

NOAA-15 HRPT RGB-CH1,CH2,CH4 09/18/2003 11:53 UTC (7:53 AM EDT)



The Realities of New England Hurricanes: *Know Thy Enemy!!*

**New England Hazard Resiliency Summit
November 19th and 20th, 2008**

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Objectives

- Understand the behavior of our New England breed of Tropical Cyclone
 - A historical perspective
 - The three primary hazards
 - How can we best prepare ourselves?
 - Short term impacts
 - Long term ramifications
 - Local / Regional thinking



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ANYTHING WITH A NAME IN THE BAHAMAS

Everyone in New England needs to pay careful attention!

25N

Florida

CUBA

The Bahamas

Hurricane Floyd, September 13, 1999

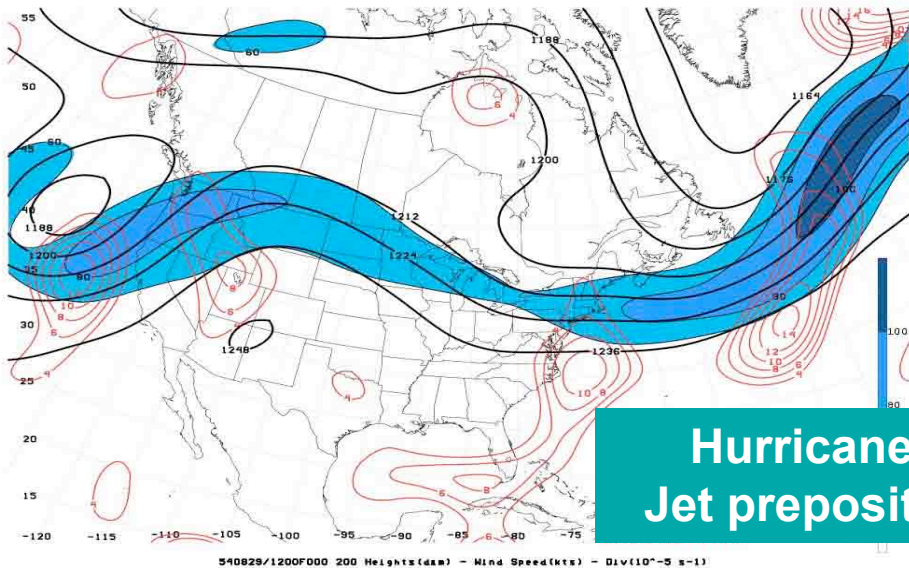
Common Characteristics

- Rapid acceleration up the coast
- High winds focused east of the track
- Storm surges focused east of the track
- Heavy rainfall usually focused along and west of the storm track

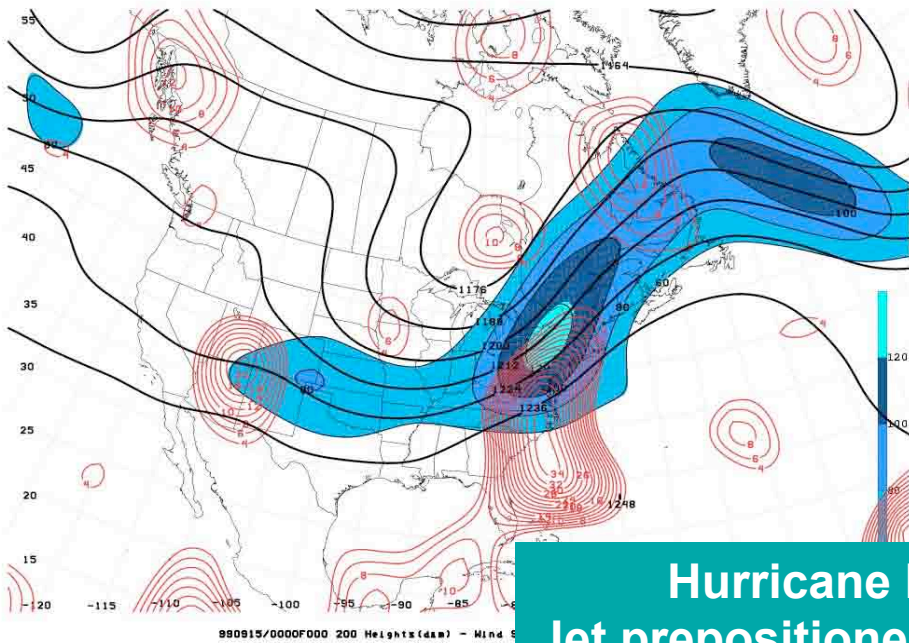
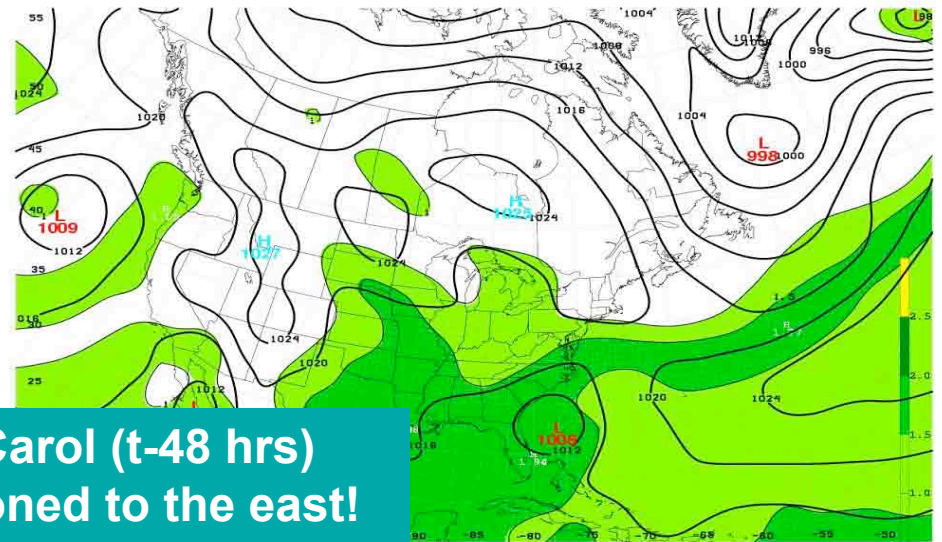
Remarkable Acceleration

- Rapid Average forward motion at land fall: 33 mph / 51 km/hr.
- The Great New England Hurricane of 1938 made the trip from Cape Hatteras, NC to Providence, RI in 8 hours!
 - Forward speed at landfall was at least 51 mph/82 km-hr and estimated as high as 60 mph/97 km-hr

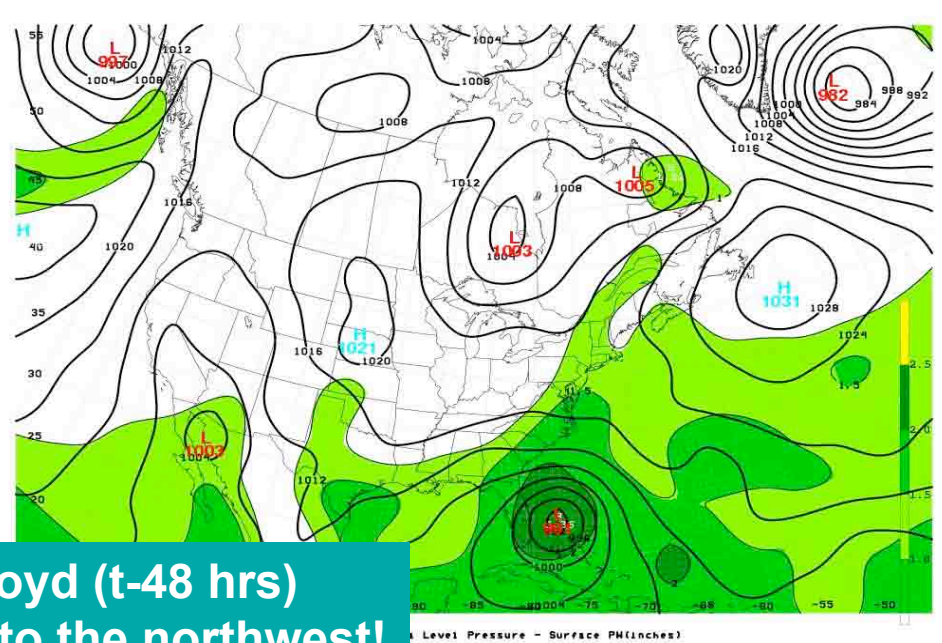
Interaction with the Westerlies



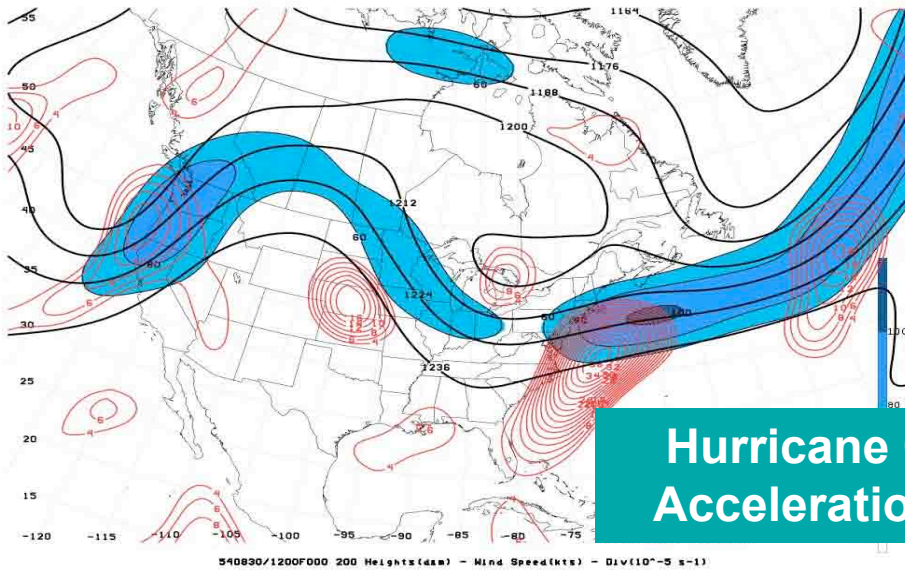
Hurricane Carol (t-48 hrs)
Jet prepositioned to the east!



