

August 4, 2015:
***Two Rare High End Severe Weather Events
Inside 12 Hours In
Southern New England***

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Overview

First Event:

Rhode Island and Southeast MA 6:00-8:30 am

- Widespread damaging wind gusts of 60 to 80 mph
- Rhode Island hardest hit, including Cranston and Providence
 - Roads/rail blocked by fallen trees making for a horrific rush hour
 - 25 percent of Rhode Island lost power (over 121,000 people)
 - *More power outages in RI than Hurricane Sandy!*
 - 10 minor injuries at Burlingame Campground in Charlestown, RI

Second Event:

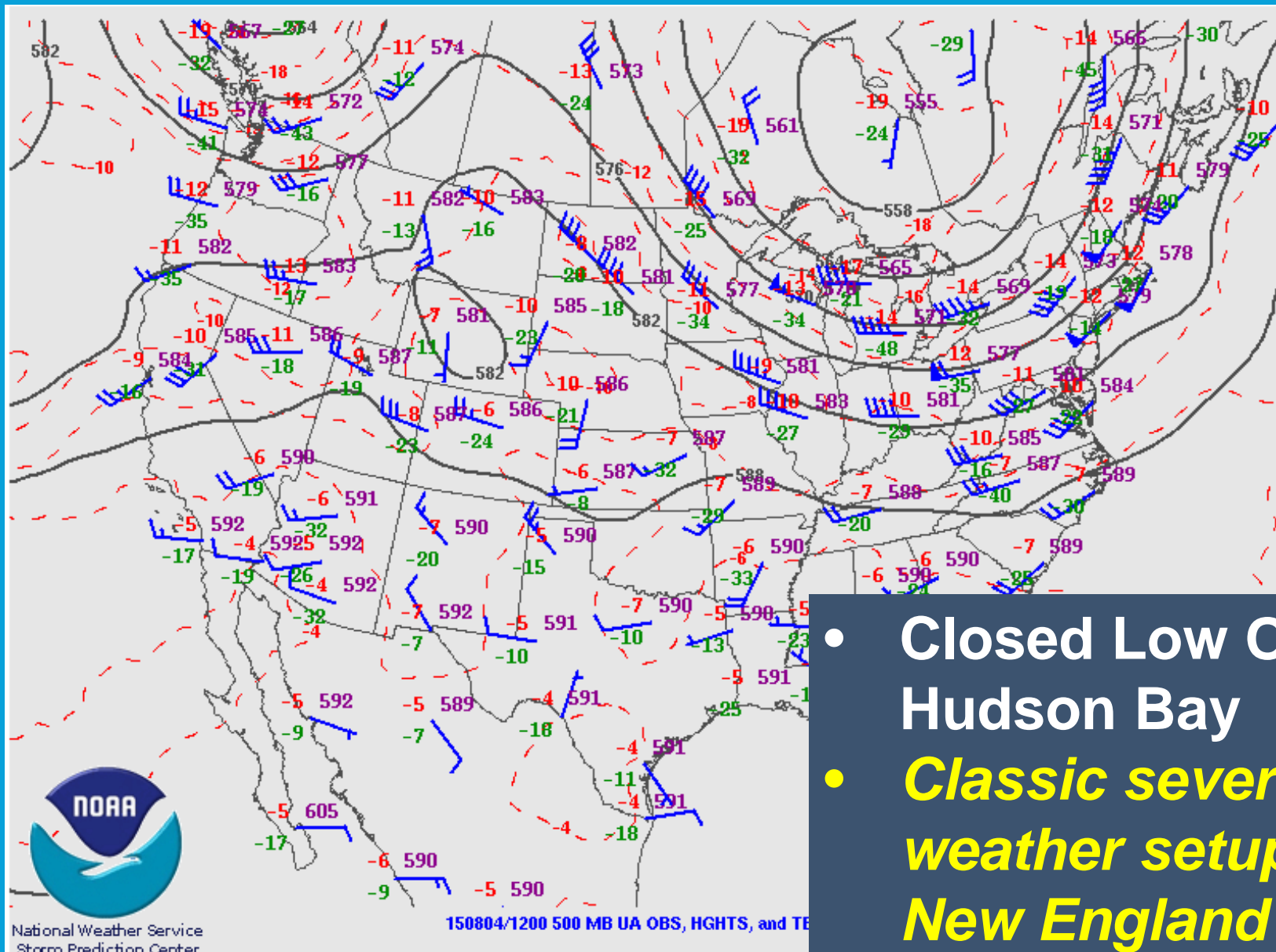
Massachusetts (along/north of Mass Pike) 12:30-4:30 pm

- Reports of golf ball to 2 inch diameter hail
 - 2" diameter hail in Boston (largest reported in Suffolk County)
- Wind gusts of 50-60 mph
 - Some tree damage and isolated power outages
- No injuries reported

Damage in Rhode Island

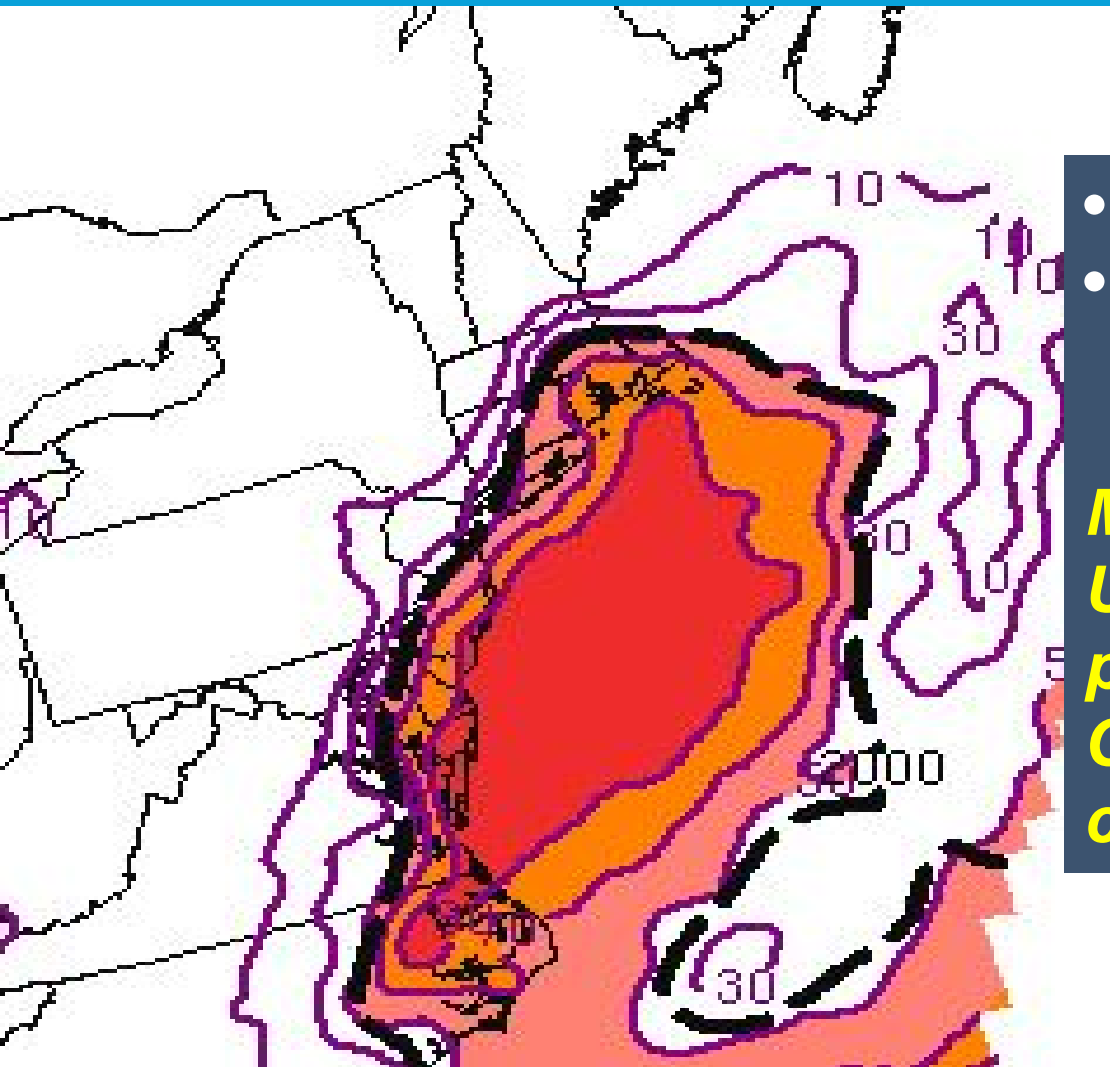


500 mb Analysis: 12 UTC August 4th 2015



- Closed Low Over Hudson Bay
- **Classic severe weather setup for New England**

SPC SREF: Mean Probabilities of MUCAPE Exceeding 2000 J/KG



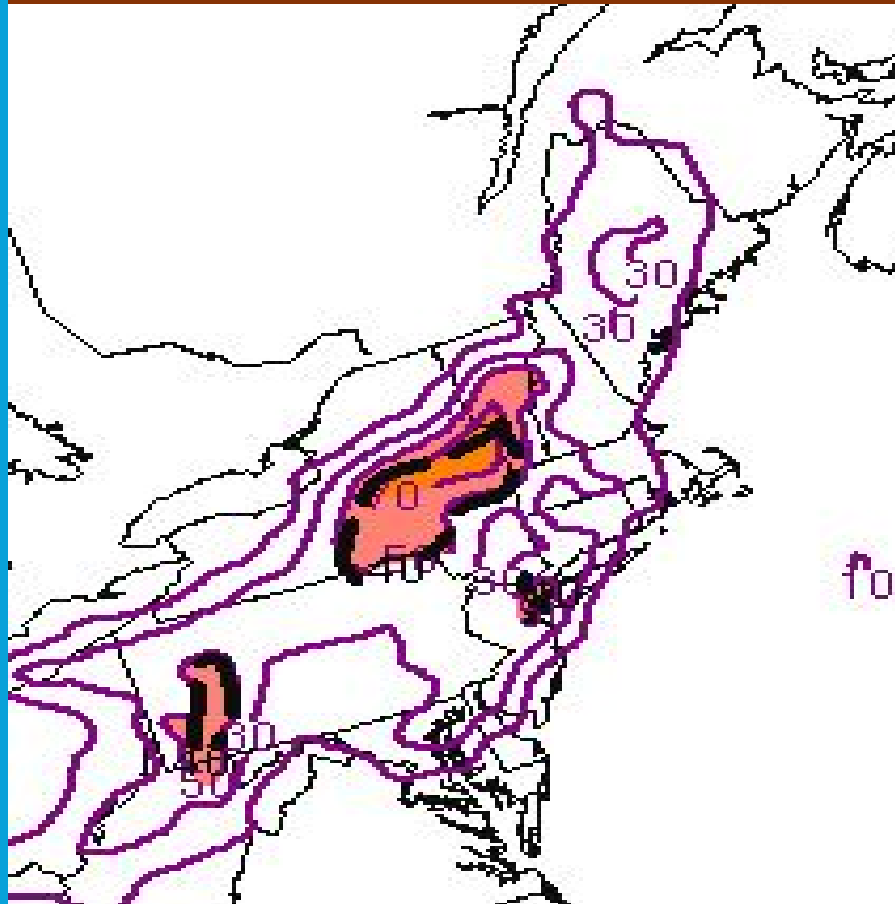
- Valid 09z August 4
- 70 to 90 percent in RI and southeast MA

