



NOAA-15 HRPT RGB-CH1,CH2,CH4 09/18/2005 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**

Atlantic
Ocean

HURRICANE
ISABEL

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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



Everyone in New England needs to pay careful attention!

Hurricane Floyd, September 13, 1999

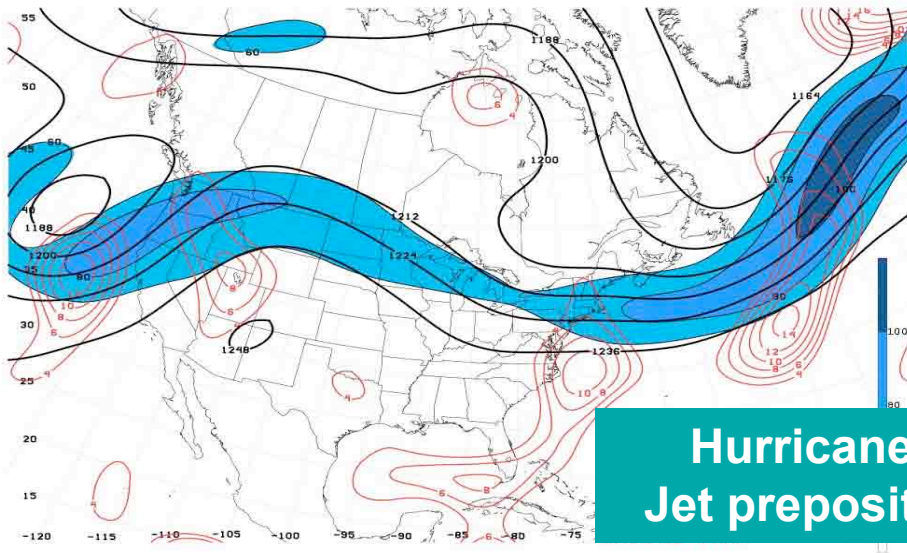
Common Characteristics

- 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

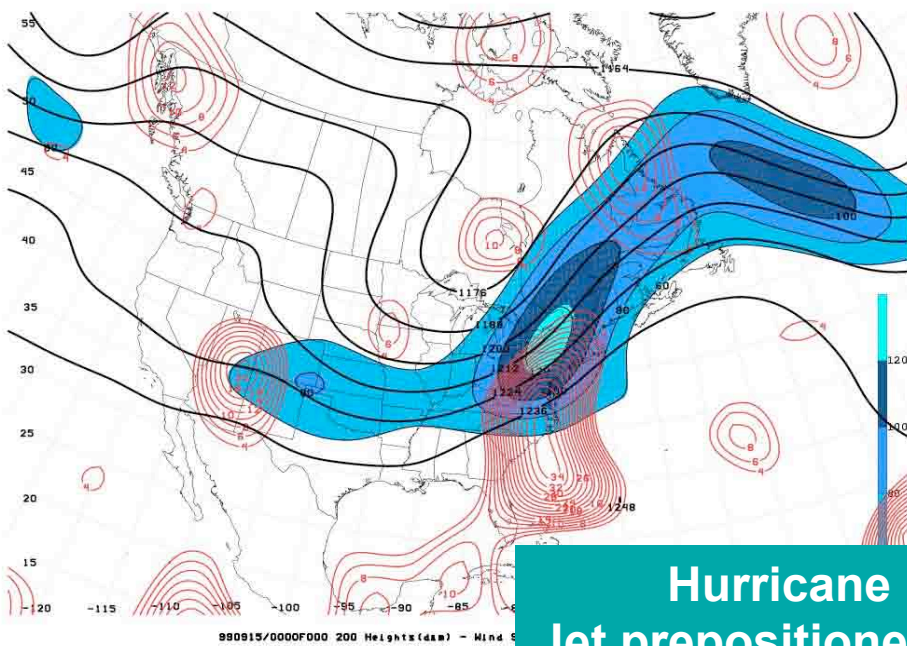
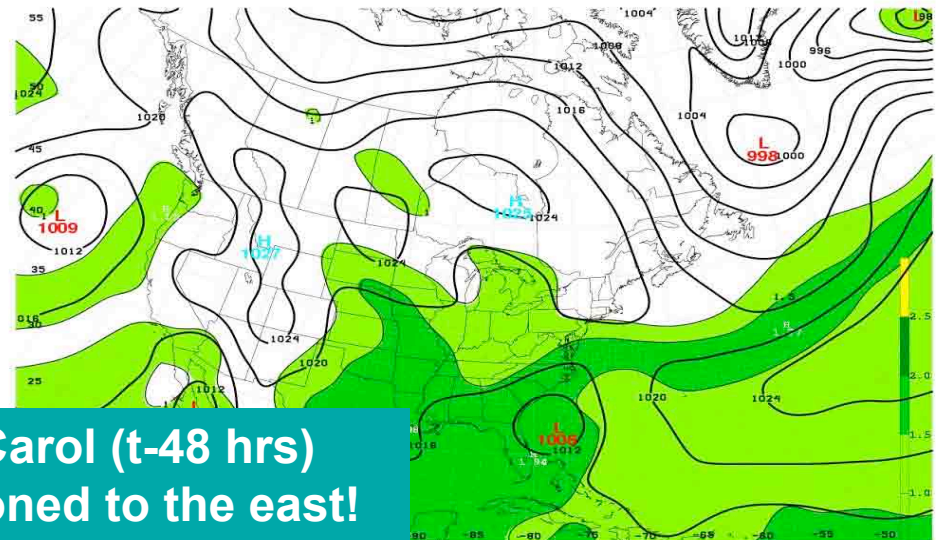
Remarkable Acceleration

- 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

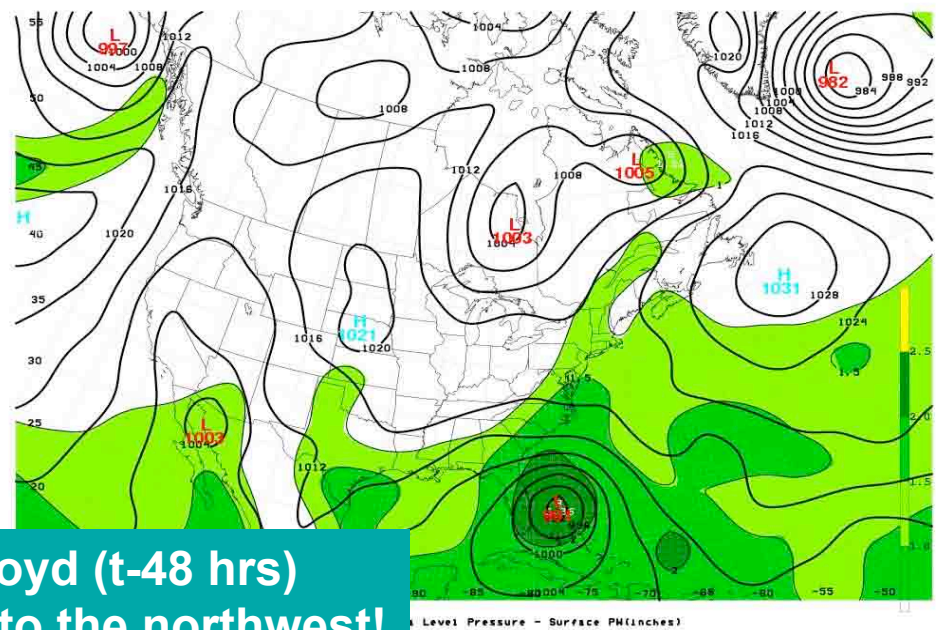
Interaction with the Westerlies



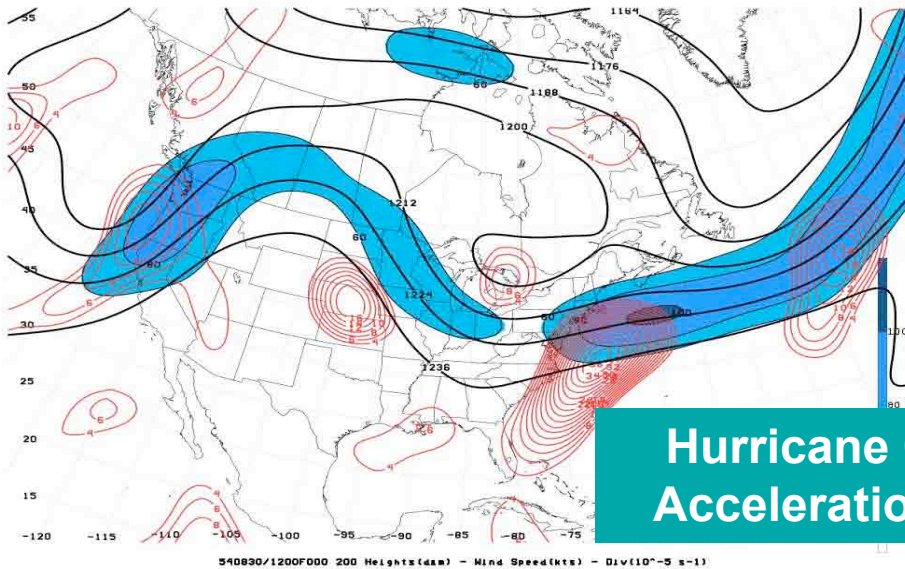
Hurricane Carol (t-48 hrs)
Jet prepositioned to the east!