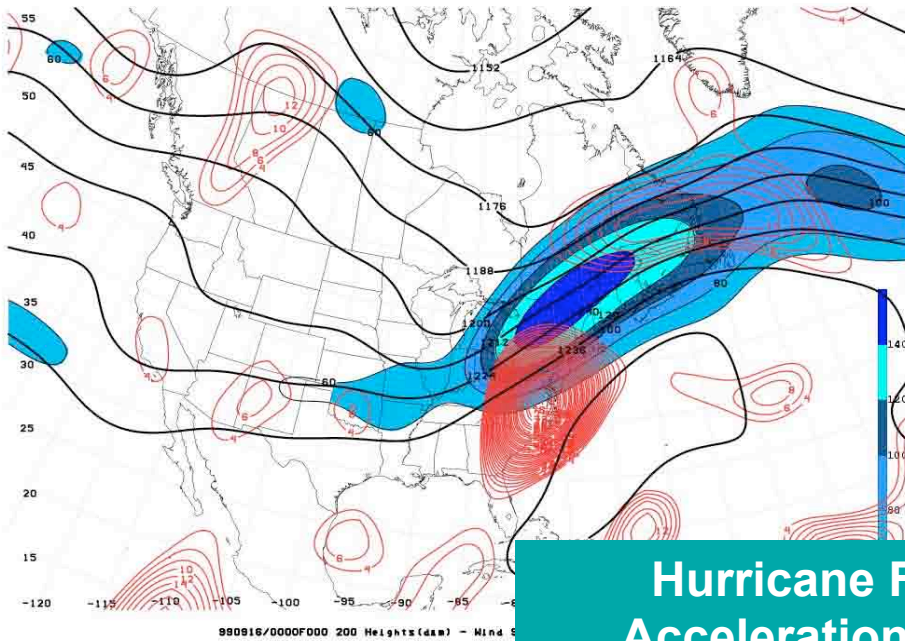
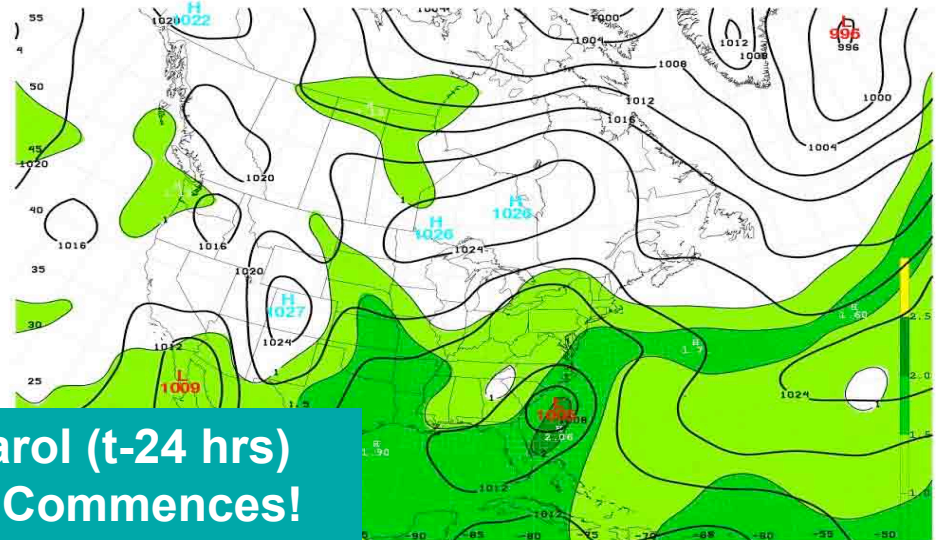
Hurricane Floyd (t-48 hrs)
Jet prepositioned to the northwest!



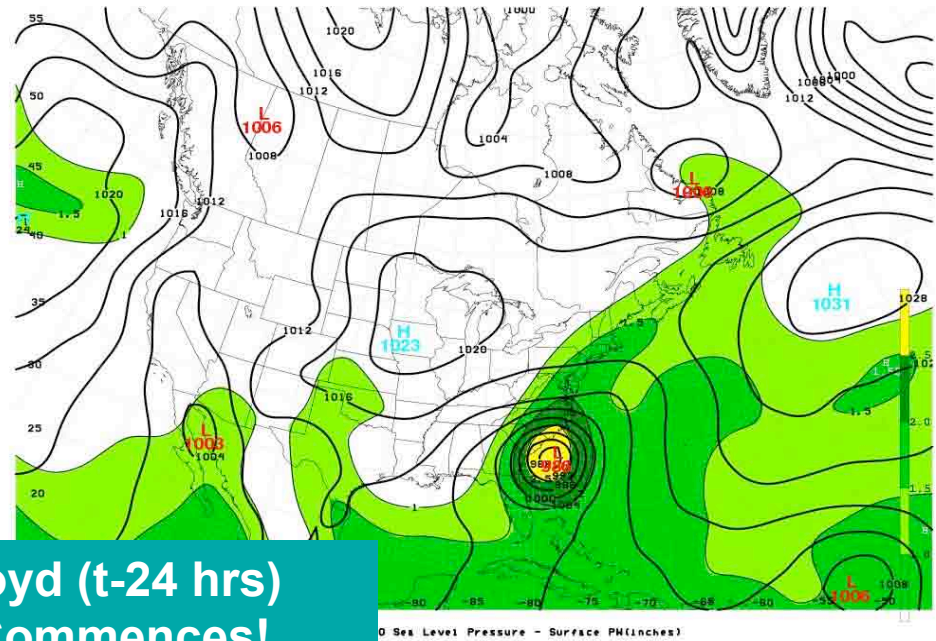
Interaction with the Westerlies



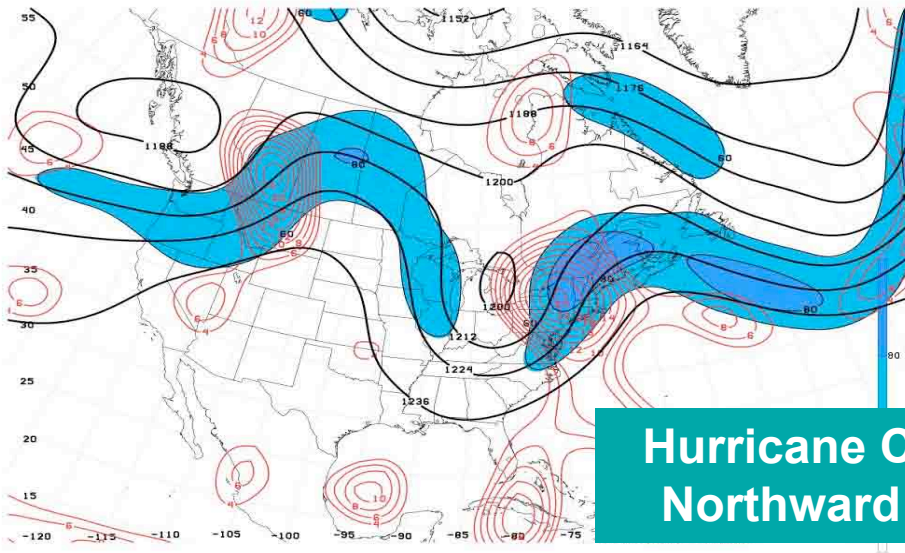
**Hurricane Carol (t-24 hrs)
Acceleration Commences!**



