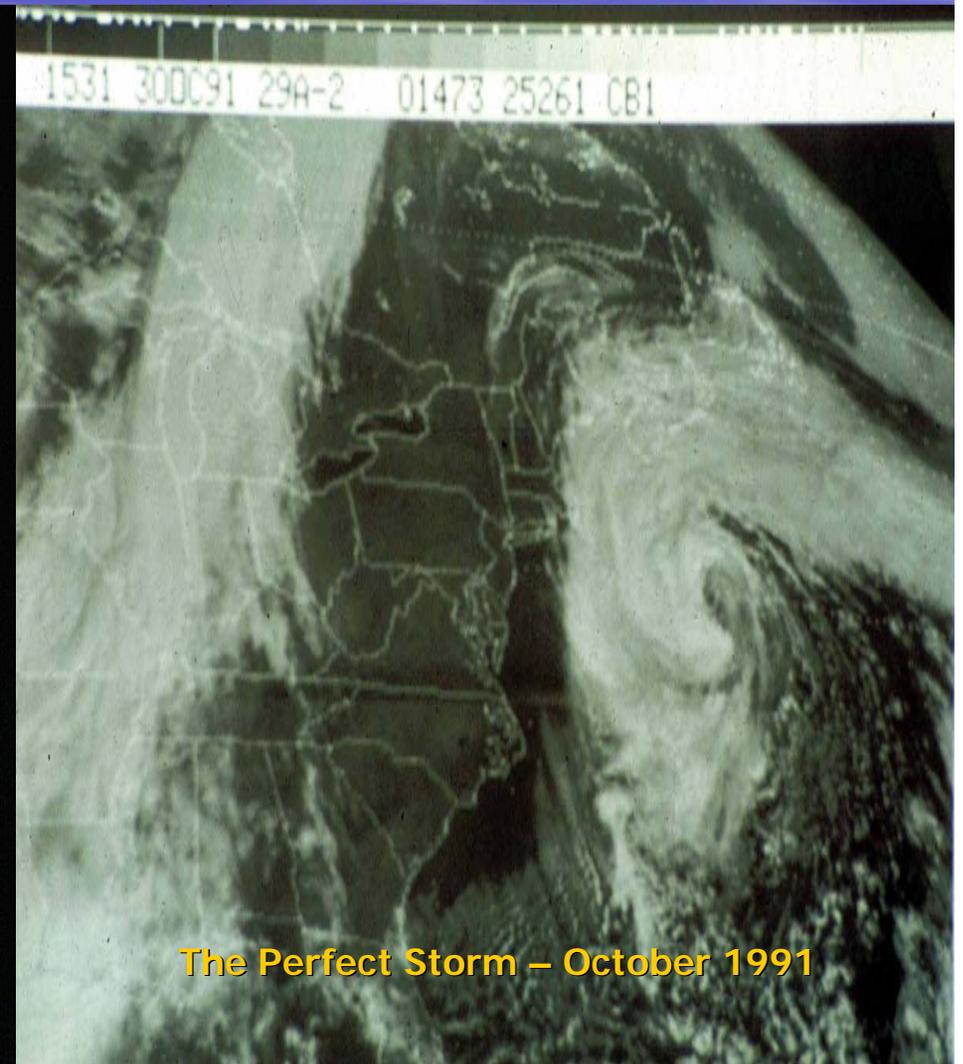


STORMS FROM DIFFERENT BREWS

HURRICANES AND NOR'EASTERS



Hurricane Bob – August 1991



The Perfect Storm – October 1991

STORMS FROM DIFFERENT BREWS

- **HURRICANES – TROPICAL CYCLONES**
 - Feed off warm ocean surface (at least 80°F)
 - Major New England hurricanes are fast-movers (30 to 60 mph)
- **NOR'EASTERS – EXTRATROPICAL**
 - Feed off low level temperature gradients and upper level wind energy – “air-sea” interaction
- **HYBRID STORMS**
 - New England hurricanes becoming extratropical
 - Extratropical systems can acquire tropical characteristics

HURRICANES OVER THE NEW ENGLAND COASTAL WATERS

A Long History Back to Colonial Times – 1635 Hurricane

- **Major fast-moving hurricane**
 - Wind rose quickly with extreme part of storm about 6 hours duration
 - Tide rose 20 feet in Buzzards Bay
- **Thatcher's Island off Cape Ann**
 - The *Watch and Wait* shipwrecked
 - Of 21 persons (including 2 families), only Anthony Thacher and his wife survived (all 4 of their children lost)
 - Island named after the Thachers because of this storm



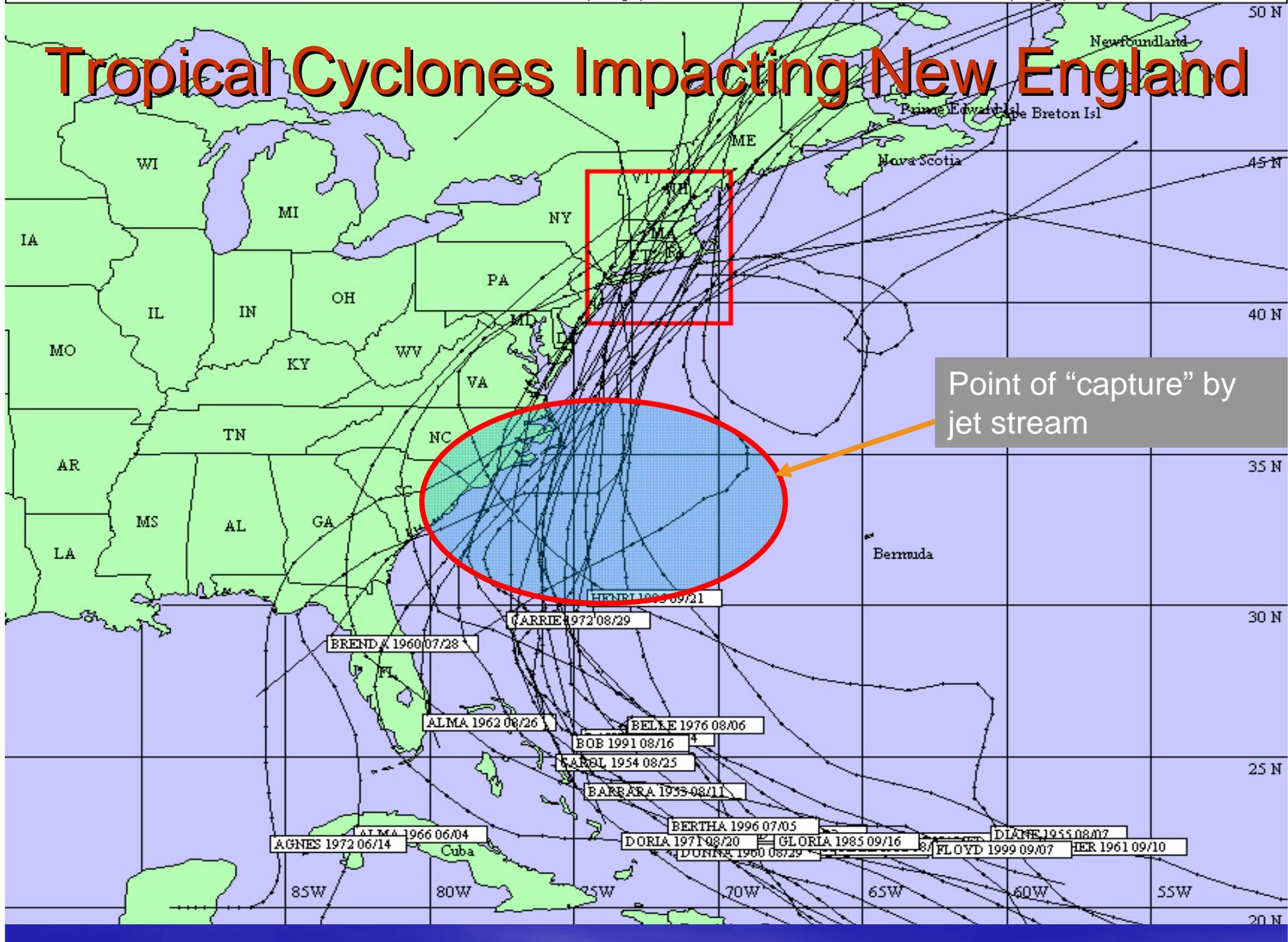
Total Storm Hits - 58 Selected - 24

>34Kt(39mph)

