EF2 Tornado
Revere, MA
Morning of 28 July 2014

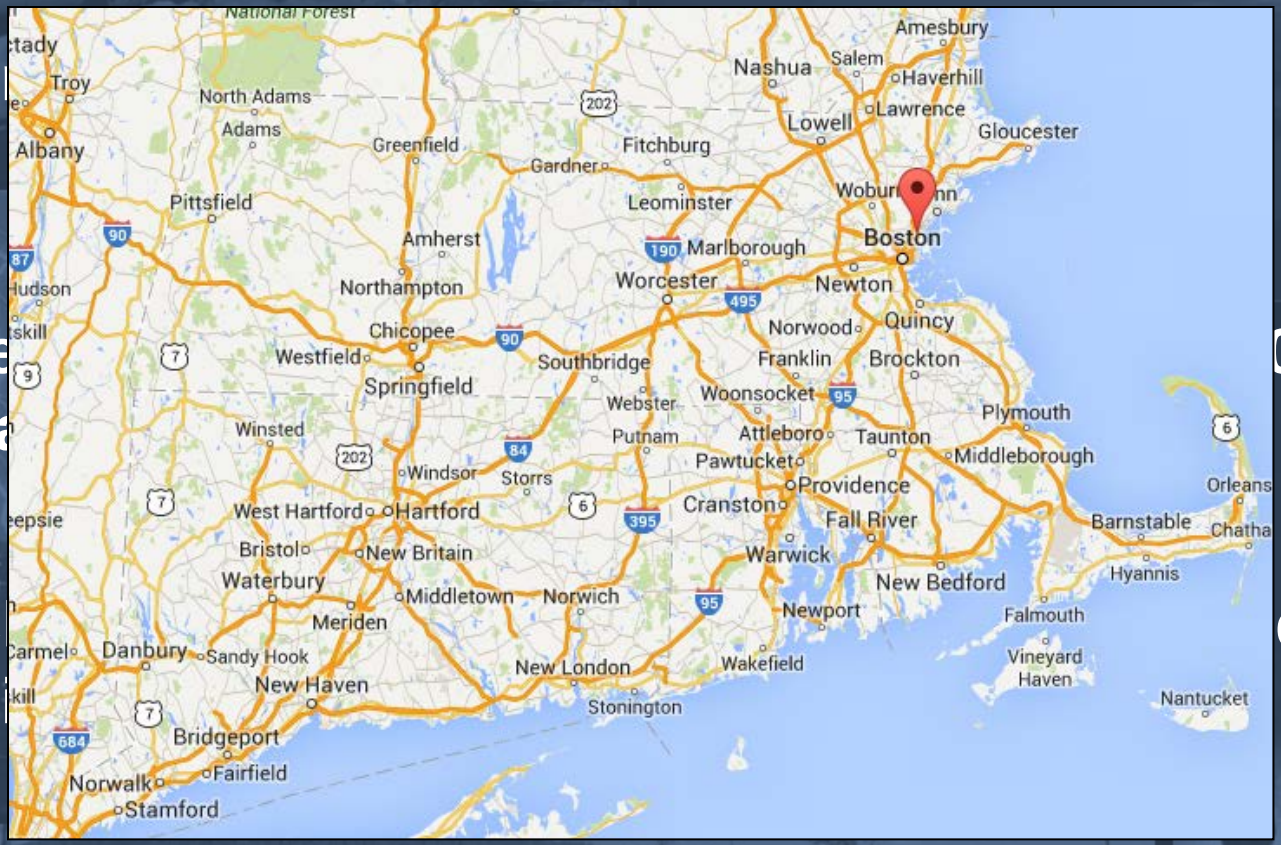
NATIONAL WEATHER SERVICE

WEATHER FORECAST OFFICE – TAUNTON, MA (BOX)

EF2 TORNADO STRIKES REVERE

ABOUT THE TORNADO

- Tornado touchdown from 932 AM to 936 AM in Revere, MA.
- No Sever in Effect.
- A Severe 0 AM, but expired a
- No Watc d from SPC duri
- Severe weather was not expected until the afternoon.



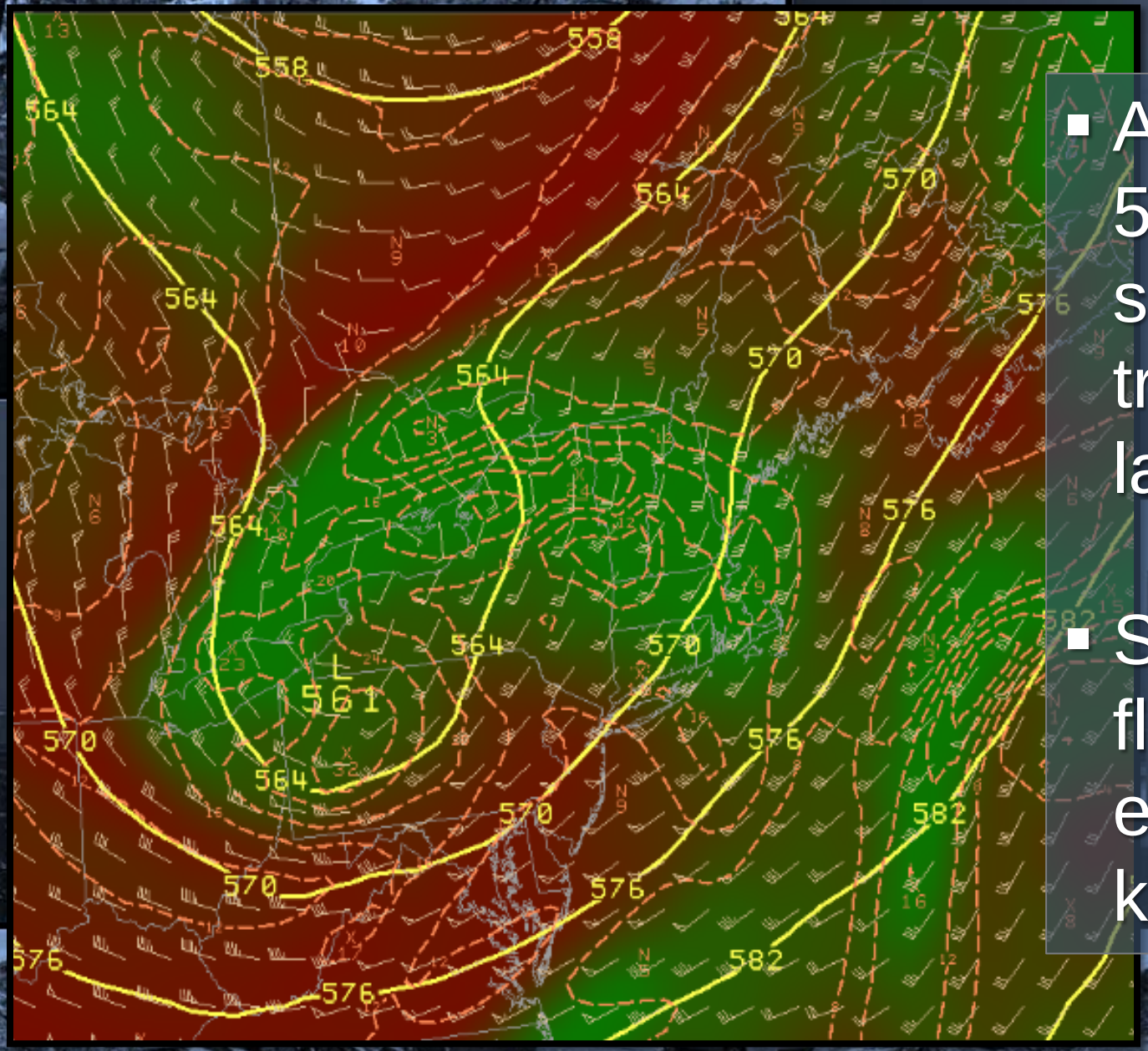
FORECAST DECISIONS MADE THAT MORNING

- The Severe Thunderstorm Warning Issued at 850 AM was for broad rotation.
- No Severe weather reports were received during the severe thunderstorm warning, so it was allowed to expire at 930 AM without an extension.
- A Flash Flood Warning was issued at 933 AM, as the tornado was touching down in Revere, MA (unknown at the time).
- Numerous reports of flooding began to roll into the office, but the tornado was not reported until after it had lifted.

OVERVIEW

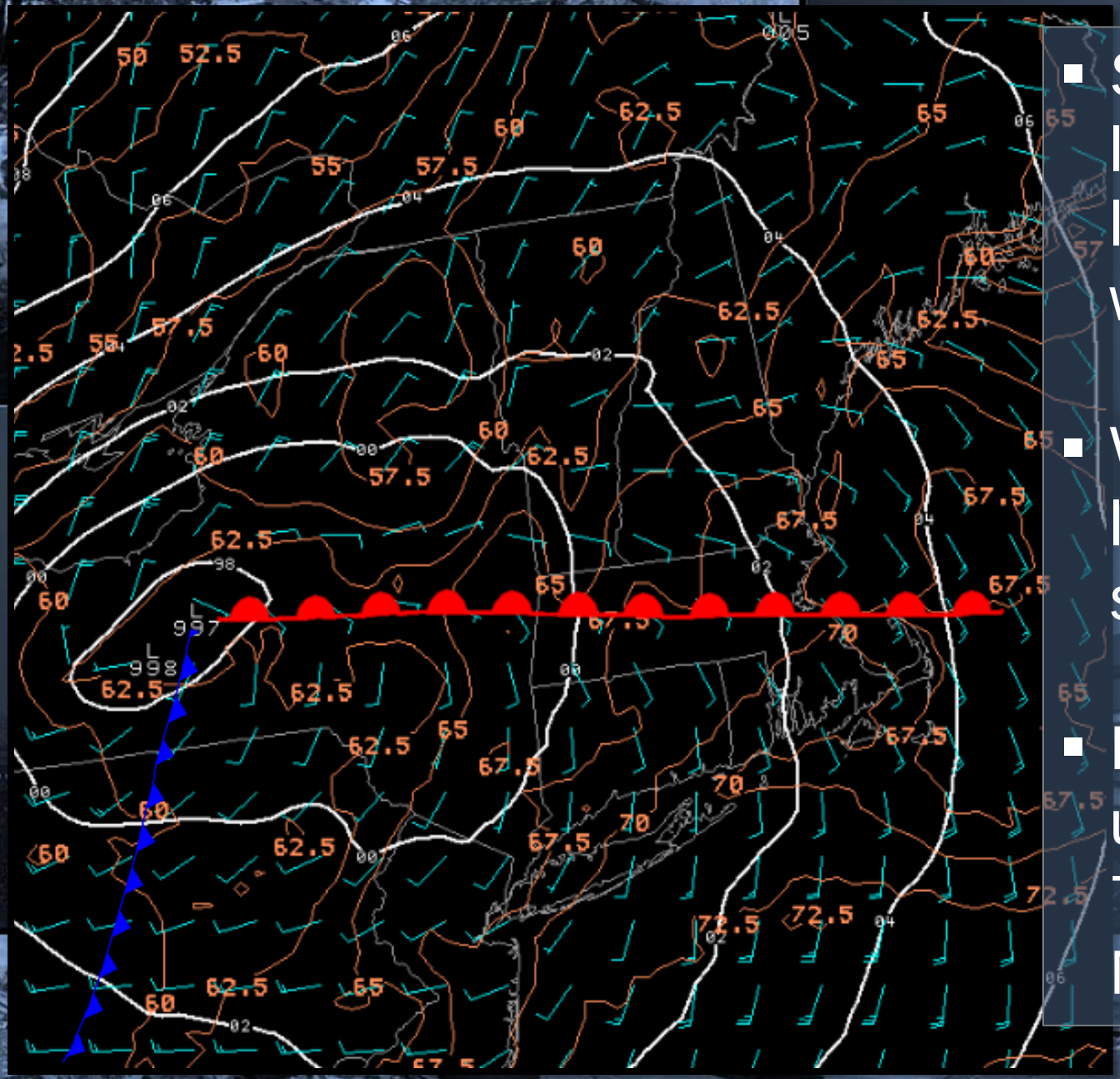
- Environment Assessment
- Satellite and Observations
- Radar Imagery
- Lessons Learned and Future Work