**Hurricane Floyd (t-24 hrs)
Acceleration Commences!**

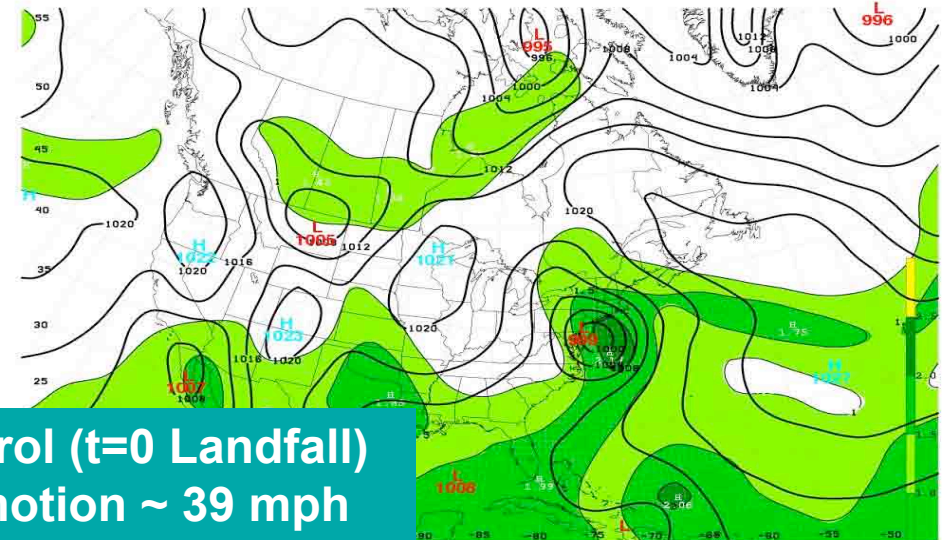


Interaction with the Westerlies

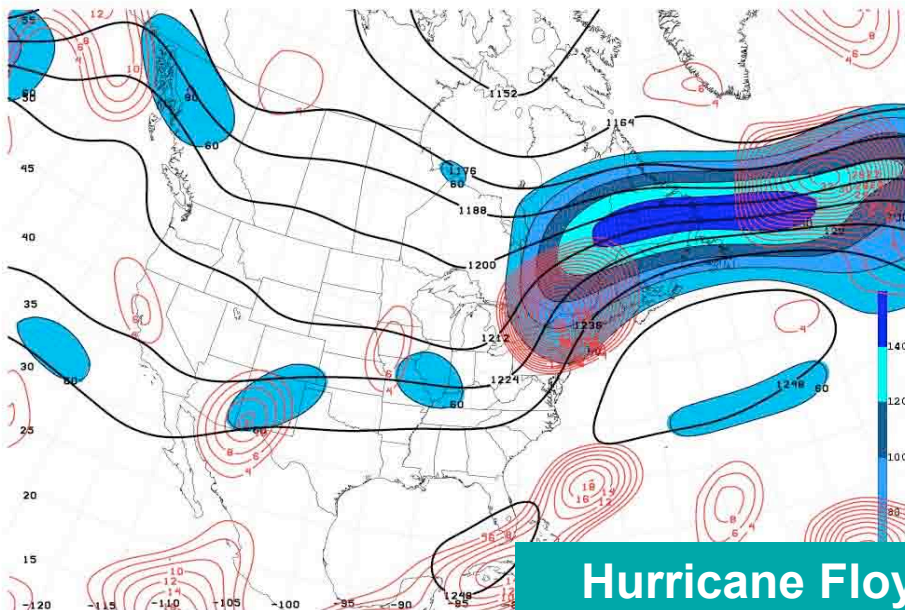


Hurricane Carol (t=0 Landfall)
Northward motion ~ 39 mph

540831/1200F000 200 Heights(dam) - Wind Speed(kts) - Div(10⁻⁵ s⁻¹)

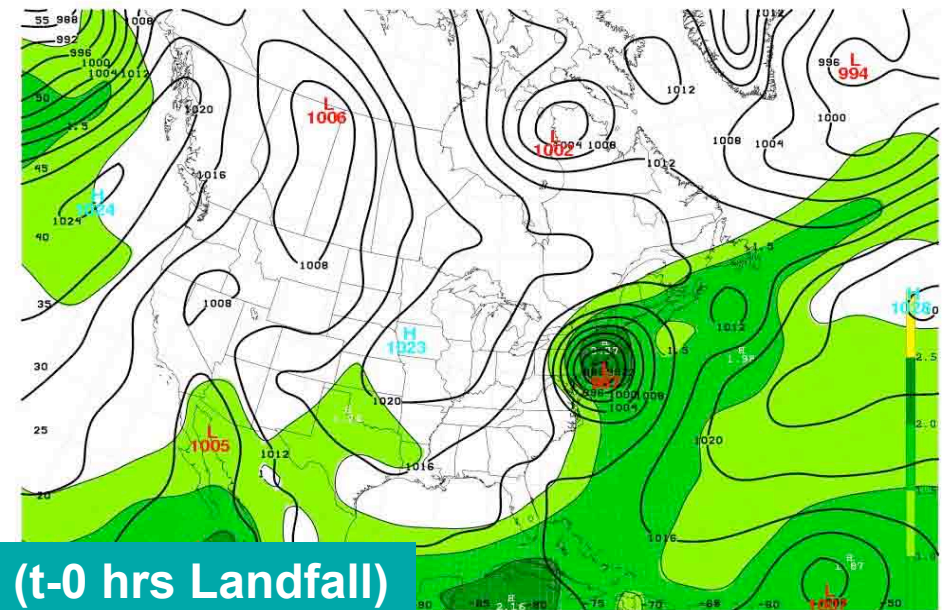


540831/1200F000 Sea Level Pressure - Surface PH(inches)



Hurricane Floyd (t=0 hrs Landfall)
North-northeast motion ~ 33 mph

980817/0000F000 200 Heights(dam) - Wind S



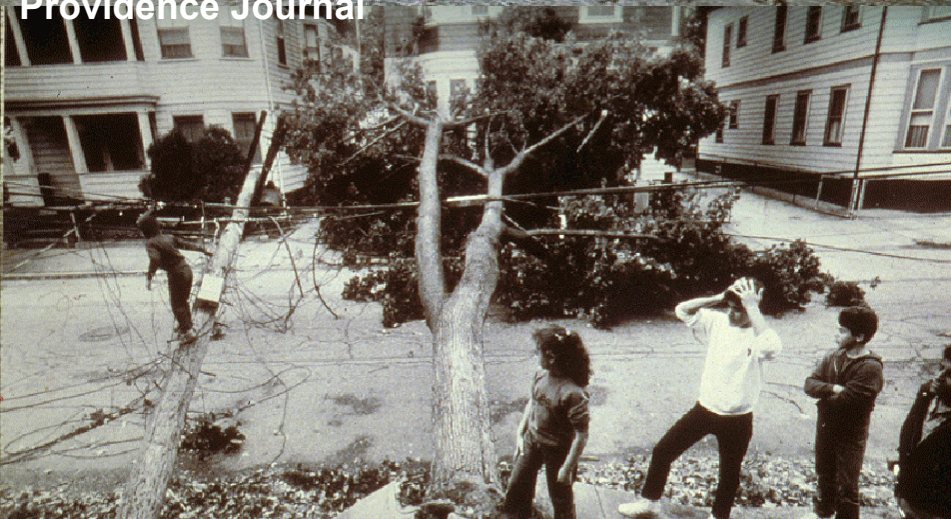
Level Pressure - Surface PH(inches)

High Winds

Hurricane Carol Wind Damage, at Bonnet Shores in Narragansett RI.

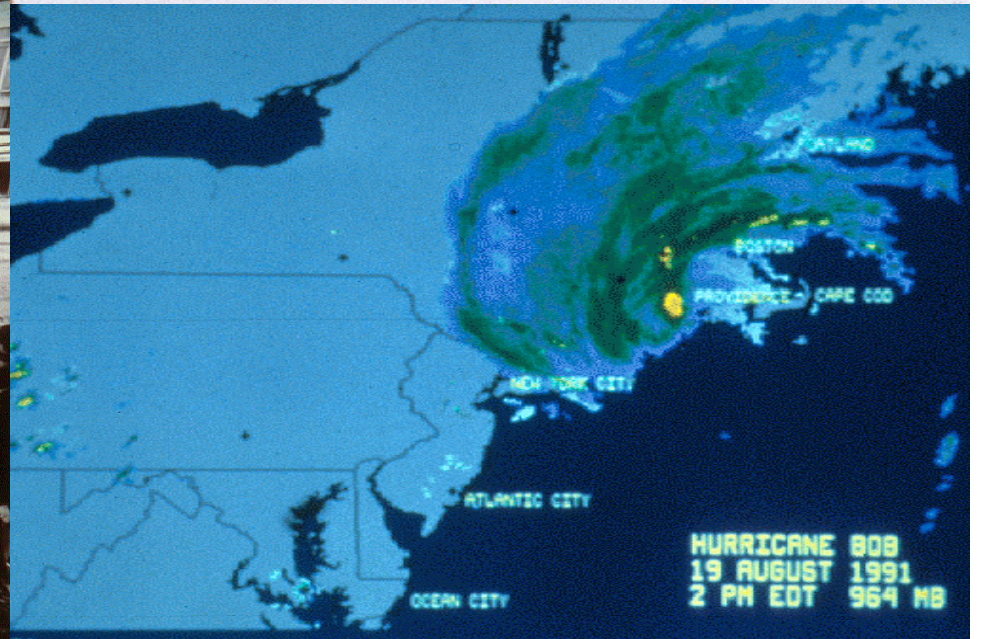
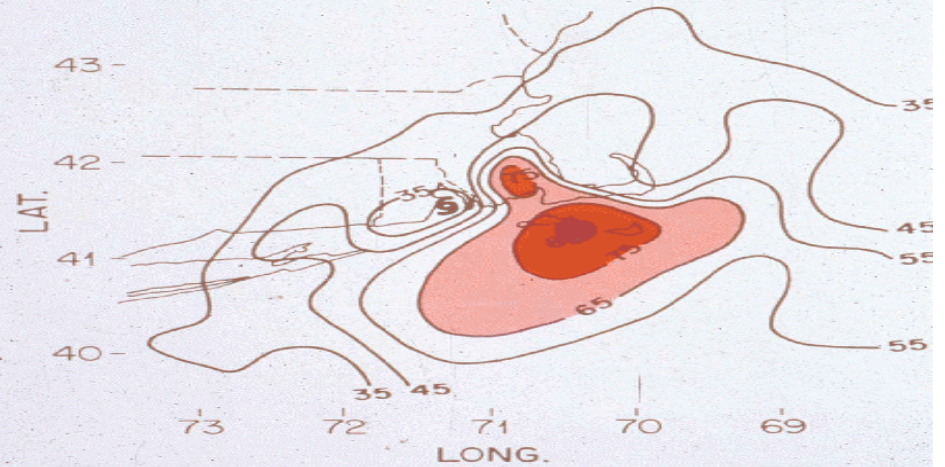