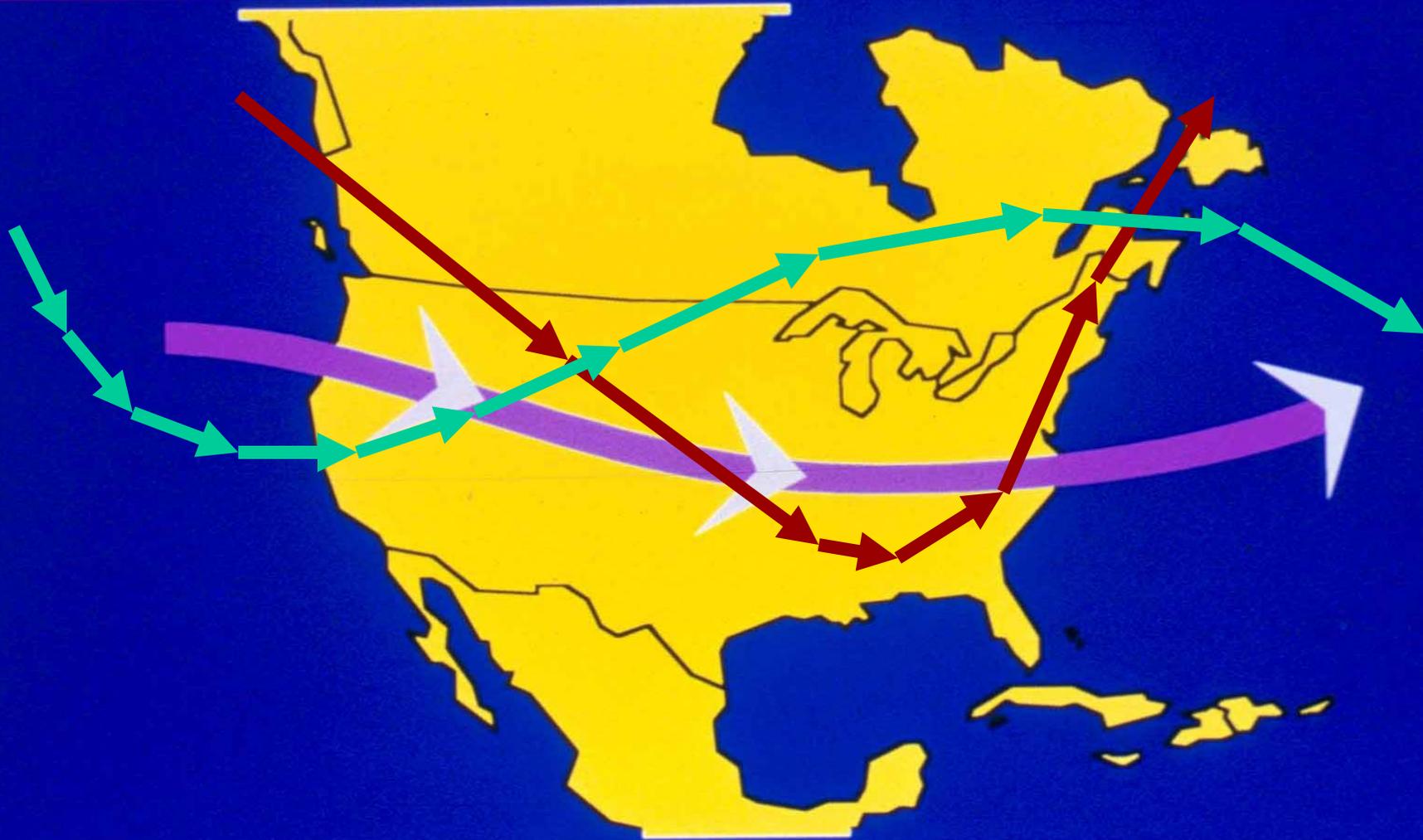
>50Kt(58mph)

>64kt(74mph)

