WFO Taunton Post Event Analysis
Event 2005_05:
"Severe Pulse Convection in a Tropical Environment in the WFO BOX County Warning Area"

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INTRODUCTION

A disorganized broken line of pulse type convective storms (Lemon, 1977), forced by an approaching cold front, developed across eastern New York State during the afternoon of 19 July 2005. A unique aspect of this case was that it formed in a very tropical and sultry air mass, with dew points in the mid 70s across much the CWA and ambient air temperatures in the mid 80s to mid 90s. This air mass was the remnants left behind by the envelope once associated with Hurricane Dennis.

Four severe events occurred during the mid afternoon. One event was warned, while the remaining three were not. The three unwarned events were covered in detail in Short Term Forecasts and Special Weather Statements. The first event produced localized wind damage and dime and penny sized hail in the city of Chicopee, Massachusetts. The second event produced localized wind damage in the town of Swanzey, New Hampshire. Both events displayed rather classic short lived pulse behavior. The last two events were associated with a line of storms that briefly intensified while they interacted with a pre-existing sea breeze front positioned from southeast Connecticut to northeast Rhode Island. These last two severe events produced localized wind damage in southeast Windham, Connecticut and in Smithfield, Rhode Island. This event report will review the mesoscale and radar characteristics associated with these four severe storms.

SYNOPTIC SETTING

Numerical Weather Prediction (NWP) guidance was forecasting the passage of a cold front during the late afternoon of 19 June 2005. NWP guidance from the NAM indicated CAPEs in excess of 3000 J/kg were quite likely across much of the interior.
Surface observations and LAPS-analyzed CAPE verified the model forecasts at 18 UTC, as shown in Figure 1. Also, note that surface based streamlines indicated convergence through the Connecticut Valley, where two severe storms would later form. Given the tropical nature of the air mass, and with little bulk shear in the low and mid level wind fields, pulse type convection was the expected behavior. Winds aloft were at most 20 to 25 kts through the lowest 500 mb. Based on modified morning sounding data (not shown), the wet bulb zero elevation was 13.5 kft, the 0°C elevation was 15.7 kft and the height of the -20°C elevation was 26.2 kft.

THE SWANZEY, NH AND CHICOPEE, MA STORMS

Convection began to develop across the western Connecticut Valley from Cheshire county, NH to Hartford county, CT between 18 and 19 UTC. Nearly simultaneously, two cells rapidly developed in vertical extent.

The Swanzey cell experienced its first significant pulse at 1916 UTC. At this time, a core of 60 dBZ up to a height of 22.5 kft was achieved (Figure 2). The second pulse occurred at 1925 UTC, and it was accompanied by a 58 dBZ core up to 22 kft and a 52 dBZ core up to 27 kft (Figure 3). VIL Density of 3.5 was associated with this storm, which is representative of the low end of severe damage likely for WFO BOX CWA (Maxwell 1996). Amateur radio skywarn spotters reported a small area of downed trees along route 12 and wind damage to a garage.

While the Swanzey cell was pulsing, a new storm rapidly developed over Chicopee, MA. This storm experience one significant pulse, as depicted in Figure 4. By 1921 UTC, a core of 63 dBZ up to a height of 25 kft and a 58 dBZ core up to 31 kft had developed. This pulse corresponded to the highest VIL of the day, 58, with a corresponding echo top of 43 kft. Thus, this cell had a VIL Density of 3.75. This storm experienced a pronounced core collapse at 1929 UTC, as indicated in Figure 5, followed by reports of wind damage and hail approximately 9 minutes later. In fact, the Swanzey cell blew tree limbs down on power lines and produced several minutes of penny and dime sized hail as it moved over the Westover Air Base. It has been presented (WDTB 2004) that nearly all storms producing 65 dBZ cores above the freezing level go on to produce severe weather, and that the higher the dBZ aloft above the -20°C the greater the hail threat. This storm's behavior also provides greater support to a previous study on severe weather conducted by Maxwell (1996), who showed a high probability of severe damage due to wind and/or hail with collapsing cores.

THE WINDHAM, CT AND SMITHFIELD, RI STORMS

Later in the afternoon, several convective storms evolved into a ragged LWEP as they moved into southern Worcester County and north central Connecticut (Figure 6). Note the convergence zone illustrated by the confluent streamlines from southeast Connecticut into eastern Rhode Island. This convergence zone lifts slowly northwest by 21 UTC as the southwest part of the convective line begins to interact with the sea breeze front (Figure 7). The Windham, CT severe wind damage episode occurred near 2130 UTC, shortly after one storm embedded within the line intensified and pulsed with a maximum core of 53 dBZ up to a height of 22 kft (Figure 8). Frequently, convection interacting with sea breeze boundaries often weakens rapidly upon the ingestion of more stable maritime air. In this case, however, the pre-existing tropical air mass diminished the impact of the stable marine layer. CAPE along and south of the boundary was in the 2000-3000 J/Kg range (not shown) and allowed the boundary convergence to enhance the convection rather than suppress it. By 22 UTC (Figure 9), the convection intensified as it continued southeast across Rhode Island. Severe wind damage occurred around this time in Smithfield, RI. This severe event was associated with what appears to be a weak rear

inflow notch over a storm, which continued to pulse as it passed through Smithfield, RI (Figure 10).

WARNING VERIFICATION

Table 1 provides a summary of the products issued during the event. Table 2 provides the Local Storm Report (LSR) for this event. A Special Weather Statement and an updated Hazardous Weather Outlook were issued during the late morning to raise awareness across the region being placed in a Slight Risk of Severe Thunderstorms. SPC collaborated the issuance of Severe Thunderstorm Watch 645 for the region, valid 1810 UTC 19 July through 00 UTC 20 July. WFO Taunton verified its only warning issued for the Chicopee, MA storm. No warnings were issued for the other three severe events that occurred that day; however, these storms were covered by Short Term Forecasts and Special Weather Statements.

In Windham, Connecticut, trees were reported downed along route 12, however, this information was not provided to WFO BOX by county police until 01 UTC 20 July. Doug Haywood, ASOS ET at WFO BOX, surveyed the damage in Windham County, while out on his trip to repair the Willimantic, CT ASOS, which was struck by lightning by this same storm. Figures 11 and 12 clearly show straight-line wind damage, with winds estimated around 60 mph in this location.