Providence Journal



Public Safety Hazards after Bob Downtown Providence, RI Aug '91

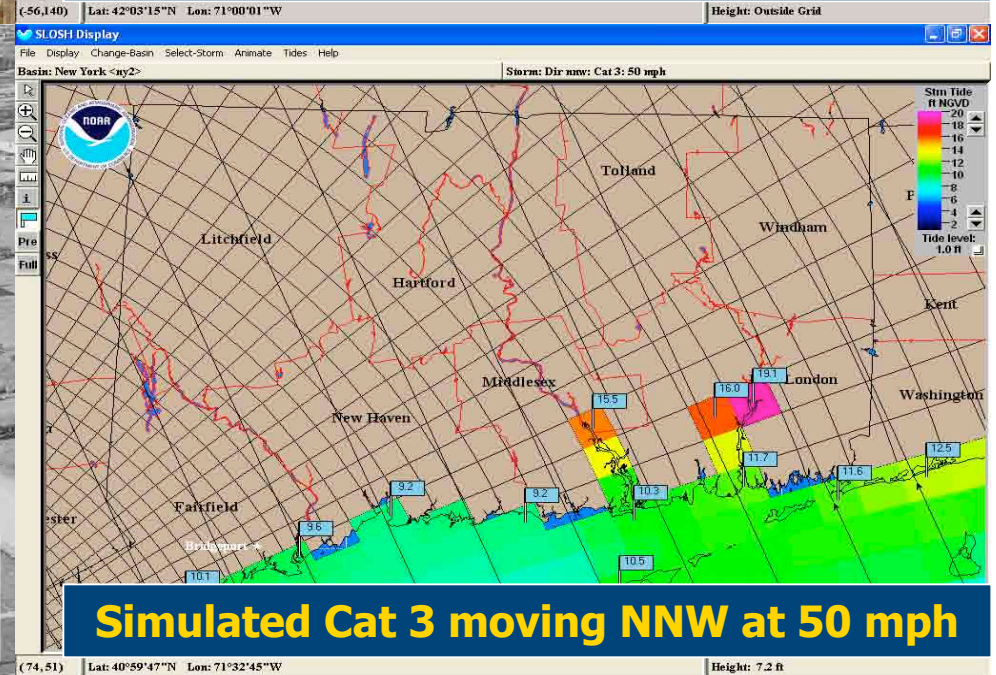
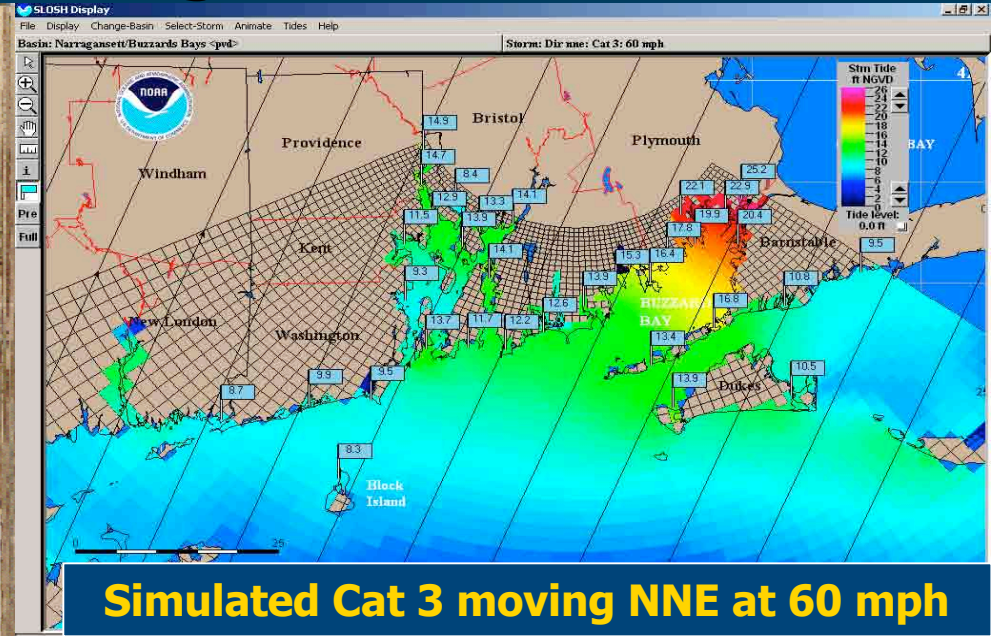
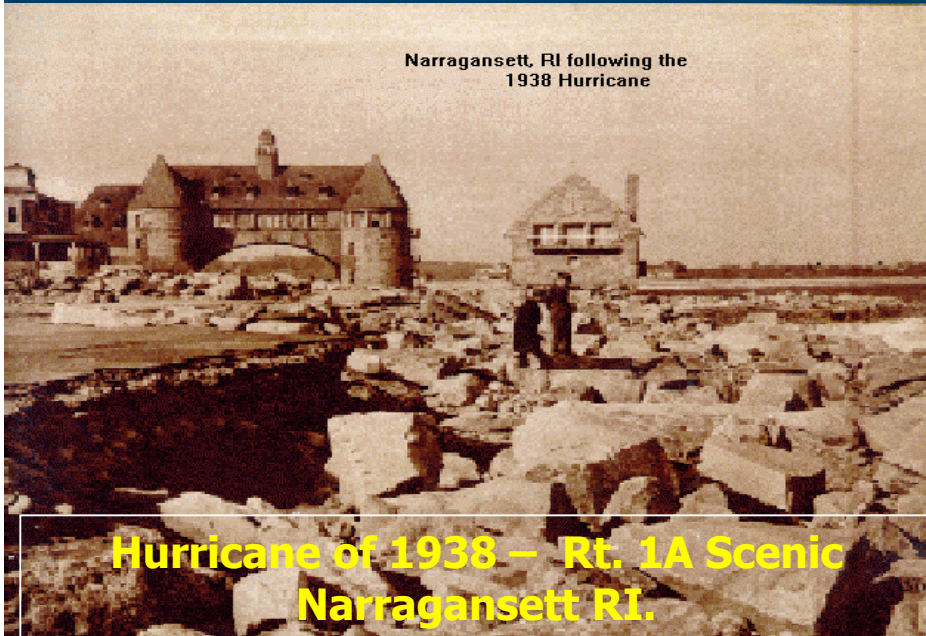
*HURRICANE BOB ISOTACHS
2PM AUG 19, 1991*



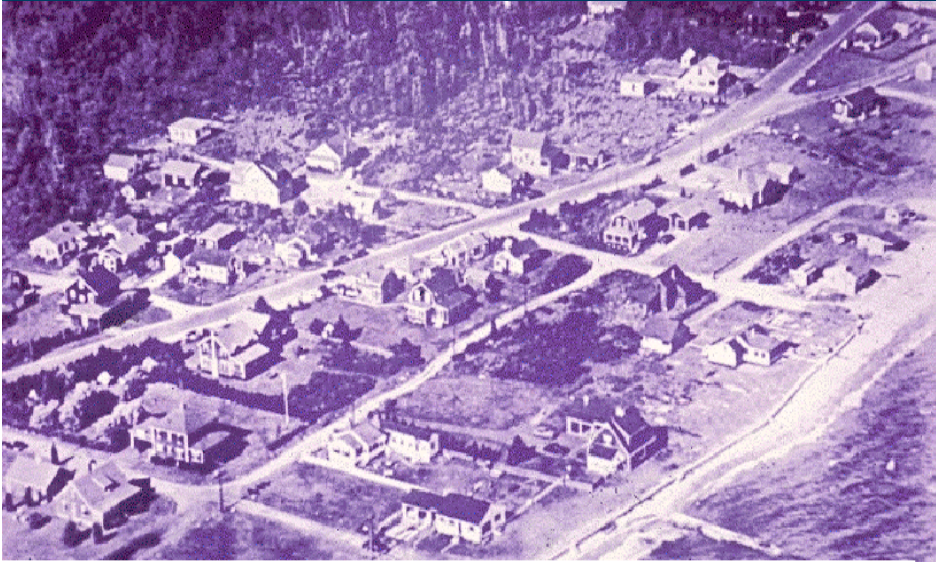
It's just a little breeze....