Tropical Cyclones Impacting New England

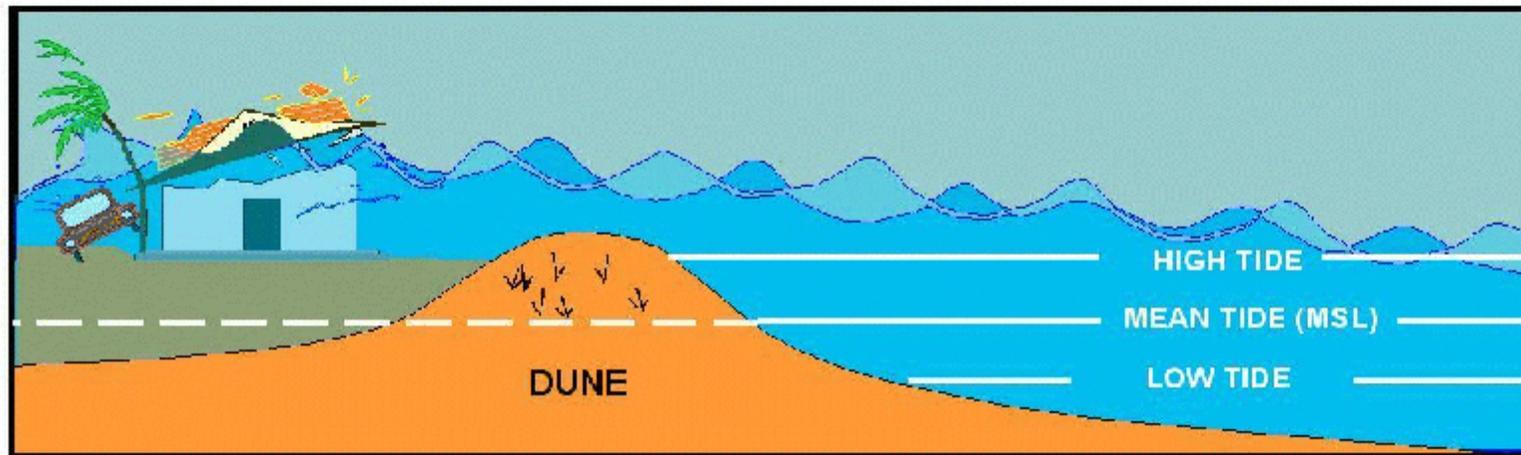


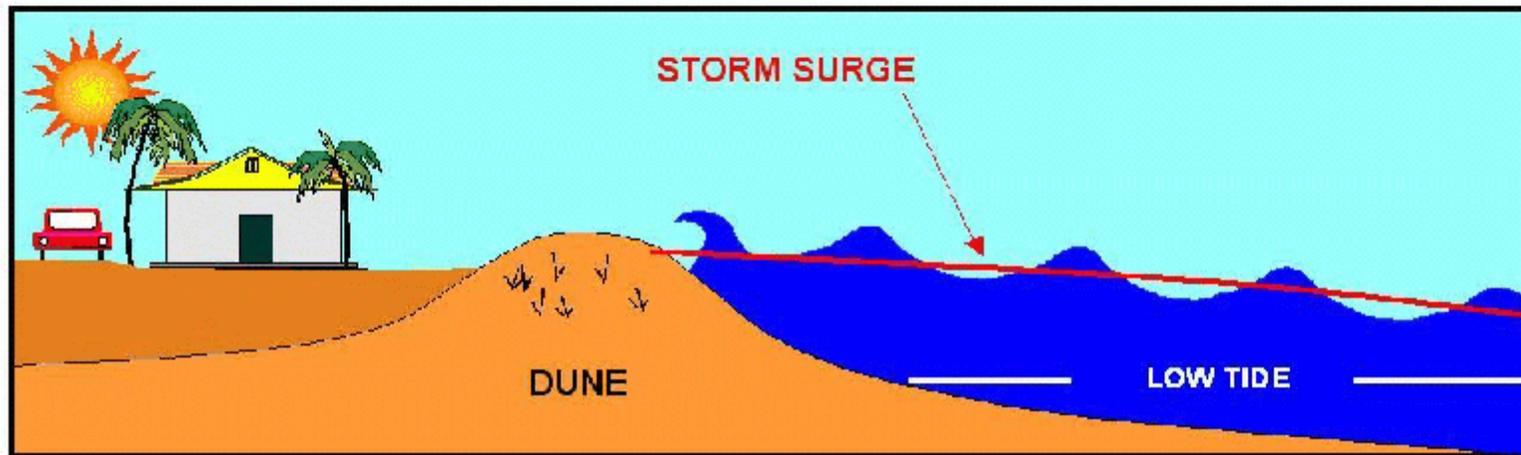
PREVAILING WESTERLIES



HURRICANE IMPACTS

- Heavy Rain – Inland Flooding
- Wind
- **Storm Surge – Coastal Flooding**





Let's take a trip to the Menauhant section of Falmouth, Massachusetts



Wondering what this might look like during
an actual Storm Surge???



Hurricane Bob's Six Foot Storm Surge!



SLOSH Forecast Model

Sea

* Calculates the water level at the coast and inland.

Lake

Overland

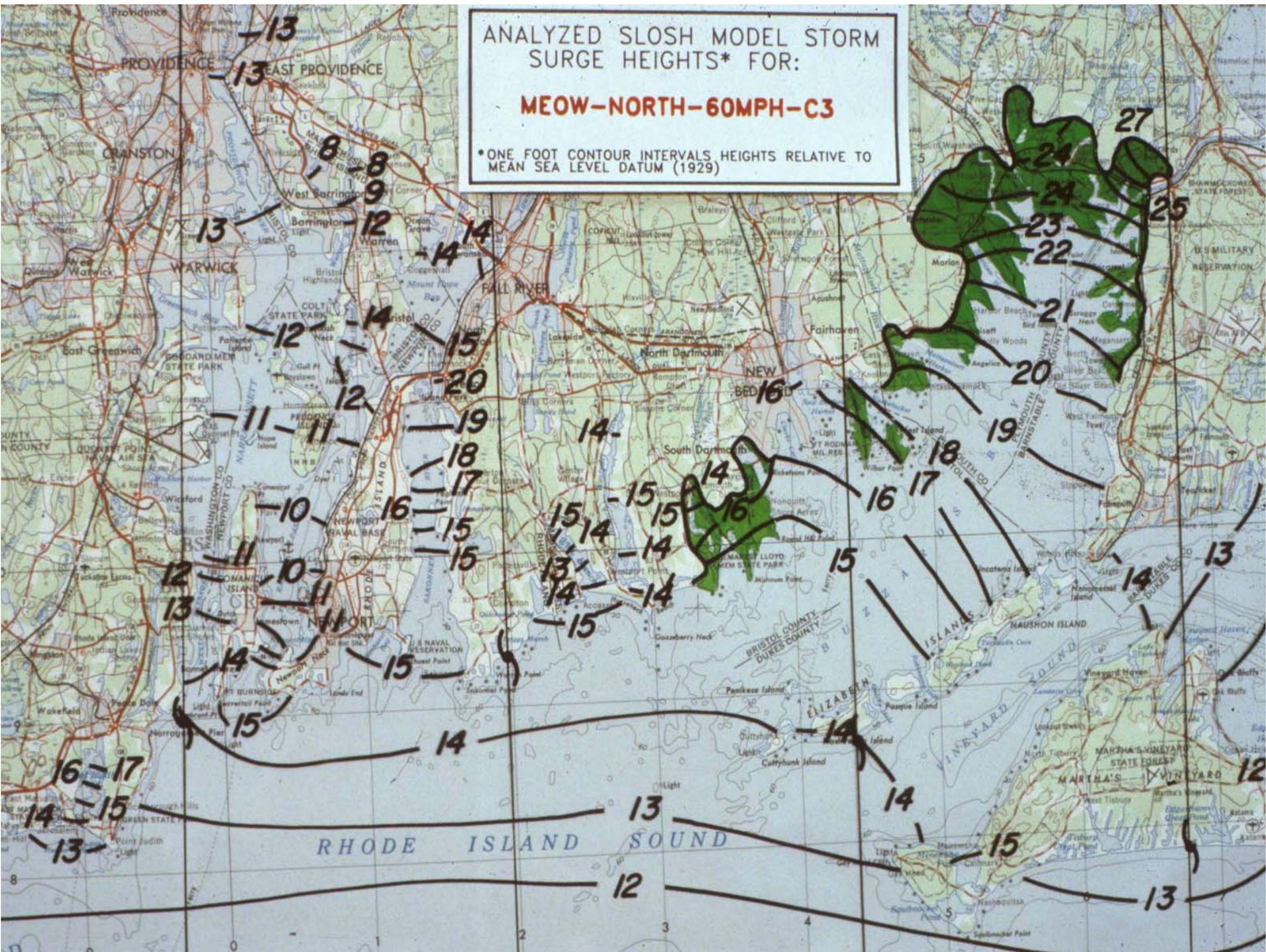
* Proven to be 90 % accurate!

Surges

from

Hurricanes

ANALYZED SLOSH MODEL STORM SURGE HEIGHTS* FOR:
MEOW-NORTH-60MPH-C3
 *ONE FOOT CONTOUR INTERVALS HEIGHTS RELATIVE TO MEAN SEA LEVEL DATUM (1929)



So what's the real potential in Falmouth?

Falmouth, MA

A 12+ foot storm surge at this location for cat 3 moving north at 60 mph!