In Smithfield, Rhode Island, Amateur radio operators at the Smithfield EOC reported trees blown down around 22 UTC. In addition, their EOC weather tower measured a maximum wind gust of 52 mph as this storm passed overhead.

WFO BOX SYSTEM ISSUES

Frequent lightning produced by a squall line near the Taunton WSR-88D, resulted in multiple Wide Band failures between the WSR-88D RDA and RPG. As a result, nearly one dozen periodic radar disconnects occurred, making it difficult for the radar operator to maintain watch on the storms. WFO OKX's radar was used extensively during this time. At one point, the WSR-88D shut down and placed itself on Standby. WFO Taunton personnel manually placed the system back on-line toward the end of the lightning episode. After consulting with the WFO BOX Electronics staff, it is believed that the implementation of the new Fiber Optic cables to the WSR-88D will greatly improve this problem, as has been noted at other WSR-88D sites in the country.

It appears that due to multiple recordings of the initial SEL05 Watch, the CRS database became corrupt. The system remained on-line through the duration of the event, but it took manual intervention to remove the bad products. The unit eventually failed completely later that night, requiring the installation of a clean database the next morning.

SUMMARY

WFO Taunton experienced a pulse convection episode on 19 July 2005, in a tropical air mass left behind by Hurricane Dennis. High dew points, hot ambient air temperatures, and an approaching cold front produced a disorganized broken line of showers and thunderstorms. Two of these storms pulsed, producing localized severe weather. This episode was an isolated case of pulse type convection, but was handled well by the warning team. The Albany study (Cerniglia and Snyder 2002) on severe pulse convection was reviewed during the 2005 Severe Weather Workshop at WFO Taunton, and forecasters had reviewed modules pertaining to mechanisms responsible for wind and hail production as part of the AWOC course.

Forecasters are encouraged to make use of the variety of severe weather cases resident on the Weather Event Simulator in order to practice radar techniques and to maintain their proficiency on radar and warning operations. They are also encouraged to review local regional research and AWOC models to maintain proficiency on severe radar detection techniques.

REFERENCES

Cerniglia, C. S., and W. A. Snyder, 2002: Development of warning criteria for severe pulse thunderstorms in the northeastern United States using the WSR-88D. ERH-TA No. 2002-03.

Lemon, L. R., 1977: New severe thunderstorm radar identification techniques and Warning criteria. *NOAA Tech. Memo*. **NWS NSSFC-1**,. Kansas City MO, National Severe Storms Forecast Center, 60 pp.

Maxwell, C., 1996: Local research results on the likelihood of severe weather as a function of VIL Density. WFO Taunton Severe Weather Reference.

Warning Decision Training Branch (WDTB), 2004: Hailstorm Characteristics. *NOAA/NWS.* Advanced Warning Operations Course (AWOC), IC3-V-D.

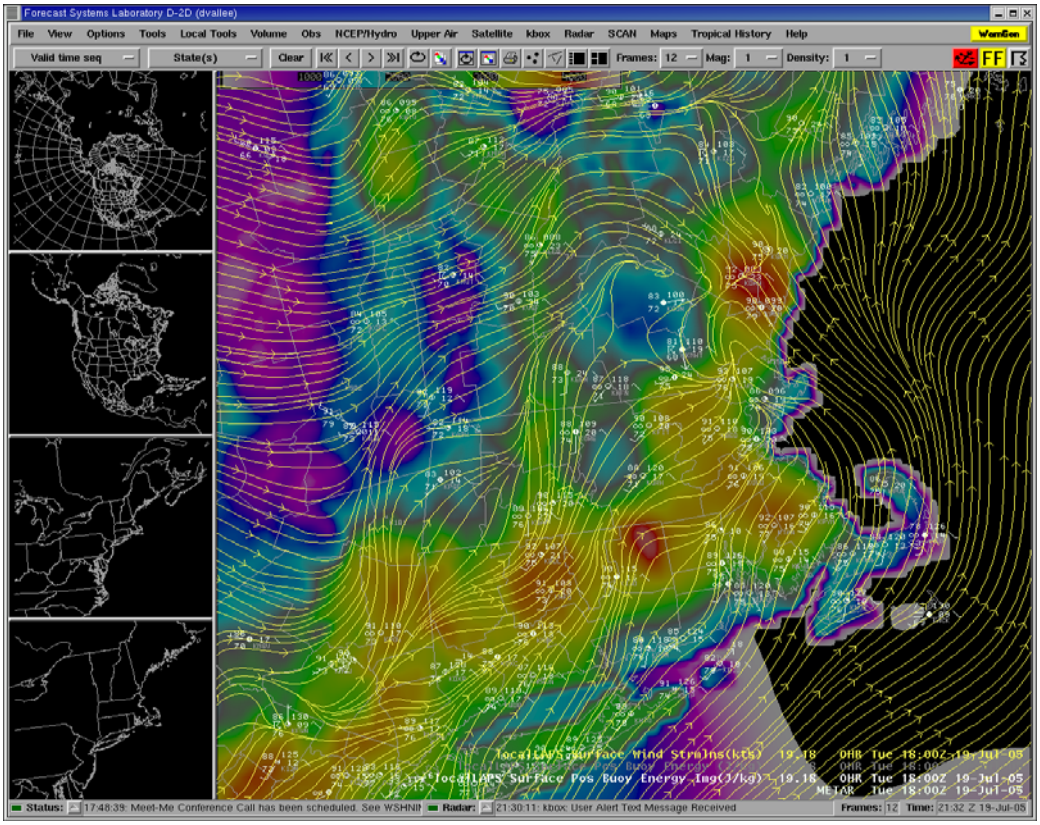

Figure 1. Plotted surface observations at 18 UTC, 19 July 2005. CAPE is depicted by the colored image where values >2500 J/Kg are shaded in warm colors. Surface based streamlines are noted by the solid yellow lines.