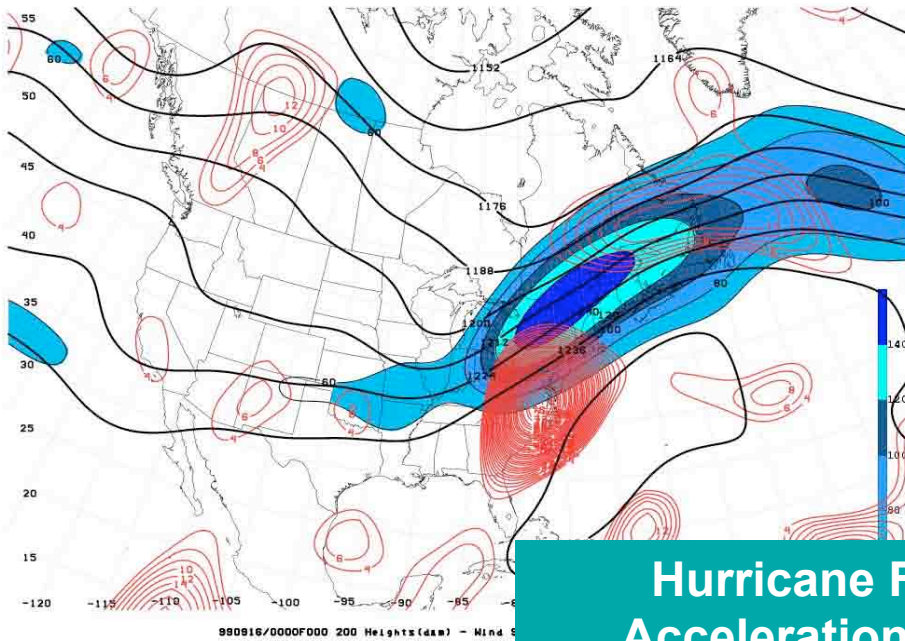
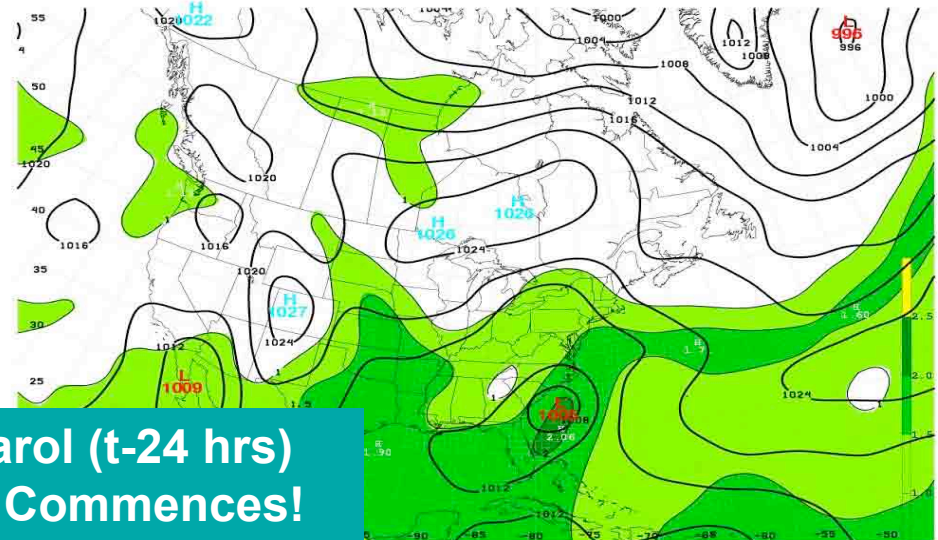
Hurricane Floyd (t-48 hrs)
Jet prepositioned to the northwest!



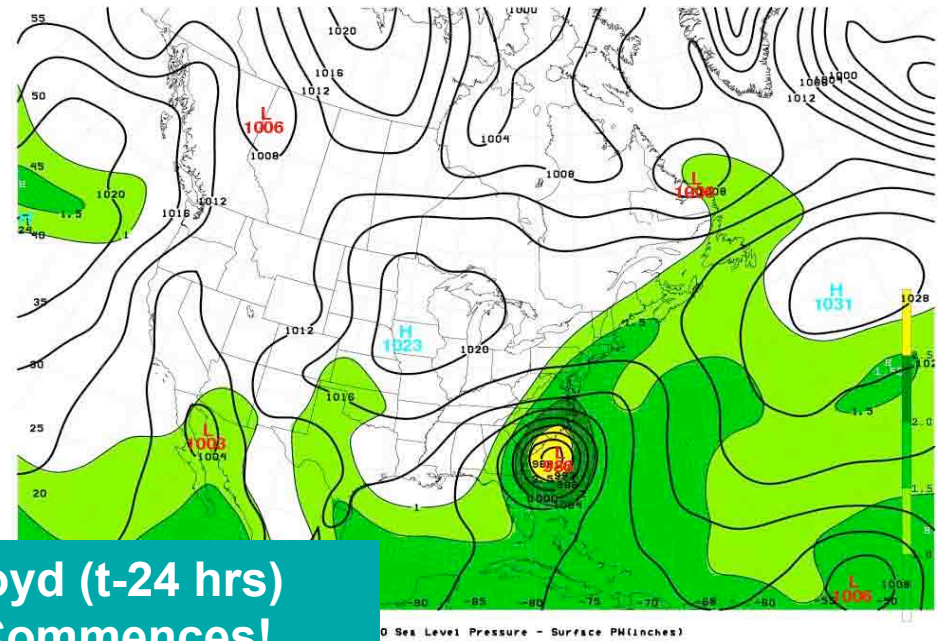
Interaction with the Westerlies



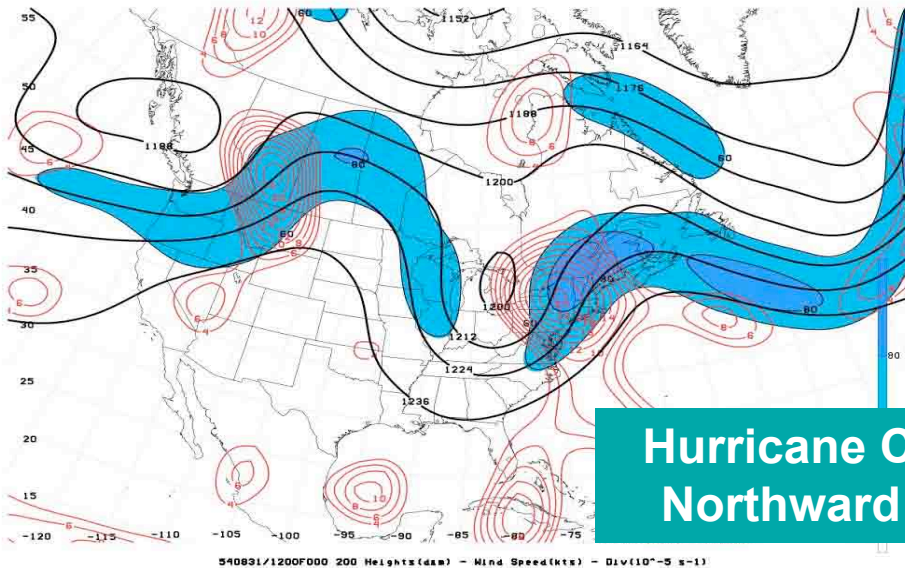
**Hurricane Carol (t-24 hrs)
Acceleration Commences!**