17' surge

12' surge

6' surge on high tide

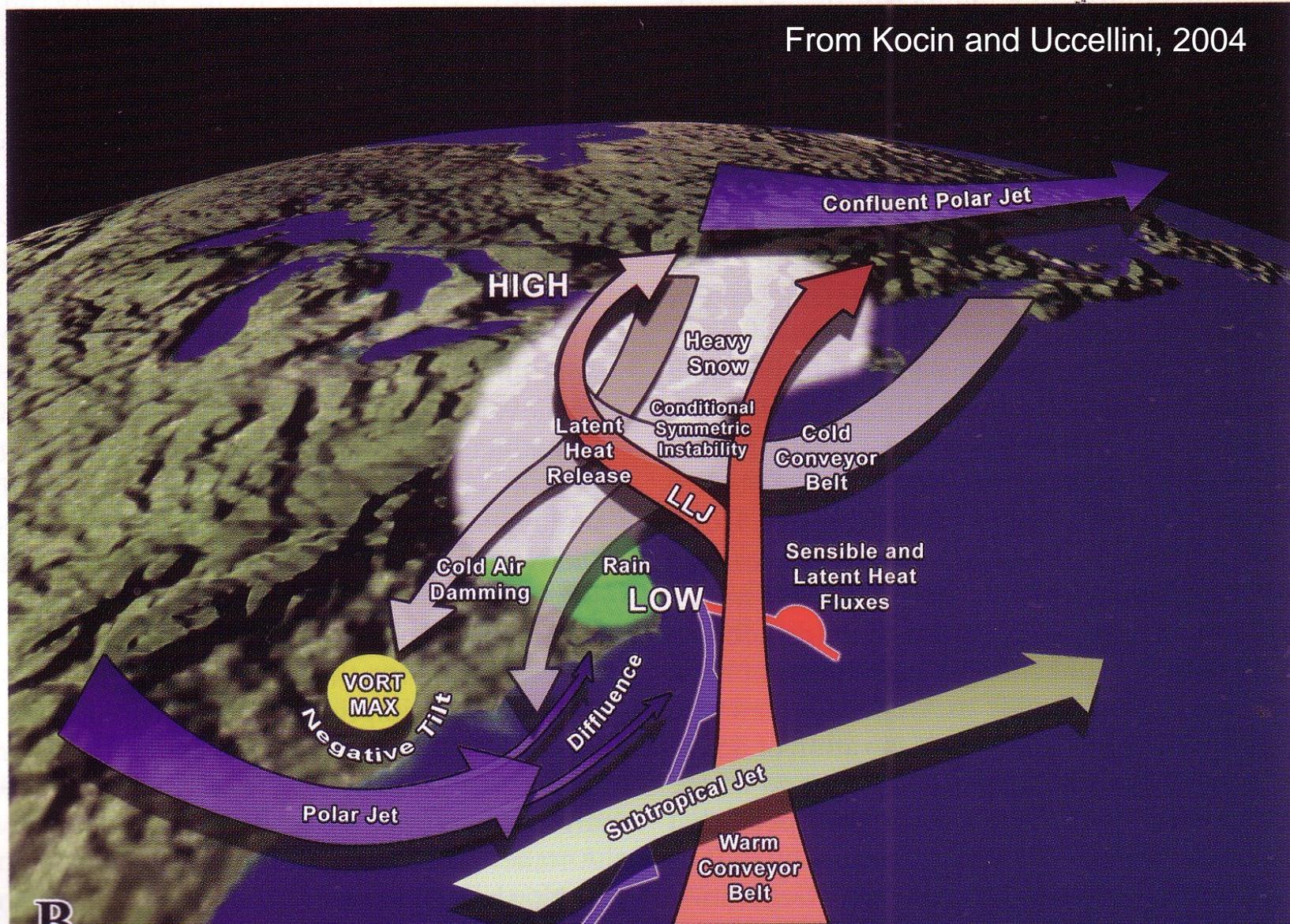


GLOBAL WARMING INFLUENCE ON HURRICANE FREQUENCY AND INTENSITY?

- **Debate in scientific community**
- **Recent NOAA study suggests:**
 - **Slightly fewer hurricanes and**
 - **Slightly more intense ones**