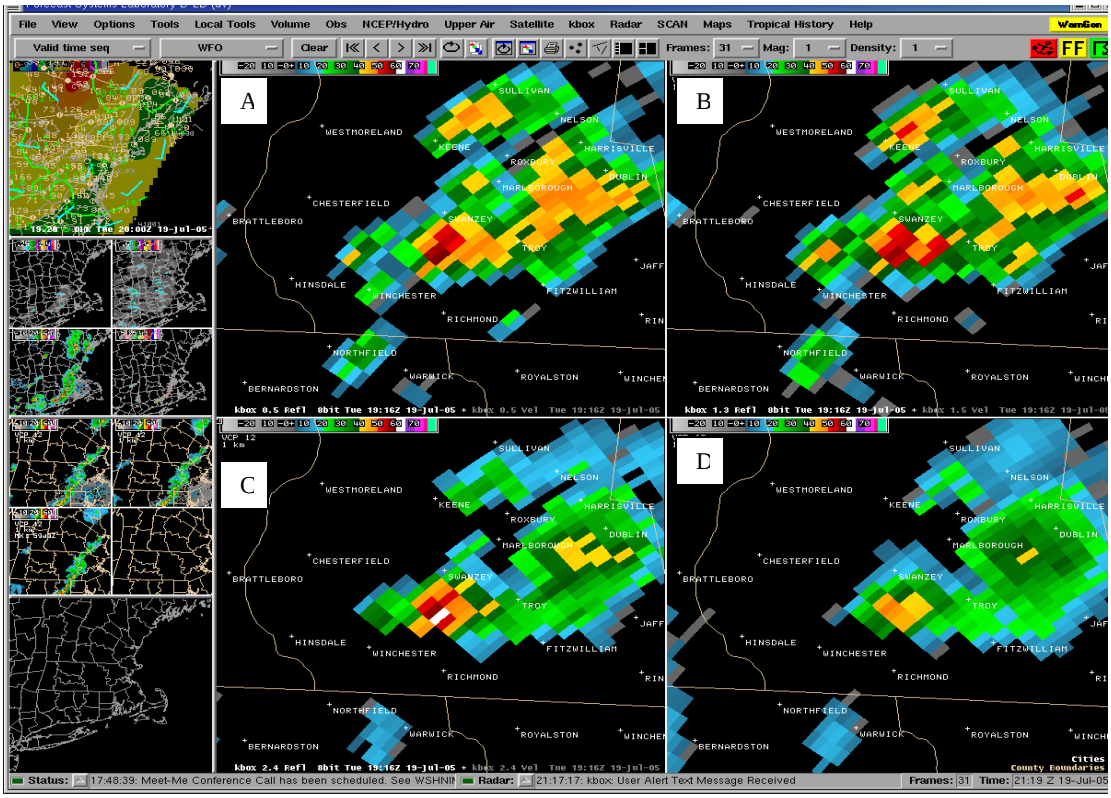

Figure 2. Four panel base reflectivity, valid at 1921 UTC over Cheshire county, NH. Panes A-D are at 0.5, 1.3, 2.4 and 3.1 degrees, respectively. Note the elevated core of 60 dBZ up to a height of 22.5 kft is depicted in panel C.

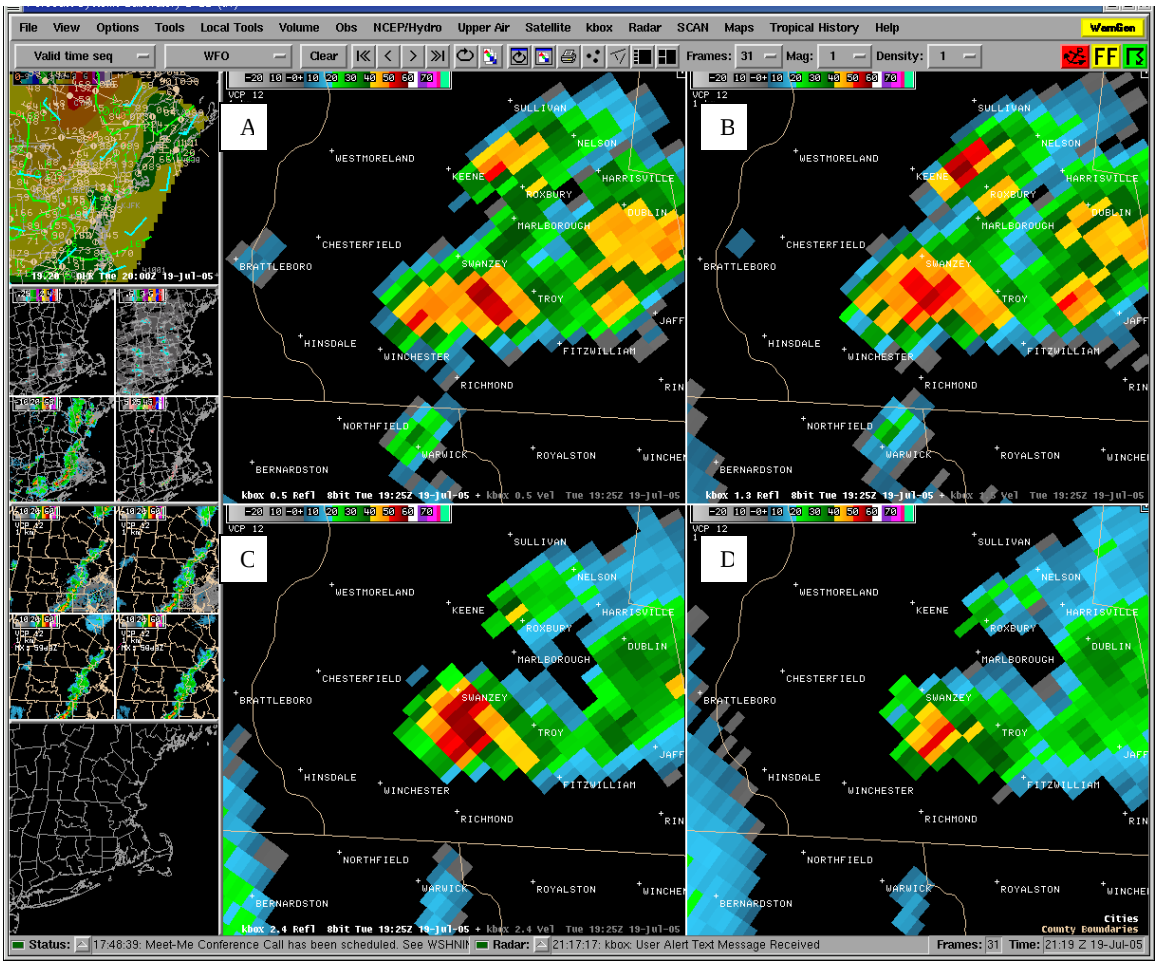

Figure 3. Same as Figure 2, except valid at 1925 UTC. Note the second pulse has reached 55 dBZ as high as 27 kft as per Panel D.