GFS 500 MB Forecast Valid 28 July 2014 - 12z



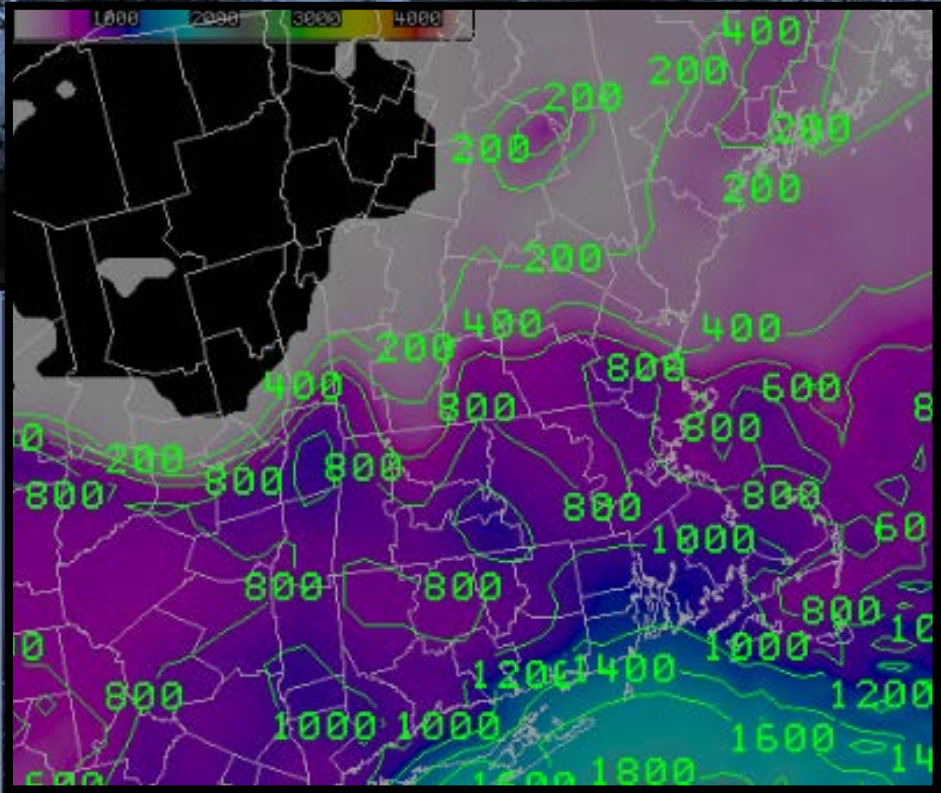
- Anomalous 500 MB shortwave/ trough for late July
- Southwest flow exceeding 50 knots

GFS Surface Forecast Valid 28 July 2014 - 12z

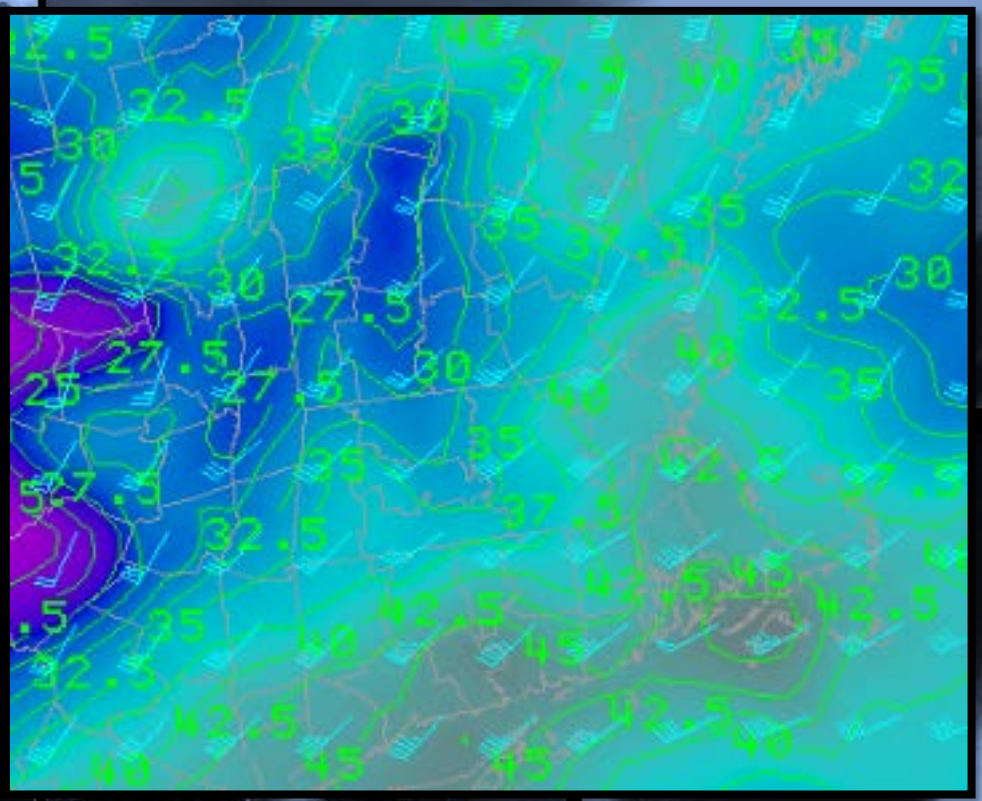


- Strong surface low pressure for late July to the west
- Warm front lifting up from south to north
- Dewpoints upper 60s/lower 70s in Orange, MA