MUCAPE (Most Unstable CAPE) better predictor than surface CAPE for nighttime convection

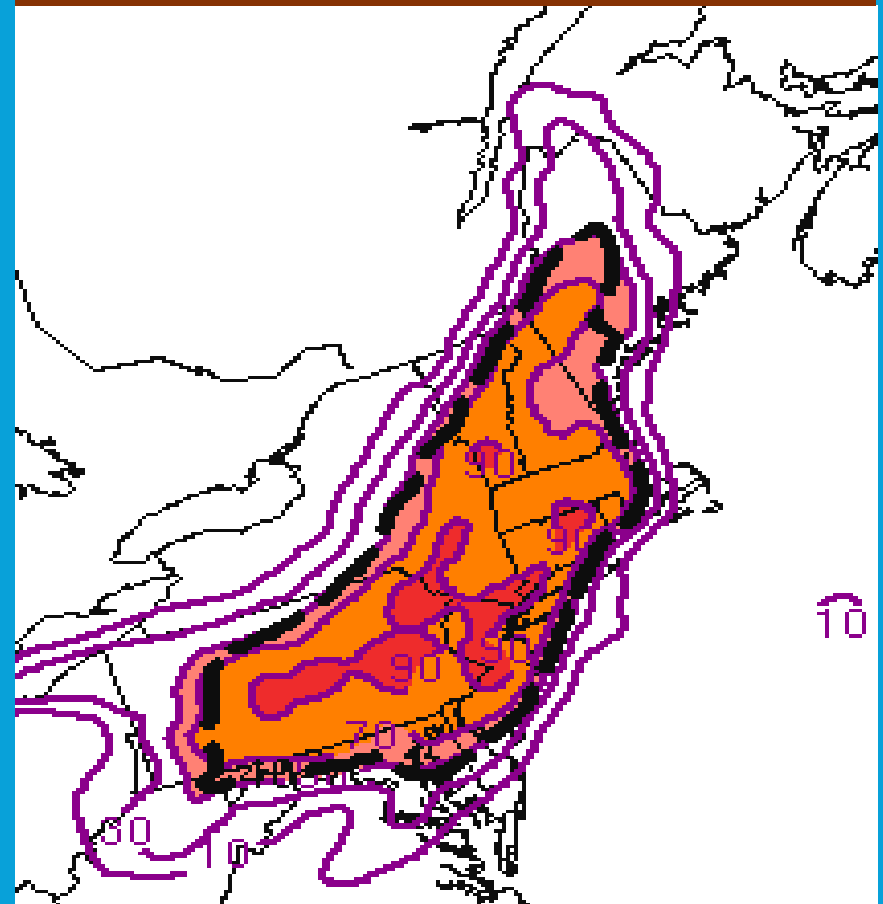
15 Hour Forecast from SREF

SPC SREF: Mean Probabilities of 0-6 km Bulk Effective Shear Exceeding 40 Knots

09z August 4th 2015



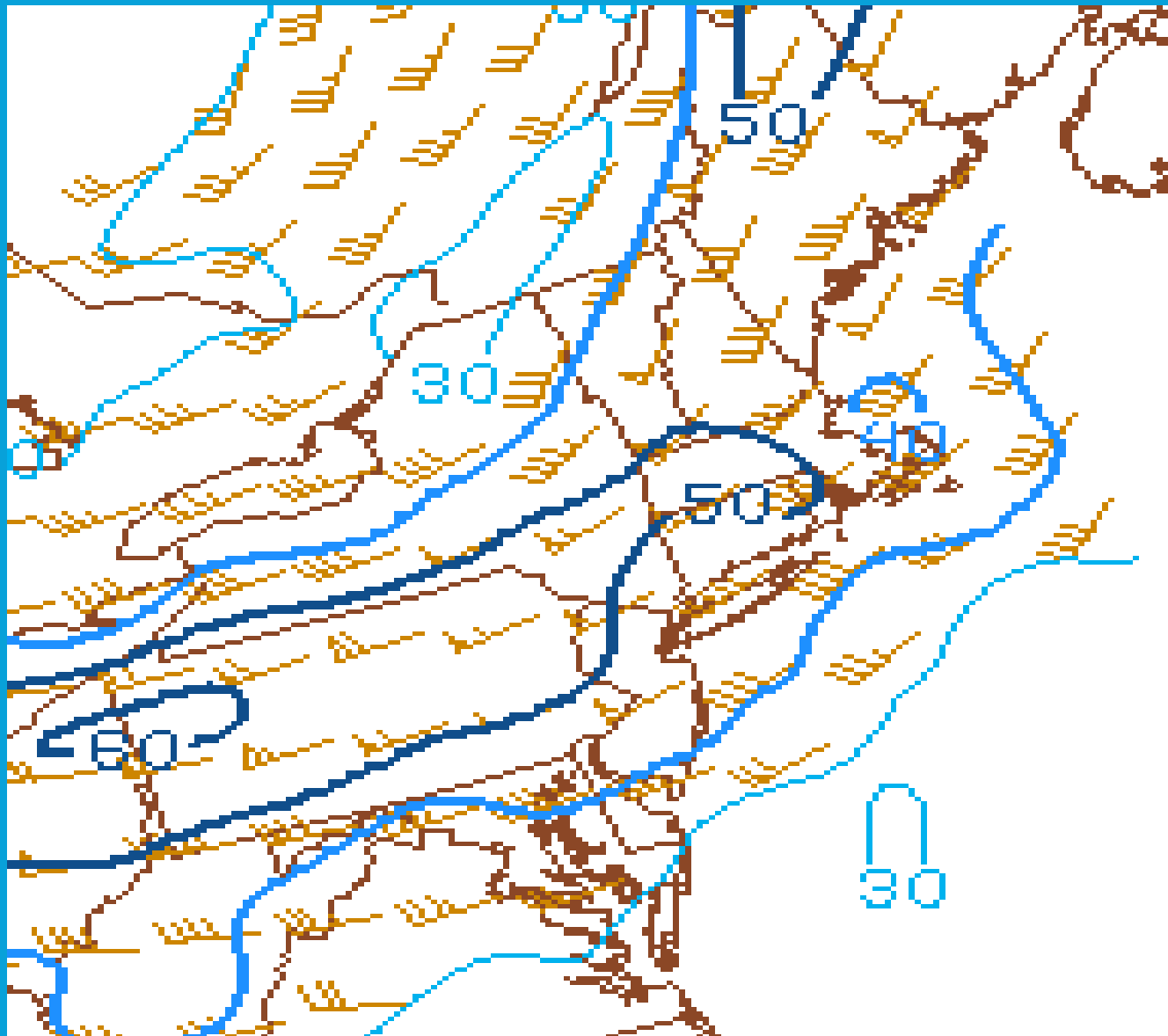
12z August 4th 2015



Probabilities rapidly increase
in response to approaching shortwave

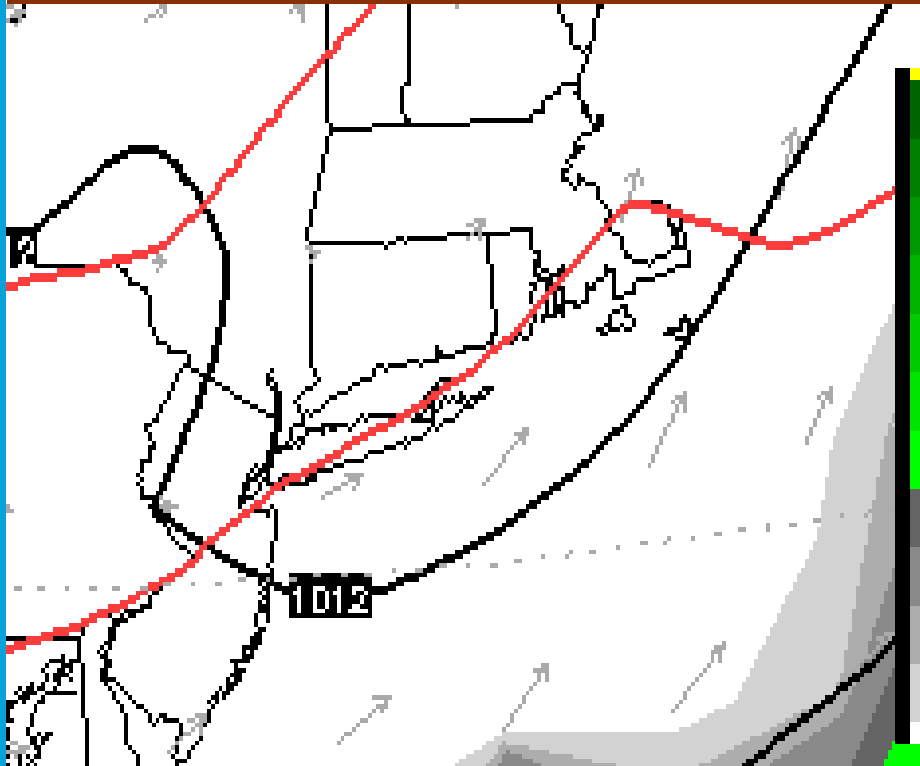
SPC Mesoanalysis: 11z