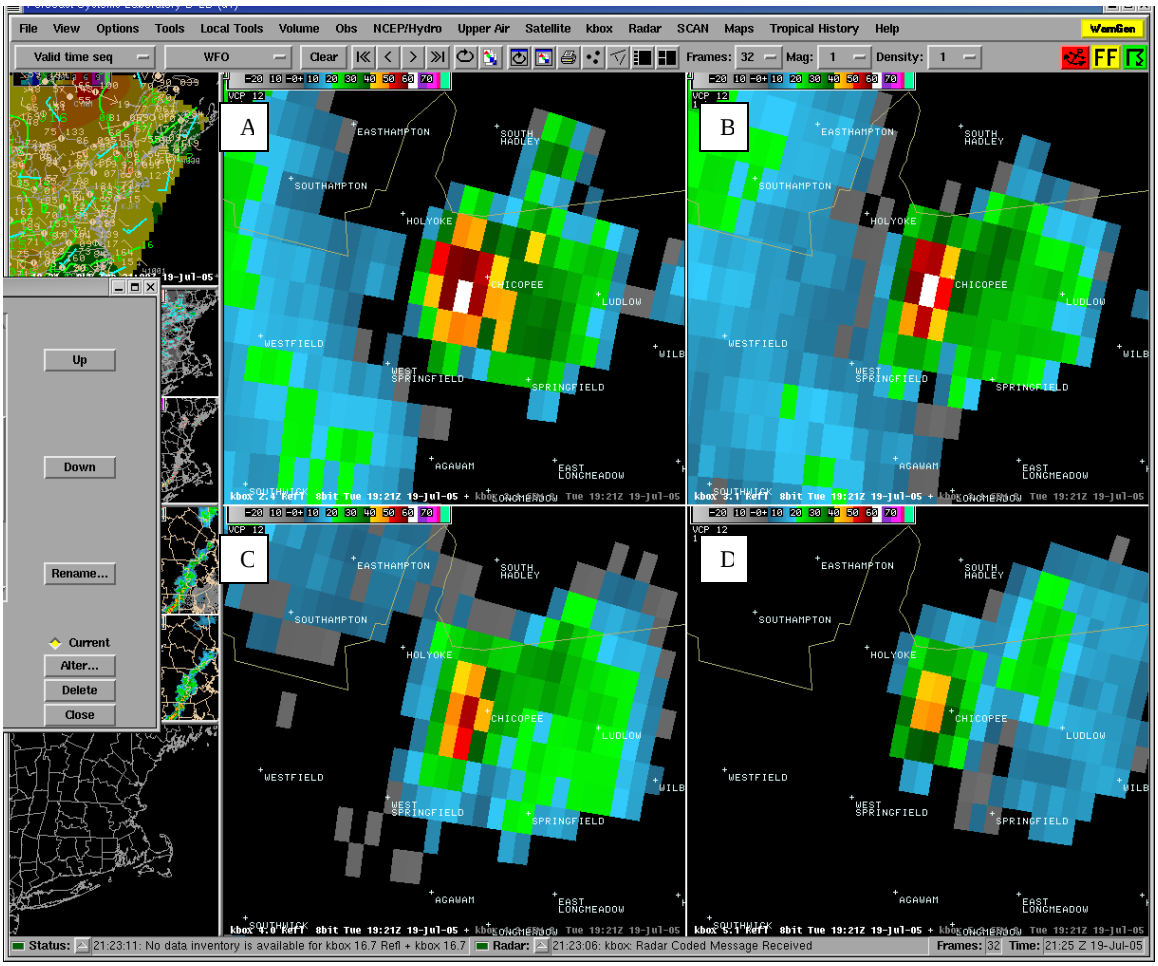

Figure 4. Four panel base reflectivity image over Hampden County, MA, valid at 1921 UTC. Panes A-D are for elevations of 2.4, 3.1, 4.0 and 5.1 degrees, respectively. Note the elevated core of 63 dBZ at 24 kft and 58 dBZ at 31 kft, as noted in panes B and C, respectively.