NAM Cape Valid 28 July 2014 - 15z

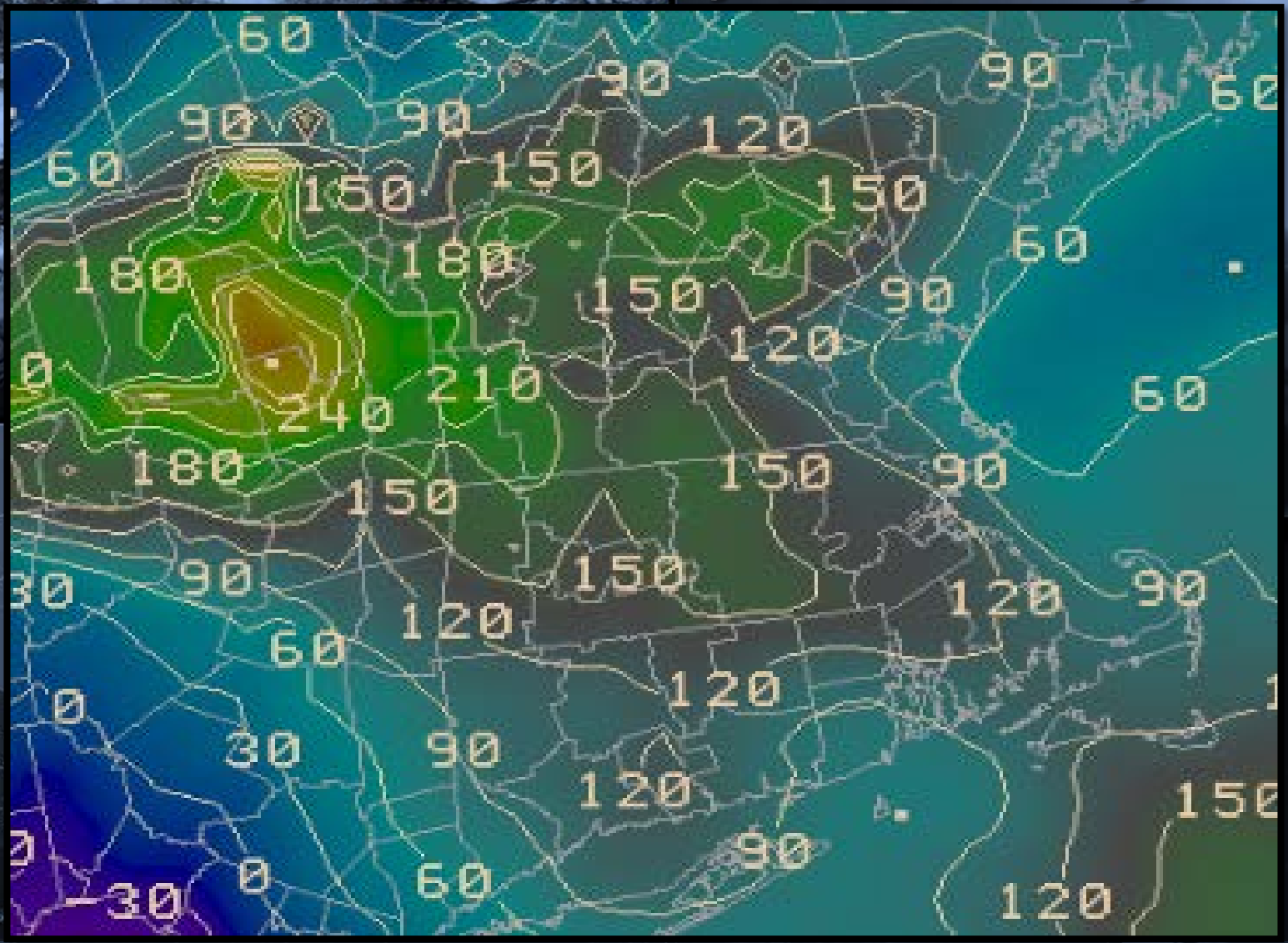


NAM 0 to 6 KM Shear Valid 28 July 2014 - 15z



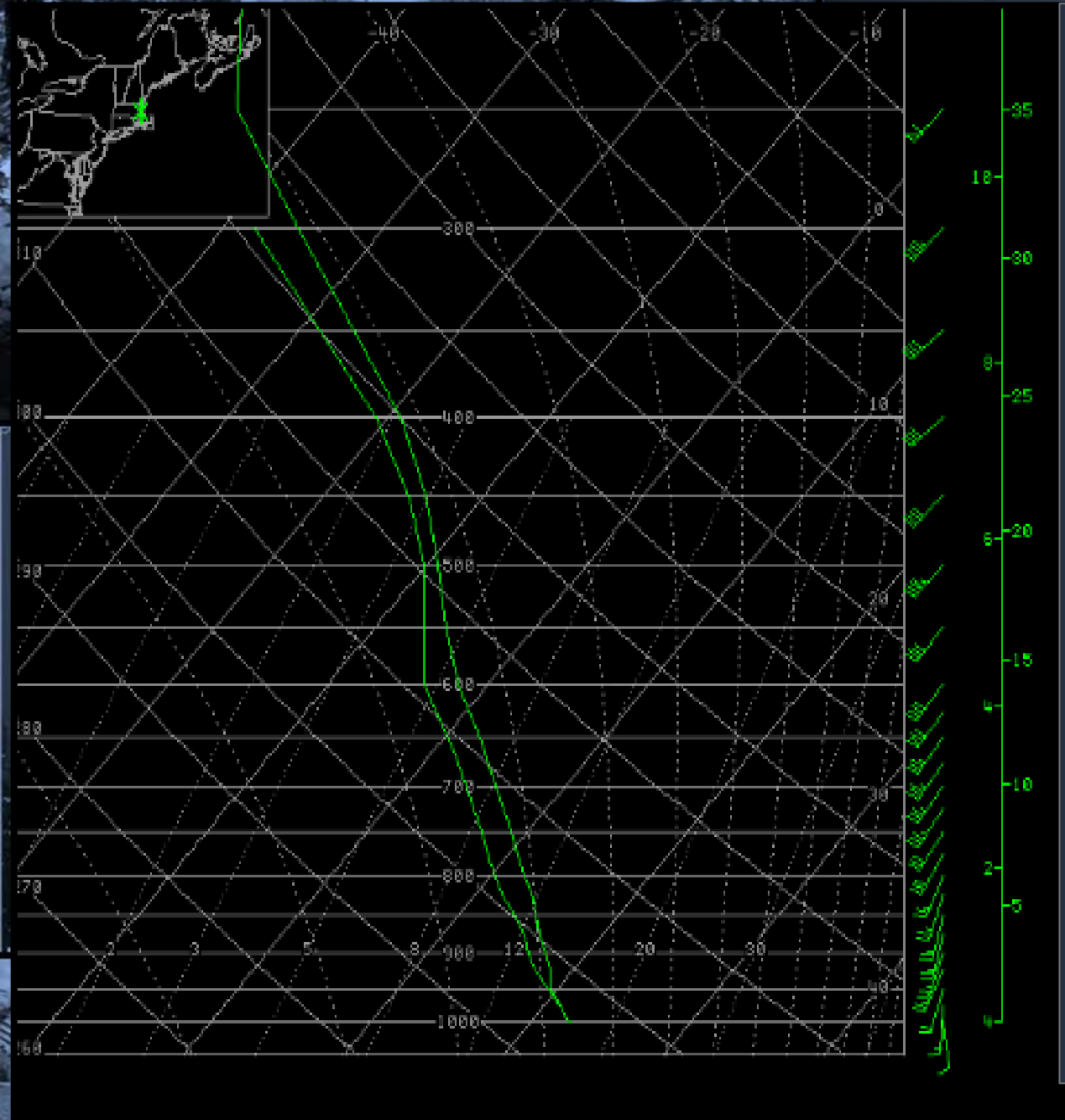
Surface Cape Approaching 1000 J/Kg
0 to 6 KM Shear of 35 to 45 Knots

NAM 0 to 1 KM Helicity- 15z 28 July 2014



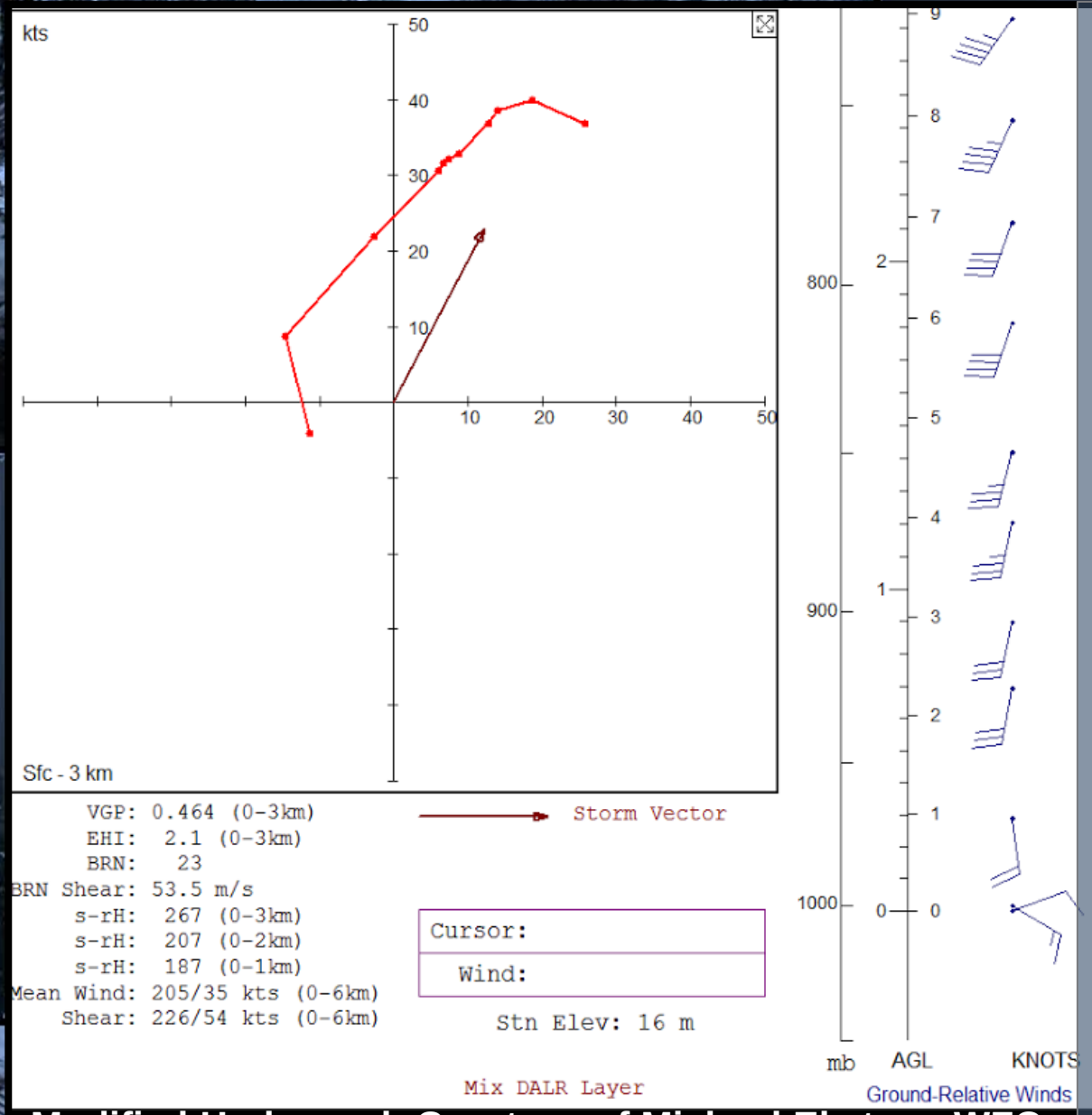
Values exceeding 100 suggest strong low level shear in the vicinity of the warm front

Revere NAM Forecast Sounding - 12z 28 July 2014



- Strong Winds through the profile
- Winds veering with height, especially in the lowest 1 KM
- Nearly saturated boundary layer, results in low LCL’s

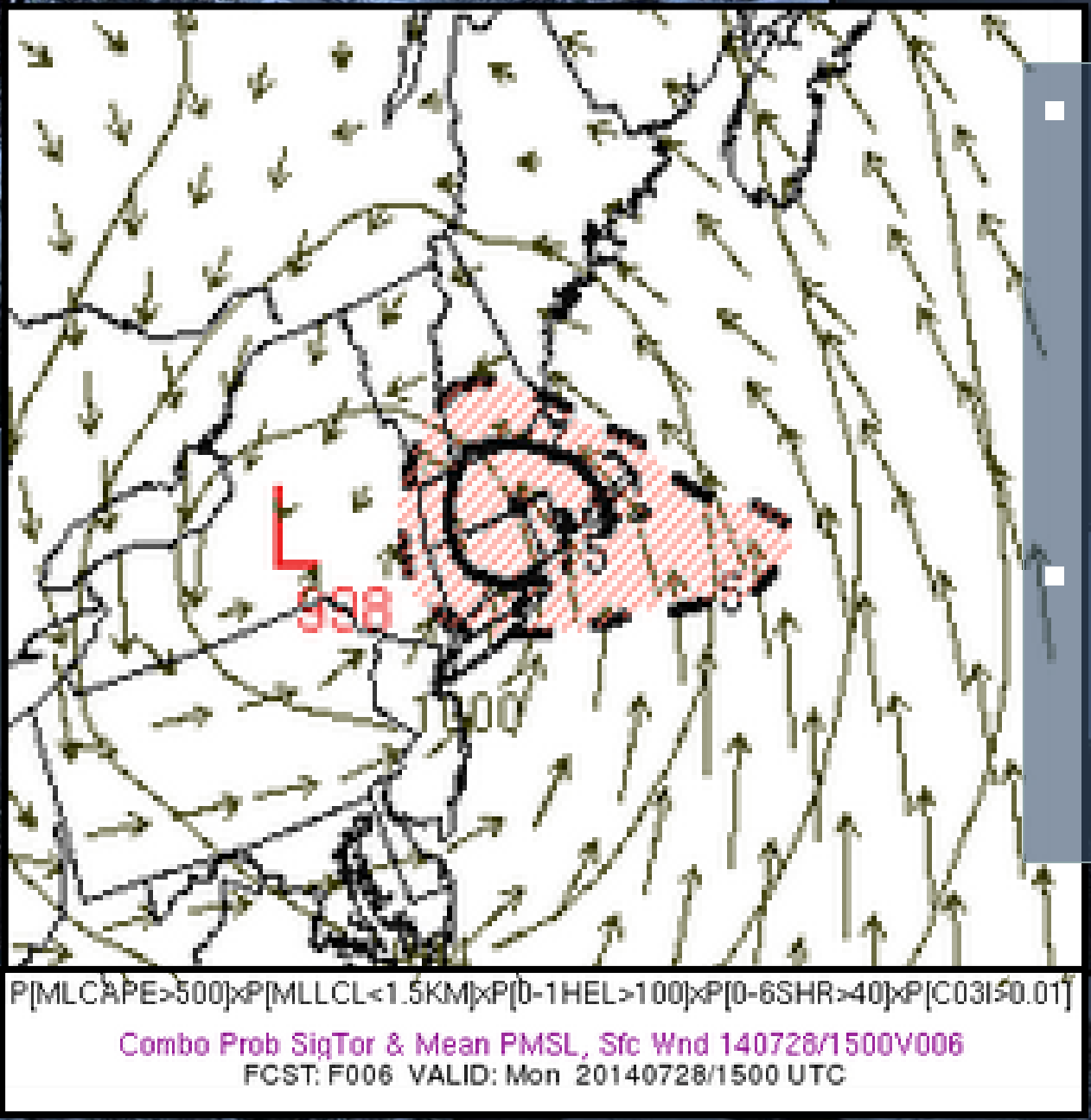
Revere Forecast Sounding 12Z 28 July 2014