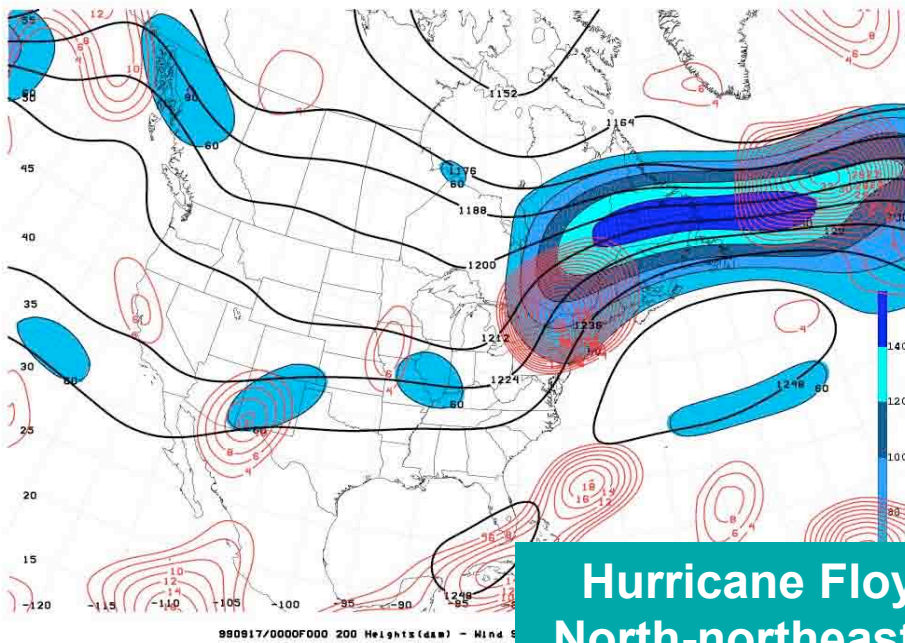
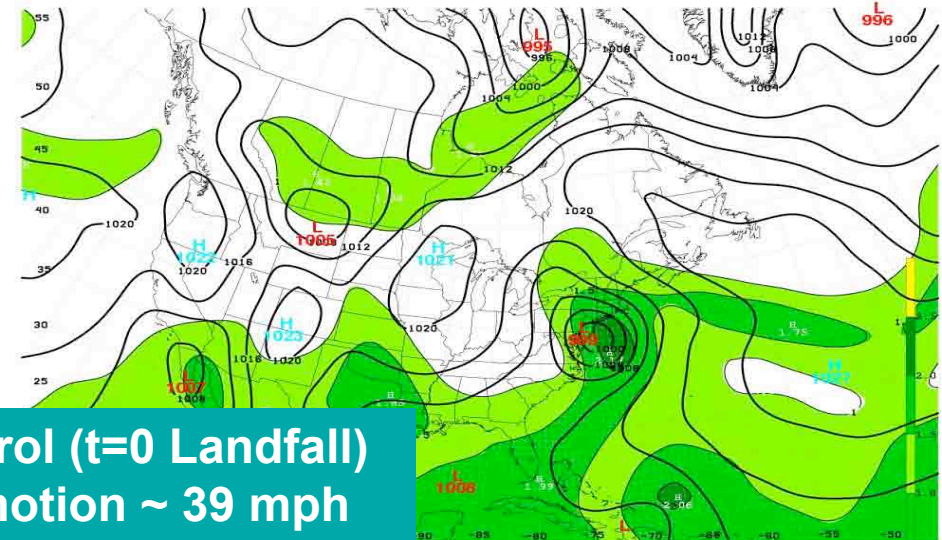
**Hurricane Floyd (t-24 hrs)
Acceleration Commences!**