Strong 0-6 km Shear

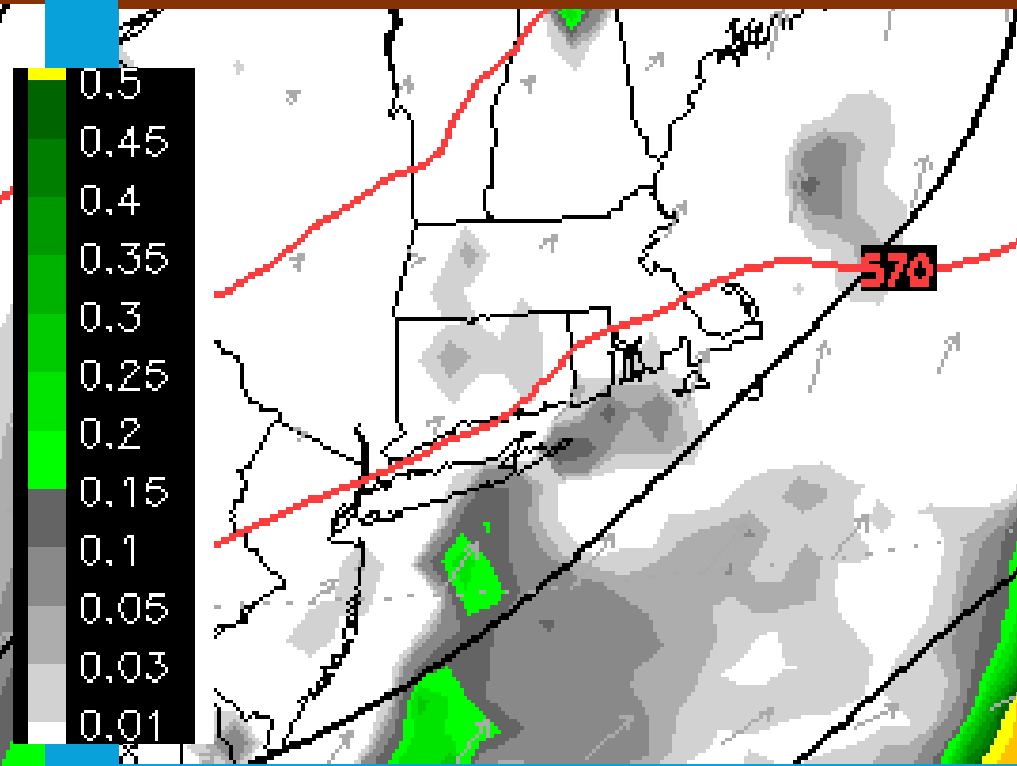


Forecaster Uncertainty: Several Models Forecasting a Shutout Inside 36 Hours

ECMWF QPF 06z to 12z



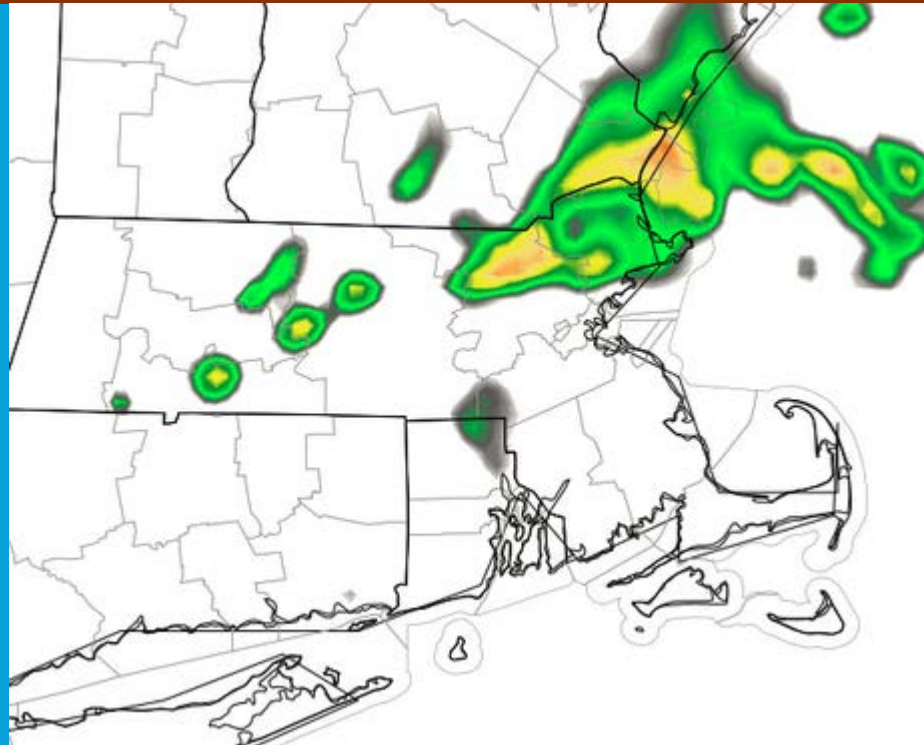
GFS QPF 06z to 12z



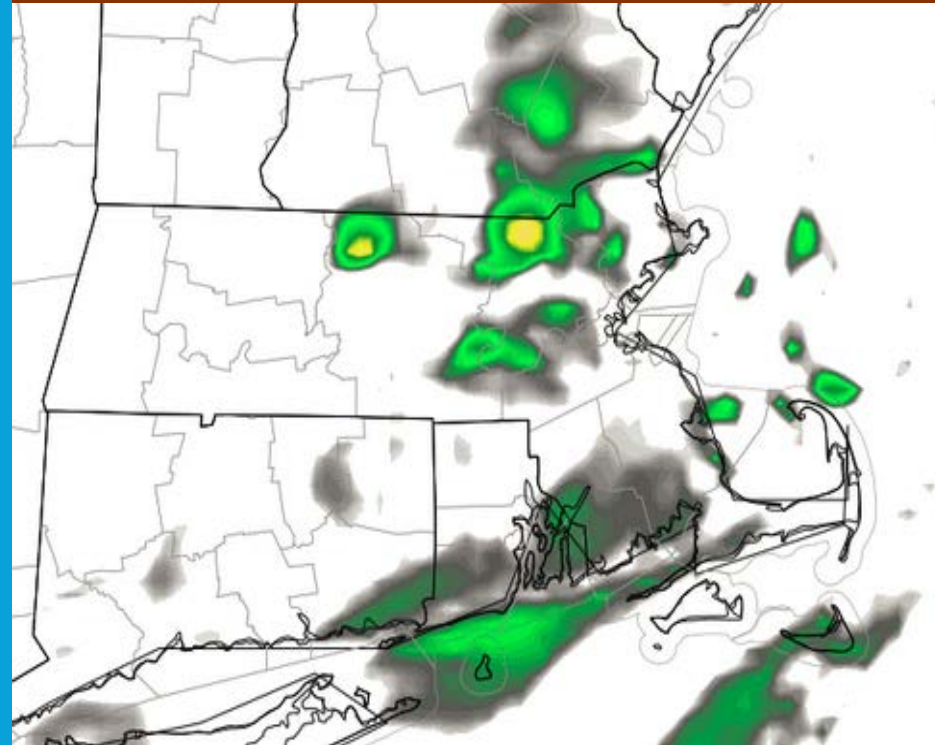
- Need some type of forcing to ignite potentially potent environment.
- GFS/ECMWF suggest there is not enough of a trigger.
- ***How do you handle this as a forecaster ?***