- Modified ACARS Hodograph using lots of available data near BOS
- Near storm environment often has locally higher shear/instability than on a general analysis
- 0 to 1 KM helicity near 200!

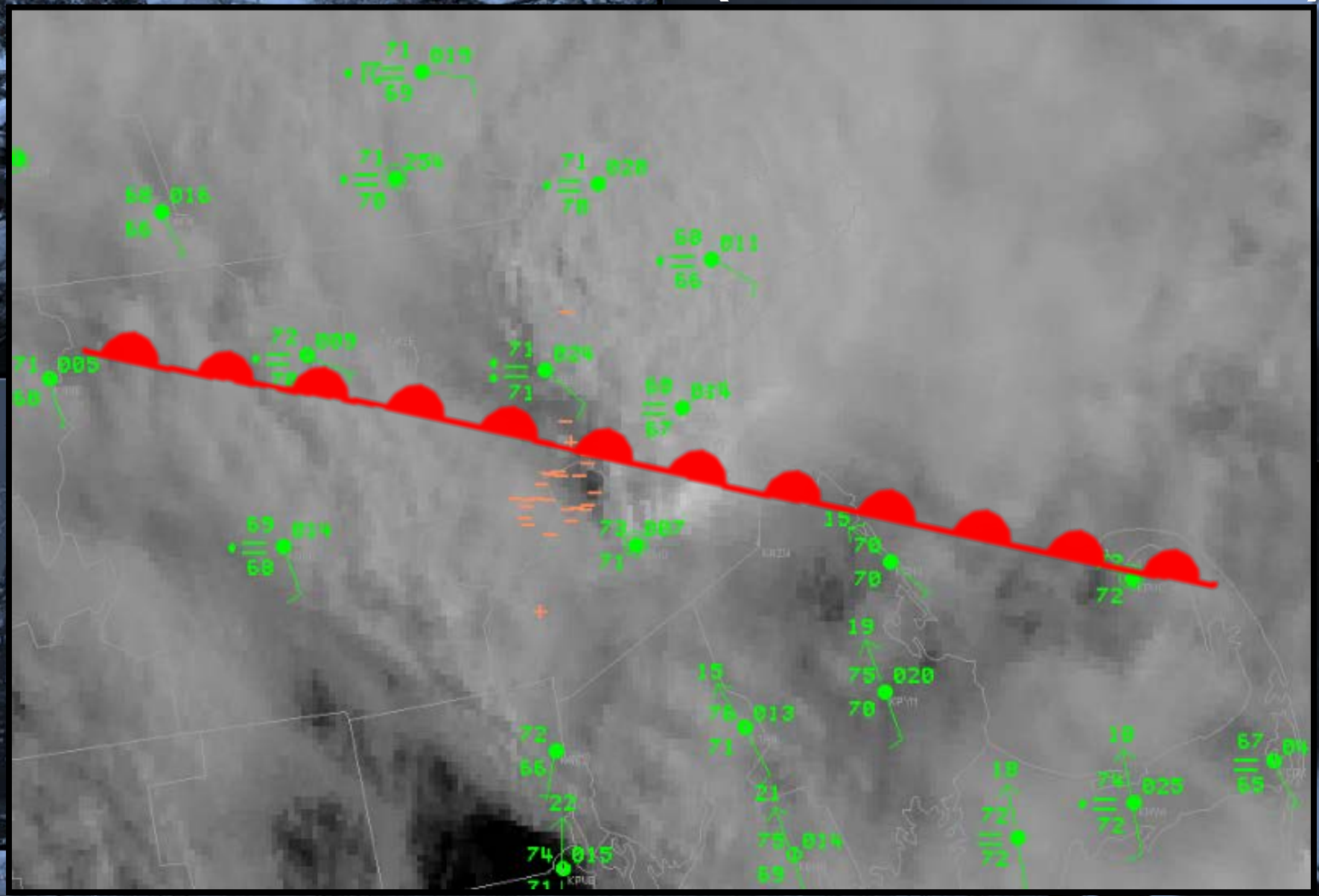
Modified Hodograph Courtesy of Michael Ekster – WFO GYX

SPC SREF Significant Tornado Parameter 15z



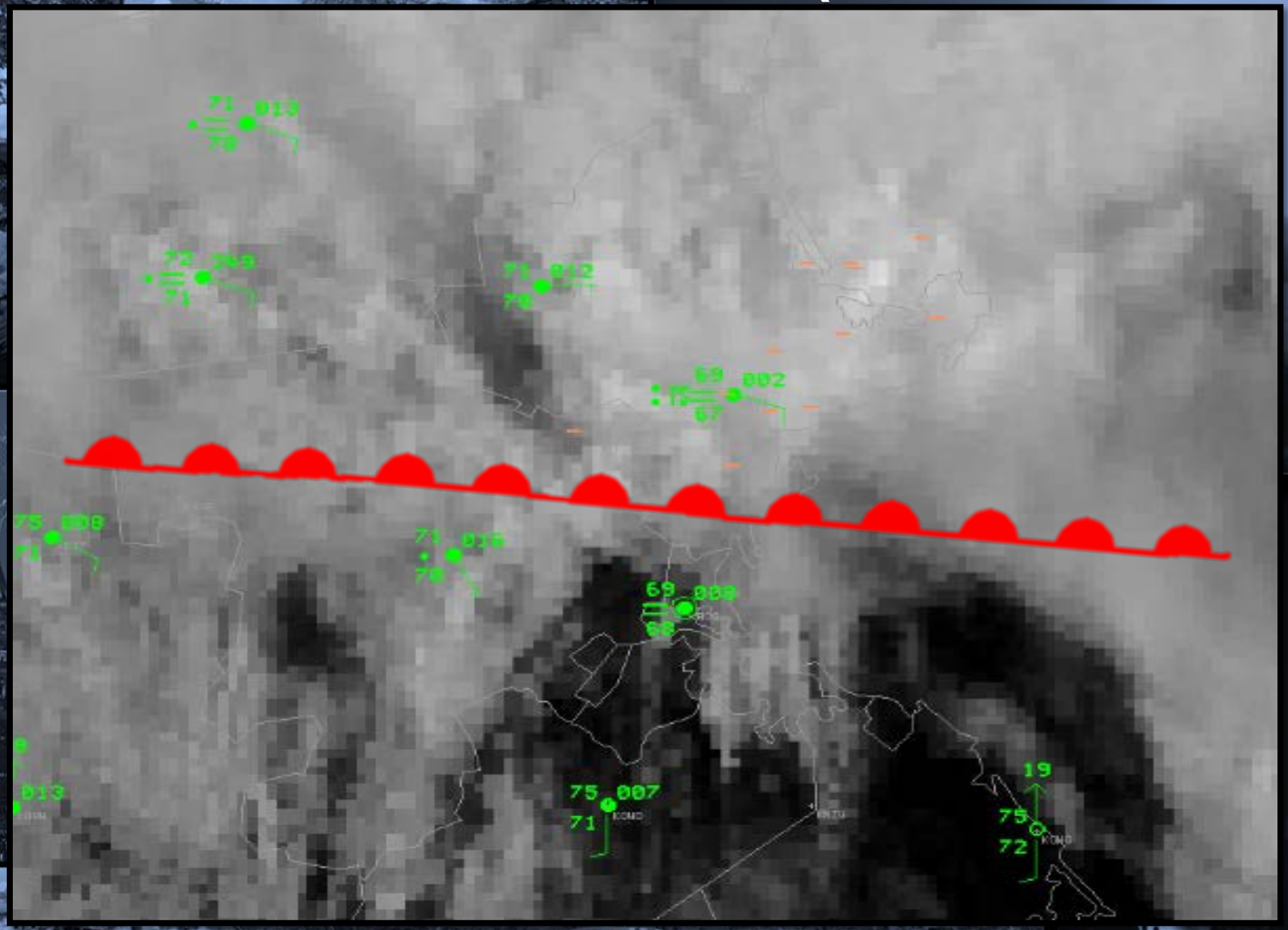
- SPC/SREF – Significant Tornado Ingredients Parameter
- Southern New England was actually highlighted at 15z.