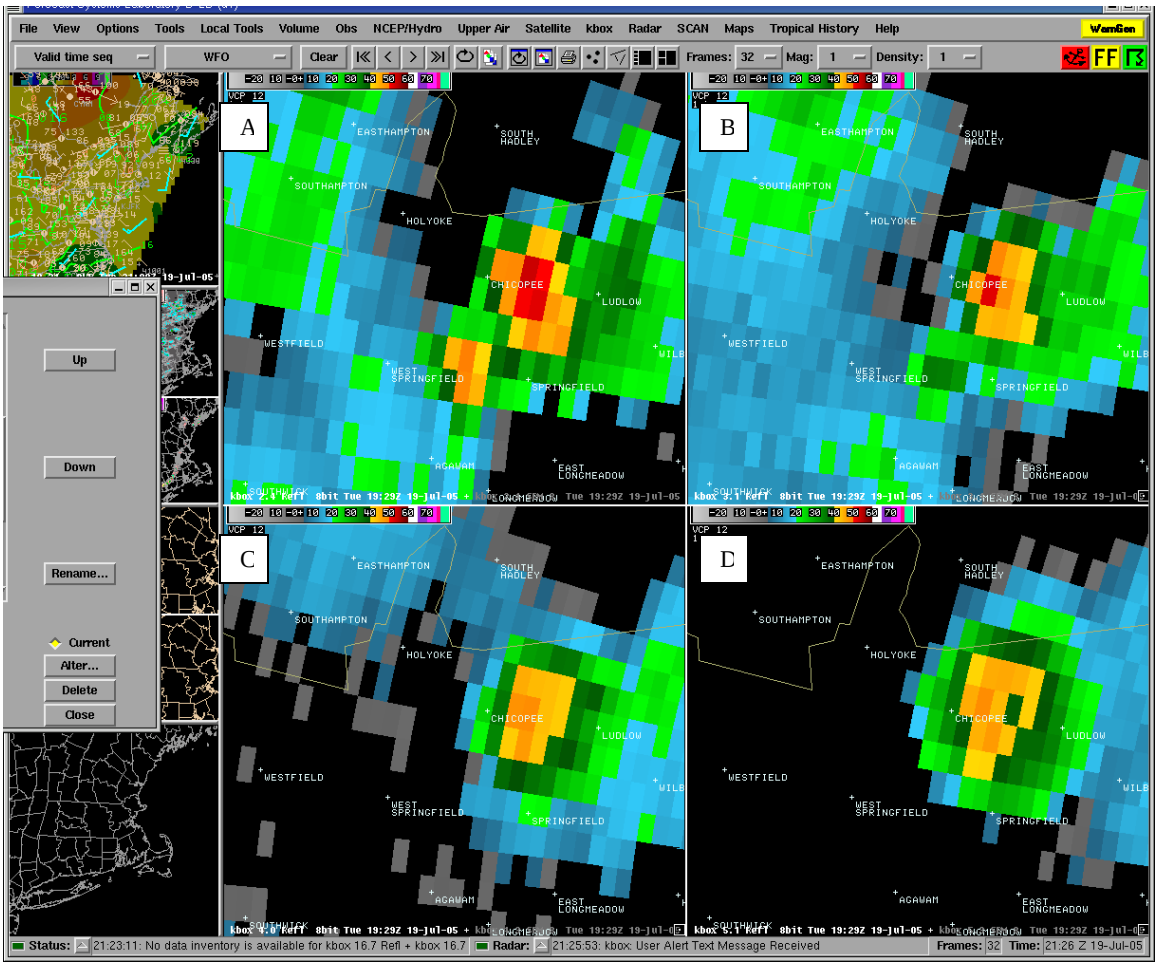

Figure 5. Same as figure 4, except valid at 1929 UTC. Note the marked collapse of the storm's core in panes B-D. Damage was reported several minutes after this volume scan.

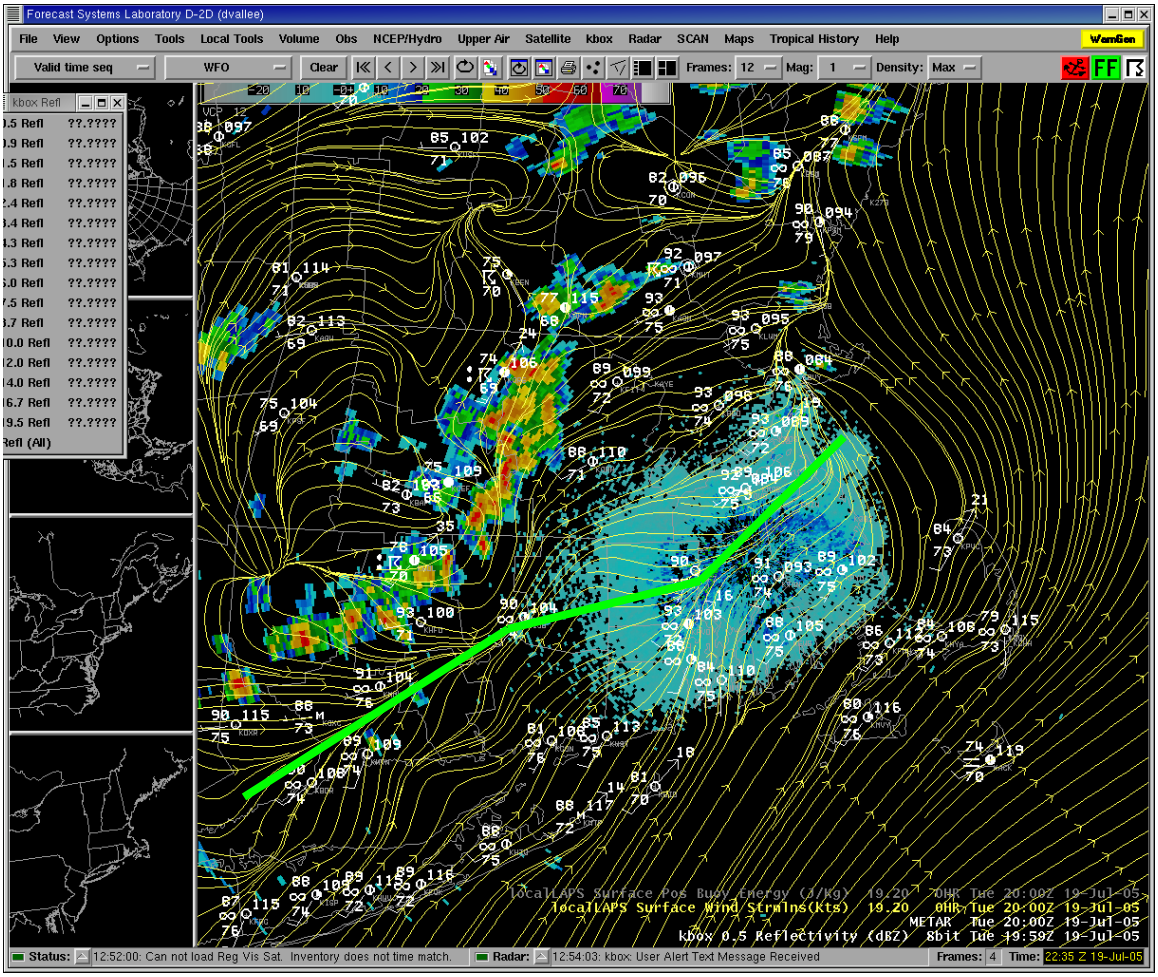

Figure 6. Base reflectivity at 0.5 degrees is depicted above. Surface observations are plotted in white and surface based streamlines are depicted by the solid yellow lines. Note the ragged appearance of the convection and the placement of a convergence zone denoting the location of the sea breeze boundary, as indicated by the solid green line. While not shown, visible satellite imagery showed an absence of Cumulus clouds south of the boundary.