Anatomy of a Major Nor'easter

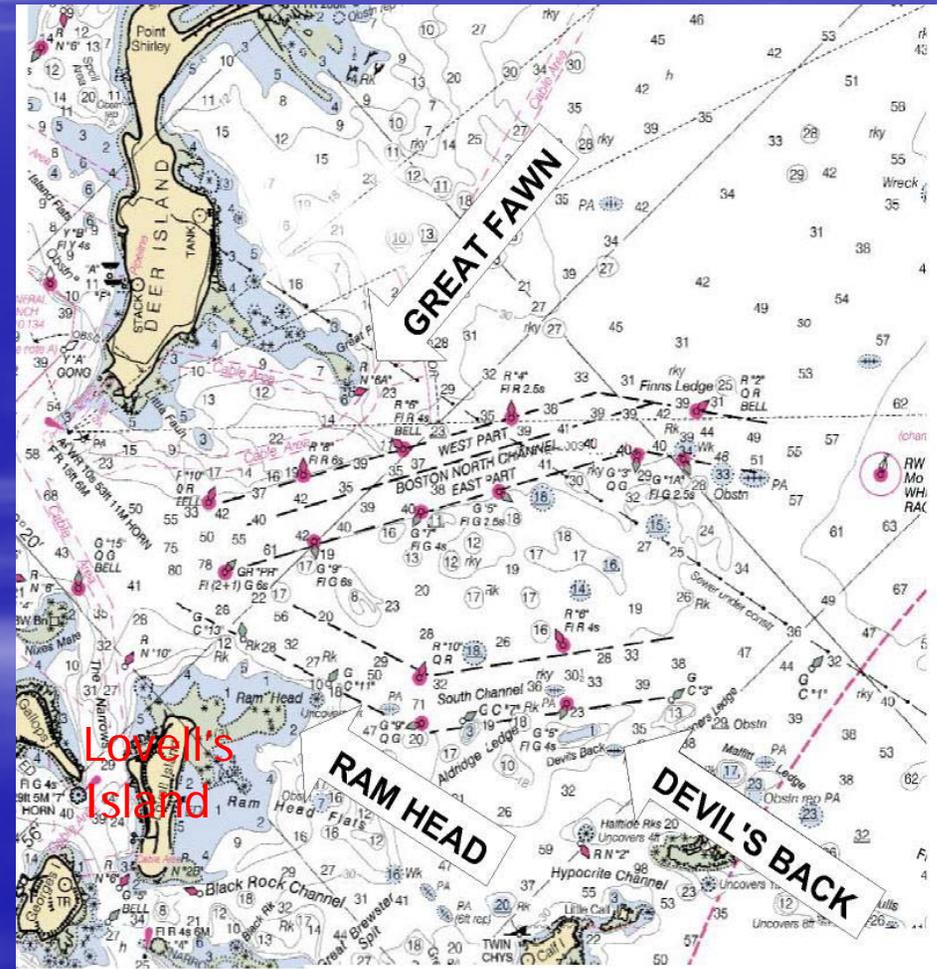
From Kocin and Uccellini, 2004



LONG HISTORY OF NOR'EASTERS

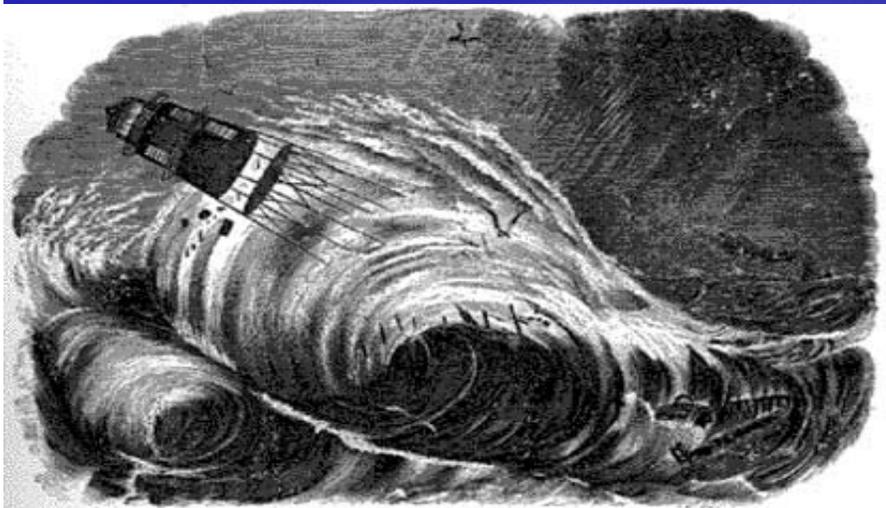
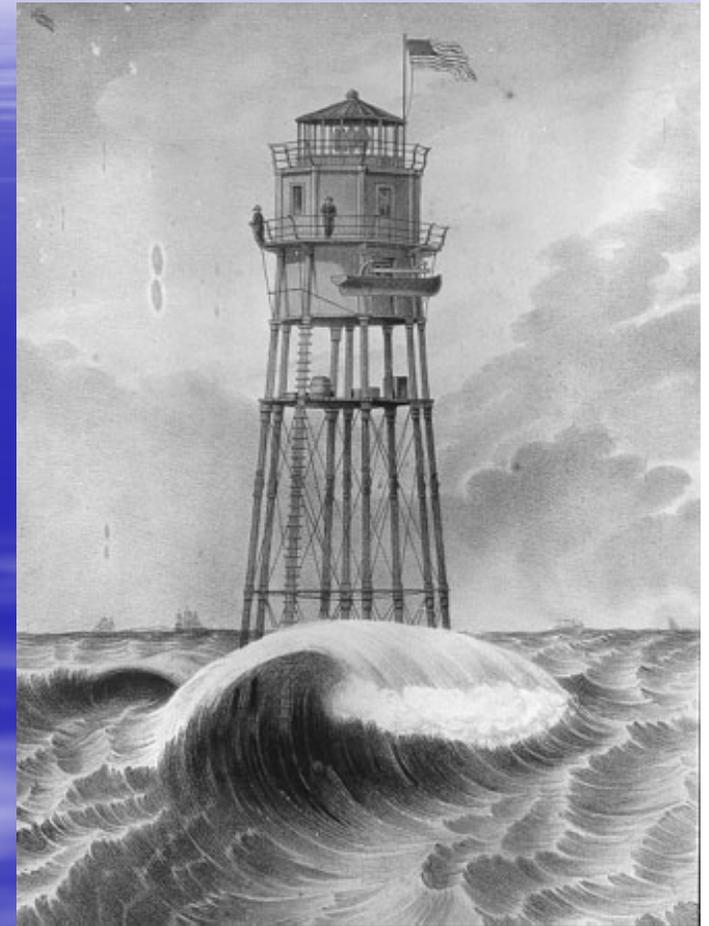
DECEMBER 1786 STORMS

- **Haystack Voyage**
 - On Plum Island Sound
 - Samuel Pulsifer and Samuel Elwell
 - Clam digging on Hog Island when caught in snowstorm
 - Three mile haystack ride
- **Lovell's Island Tragedy**
 - Sloop crashed during one of the December 1786 storms
 - All 13 crew and passengers survived shipwreck
 - All perished from exposure



MINOT'S LIGHT

- Completed January 1, 1850
 - Built on iron stilts
 - First lightkeeper considered structure unsafe after April 6, 1850 storm
 - Second lightkeeper came to same conclusion during 1850-1851 winter
- Minot's Light Storm (April 16, 1851)
 - Major nor'easter with severe coastal flooding
 - Lighthouse fell during storm
 - Two assistant lightkeepers perished

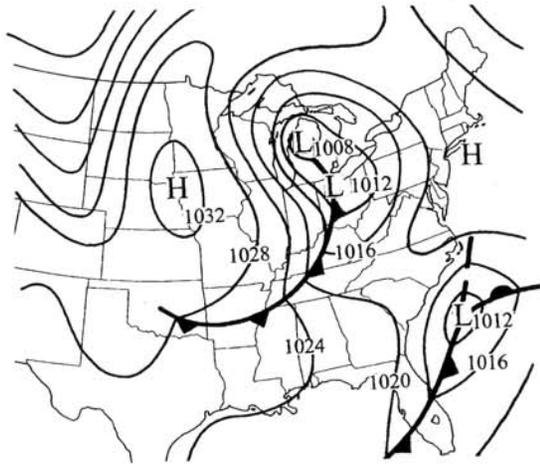


"The light house won't stand over to night.
She shakes 2 feet each way now."

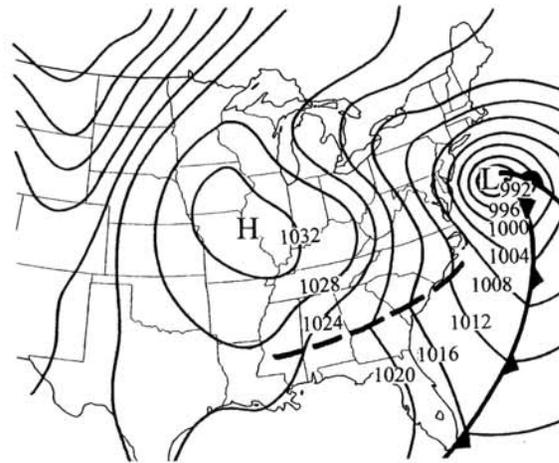
J.W. & J.A.