Surface Observations 13z (Just Before Tornado)

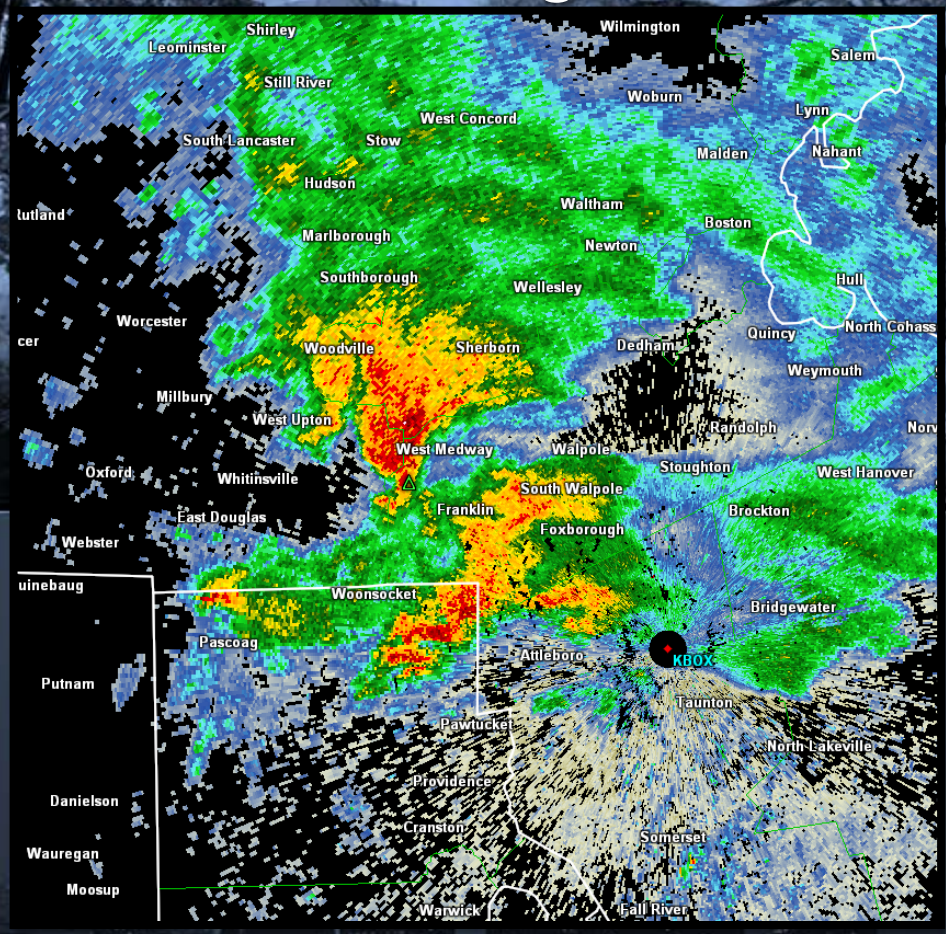


Low LCLs with low surface dewpoint depressions.

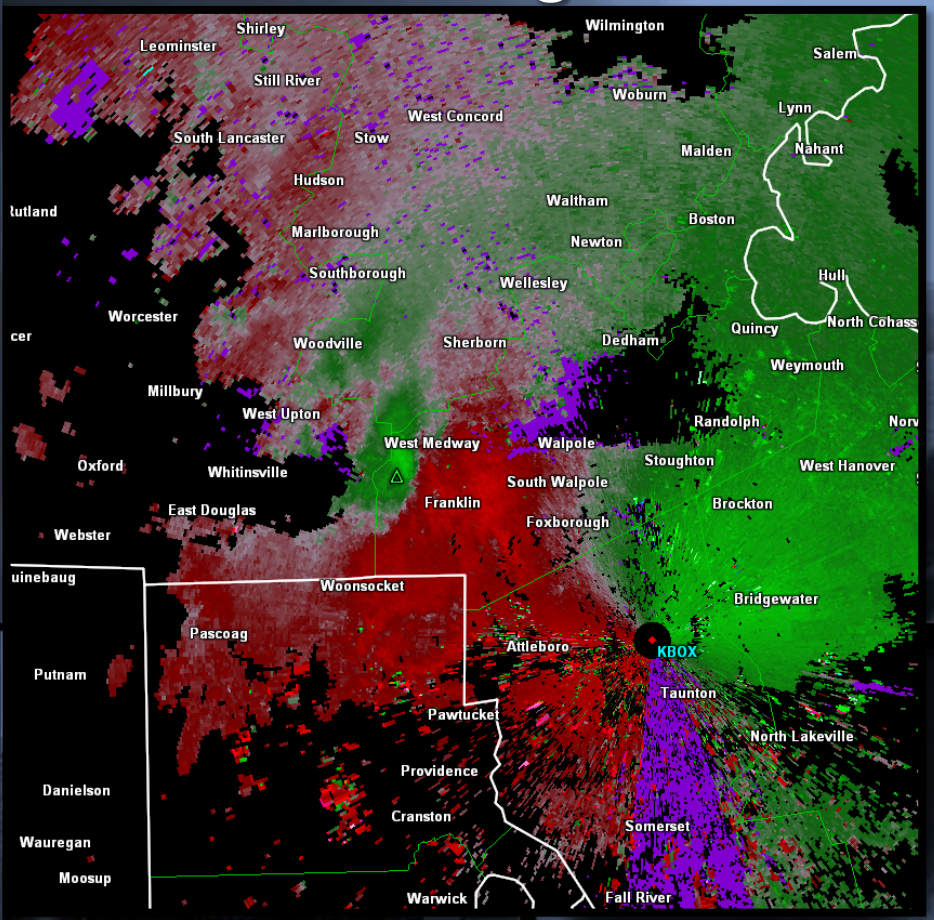
Surface Observations – Valid 14z (Just After Tornado)



1224Z 0.5 Degree REF

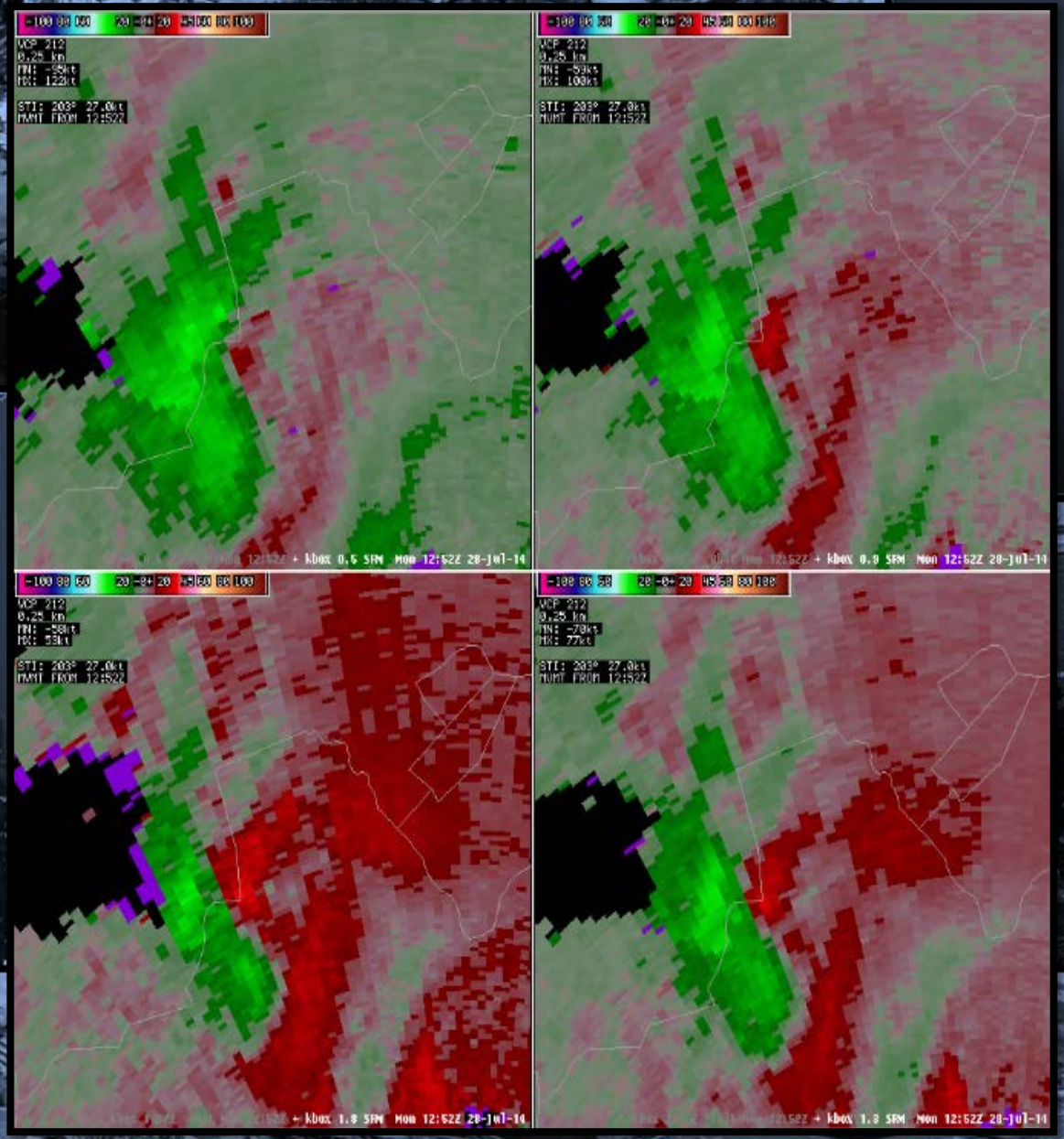


1224Z 0.5 Degree SRM



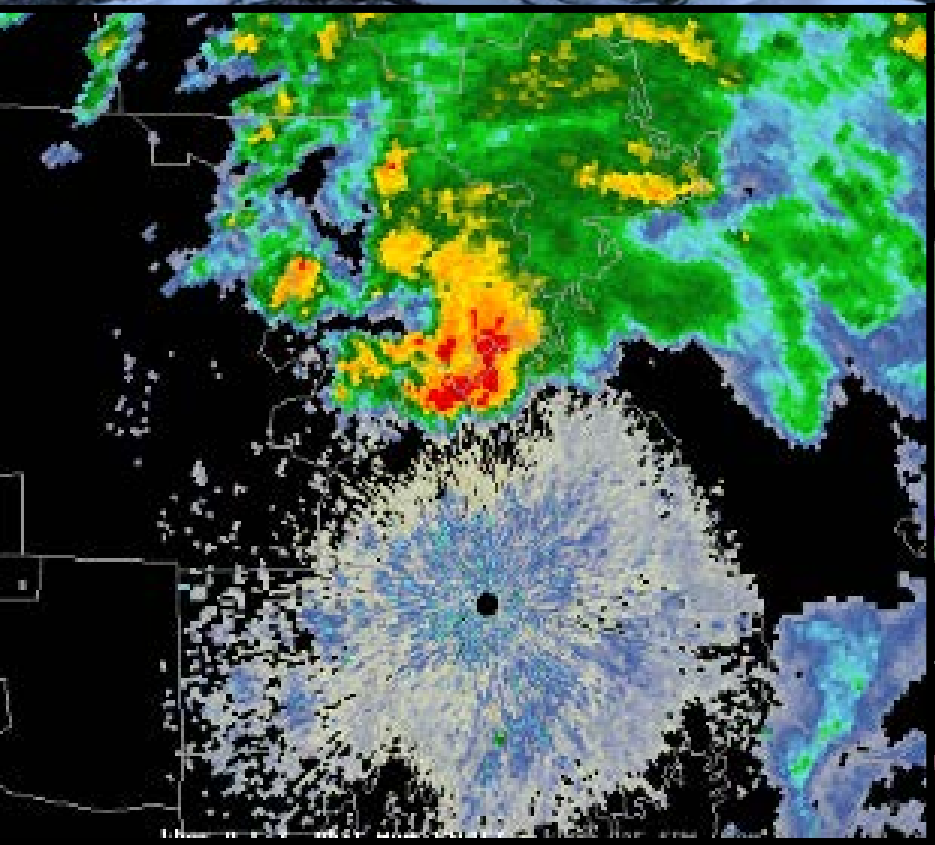
- Over 1 Hour before Tornado
- Storm near Wrentham, MA exhibiting broad rotation
- Continuous broad rotation prompted a severe thunderstorm warning at 850 AM