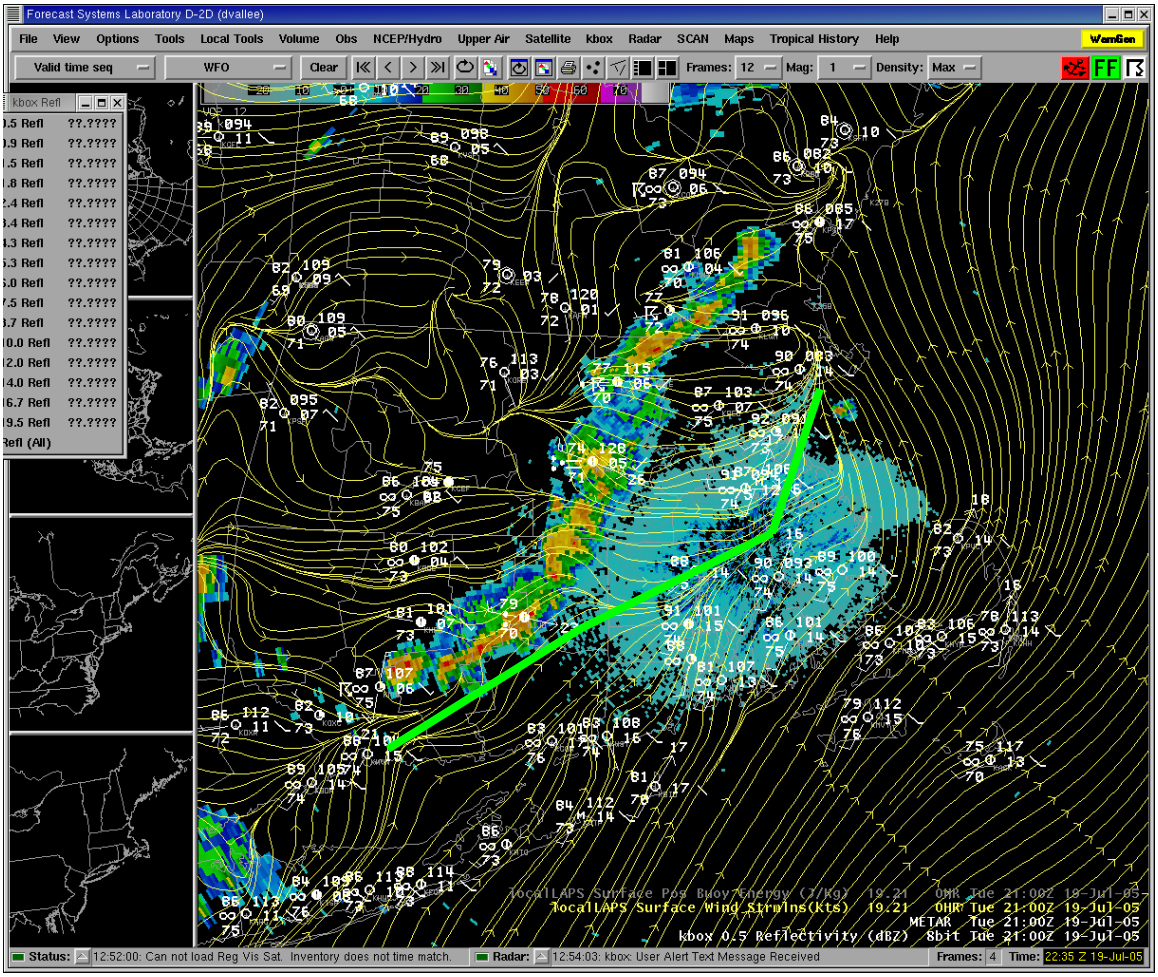

Figure 7. Same as Figure 6, but valid at 21 UTC.