High Resolution Guidance

12z Aug 3 ARW Valid 10z Aug 4



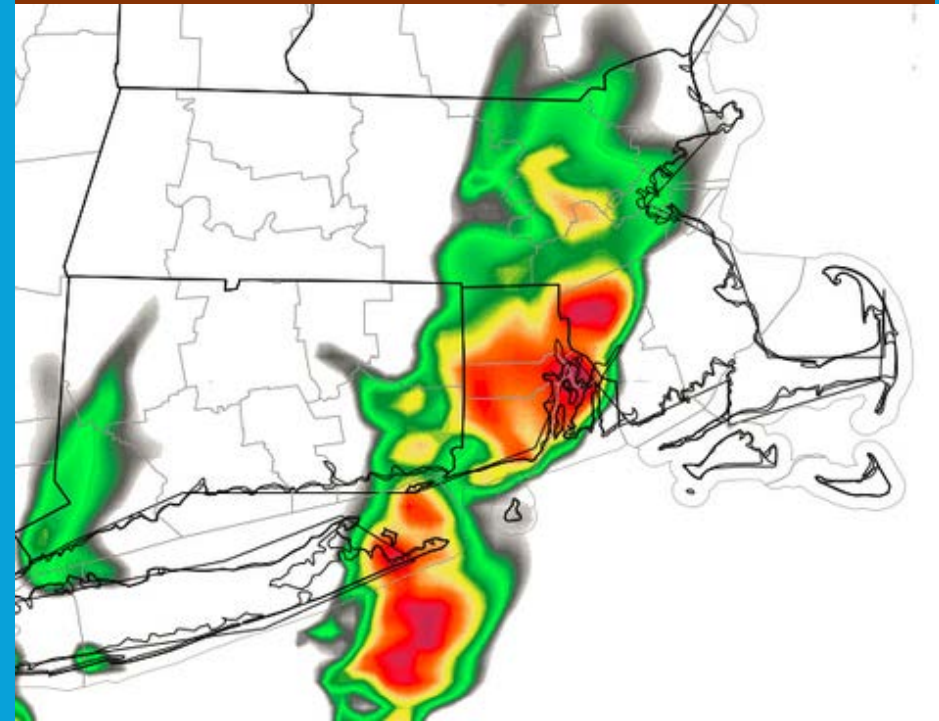
12z Aug 3 NMM Valid Aug 10z Aug



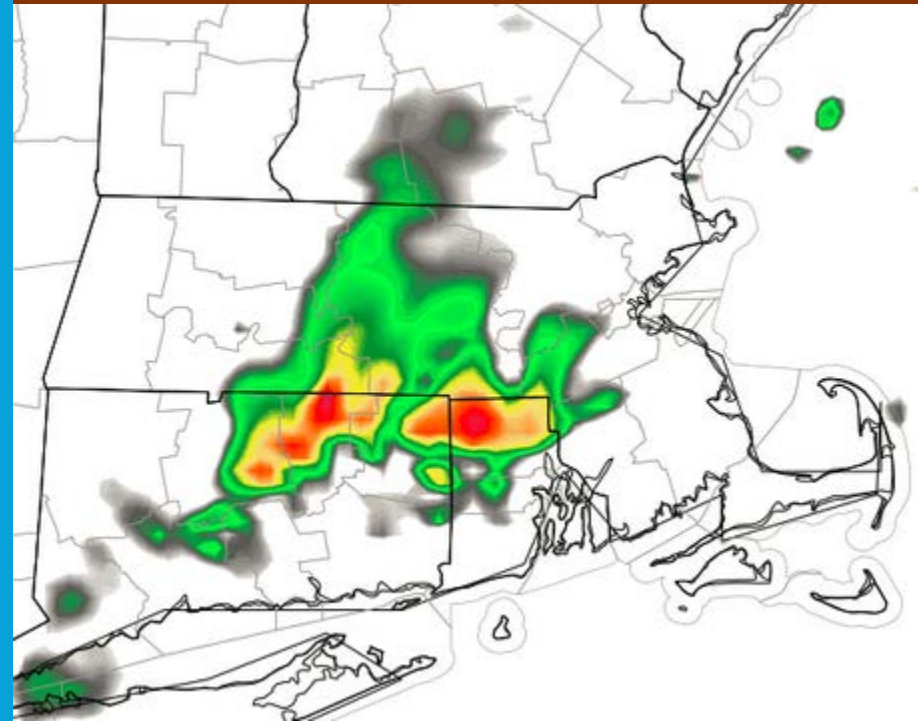
- 22-Hour Simulated Reflectivity From 4 km ARW/NMM not impressive
- Few showers/isolated thunderstorm in Northeast MA
- Little if anything farther to the south

High Resolution Guidance 12 Hours Later

00z Aug 4 ARW Valid 09z



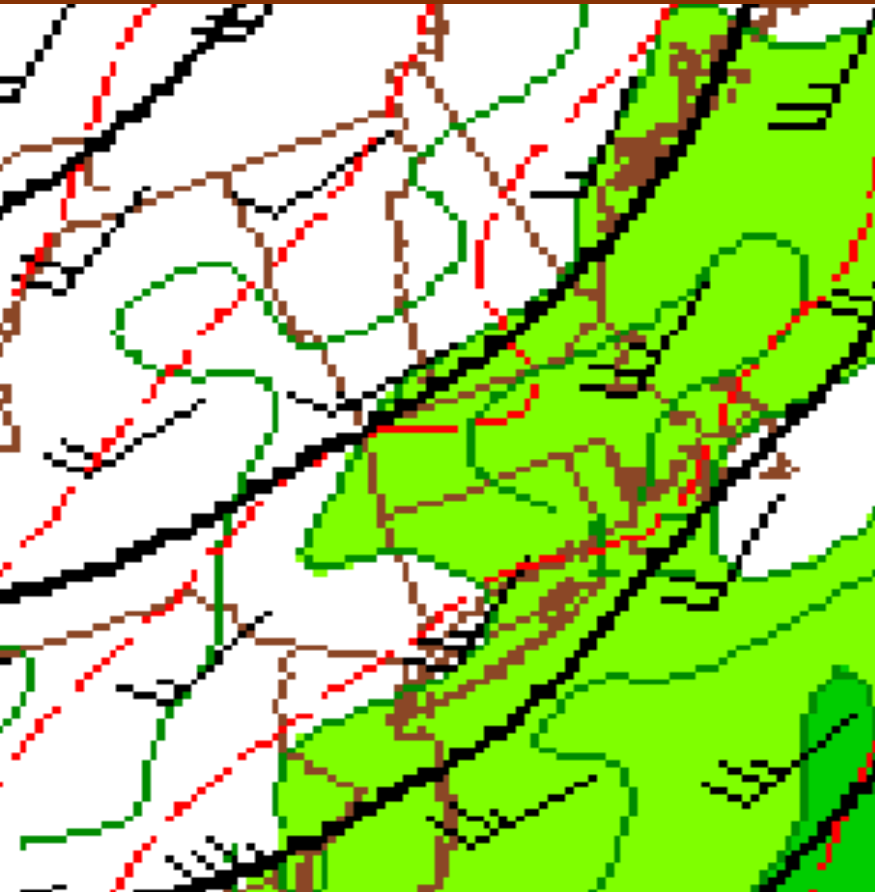
00z Aug 4 NMM Valid 09z



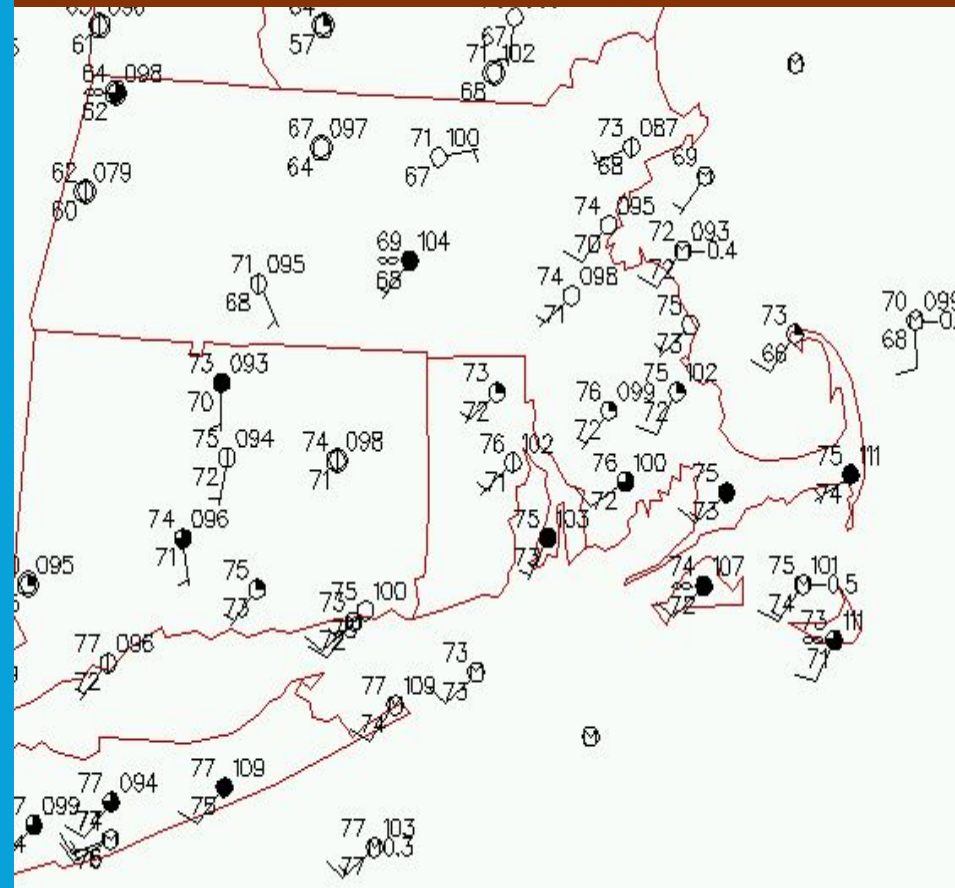
- 9 Hour Simulated Reflectivity shows better activity
- 4km NMM better, but not as impressive as the ARW
- ***What is causing this change?***