1252Z – Lowest Elevations Panel SRV

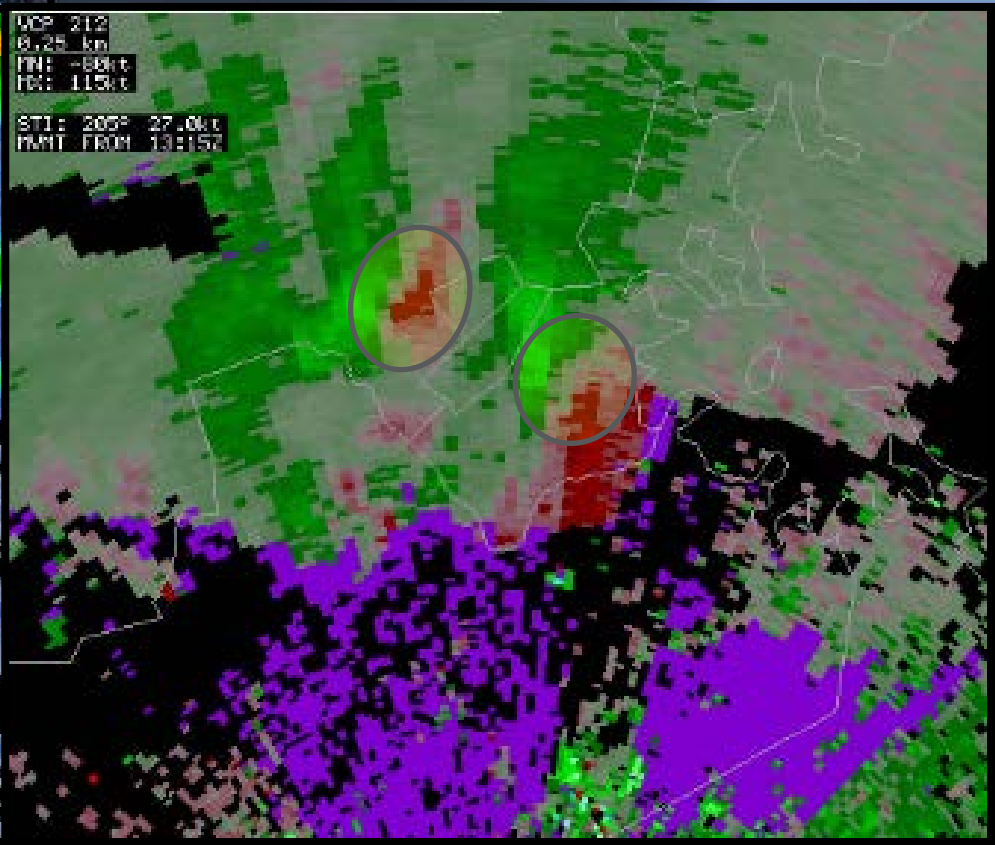


- Mesocylone near Needham, MA
- Would you justify a tornado warning based on the environment?
- Would a False Alarm on this storm discourage forecasters from issuing on the eventual tornado 40 minutes later?

0.5 Degree REF 1315z

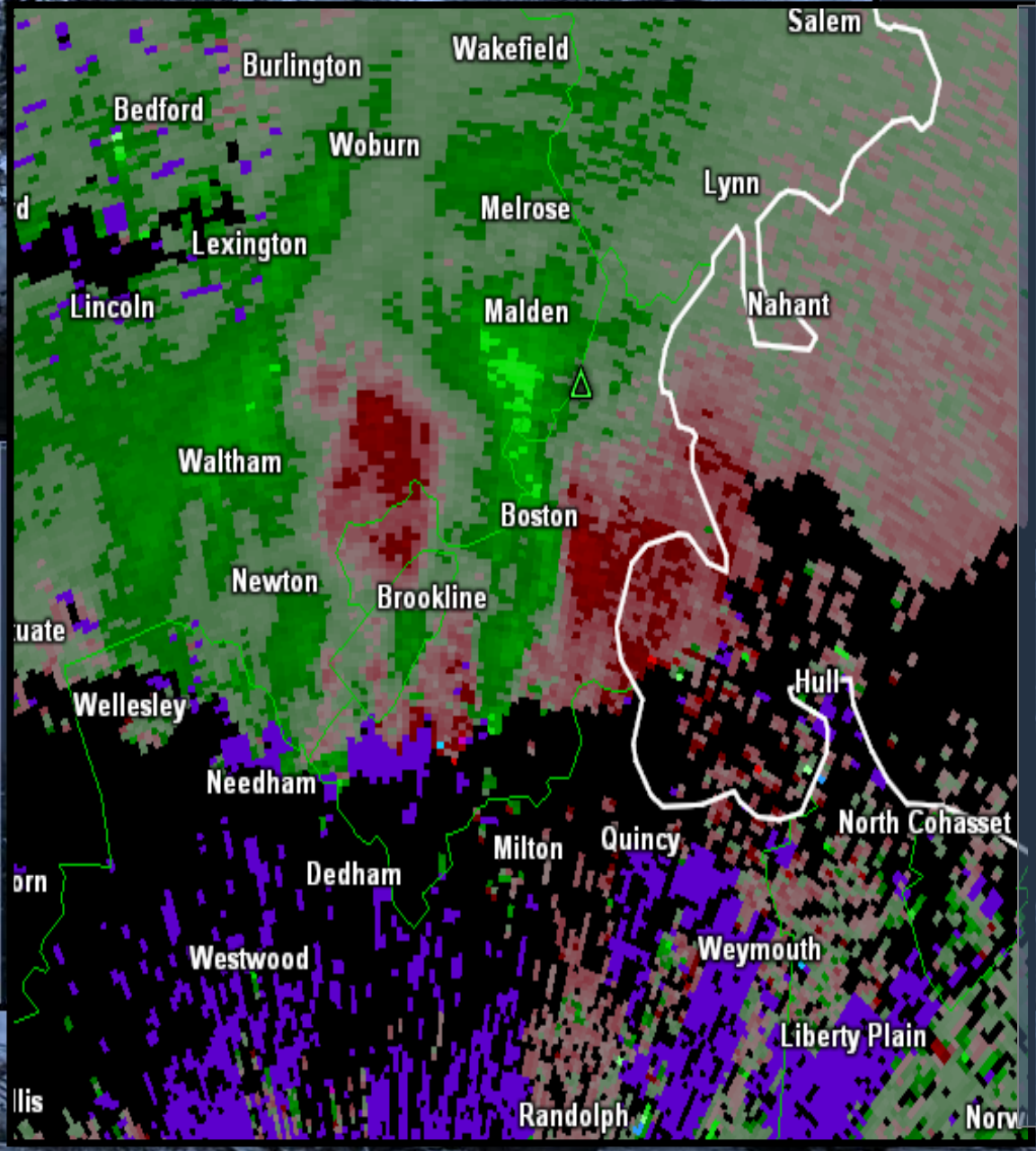


0.5 Degree SRM 1315z



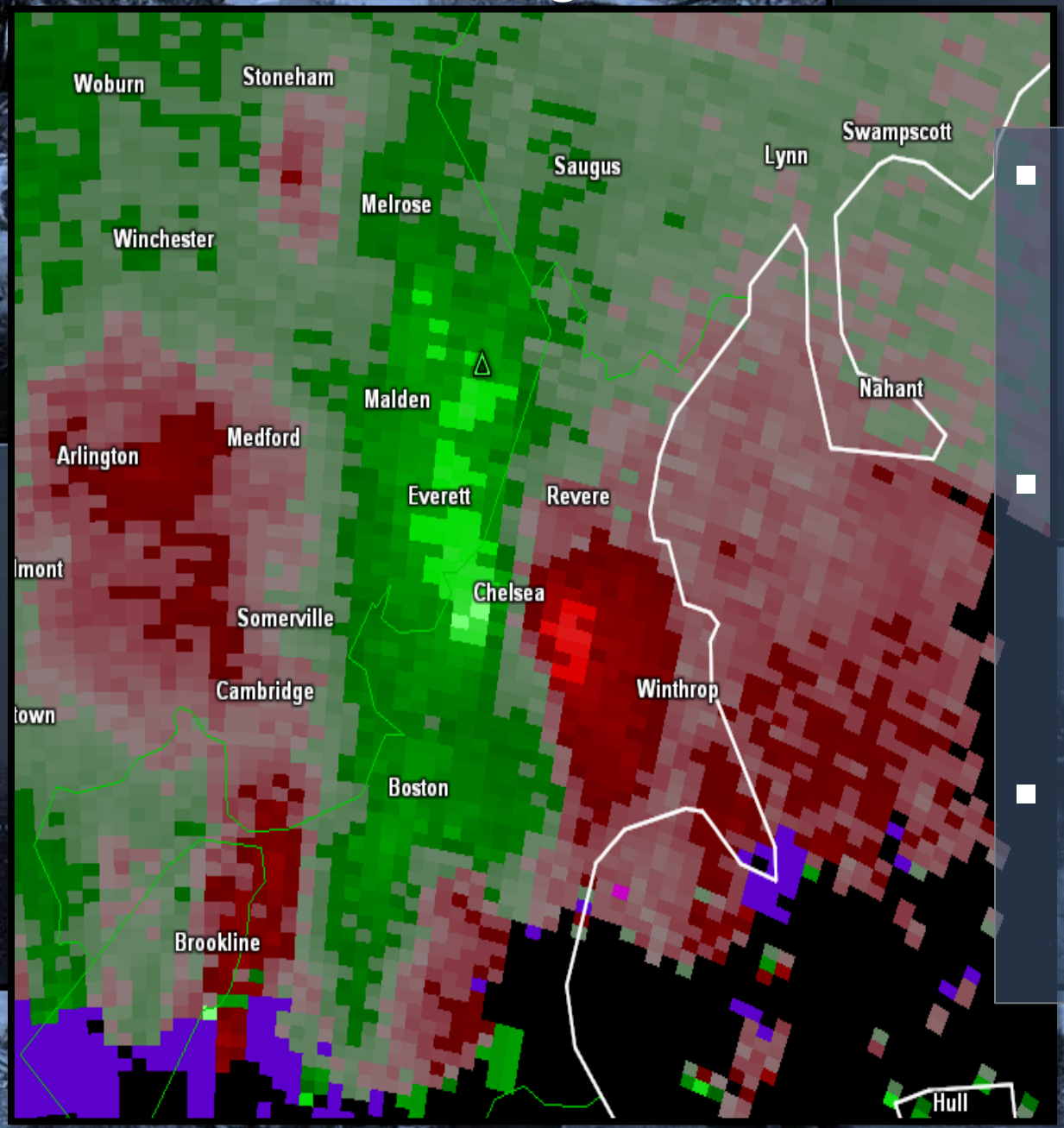
- Note 2 distinct circulations just west of Boston
- Cell merger appears to be a driving force in tornado development 15 minutes later