- Trees are weathered for Nor'easters
 - Southerly gales will produce far more wind damage
 - White Pines: Snap – lots of airborne debris
 - Oaks/maples – topple/uproot
 - Power poles – snap at the transformer level
- Structural failures most likely along the immediate coast
 - Are building codes adequate / are they being enforced??
- Power disrupted for days to weeks!
 - Are we prepared to deal with the ramifications of such an impact?
 - Must have a multi-state/regional approach to ensuring communication continues
 - Impacts commerce, transportation, health industry

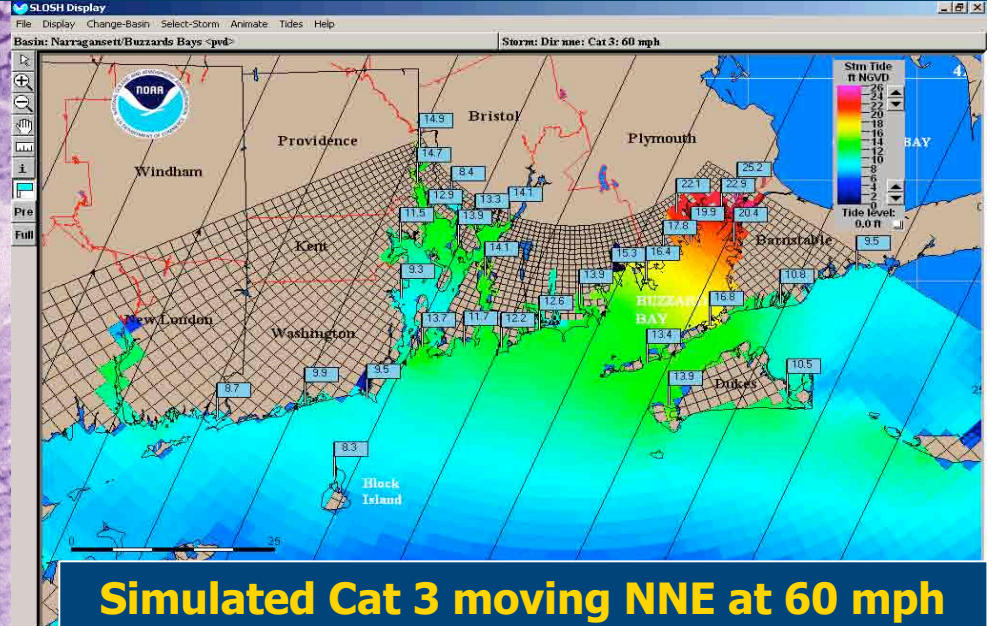
Storm Surge



Storm Surge

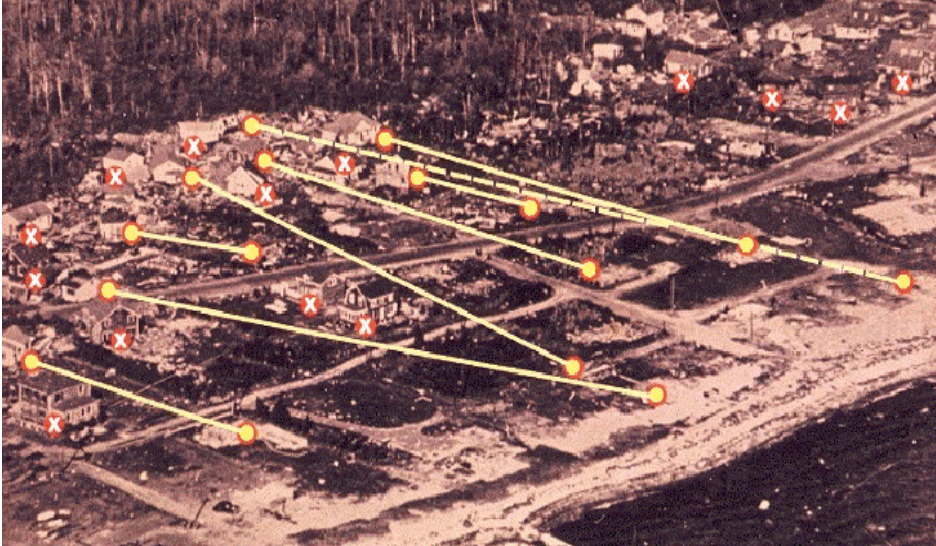


Crescent Beach, MA before Carol '54

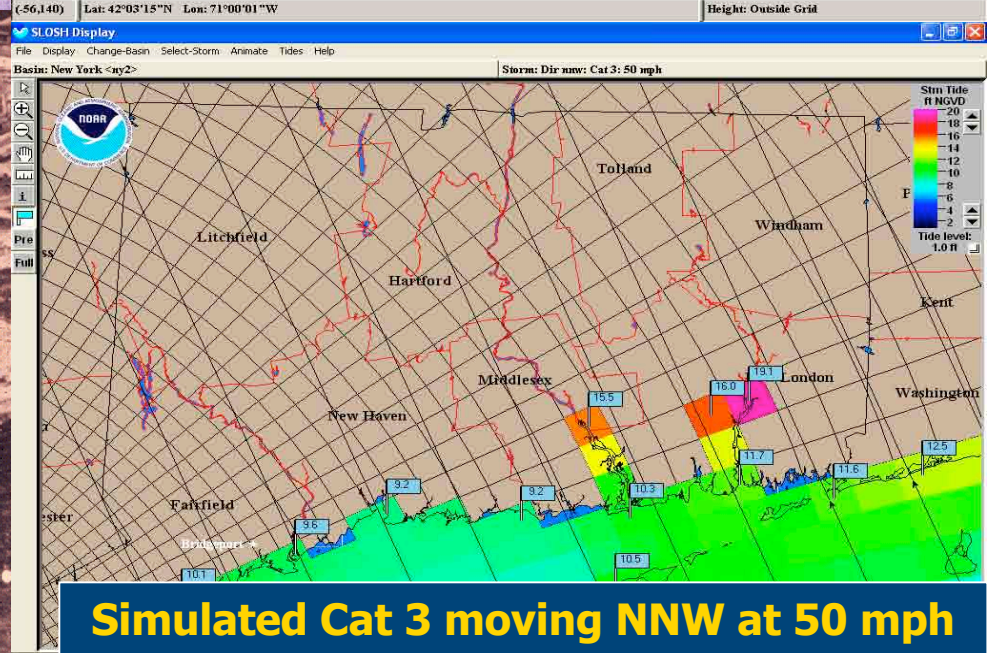


Simulated Cat 3 moving NNE at 60 mph

Providence Journal



Crescent Beach, MA after Carol '54



Simulated Cat 3 moving NNW at 50 mph

So its just a little ocean wave...

- Portions of neighborhoods – gone
 - Are evacuation plans in place and adequate?
 - Environmental impact of clean up/contamination issues
 - What do you do with the people who's homes have been destroyed?
 - What do you do related to permitting the rebuilding?
 - Hurricane Bob – folks grab hammer/nails and did it as fast as they could – no permits, no enforcement, no inspections!
 - What about infrastructure: The Ports!
 - Loss of commerce, greatly retracted capacity to supply oil, natural gas, etc. (Port of Providence)
 - Are building codes adequate / are they being enforced??



Debris line #2 – Significant debris pushed into properties causing structural damage

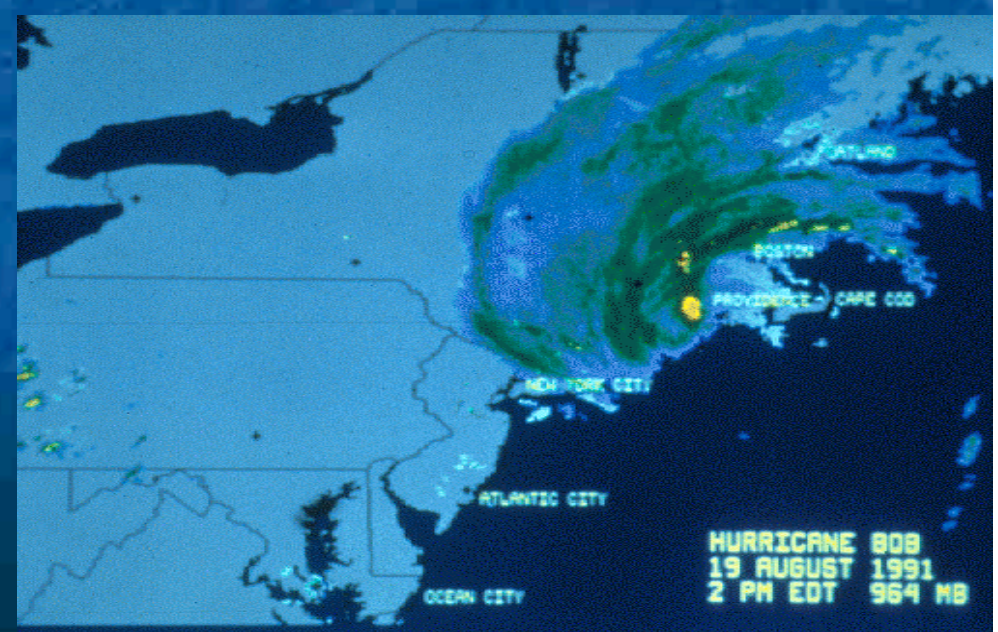
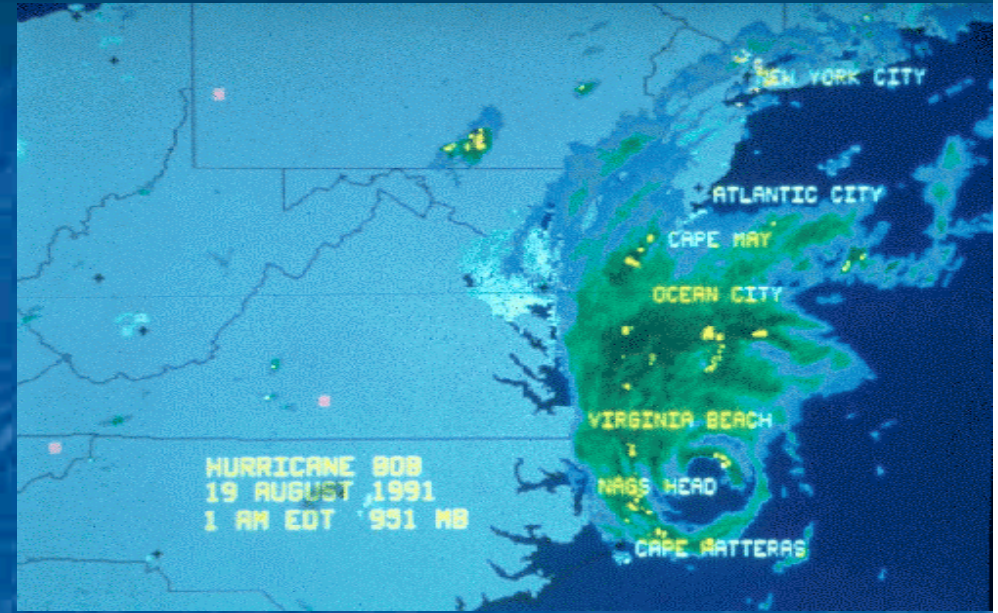
Debris line #1 – homes destroyed and dislodged from foundations