Low Level Jet and Decoupled Boundary Layer

850mb LLJ of 25 Knots at 08z



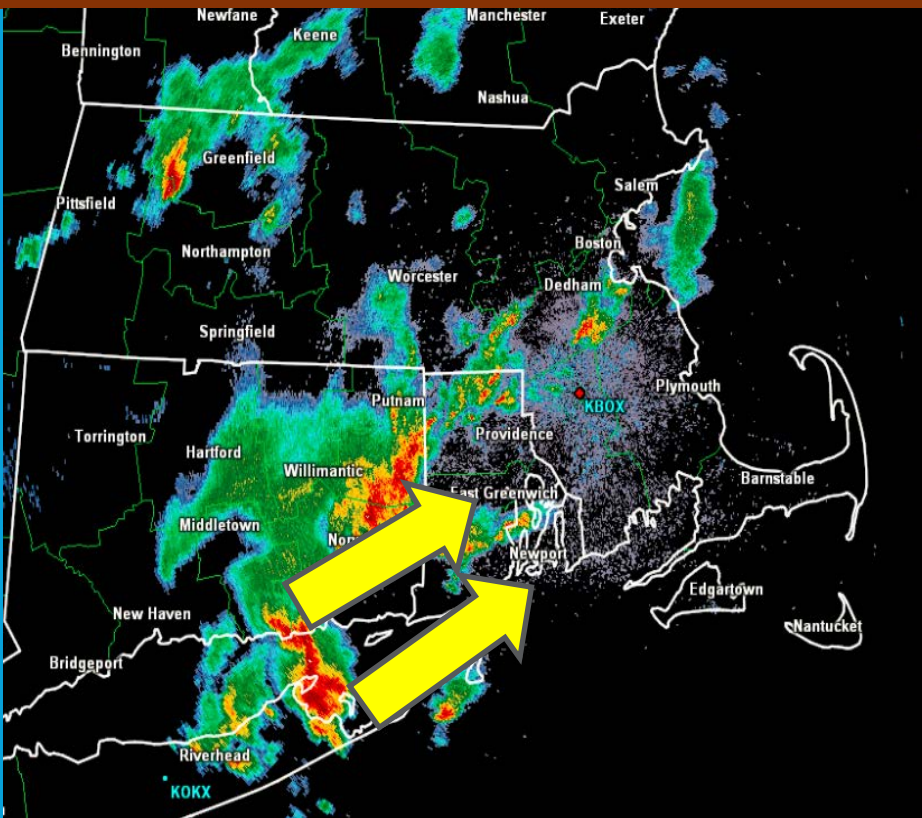
Weak Surface Winds at 08z



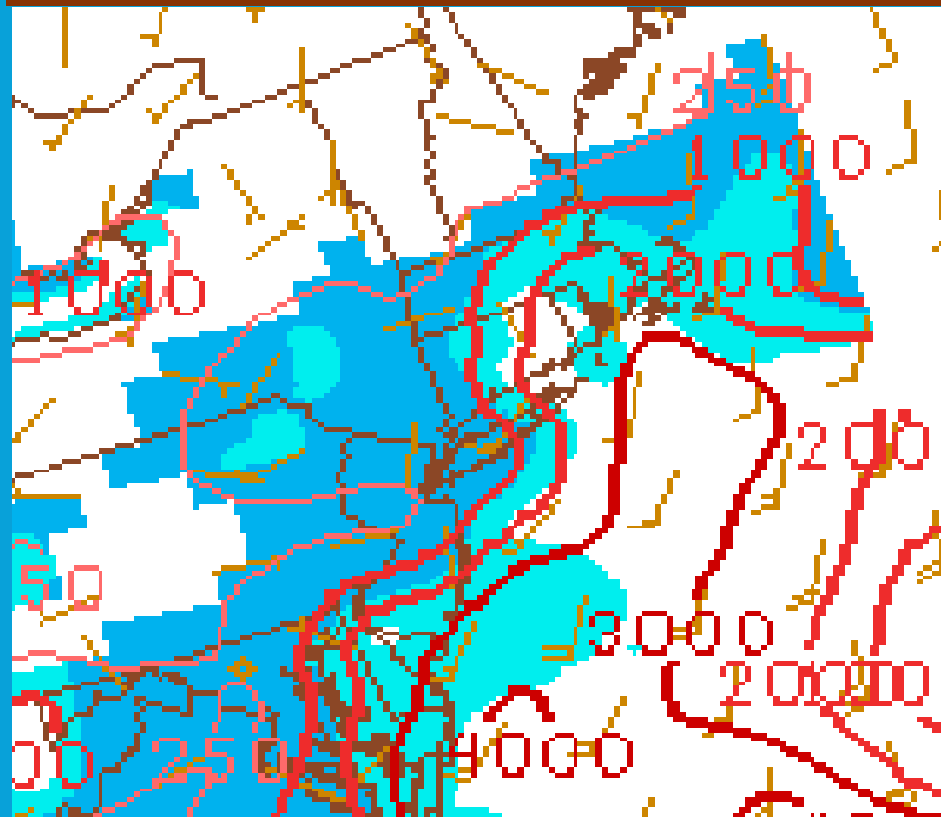
- **Low Level Jet overruns cooler decoupled boundary layer**
 - Sets up mesoscale boundary.
- **Models can struggle with this setup**
 - Often see a “Sunrise Surprise.”
 - But MUCAPE/shear usually less impressive.

Radar Imagery

Radar Imagery at 0958z



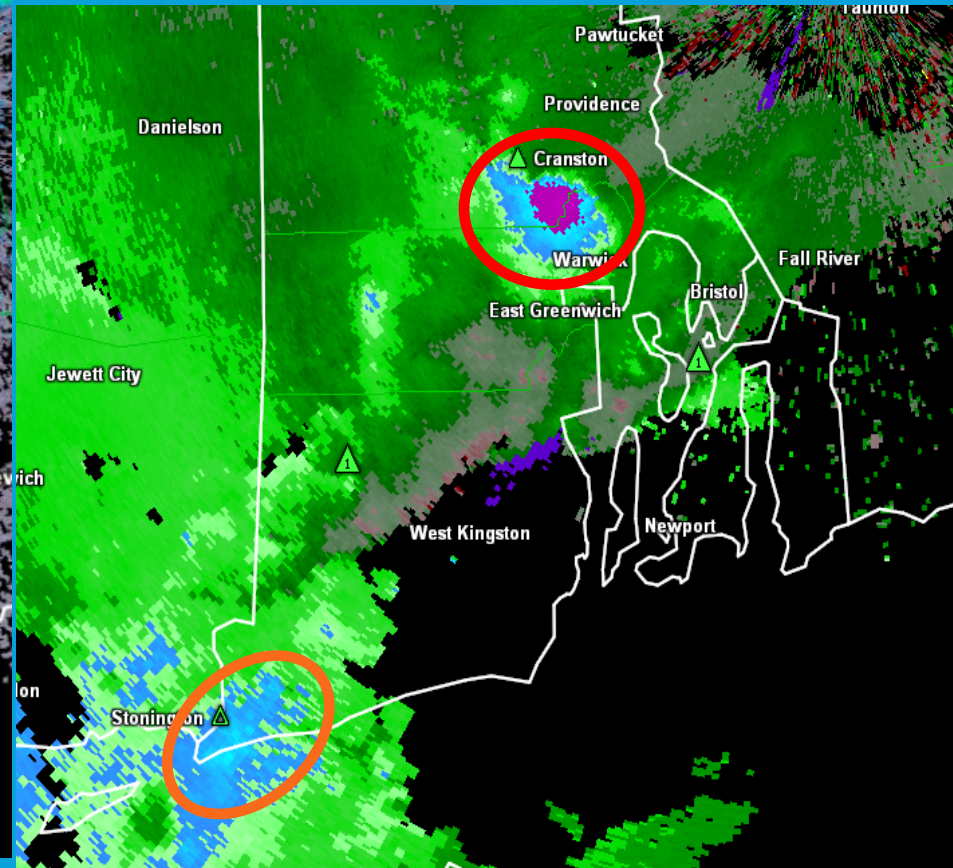
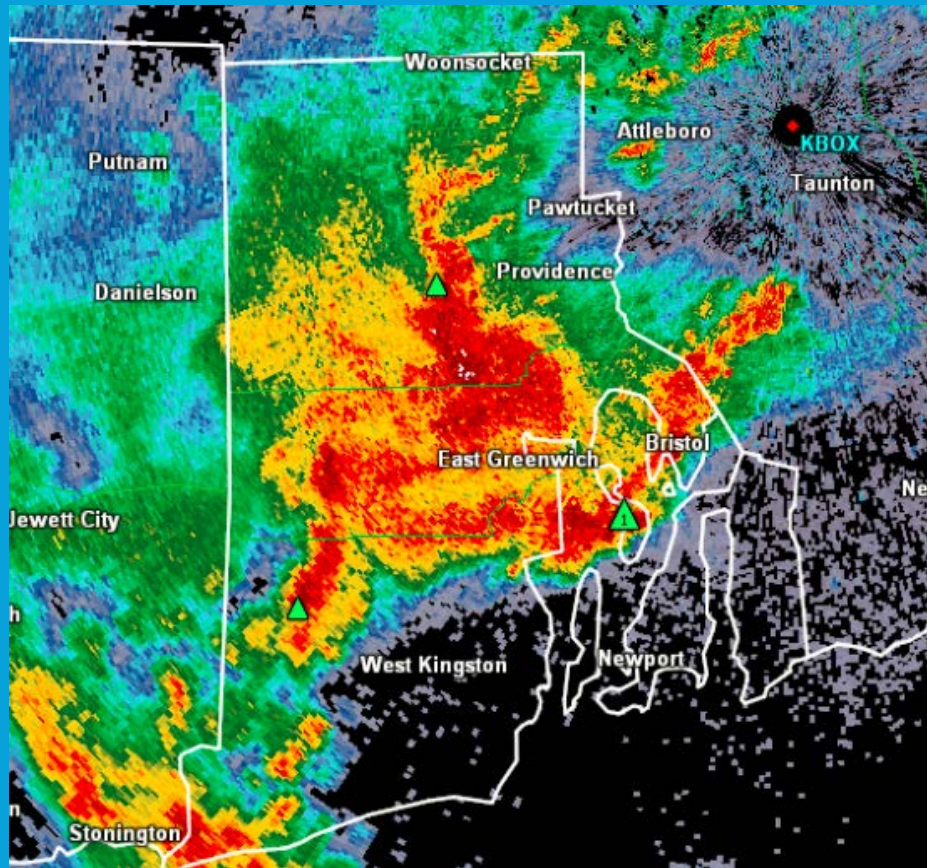
Storms moving into 2-3K of MUCAPE



- Storms formed on LLJ, moved into more favorable environment.
- 2000 to 3000 J/kg of CAPE across southeast New England
- Storms became surface based

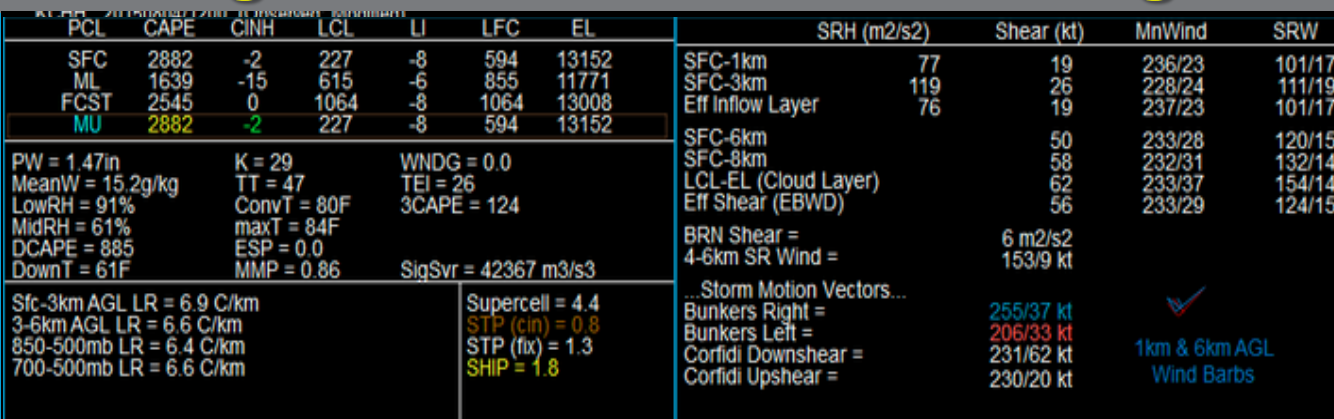
0.5 REF 1124 Z

0.5 VEL 1124 Z



- 70 to 80 knots just off the ground in Cranston, RI
- 60 to 70 knots across Southwest RI
 - Produced 83 mph gust at Charlestown, RI injuring 10 campers.