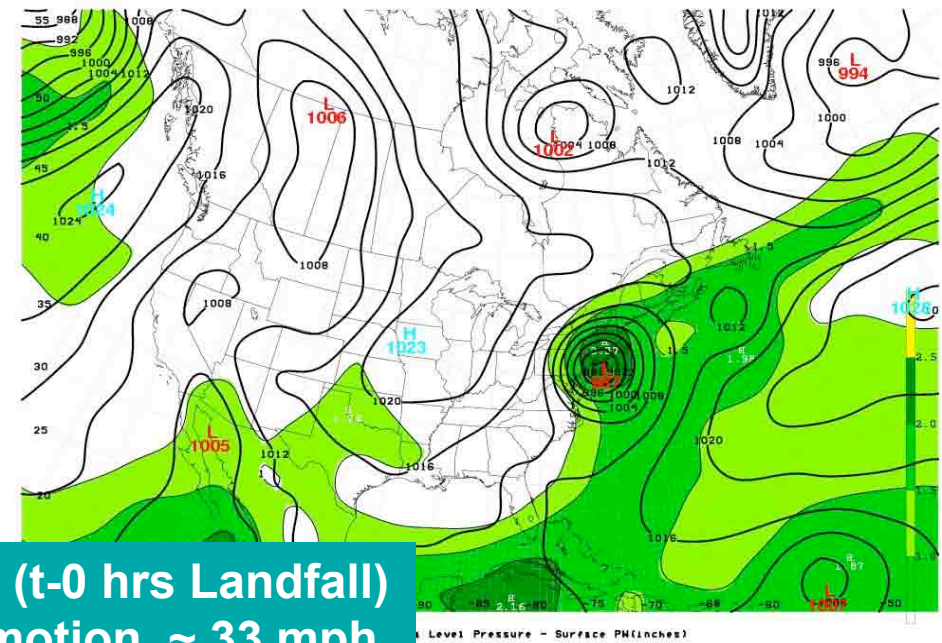
Interaction with the Westerlies



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



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

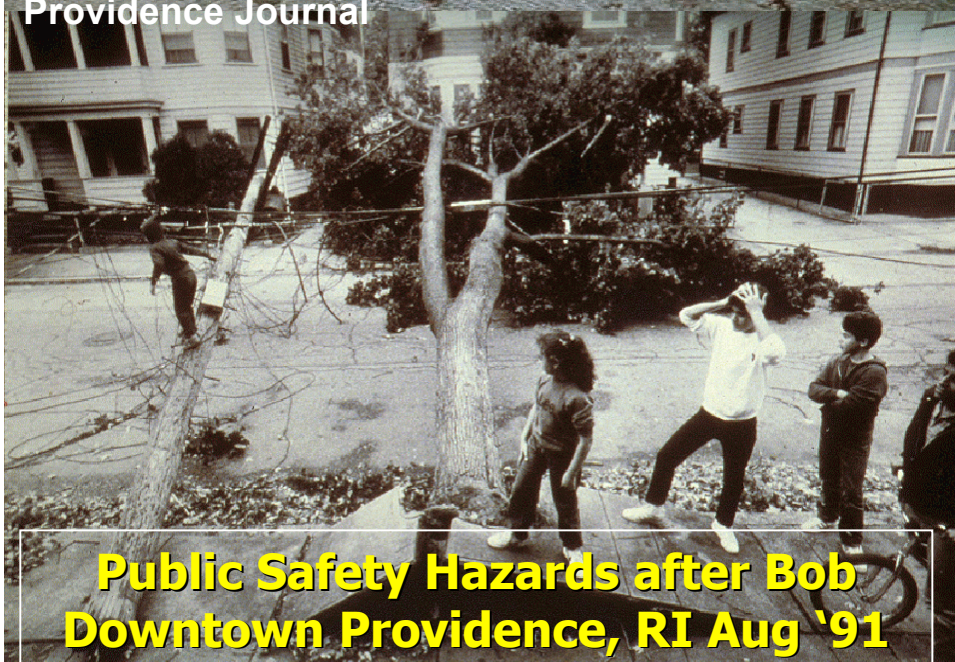


High Winds

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

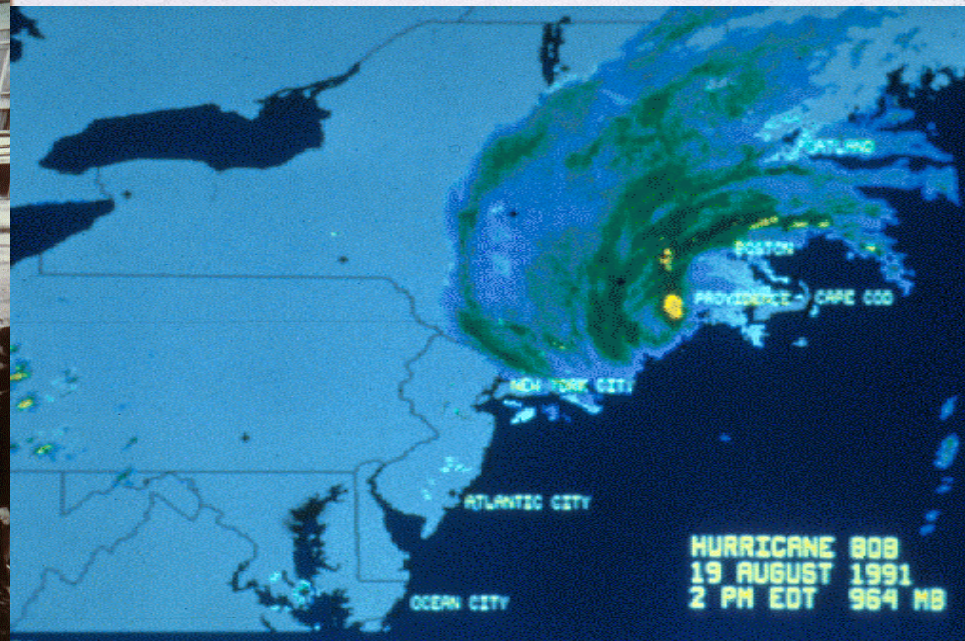
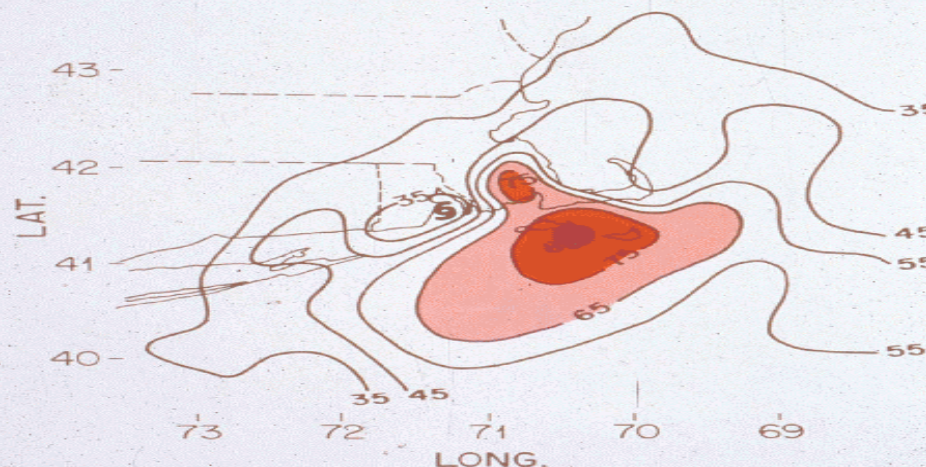


Providence Journal



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

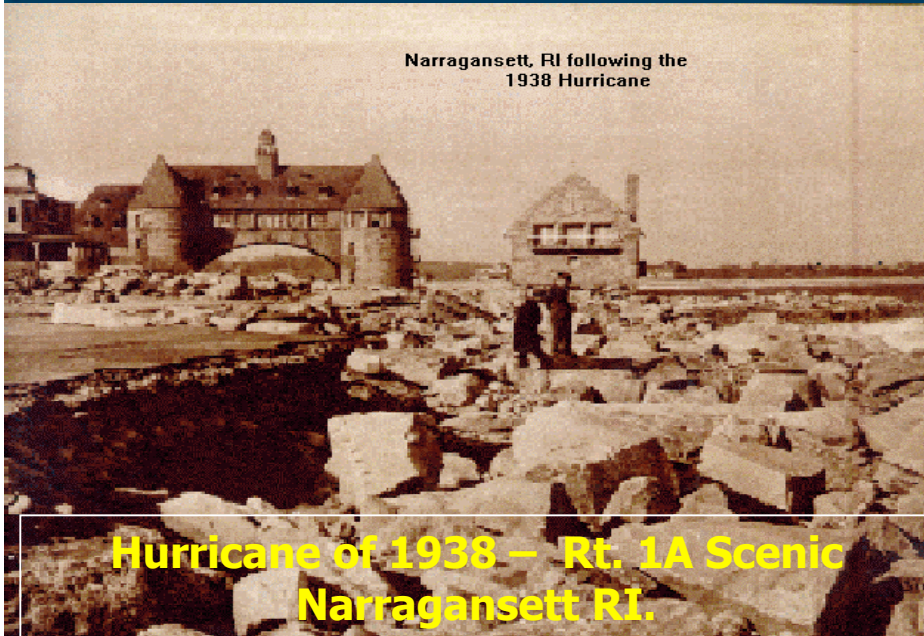
*HURRICANE BOB ISOTACHS
2PM AUG 19, 1991*



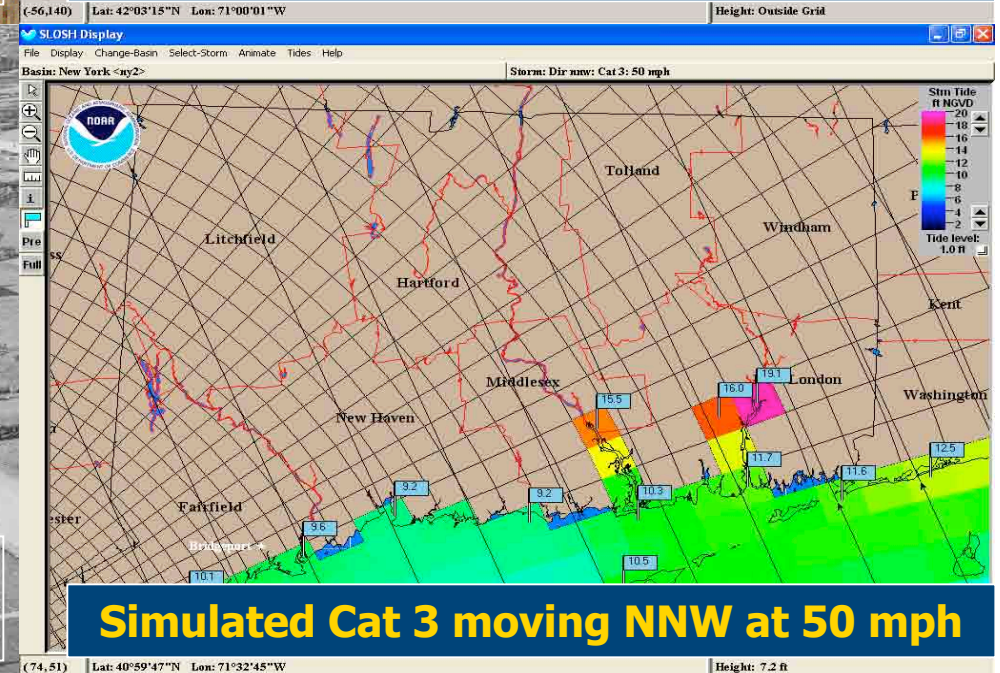
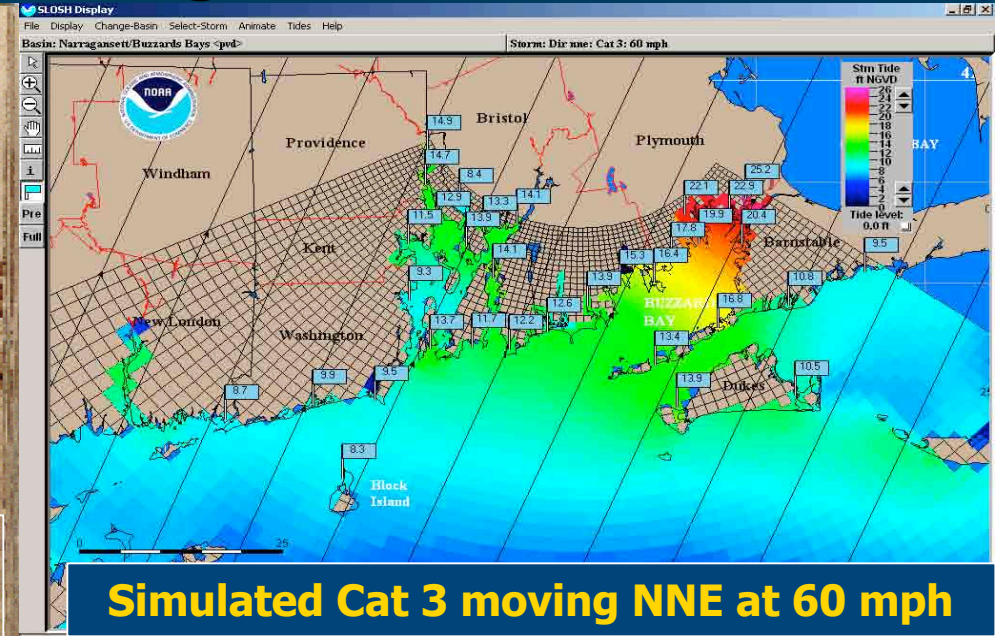
It's just a little breeze....