And what about all that debris???

Note the inland extent of structural damage!

Heavy Rainfall

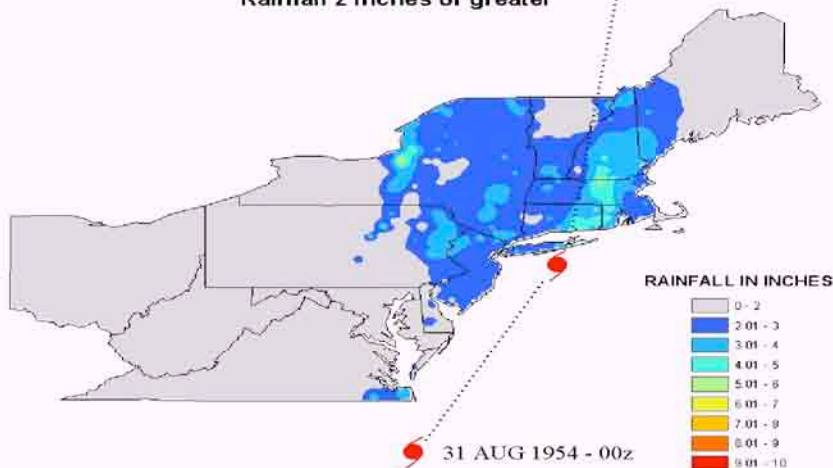
- Two types of distributions
 - Along/Right of Track
 - Left of Track
- Some systems “changed phase” as they turned and accelerated northeastward
- Nearly every tropical cyclone studied was going through some degree of extra-tropical transition
- Nearly 1/2 of all our storms produced small stream/river flooding in the region!
- Average rainfall 6-8 inches



Historical Perspective Heavy Rainfall Distribution

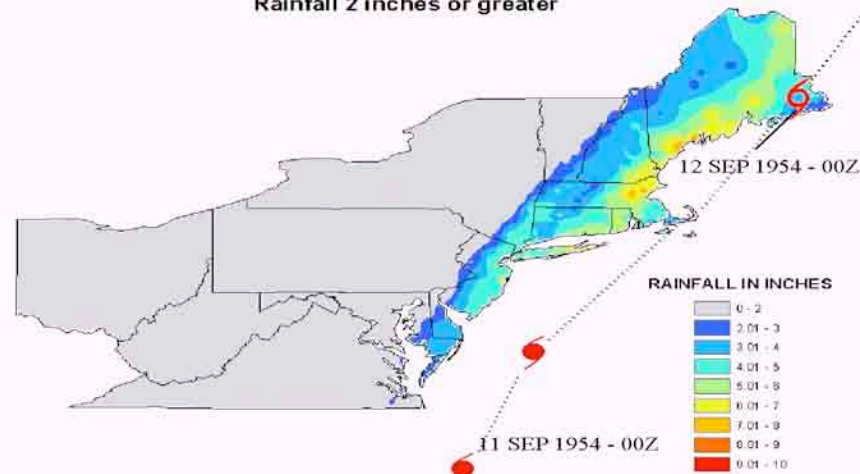
Hurricane Carol - 1954 ^L 1 SEP 1954 - 00z