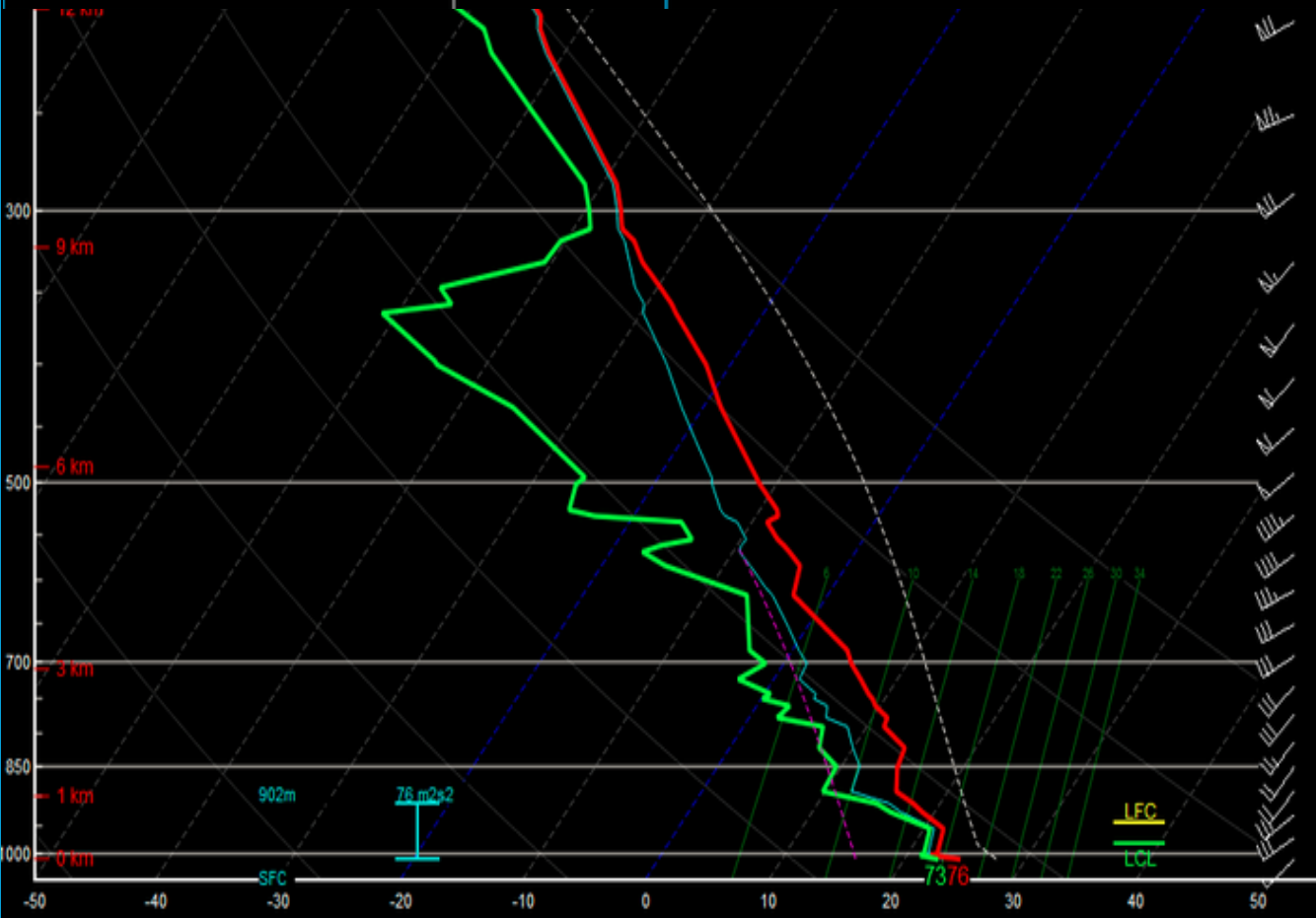
August 4th 12z CHH Sounding Modified for PVD



Modified using PVD temperature (76) and dewpoint (73) at time of the event

Courtesy of Ryan Hanrahan

- Surface CAPE: 2882 J/kg
- Effective Deep Layer Shear: 56 knots



Lessons Learned from the Early Morning Event

Highly anomalous environment *may* result in a highly anomalous event, but a trigger is still needed.

- In this case, mesoscale boundary formed from low level jet and decoupled boundary layer

Utilize SPC SREF guidance

- Probabilistic approach
- Important to communicate uncertainty in these situations

Model QPF should be considered

- Not always the determining factor on what will unfold.

Round 2: Unusually Large Hail and Damaging Winds

- All storms stayed to the north of the Connecticut and Rhode Island border.
- Hardest hit area along and north I-90 (Massachusetts Turnpike)
 - Several reports of golf ball sized hail
 - 50 to 60 mph wind gusts.
- Bulk of the area that was hit earlier in the morning was not affected by the afternoon activity.
- No tornadoes occurred during the afternoon, despite impressive radar signatures.

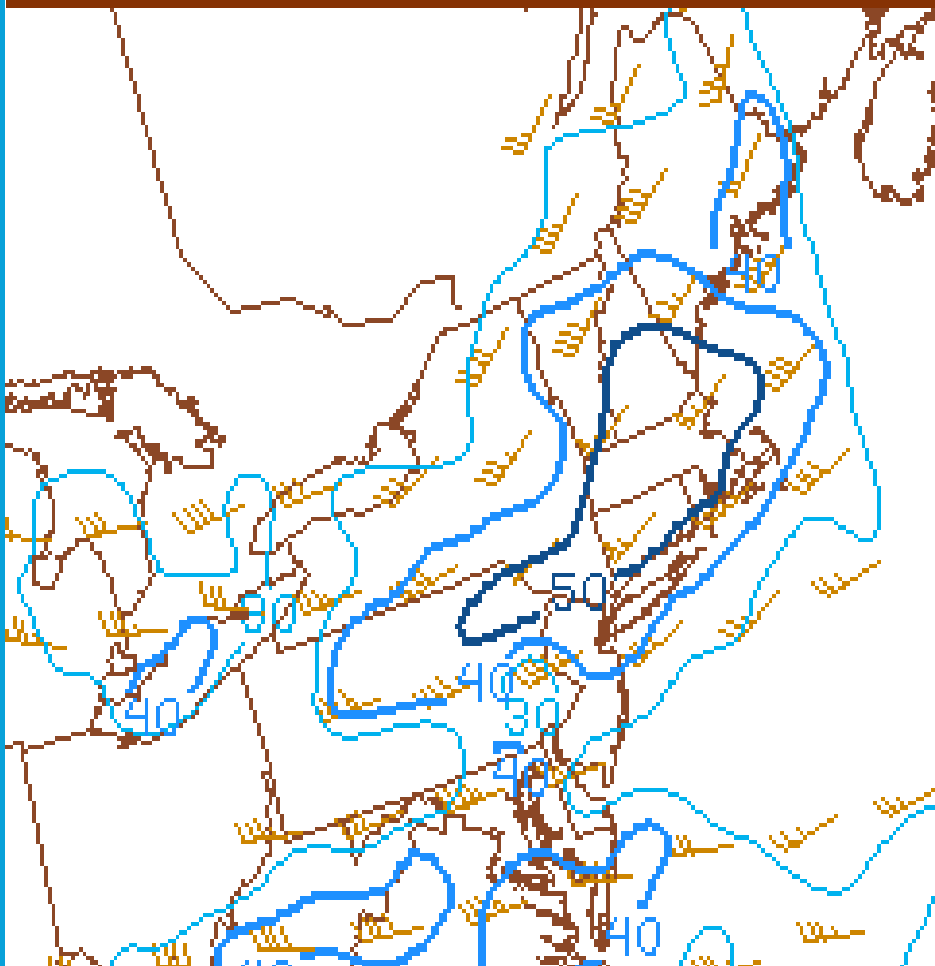
Pictures from Boston Hail Event



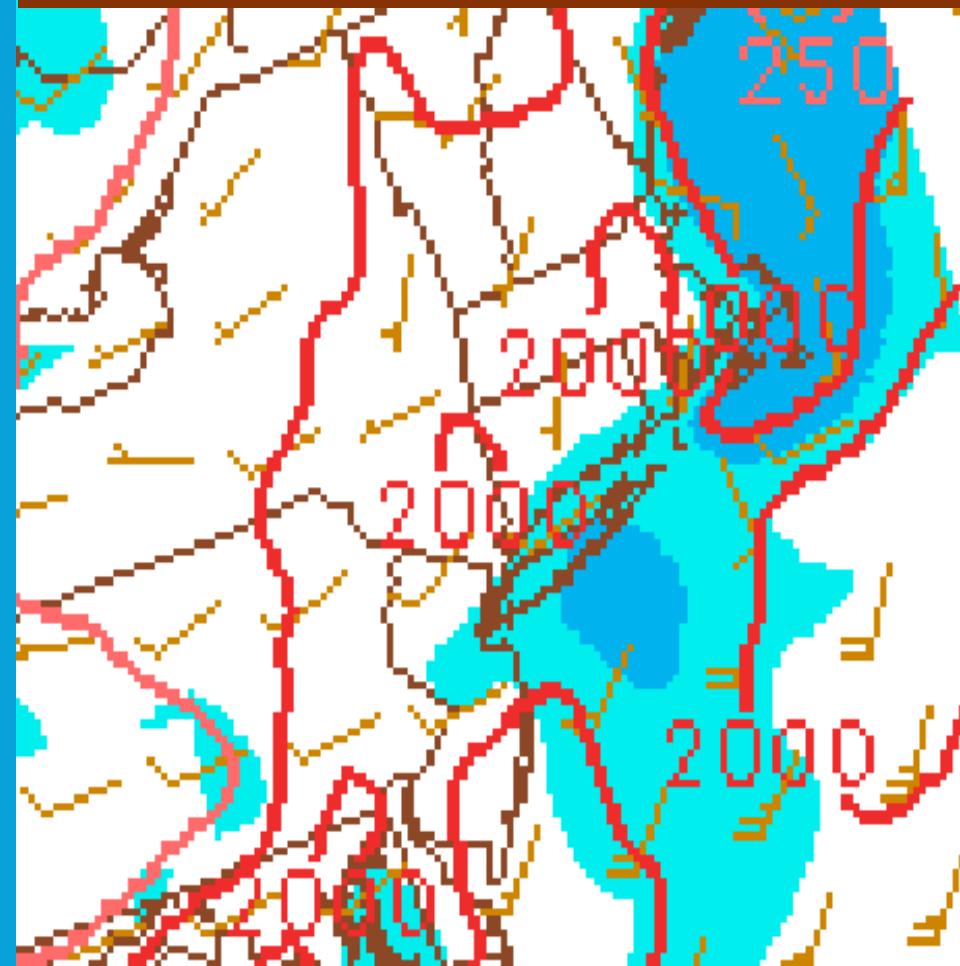
These pictures were taken in Brighton, MA courtesy of Rachel Rumely