- 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



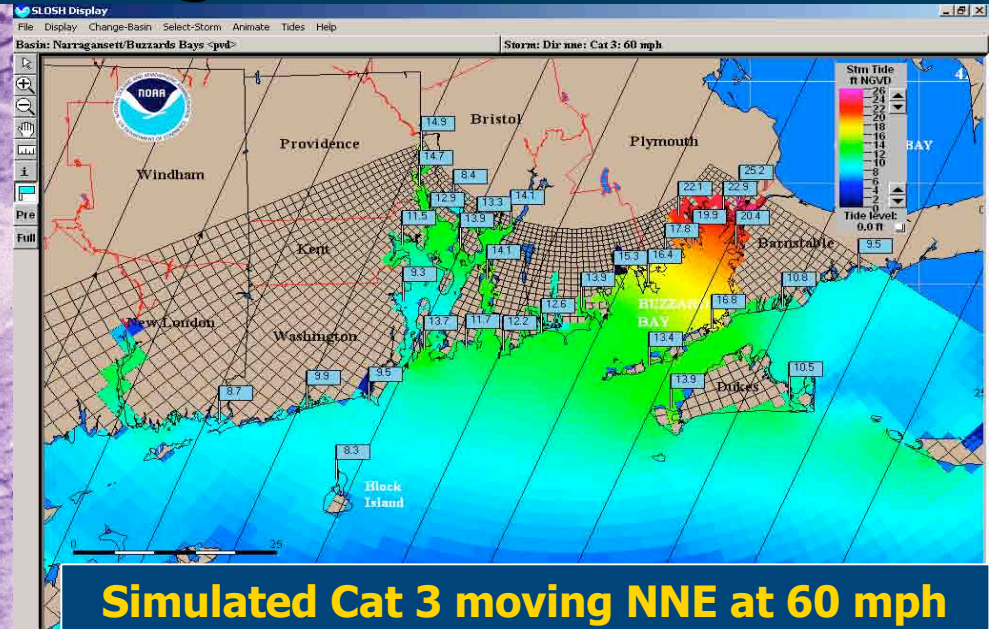
Providence Journal



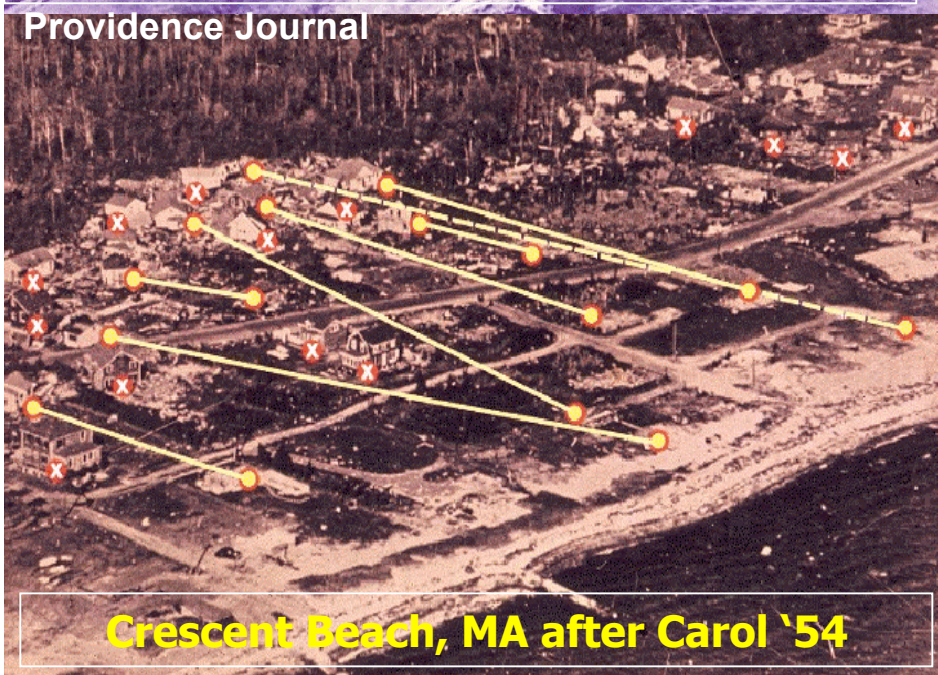
Storm Surge



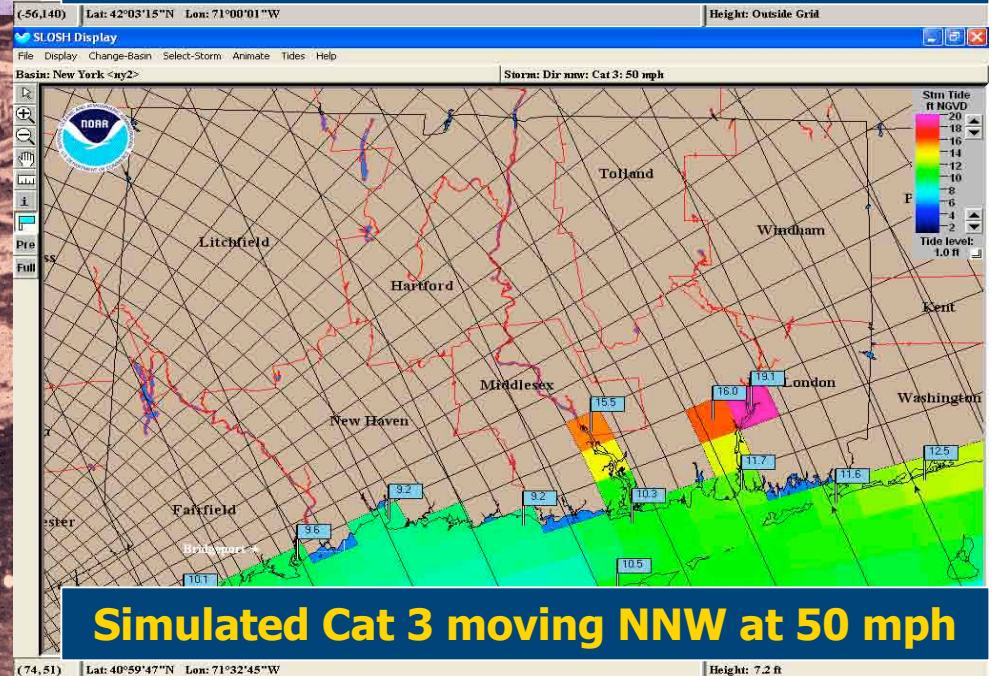
Crescent Beach, MA before Carol '54



Simulated Cat 3 moving NNE at 60 mph



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

The photograph is an aerial view of a coastal town. A yellow line, labeled 'Debris line #2', starts near the top left and follows a path of debris into residential areas. A red line, labeled 'Debris line #1', starts further inland and follows a path of destroyed homes. The town is densely packed with houses, many of which appear damaged or destroyed. The coastline is visible on the right side, with some boats in the water. The overall scene depicts the aftermath of a major disaster, likely a hurricane or storm surge.