Rainfall 2 Inches or greater



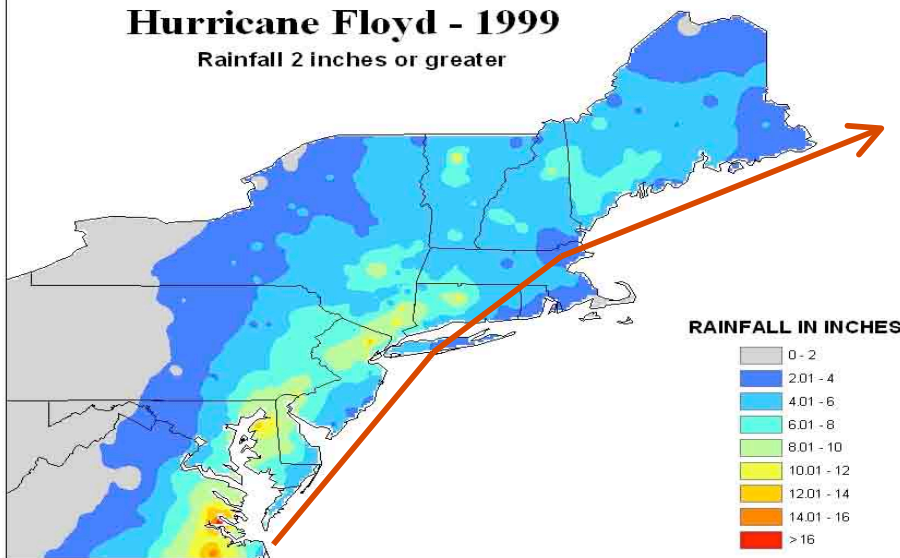
Hurricane Edna - 1954

Rainfall 2 Inches or greater



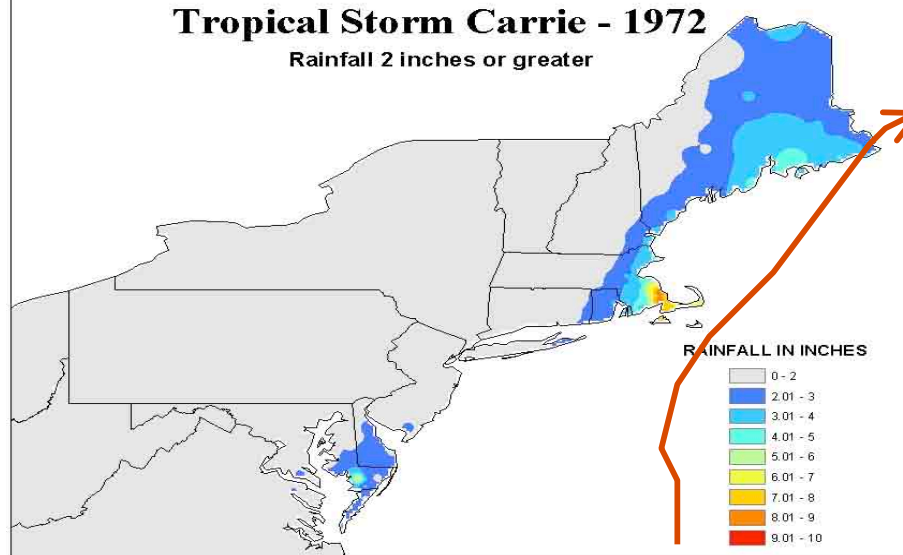
Hurricane Floyd - 1999

Rainfall 2 Inches or greater



Tropical Storm Carrie - 1972

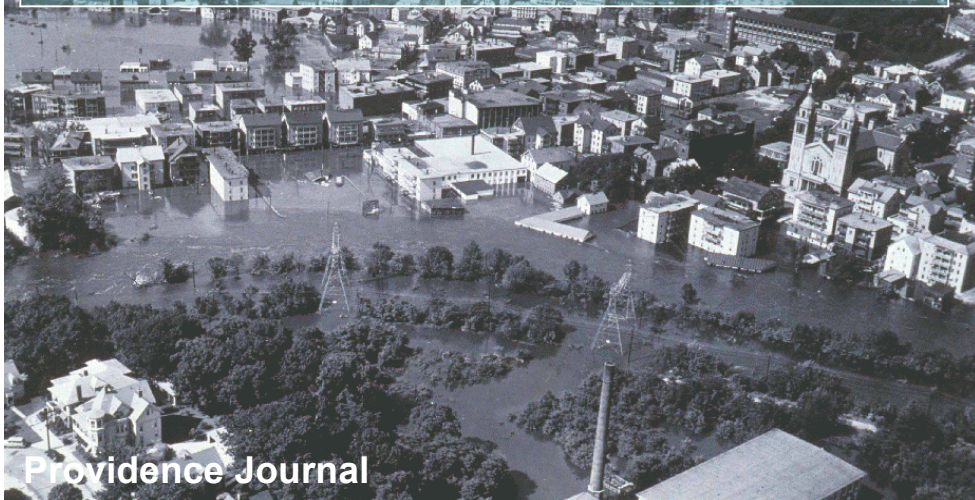
Rainfall 2 Inches or greater



Historical Perspective Widespread Flooding/Flash Flooding

City of Woonsocket, RI – Diane 1955

Flooded downtown “social/business” district



Providence Journal

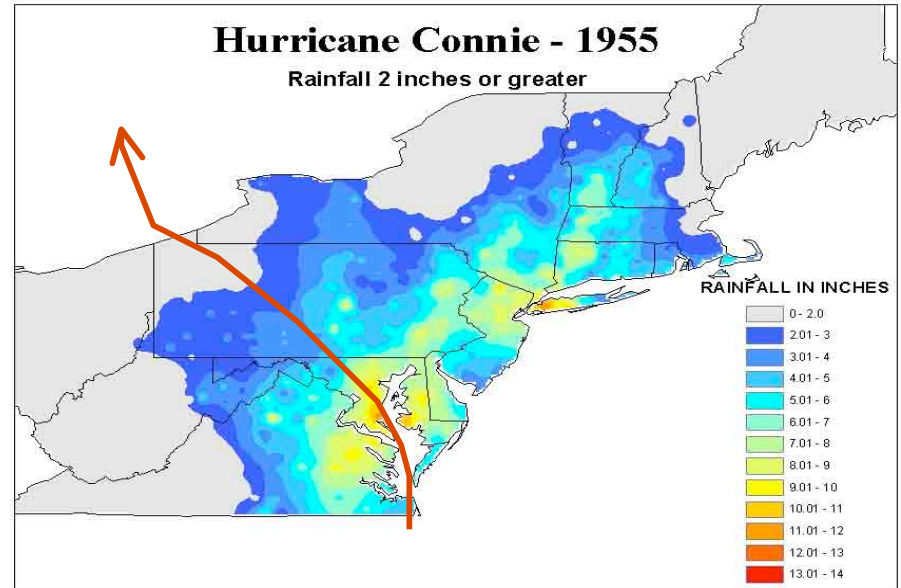
**Route 44 west – Putnam, CT
Tropical Storm Diane, 1955**



USACE NE Division

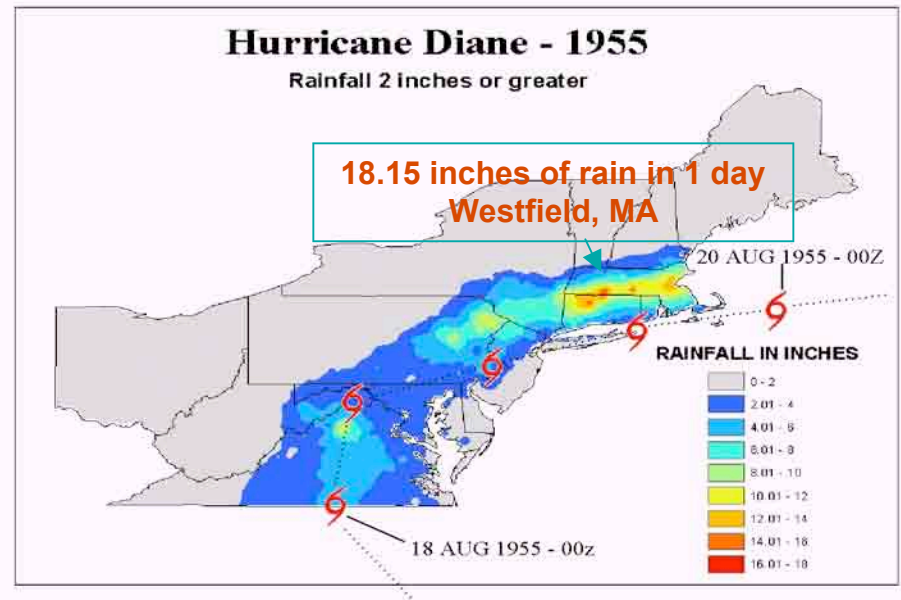
Hurricane Connie - 1955

Rainfall 2 inches or greater



Hurricane Diane - 1955

Rainfall 2 inches or greater



Historical Perspective Levee Breaches and Dam Failures

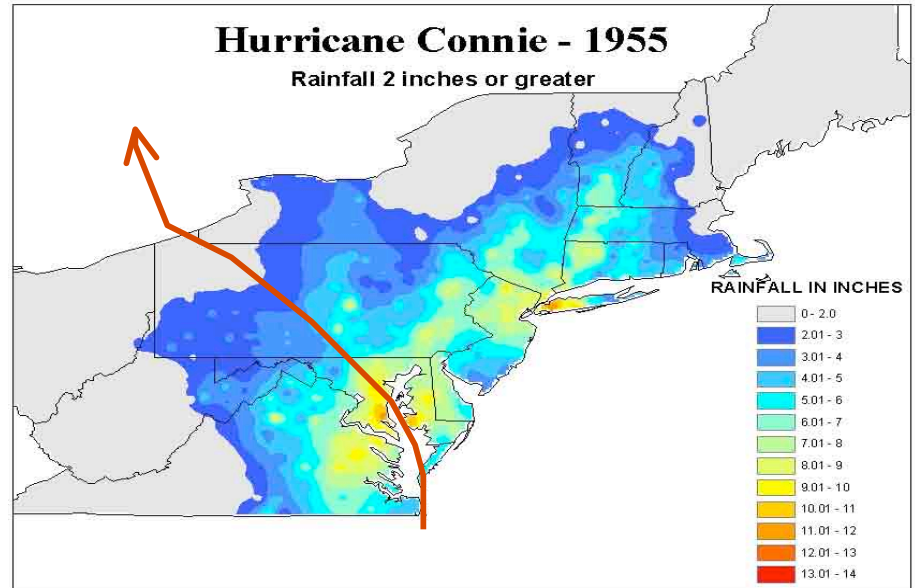
**Destroyed Shopping District – Diane 1955
Winsted, CT**



FIGURE 3.—Main shopping street of Winsted, Conn., after flood had subsided. Photograph by Hank Murphy, Hartford Times.

Hurricane Connie - 1955

Rainfall 2 inches or greater

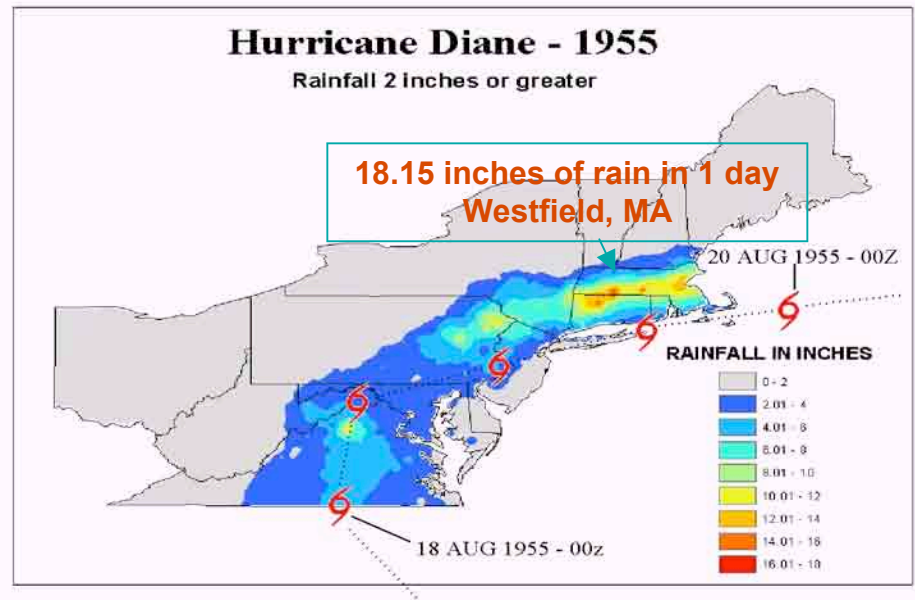


**Dozens of Dam Failures – Diane 1955
Echo Glen, Charlton, MA**

PLATE 6A.—Charlton, Mass. Scene showing dam failure at Glen Echo.