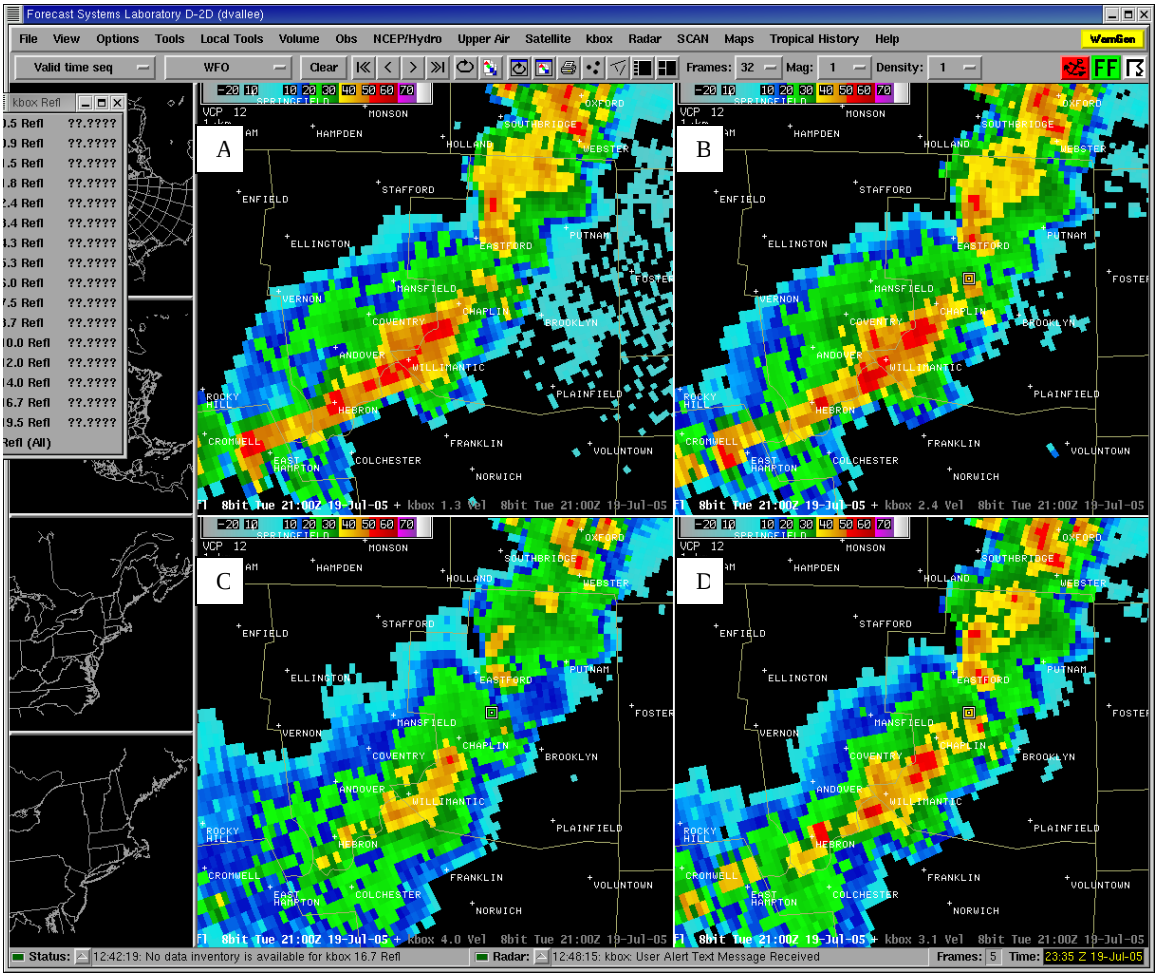

Figure 8. Four panel base reflectivity image, valid at 2100 UTC. Panes A-D are at 1.3, 2.4, 4.0 and 3.1 degrees, respectively. The cell about to produce severe weather pulsed at this time, with a maximum core of 52 dBZ up to a height of 23 kft. Severe weather followed about 20 minutes after the core collapsed.

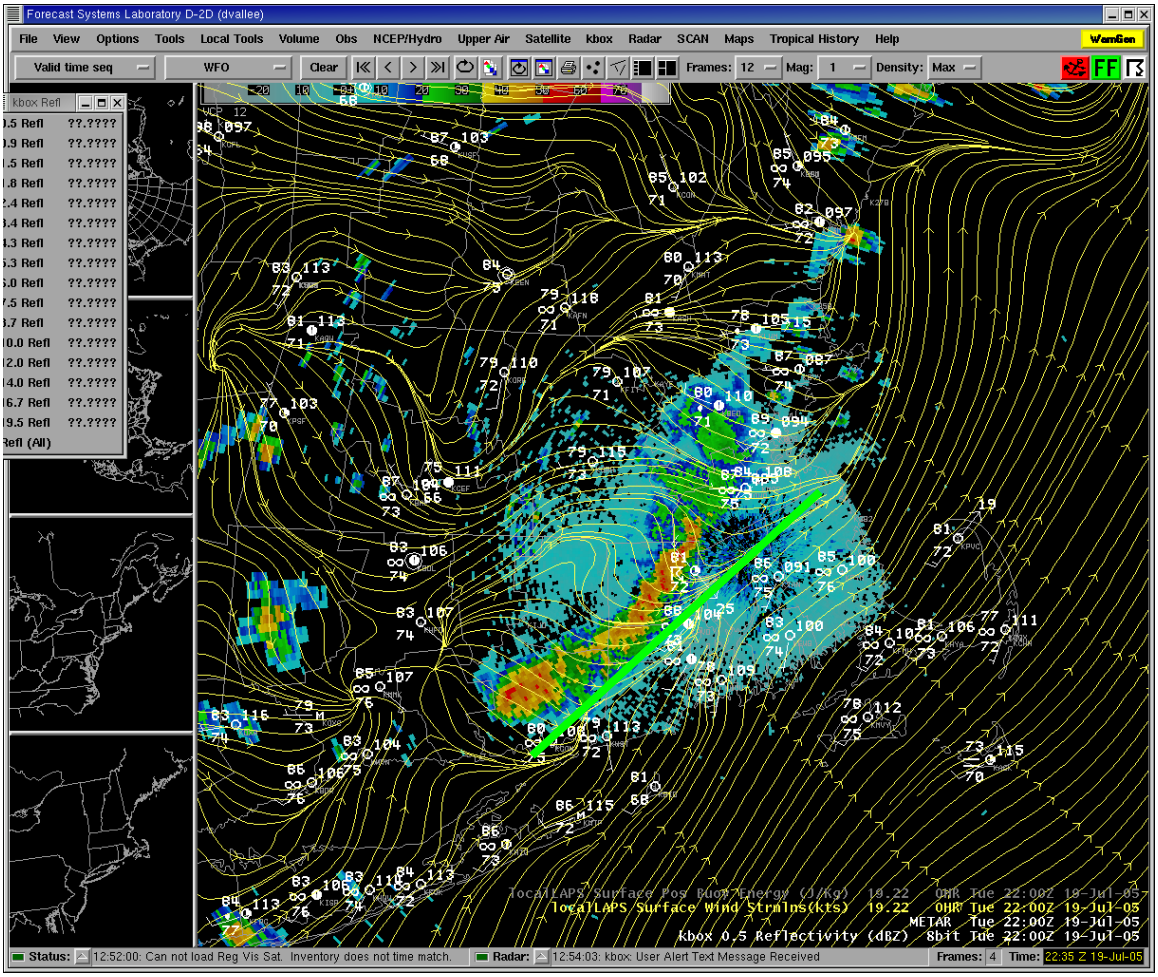

Figure 9. Same as Figure 6, except valid 22 UTC. The convection now lies just west of the sea breeze boundary.