SPC Meso-Analysis: Effective Bulk Shear and MLCAPE at 19z

Bulk Shear Values 50 to 60 Knots

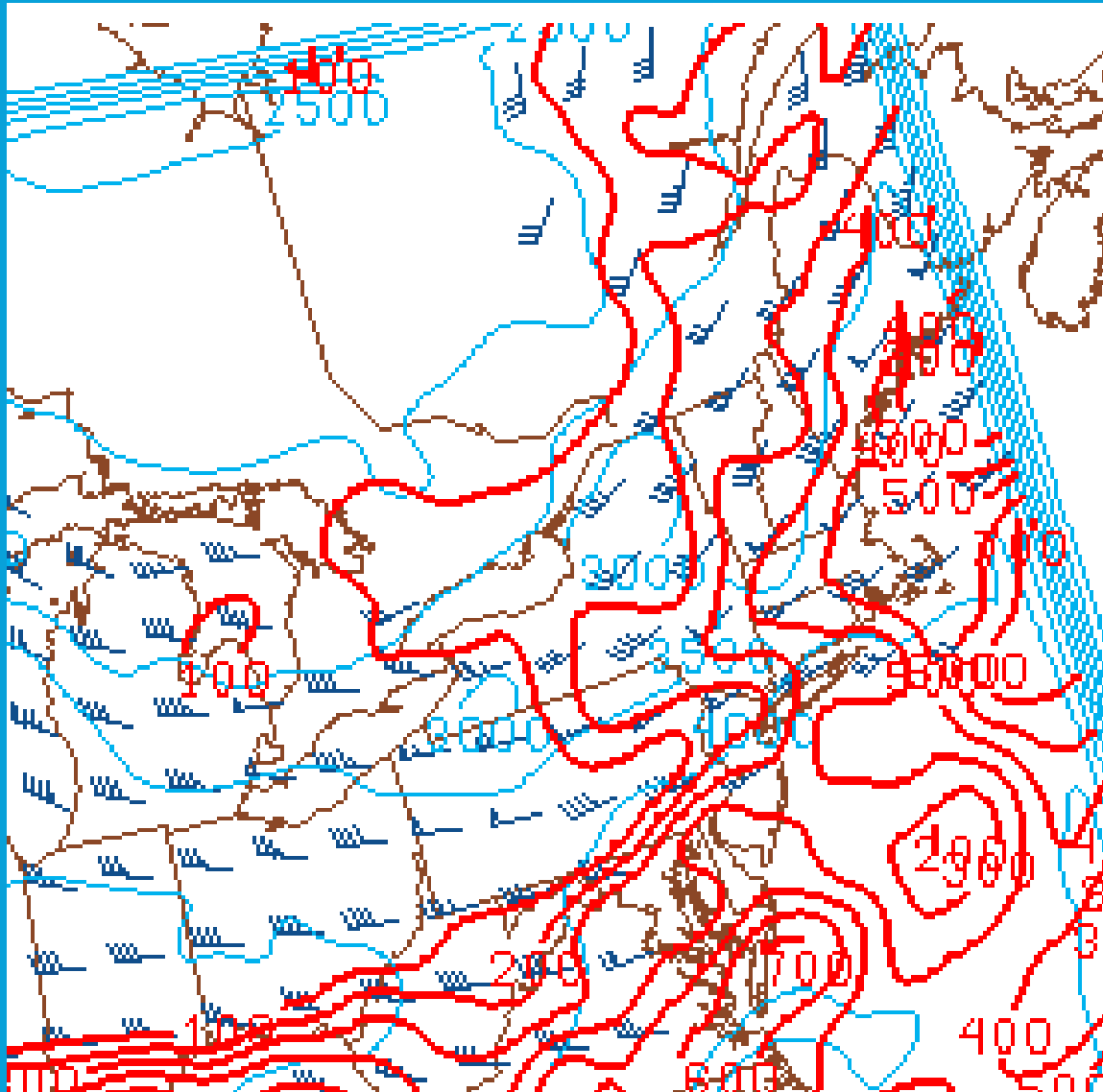


MLCAPE 1500 to 2500 J/kg



High Cape and High Shear in Place for the Entire Region

SPC Meso-Analysis: “Hail CAPE” at 19z



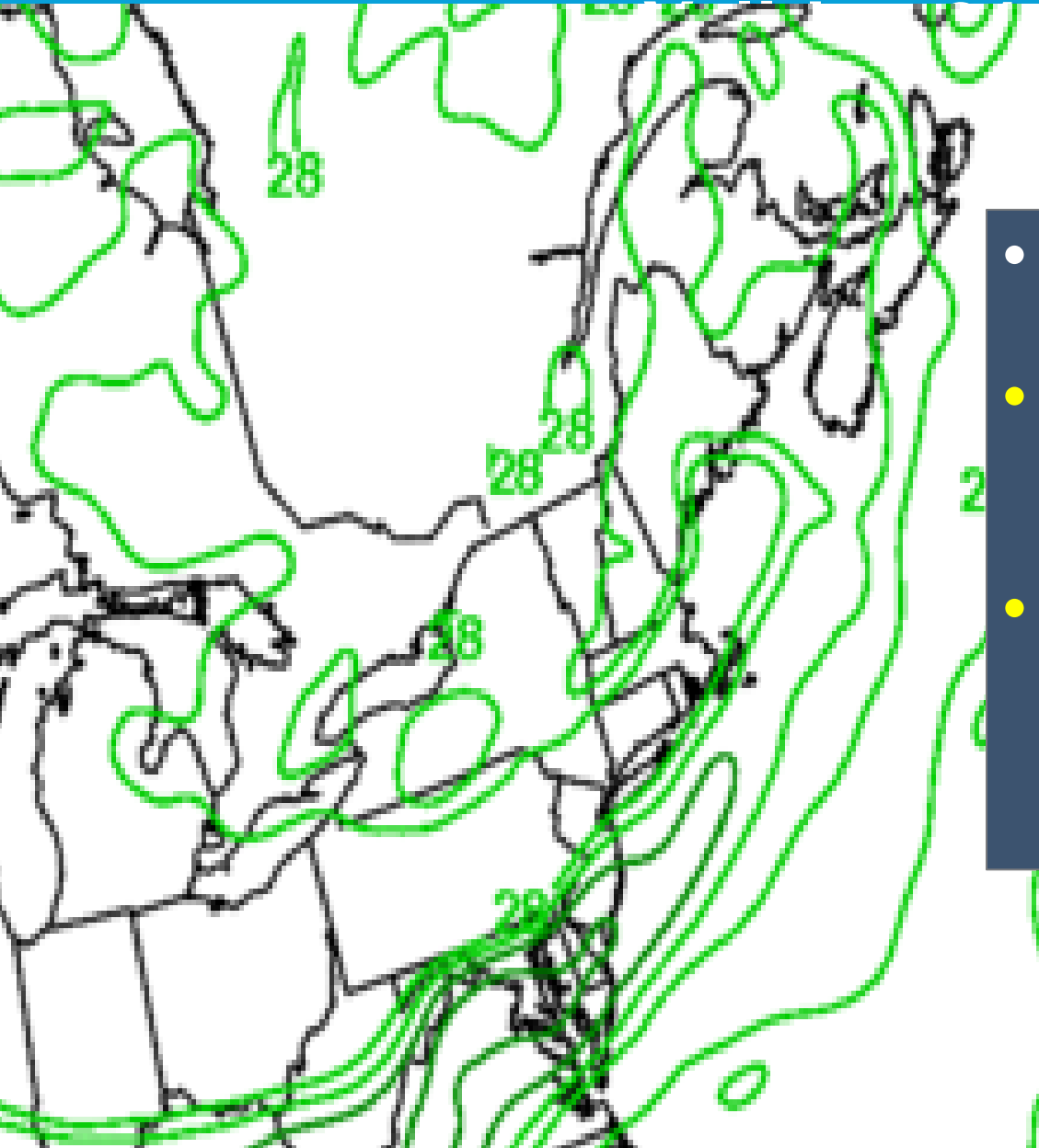
Values > 400 J/kg
in the -10 to -30°C
layer bring the
potential for very
large hail

In this case,
values were
between 400 and
550 J/kg!