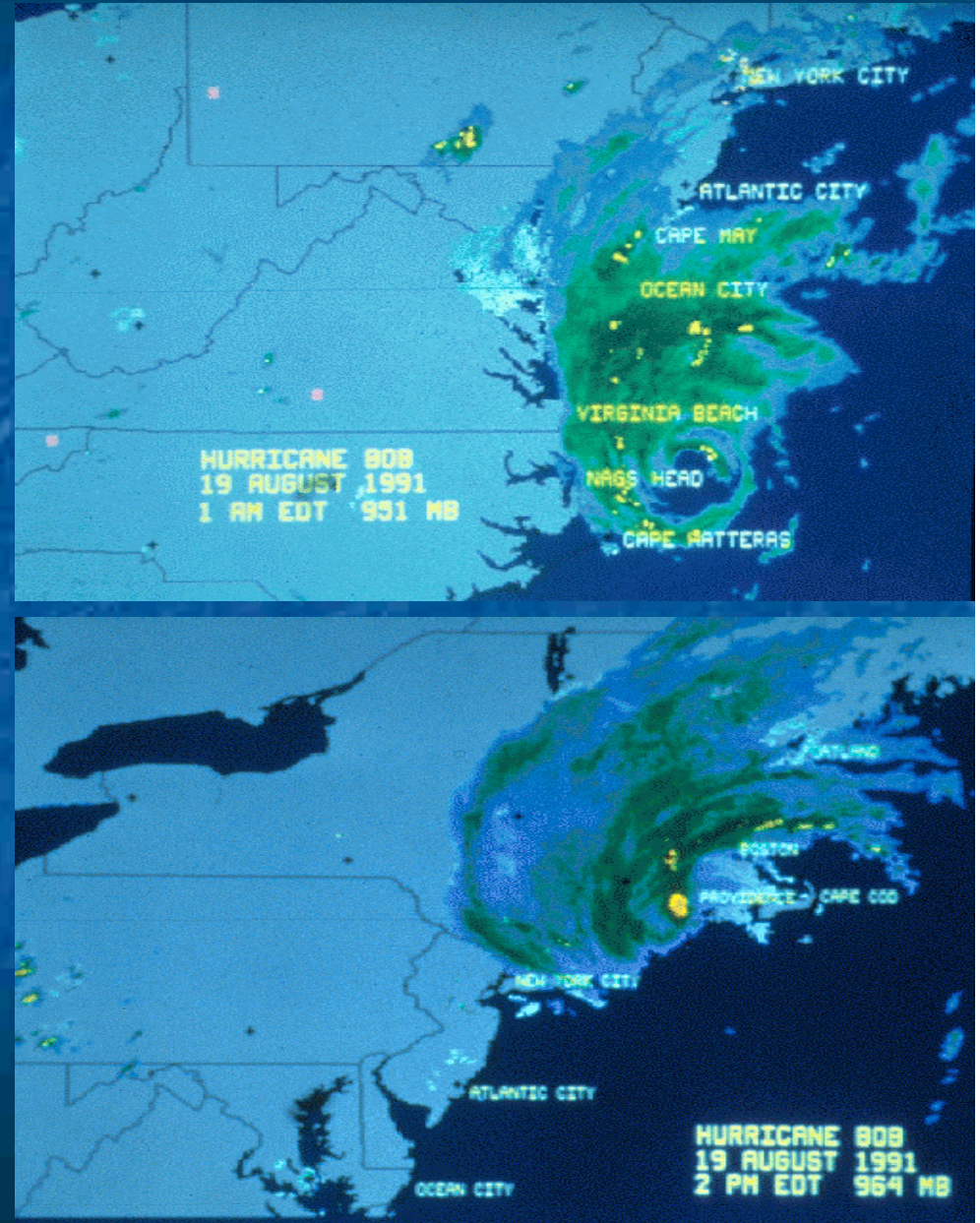
Debris line #1 – homes destroyed
and dislodged from foundations

And what about all that debris???

Note the inland extent of structural damage!

Heavy Rainfall

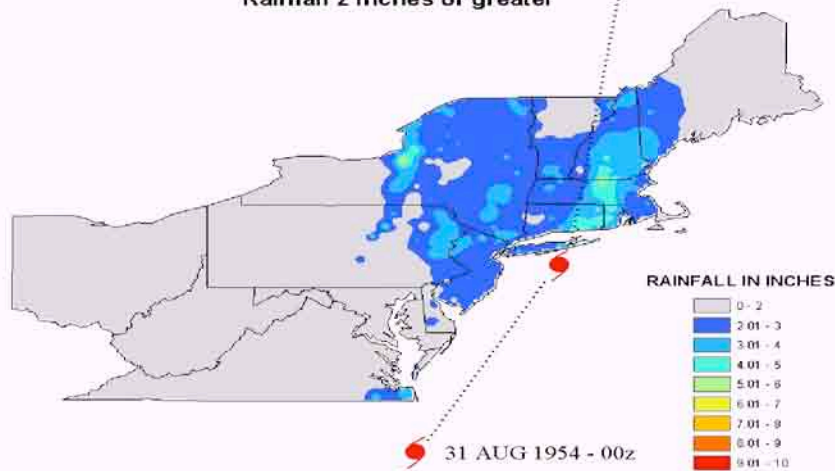
- Two types of distributions
 - Along/Right of Track
 - Left of Track
- Some systems “changed phase” as they turned and accelerated northeastward
- Nearly every tropical cyclone studied was going through some degree of extra-tropical transition
- Nearly 1/2 of all our storms produced small stream/river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