1325Z – 0.5 Degree SRM



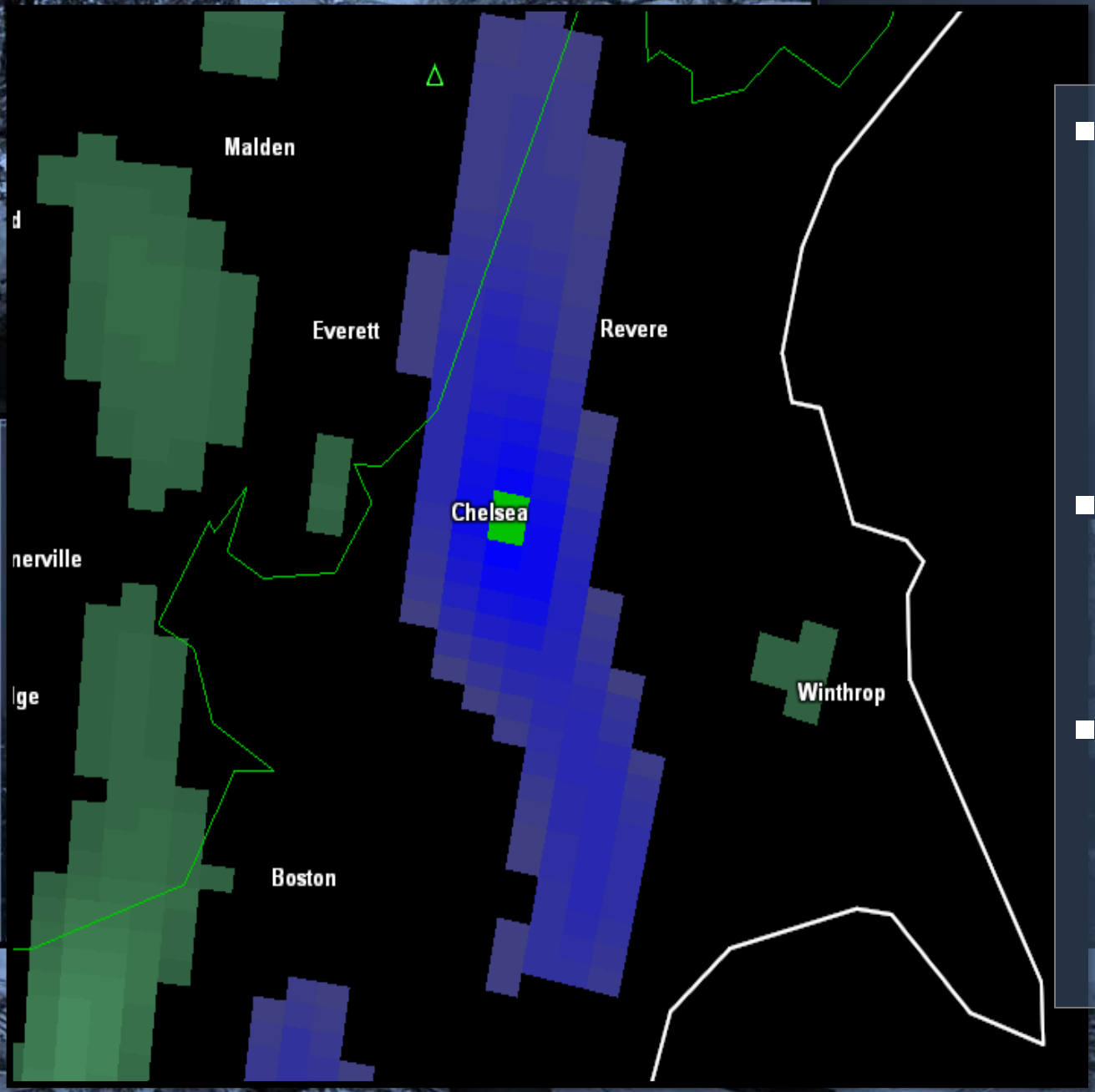
- 7 Minutes before Tornado touchdown
- Very broad weak rotation near Boston
- Nothing really alarming in this volume scan

1329Z – 0.5 Degree SRM



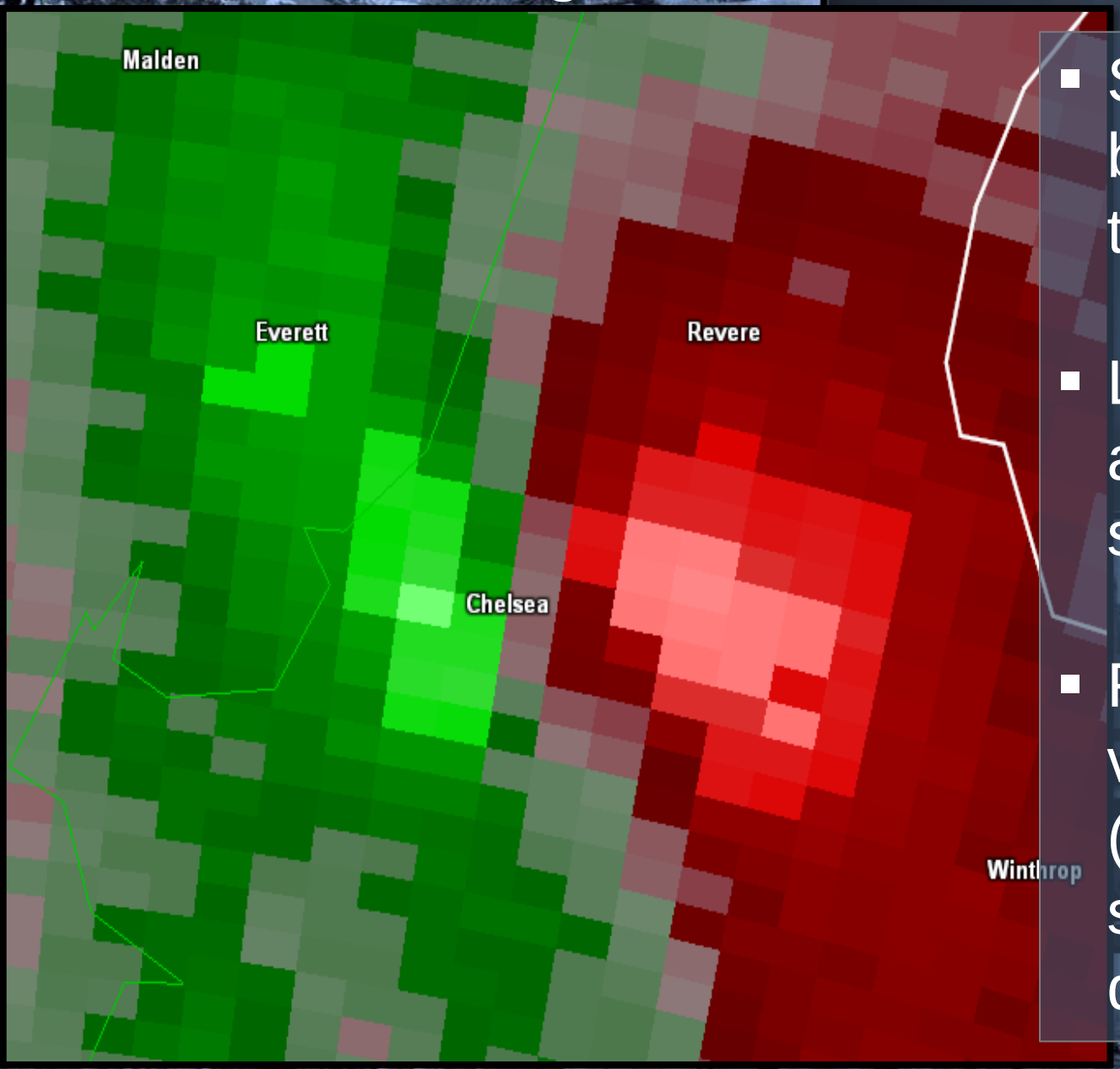
- 3 Minutes before Tornado touchdown
- Rotational velocity >30 Knots (65 Knots of Shear)
- Fairly symmetrical rotation although not “gate-to-gate”

1229Z – 0.5 Degree NROT



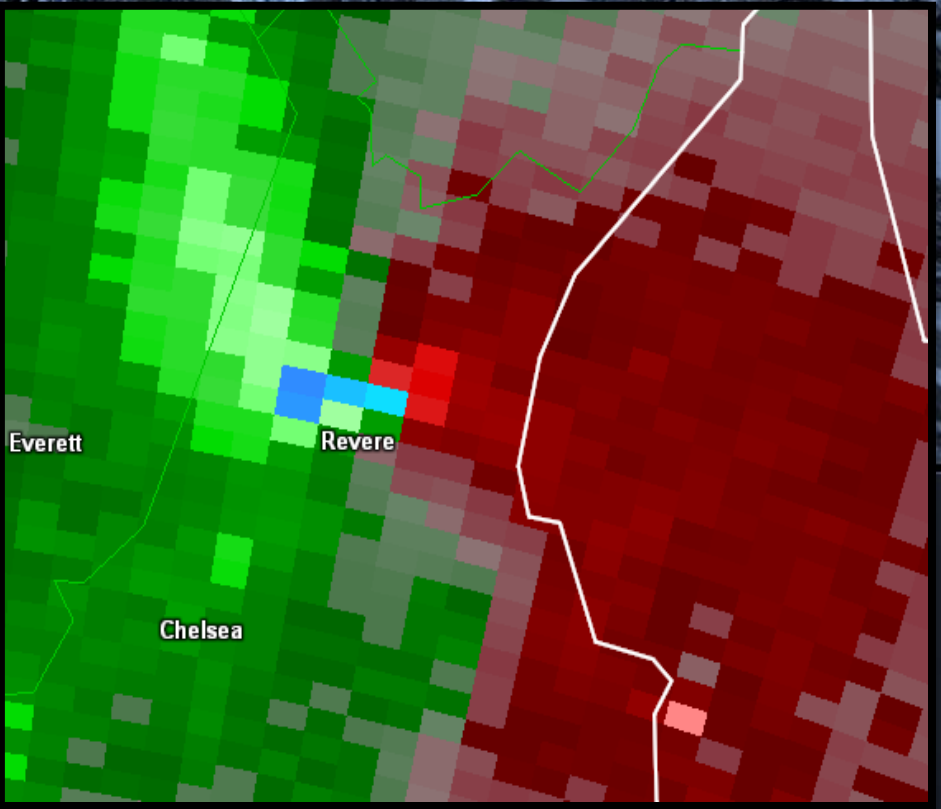
- NROT (Normalized Rotational Velocity)
- Exceeded 1 at 1229z
- Tornado warnings should be considered if NROT > 0.8