Hurricane Diane - 1955

Rainfall 2 inches or greater



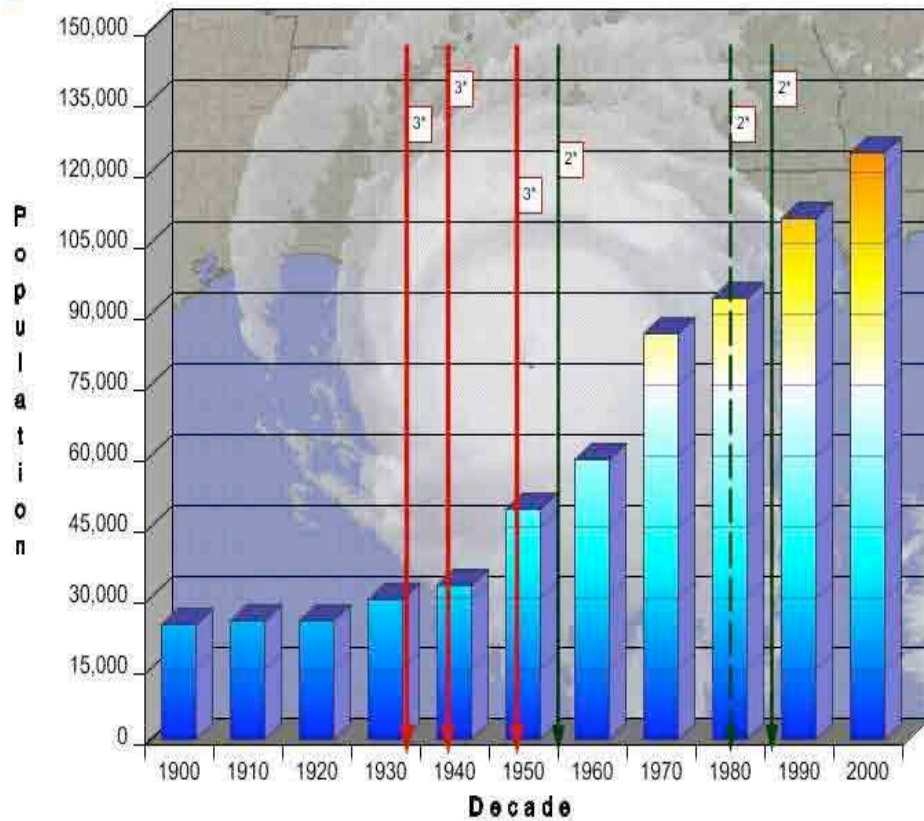
So its just a little water...

- Potential is high for levee breaches and dam failures
- Major flooding of river valleys large and small
 - Are evacuation plans in place and adequate?
 - Environmental impact of clean up/contamination issues
 - What do you do with the debris?
 - What do you do with the people who's homes have been flooded?
 - What do you do related to permitting the rebuilding?
 - Very small percent of folks are in NFIP
 - What about infrastructure:
 - Transportation – road washouts, bridge closures
 - Nursing homes, schools, businesses in the floodplain

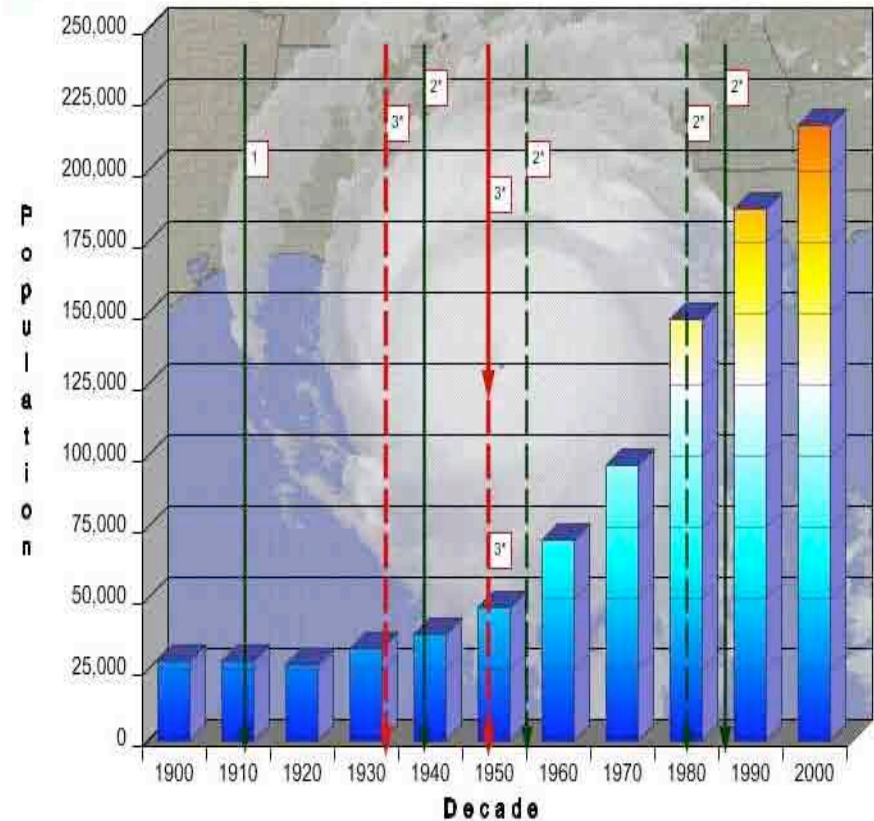
Perhaps our greatest obstacle: An inexperienced & complacent population...



Washington, RI

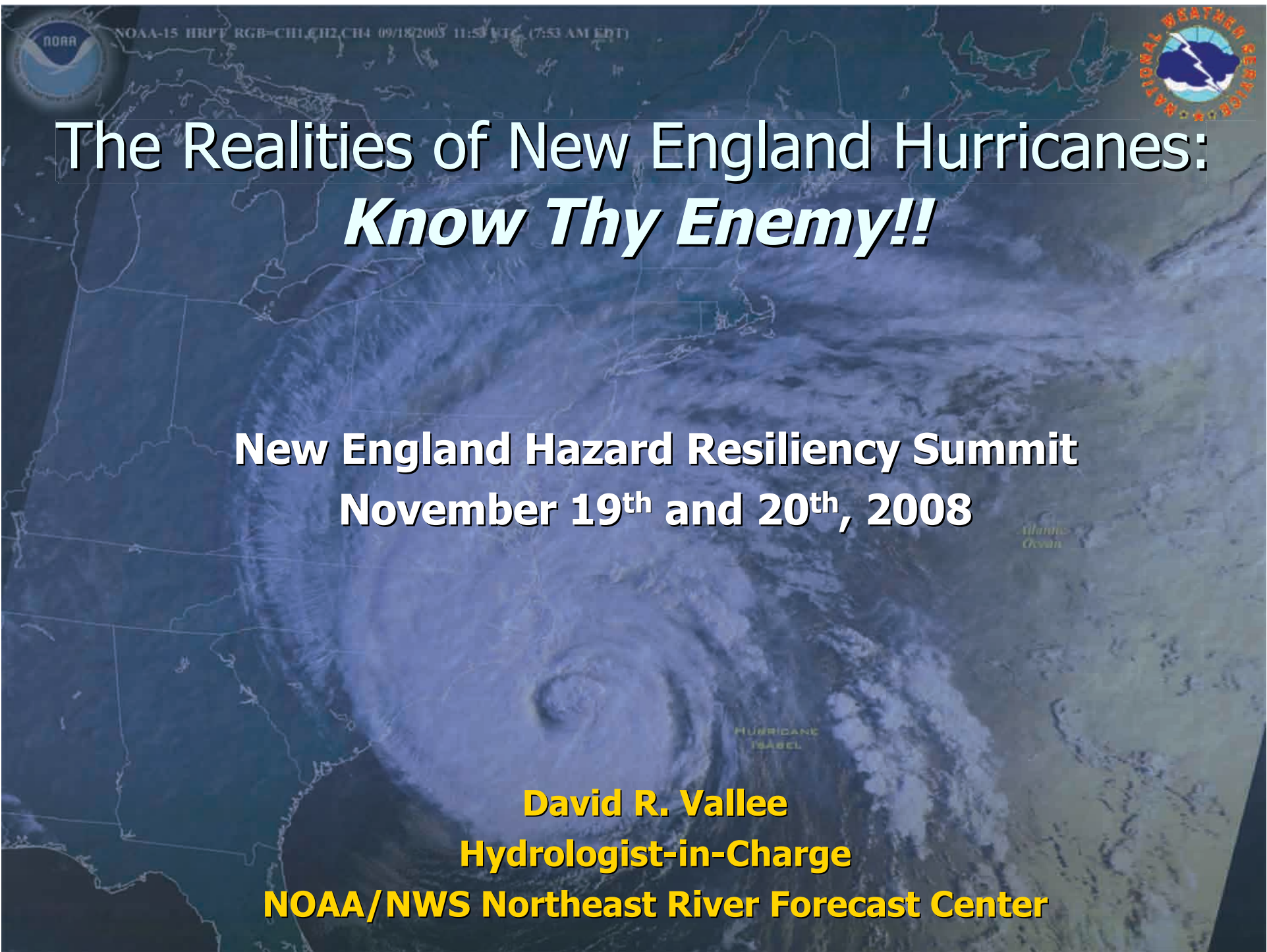


Barnstable, MA



Summary

- New England Tropical Cyclones have a particular behavior of their own
 - Driven by interaction with the westerlies
 - Desire to become Extra-tropical
- Rapid Acceleration drives the distribution of hazards
- Potential for widespread severe wind damage
- Potential for devastating storm surges
 - 20 feet or more in the upper Sakonnet River and upper Buzzards Bay
- Potential for widespread riverine flooding and flash flooding
 - Damage to neighborhoods, roadways, infrastructure



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