Historical Perspective Heavy Rainfall Distribution

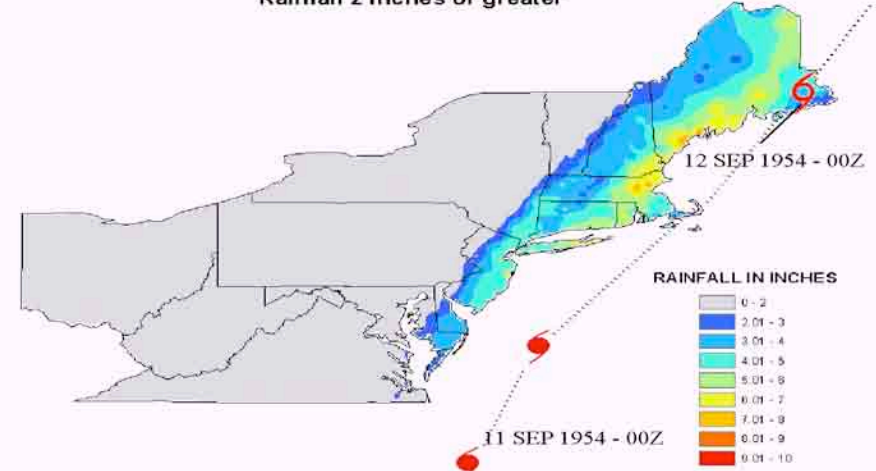
Hurricane Carol - 1954

Rainfall 2 Inches or greater



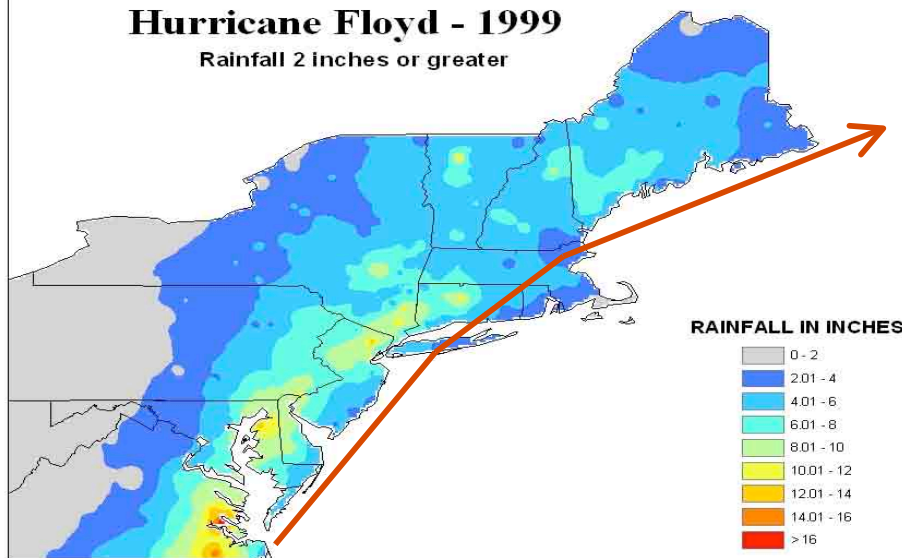
Hurricane Edna - 1954

Rainfall 2 Inches or greater



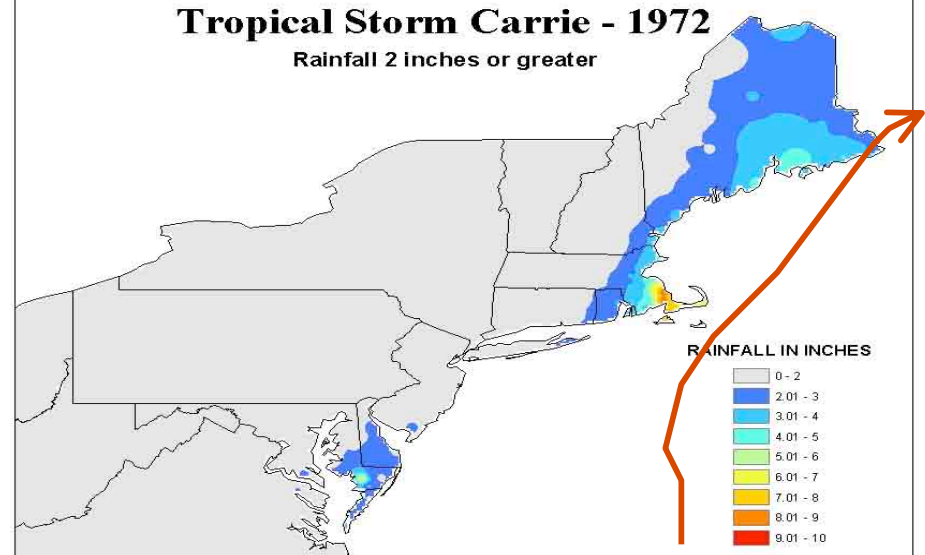
Hurricane Floyd - 1999

Rainfall 2 Inches or greater



Tropical Storm Carrie - 1972

Rainfall 2 Inches or greater

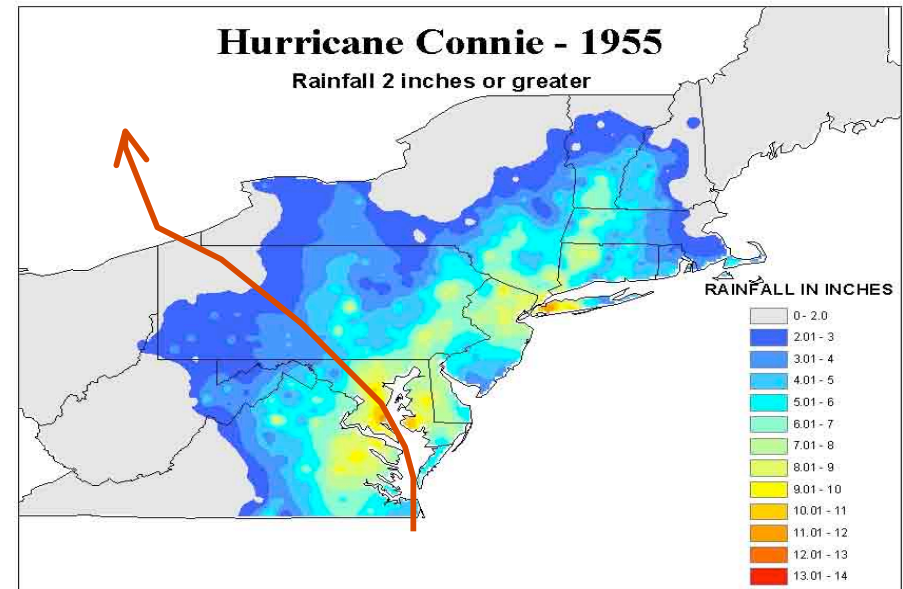
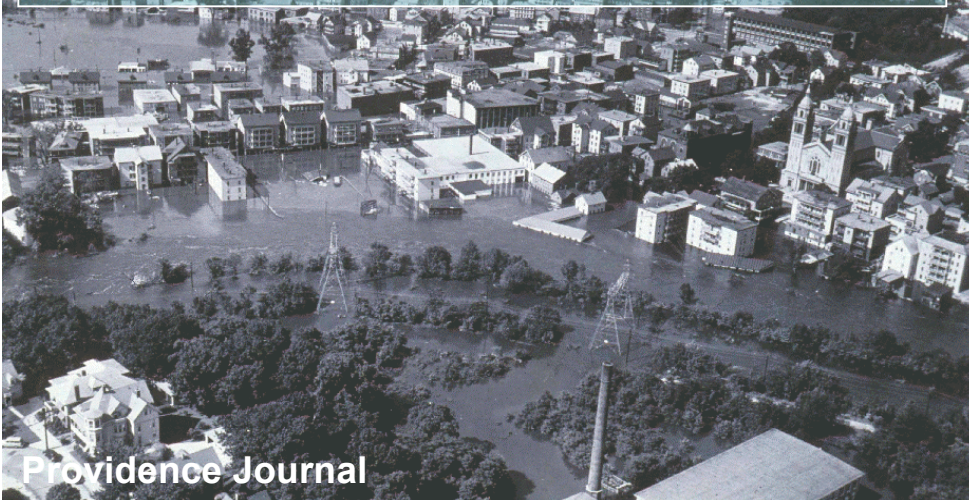