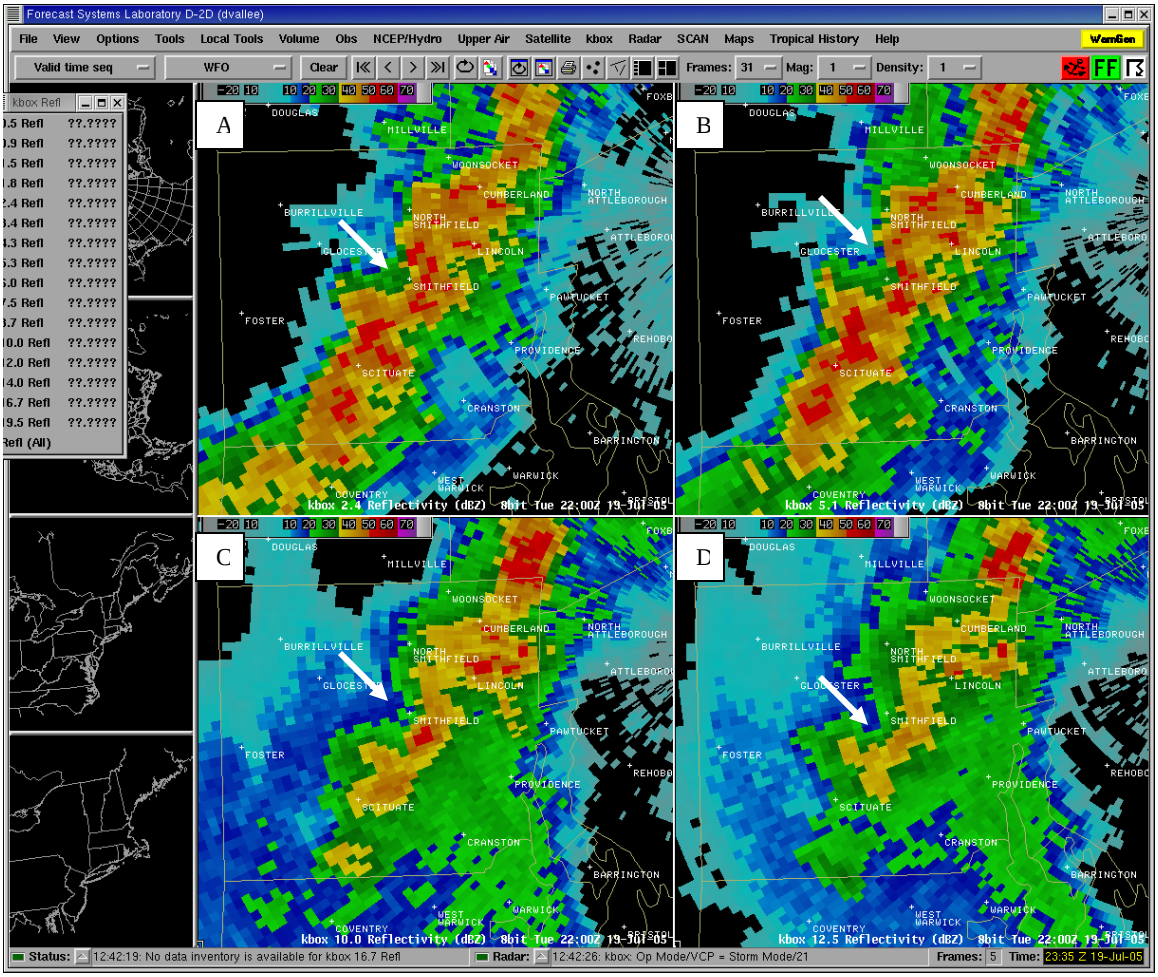

Figure 10. Four panel base reflectivity image, valid at 2200 UTC. Panes A-D are at 2.4, 5.1, 10 and 12.5 degrees, respectively. The cell which produced severe weather had an elevated core of 52 dBZ at a height up to 22 kft. Note also the presence of a subtle rear inflow notch just west of Smithfield, as shown above by white arrows.

Figure 11. Wind damage along route 12 in Windham, CT. Photos by Doug Haywood.

Table 1. Product Issuances on 19 July 2005.

Product	Issuance Time	Focus or Verification
SPSBOX	1538 UTC	Issued for area upgraded to slight risk severe.
HWOBOX	1548 UTC	Updated for convective threat
SEL05	1810 UTC	Watch #645 issued for all but the southeast 1/3 of the region.
NOWBOX	1732 UTC	Issued to address developing thunderstorms throughout the Connecticut Valley.
SPSBOX	1852 UTC	Issued for the rapidly intensifying storm approaching Swanzey, NH. Potential for gusty winds, small hail and frequent lightning.
SVRBOX	1928 UTC	Issued for Hampden County/Chicopee storm.
SPSBOX	1941 UTC	Issued for continued strong thunderstorm over Swanzey, NH.
SVSBOX	1951 UTC	Update/damage reports from the Chicopee storm.
NOWBOX	2105 UTC	Issued for RI/SE MA and eastern CT for developing line of convection heading southeast. Gusts to 40 mph and heavy rainfall possible along with frequent lightning.
NOWBOX	2140 UTC	Update for intensifying line of thunderstorms for RI/SE MA.
SPSBOX	2144 UTC	Issued for wind potential and frequent lightning as storms move through RI and SE MA.

Table 2. WFO Taunton's Public Information Statement, issued at 1213 UTC 20 July 2005.

Preliminary Local Storm Report…corrected

National Weather Service Taunton MA
813 AM EDT Wed Jul 20 2005

.Time: , event, , City location, , lat.Lon,
.Date: , .Mag, . ..County Location..St.. , source, .

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            ..Remarks..
0336 PM     Tstm wnd dmg     Chicopee                42.18N 72.57W
07/19/2005                   Hampden            MA   amateur radio
            Large limbs down on wires in the fairview section of
            town.
0338 PM     Hail             1 NE Chicopee           42.19N 72.56W
07/19/2005  0.75 inch        Hampden            MA   amateur radio
            Penny and dime size hail reported for just a few minutes
            at westover air base.
0345 PM     Tstm wnd dmg     Swanzey                 42.87N 72.28W
07/19/2005                   Cheshire           NH   amateur radio
            Trees down along route 12. Nearby garage was damaged as
            wind blew in the door.
0545 PM     Tstm wnd dmg     S Windham               41.70N 72.17W
07/19/2005                   Windham            CT   law enforcement
            Trees downed and uprooted.
0556 PM     Lightning        Smithfield              41.88N 71.55W
07/19/2005                   Providence         RI   amateur radio
            Lightning strike set transformer on Fire.
0600 PM     Tstm wnd dmg     Smithfield              41.88N 71.55W
07/19/2005                   Providence         RI   amateur radio
            Trees down in town. Measured wind gust at the Smithfield
            police station of 52 mph.
0630 PM     Lightning        Jamestown               41.48N 71.37W
07/19/2005                   Newport            RI   broadcast media
            Lightning strikes knocked out main power supply to town
            of jamestown.
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