THE PORTLAND GALE

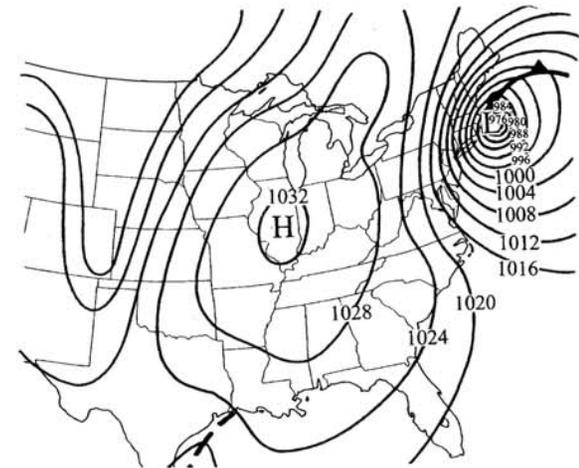
SURFACE ANALYSES



1300 UTC 26 NOVEMBER 1898



0100 UTC 27 NOVEMBER 1898



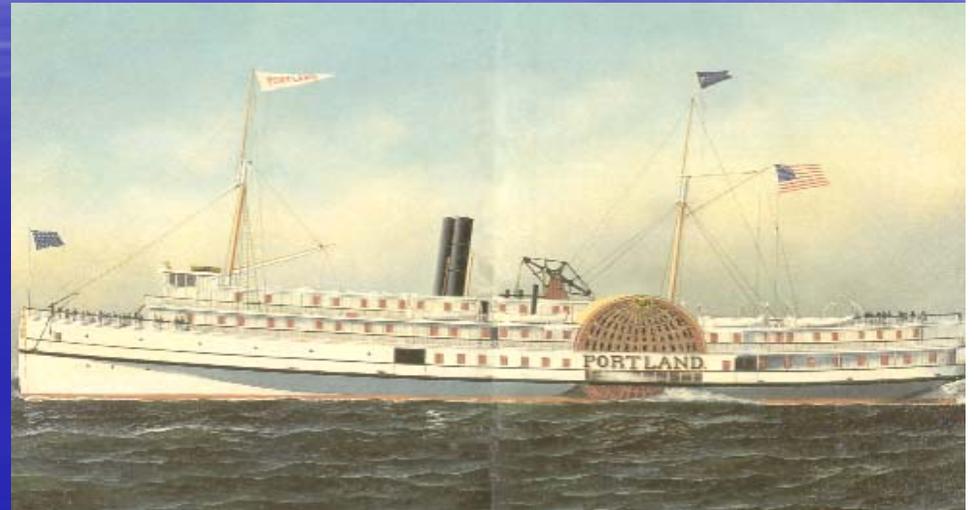
1300 UTC 27 NOVEMBER 1898

Analysis by Paul Kocin

THE PORTLAND GALE

Maritime Impact

- 141 vessels wrecked
- Over 400 lives lost
 - 192 with the *Portland* alone



Pilot Boat *Columbia* ashore in Scituate



Metro | Region

Blizzard of '78 | STORM OF THE CENTURY

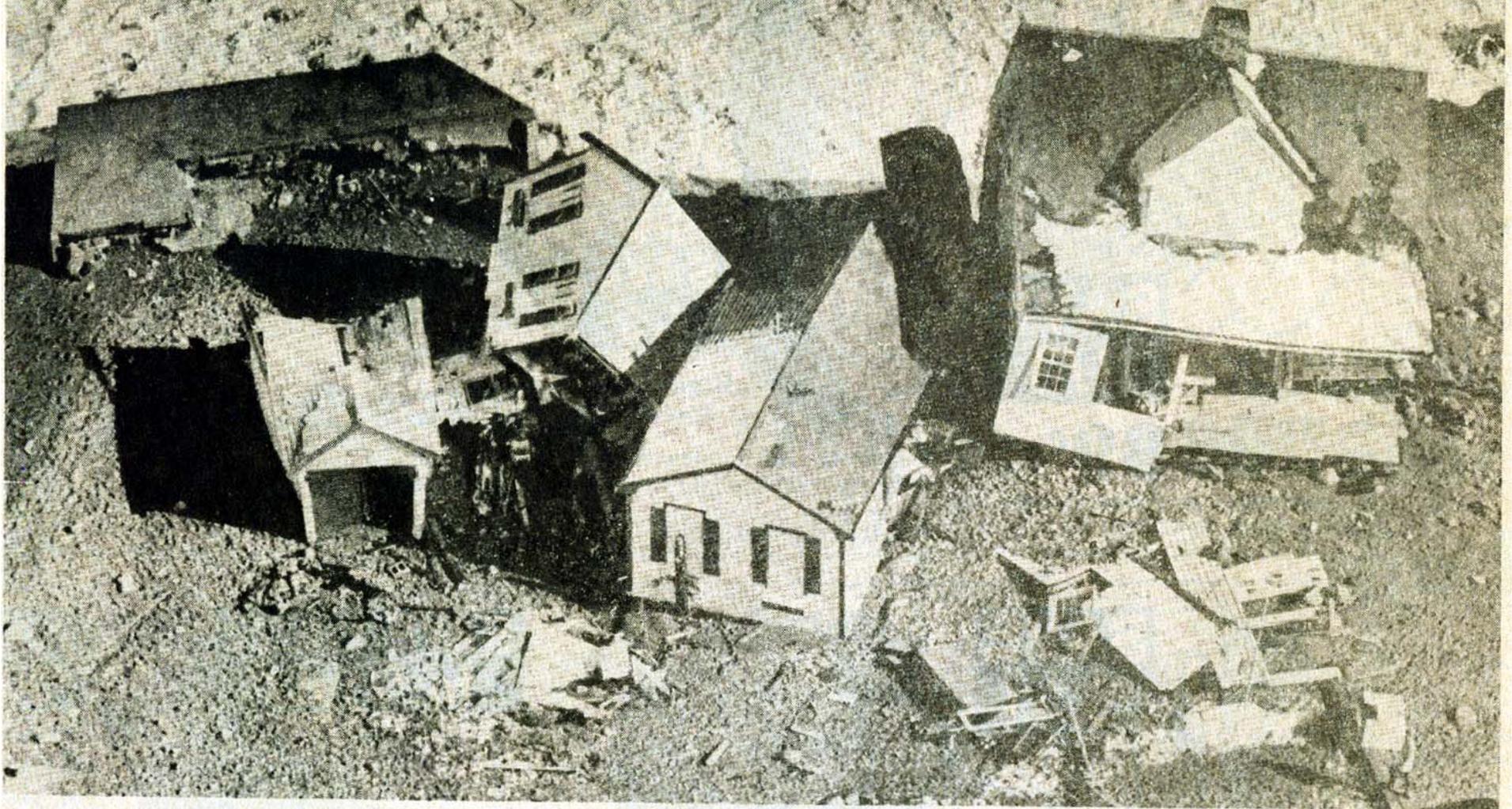
"I'll never forget

it. I was sitting in my living room when the waves and the wind were rocking the house. Then, this one wave hit. It was a sound like no other. It roared and whined like a siren. The house groaned and I knew it was time to get out. "



- Ginny Deveau, whose home in the Beachmont section of Revere was destroyed by the storm. Homes in Scituate (above) took a similar beating.

Sea-ravaged houses along Peggoty Beach in Scituate



Sea-ravaged houses along Peggoty Beach in Scituate.

(Globe aerial photo by Bill Brett)

NOR'EASTERS

OCTOBER 1991



COASTAL STORMS

Major Hurricanes and Destructive Nor'easters
Low Frequency High Impact Events



Coastal Buildup and Inexperienced Population

WARNING PROGRAM

- **Today**
 - Hurricane Watches and Warnings
 - Coastal Flood Watches and Warnings
 - Go to: weather.gov (weather.gov/boston for MA/RI)
 - Emergency management conference calls
- **Future**
 - Improved science for better lead time and accuracy
 - Visualization tools
 - Better communication of uncertainty



National Weather Service Forecast Office

Boston, MA

weather.gov/boston



Home

News

Organization

Search

Search

Local forecast by "City, St" or zip code

Go

Current Hazards

- Southern New England Severe Weather
- Tropical/Hurricane**
- Hazardous Outlooks**
- Send Us Your Report

Recent Conditions

- Observations
- Hourly Roundups
- Rivers & Lakes AHPS
- U.S. & World Cities Summaries
- Satellite Images
- Hydrologic Observations
- Marine
- Record Breaking
- Storm Totals - Info
- Storm Damage

Radar Imagery

- Taunton, MA
- New England
- Nationwide

Forecasts

- New England
- Extended Outlooks
- River-Flood-Drought
- Graphical Table
- Graphical 2D
- National Digital

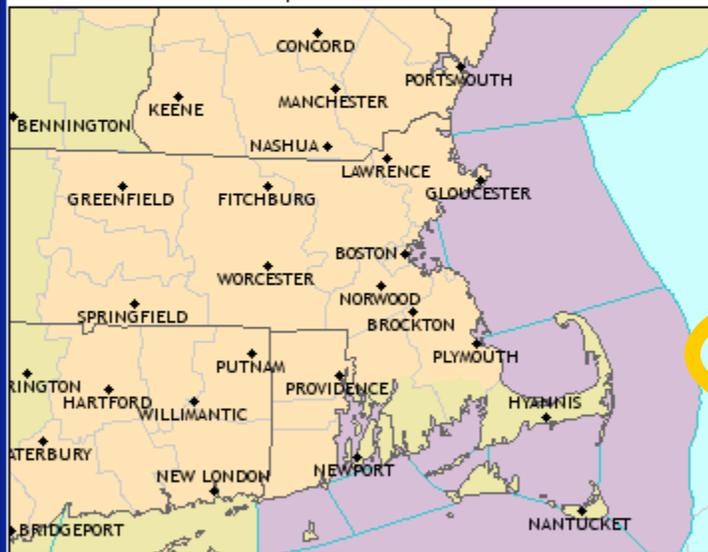
Top News of the Day:

- **Weather highlights and news** for Southern New England. Updated: June 6, 2006
- There are **Statements/Outlooks** in effect for Southern New England
- Check out our new **Sea Surface Temperature Analysis Page!**
- Planning is well underway for **The 7th Southern New England Weather Conference!**

Quick Glimpse at the Weather

Boston, MA

Click on the map below for the latest forecast.