Forecast Uncertainty During the Afternoon

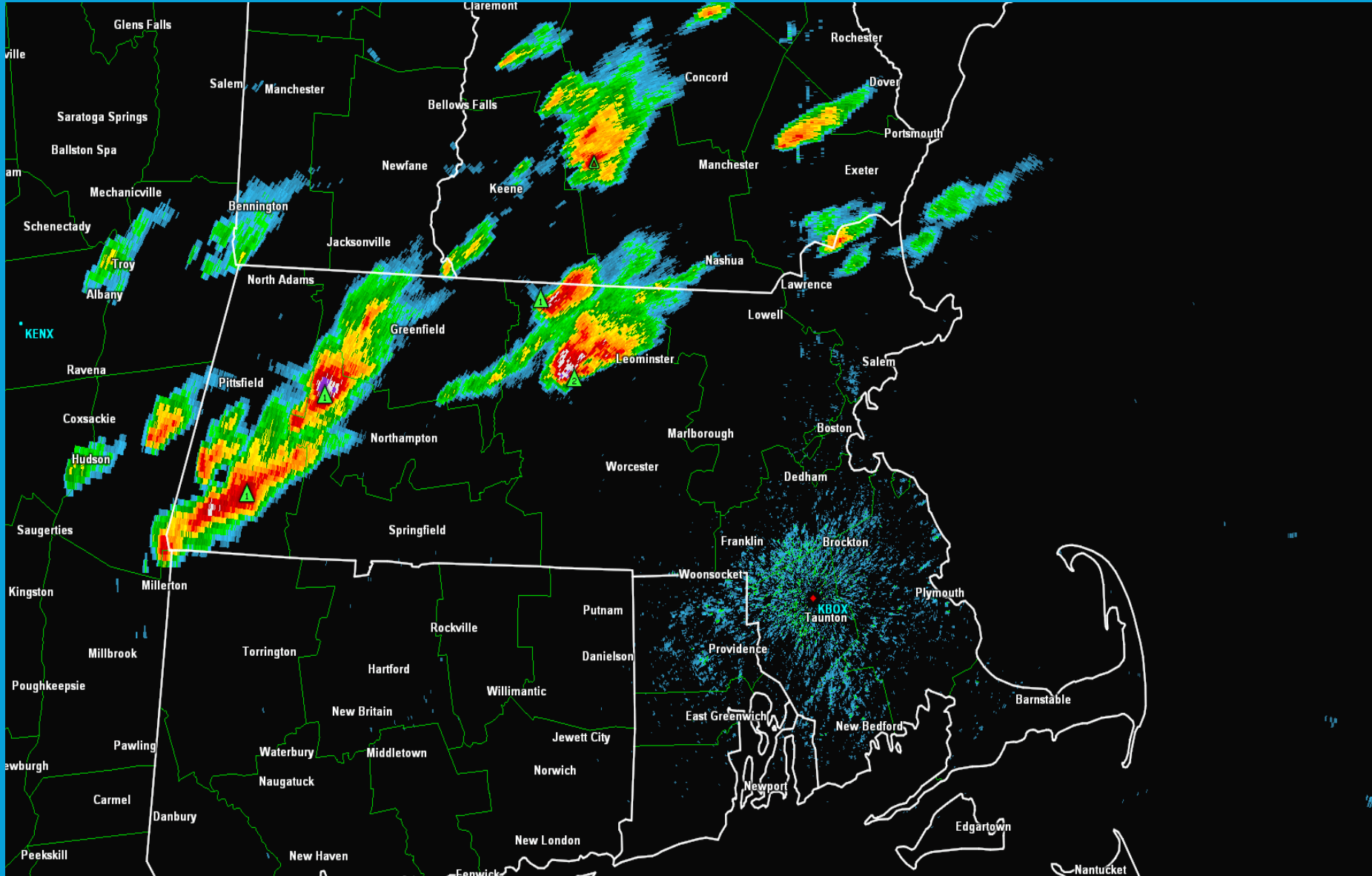
- Anomalously High CAPE/High Shear in place with 6.5C/km mid level lapse rates
 - **Very cold aloft with >400 J/kg of Hail CAPE**
- Approaching Shortwave/Cold Front would be the potential trigger for another round of high end severe weather
- Biggest uncertainty was amount of mid level dry air that would work into the region behind earlier convection.
 - **Some mid level dry air can increase lapse rates and promote risk for severe wind and hail.**
 - **Too much mid level dry air will cutoff thunderstorm updrafts and prevent severe weather.**
 - ***It's a very delicate balance!***

Another Look at Moisture: K Index



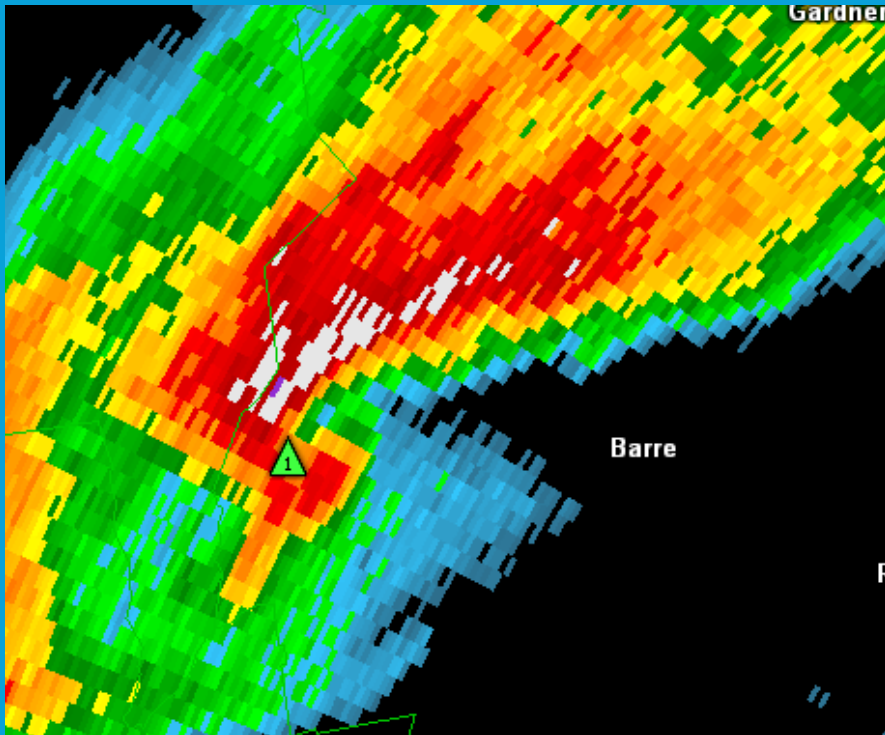
- “Higher” values near & north of the MA Pike
- ***Just enough mid level dry air prevented storms to the south***
- ***Helped in large hail and strong wind production across Northern MA***

Radar Loop from the Afternoon Storms

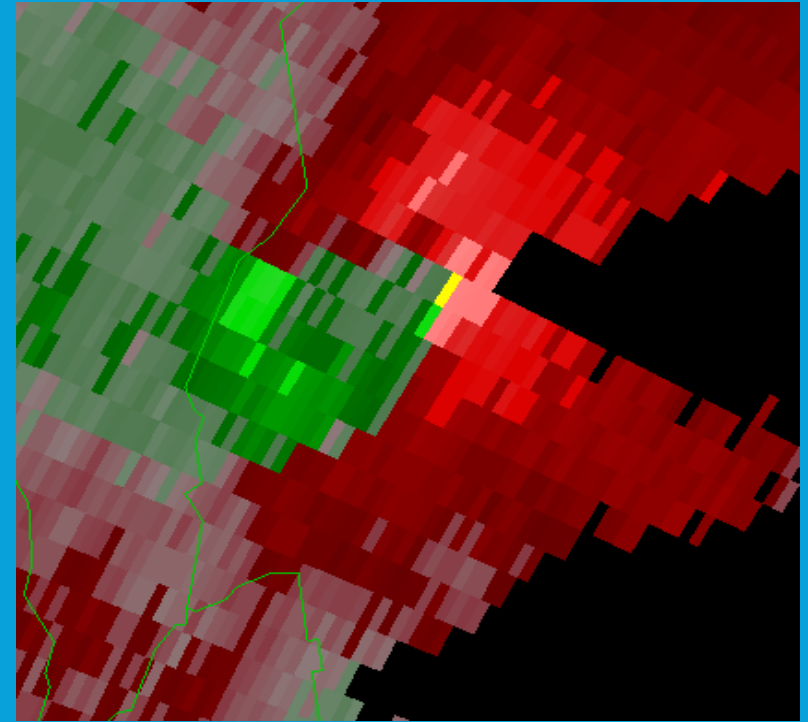


A Few Storms in Northern Massachusetts Prompt Tornado Warnings

0.5 REF: 1937 Z

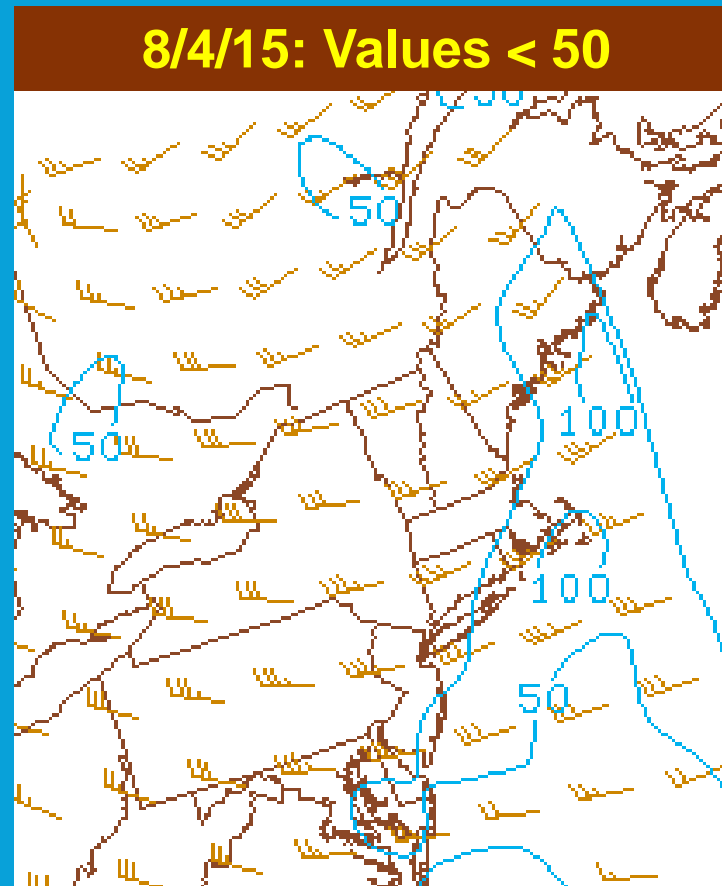


0.5 SRM: 1937 Z



- Classic Hook Echo
- Gate-to-gate shear: 67 knots (7K feet from radar)
- Tornado Warning was issued but no tornadoes confirmed on damage survey

No Confirmed Tornadoes in Southern New England



- Low level helicity less than 100, likely prevented tornadoes.
- Dry air at low levels was likely also a factor

Summary of Two High End Severe Weather Events

Favorable Environment in Place

- Anomalous instability
- Deep shear/moisture
- Mid level lapse rates near 6.5C/km.

Round 1

- *Trigger: Mesoscale boundary from increasing shear/low level jet across southeast New England*
- Widespread 60 to 80 mph wind gusts

Round 2

- *Trigger: Shortwave/cold front which brought very large hail to Northern MA*
- Mid levels dried out too much across CT/RI
- Lack of 0 to 1 KM helicity and dry air at lower levels were probably the reasons we did not have any confirmed tornadoes