Historical Perspective

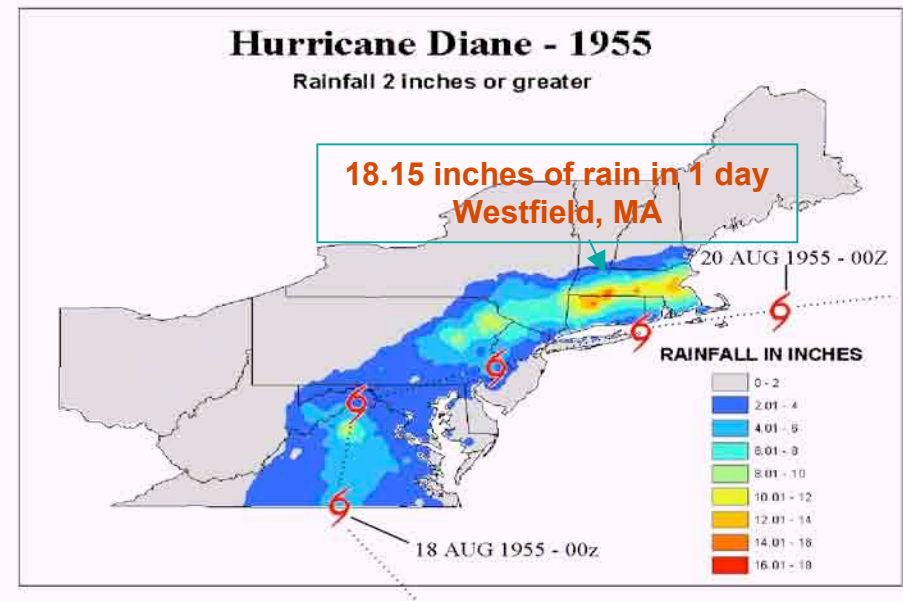
Widespread Flooding/Flash Flooding

City of Woonsocket, RI – Diane 1955

Flooded downtown “social/business” district



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



Historical Perspective Levee Breaches and Dam Failures

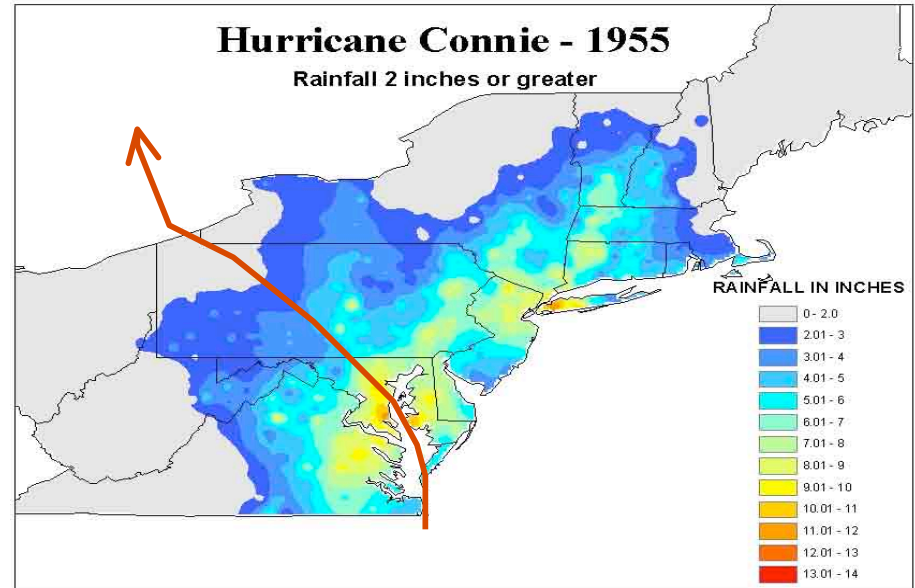
**Destroyed Shopping District – Diane 1955
Winsted, CT**



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

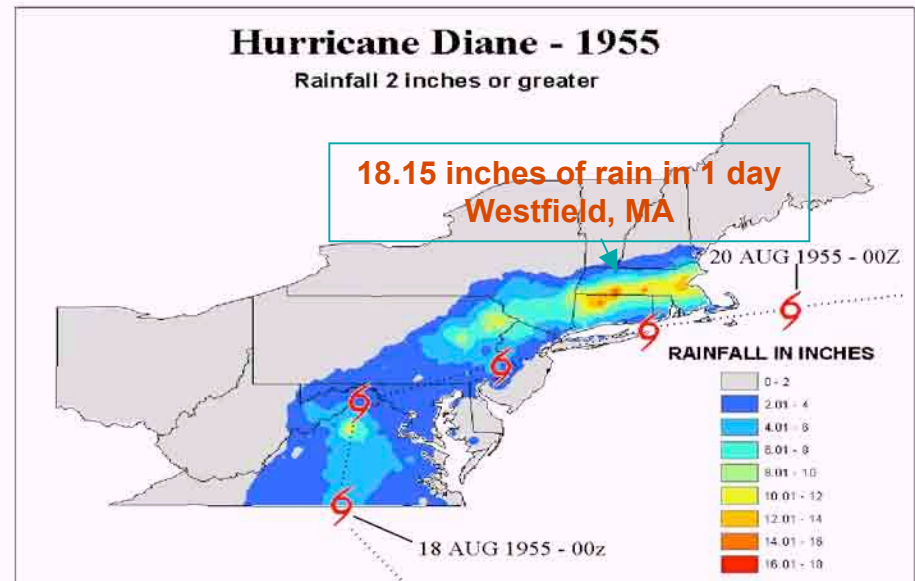


**Dozens of Dam Failures – Diane 1955
Echo Glen, Charlton, MA**

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

Hurricane Diane - 1955

Rainfall 2 inches or greater



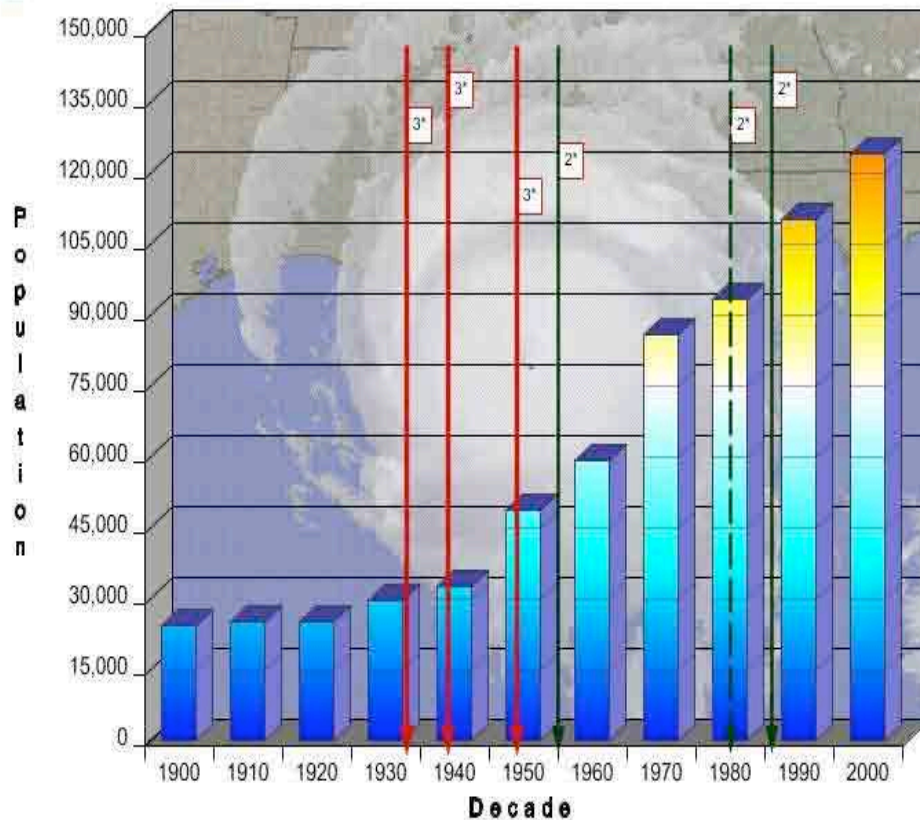
So its just a little water...

- 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

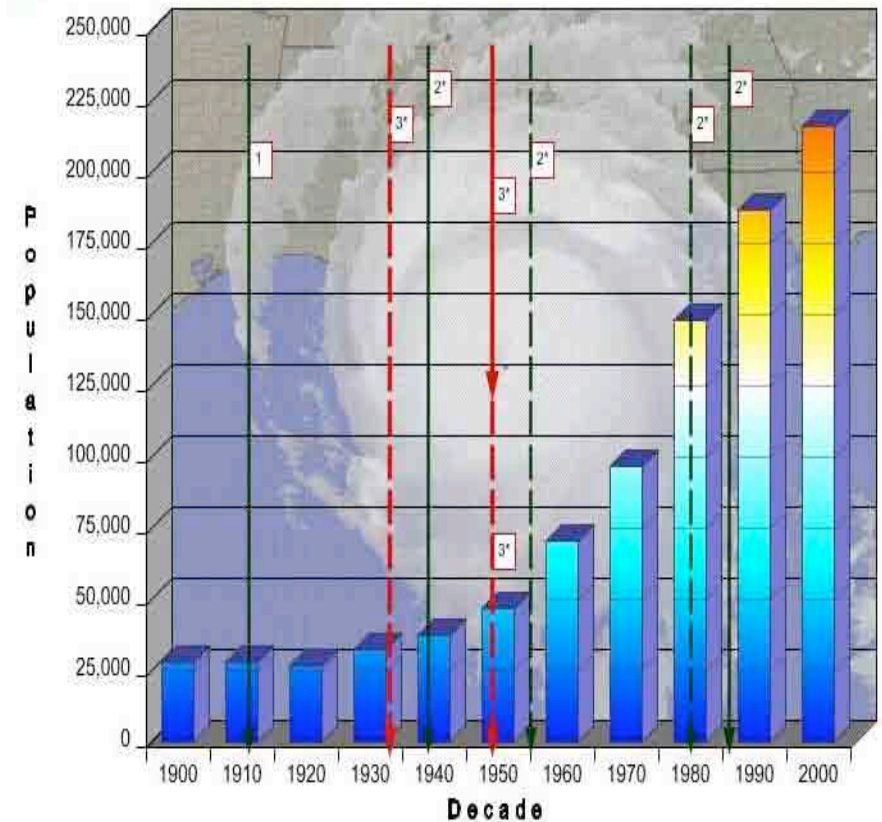
Perhaps our greatest obstacle: An inexperienced & complacent population...



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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