(MON) 8.7.2006 12:30:44 PM (EDT)

Read watches, warnings & advisories.



Small Craft Advisory



Special Weather Statement



Hazardous Weather Outlook



Choose from the options below for other ways to view your NWS forecast

Text Forecasts



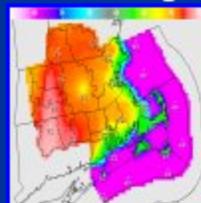
Area Forecast Matrix



Graphical Forecast



Experimental Forecast Images



Comments?

National Weather Service Forecast Office
Boston, MA

Home News Organization Search Search

- Local forecast by "City, St" or zip code
 City, St
- Current Hazards
 - Southern New England
 - Severe weather**
 - Tropical/Hurricane**
 - Hazardous Outlooks
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 - Radar Imagery
 - Taunton, MA
 - New England
 - Northeast Sector Mosaic
 - Nationwide Mosaic
 - forecasts

Top News of the Day:

- Weather highlights and news for Southern New England. Updated: July 27, 2007
- There are Outlooks in effect for Southern New England

Quick Glimpse at the Weather **Boston, MA**

Click on the map below for the latest forecast.

Read watches, warnings & advisories

- Hazardous Weather Outlook
- Air Quality Alert
- Flood Watch

Last map update: Mon, Jan. 7, 2008 at 3:40:28 pm EST

Choose from the options below for other ways to view your NWS forecast

- Text Forecasts
- Area Forecast Matrix
- Graphical Forecast
- Experimental Forecast Images

FUTURE WARNING PROGRAM

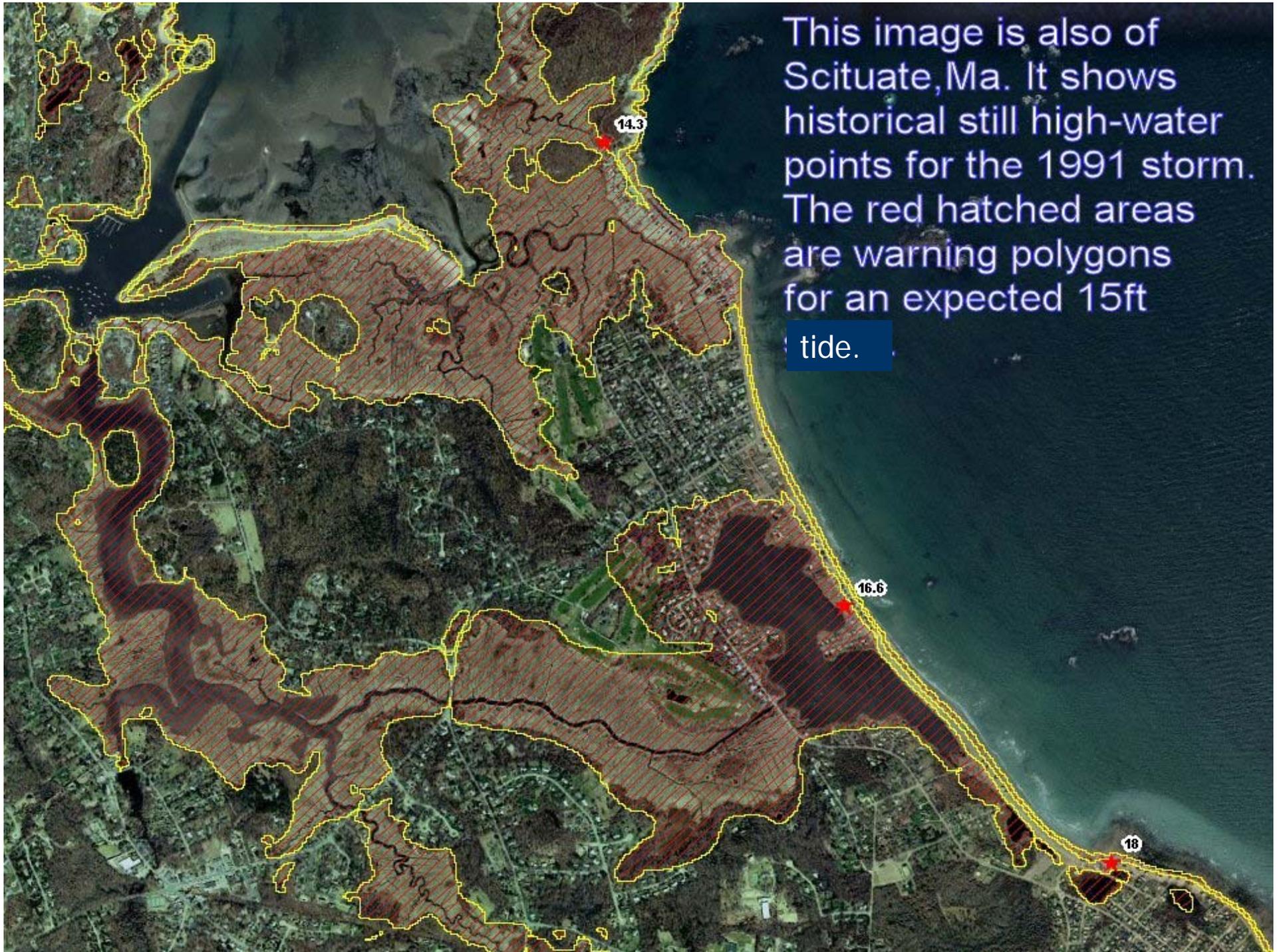
- Implement new science and technology
 - Improved near shore wave forecasts
 - Improved storm surge forecasts
 - Means of operationally handling wave run-up
 - Incorporation of model ensembles
- Better visualization of areas at risk
- Better depiction of uncertainty