1329Z – 0.9 Degree SRM

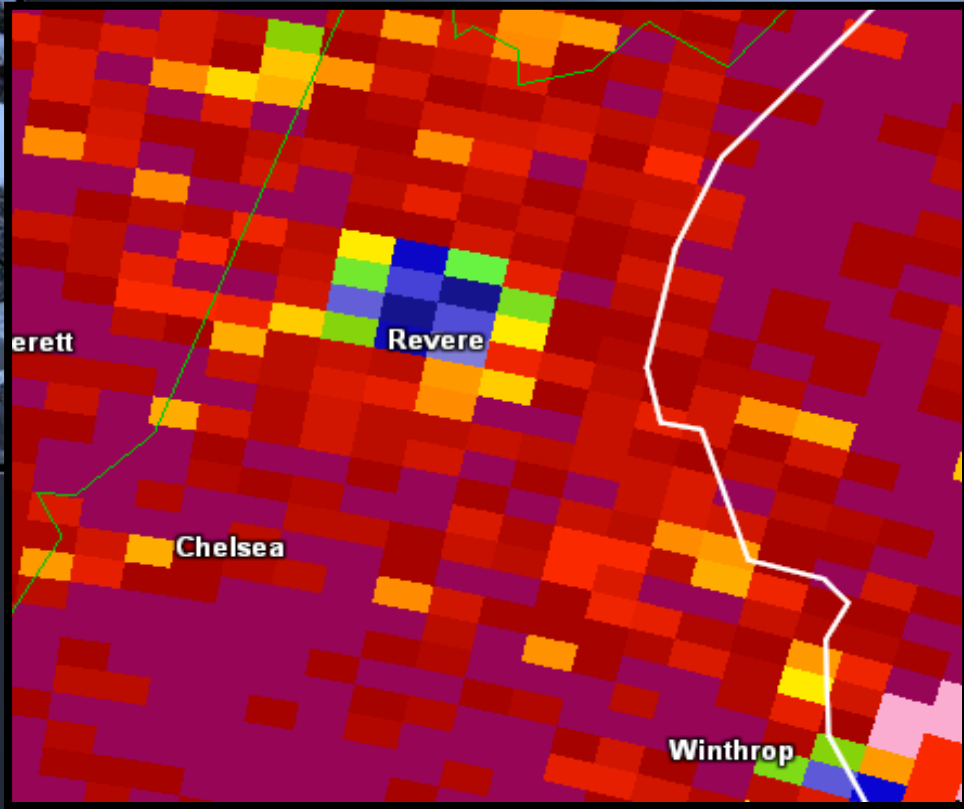


- Still 3 minutes before touchdown
- Looking just above 0.5 degree slice
- Rotational velocity 37 knots (75 knots of shear) at 0.9 degrees

1334Z – 0.5 Degree SRM

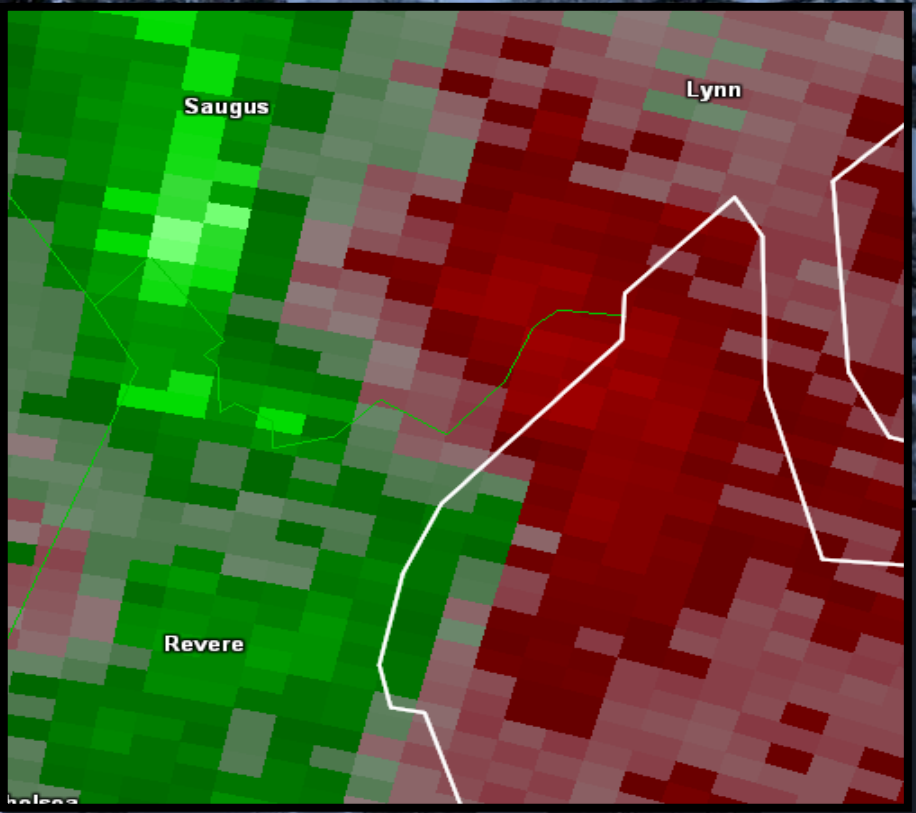


1234Z – 0.5 Degree CC

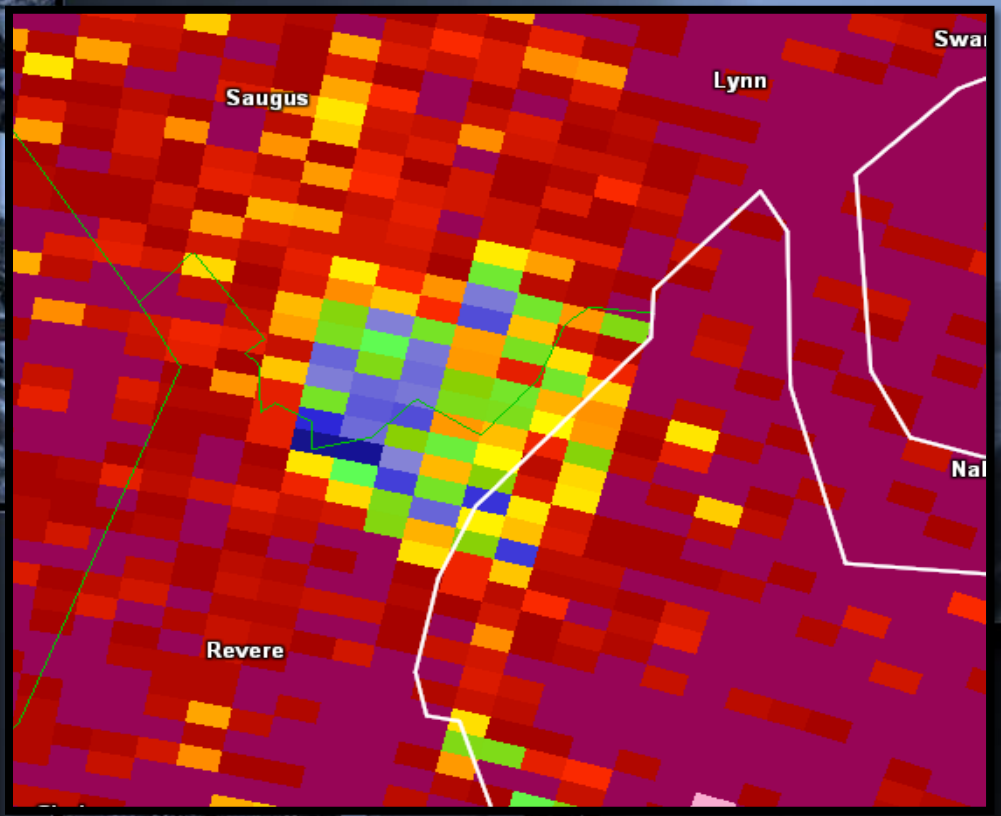


- Gate-to-gate shear of 80 knots
- Correlation Coefficient (CC) well below 0.8 co-located with SRM data
- CC confirms a tornado on the ground at time of scan

1339Z – 0.5 Degree SRM



1339Z – 0.5 Degree CC



- Shear weakened considerably on the next scan
- Tornado had lifted by this time
- CC still suggests debris lofted by tornado

LESSONS LEARNED FROM THE REVERE TORNADO

- Morning Tornadoes are unusual, but not unheard of in Southern New England

- Environmental Conditions favorable for Tornadoes:
  - 0 to 6 KM shear 35 knots or greater
  - 0 to 1 KM helicity near 100 or greater
  - Dewpoints upper 60s or higher
  - Low Temperature/Dewpoints Spreads (Low LCL's)
  - Anomalous upper trough or closed low over Great Lakes
  - Warm Front in the Vicinity of the region

LESSONS LEARNED FROM THE REVERE TORNADO

- Severe Weather was not expected in the morning, and staffing was reserved for the afternoon.
- Flash Flooding became the primary focus, as no severe reports were received until the tornado had lifted.
- Numerous flooding reports made it challenging for the warning forecaster to focus on severe/tornado potential.
- Severe and Flash Flooding threats should always be handled with two warning forecasters

LESSONS LEARNED - TORNADO DEBRIS SIGNATURE ON DUAL POL

- CC Value < 0.8 co-located with a mesocyclone indicate a tornado is on the ground
- NWS Offices need to be pro-active and utilize new technology
- A Tornado can be confirmed ahead of a damage survey with A TDS signature

FUTURE WORK

- WFO BOX plans to do research on these short lived-rapidly evolving tornados.
- Will include a student intern during the Winter-Spring of 2014-2015.
- Primary research roll will be to determine earlier indicators/rules of thumb that can be used to allow for better lead time…or at least have a warning.

Thank You!
Questions?

Special thanks to:

Hayden Frank, Senior Forecaster

Weather Forecast Office – Taunton, MA (BOX)