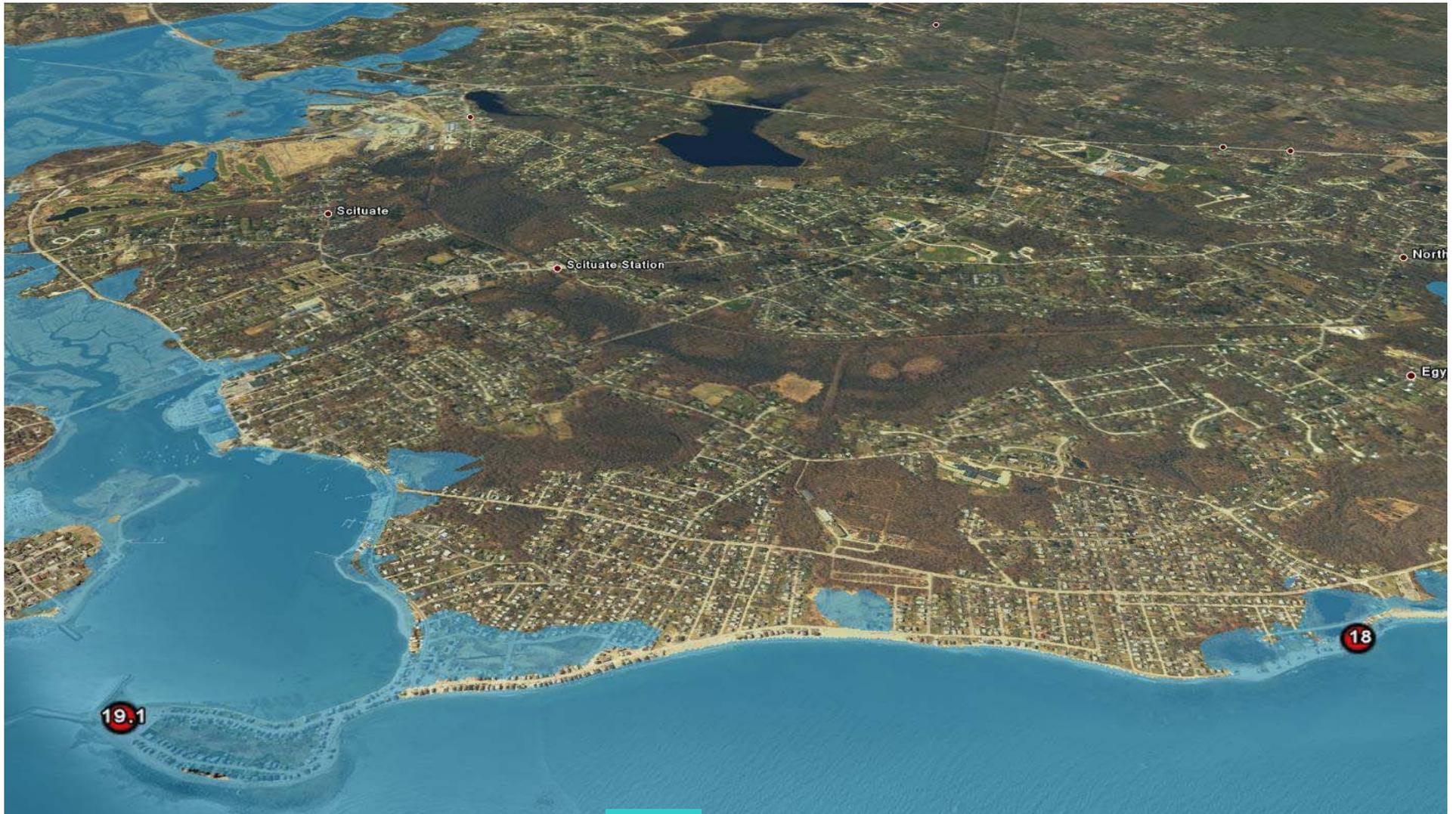
This image, created in ArcMap shows Scituate, MA. The blue areas represent different depths from a simulated 15ft storm tide

Another view of a simulated tide of 18ft for Scituate, MA displayed in Google Earth. The red areas are surge warning zones and the points are historical still high-water marks for the 1991 storm.





This image is also of Scituate, Ma. It shows historical still high-water points for the 1991 storm. The red hatched areas are warning polygons for an expected 15ft tide.



This image shows a theoretical 18ft **tide** to Scituate, Ma displayed in Google Earth format. It also shows historical still high-water mark areas for the 1991 storm.

Another 15 ft tide simulation for Saco, Maine looking North and from above.

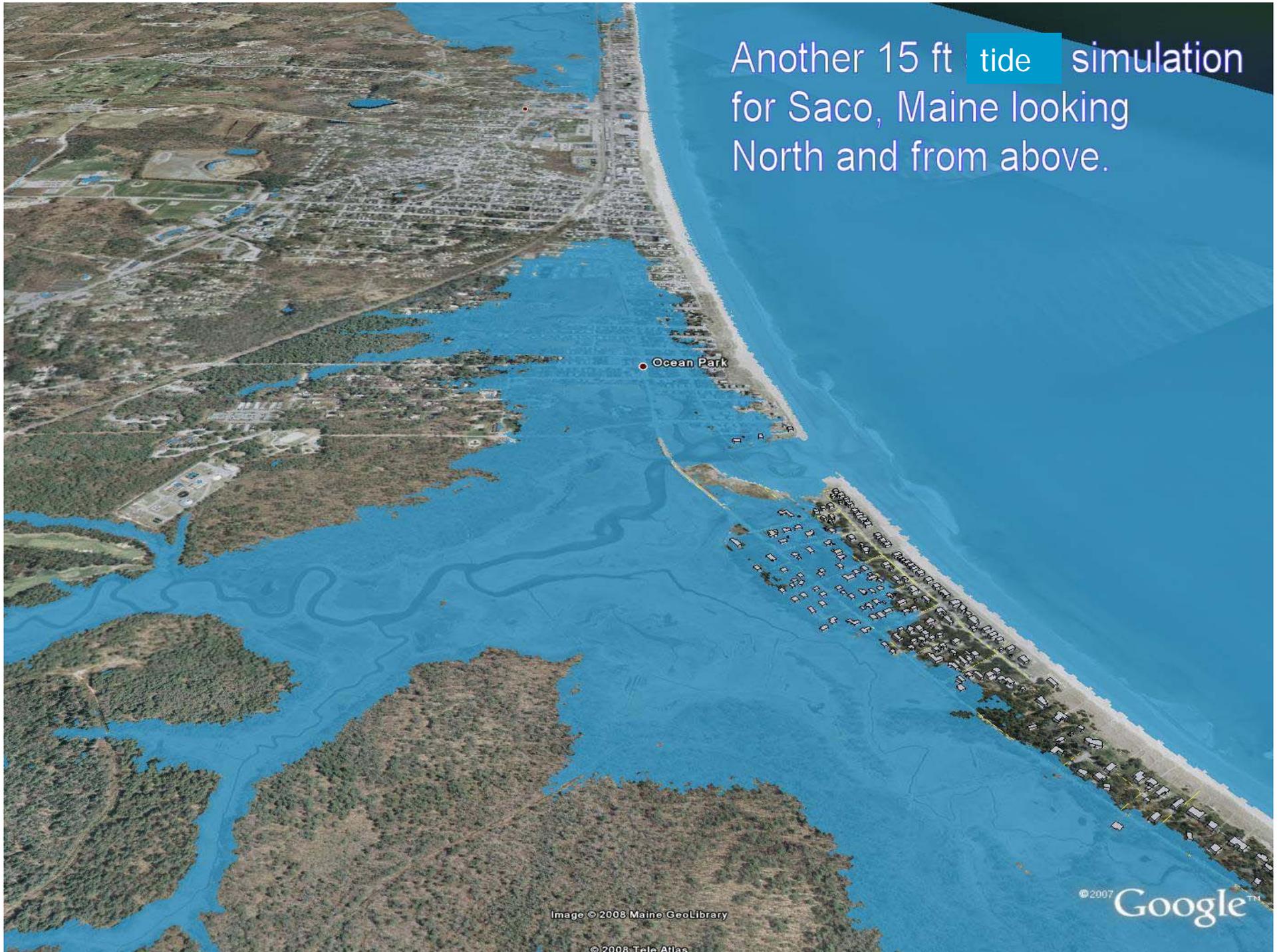


Image © 2008 Maine GeoLibrary

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Can never do enough preparedness!

SUMMARY/FUTURE

- **Global warming impacts or not**
 - *Build up along our coastline and inexperienced population a major concern*
- **Sea level rise will raise stakes along coast**
- **Enhancements to warning program:**
 - Incorporate new science and modeling capabilities into storm surge and wave forecasts
 - Expand data collection to validate new models
 - Provide means for people to visualize impact
 - Better communicate uncertainty