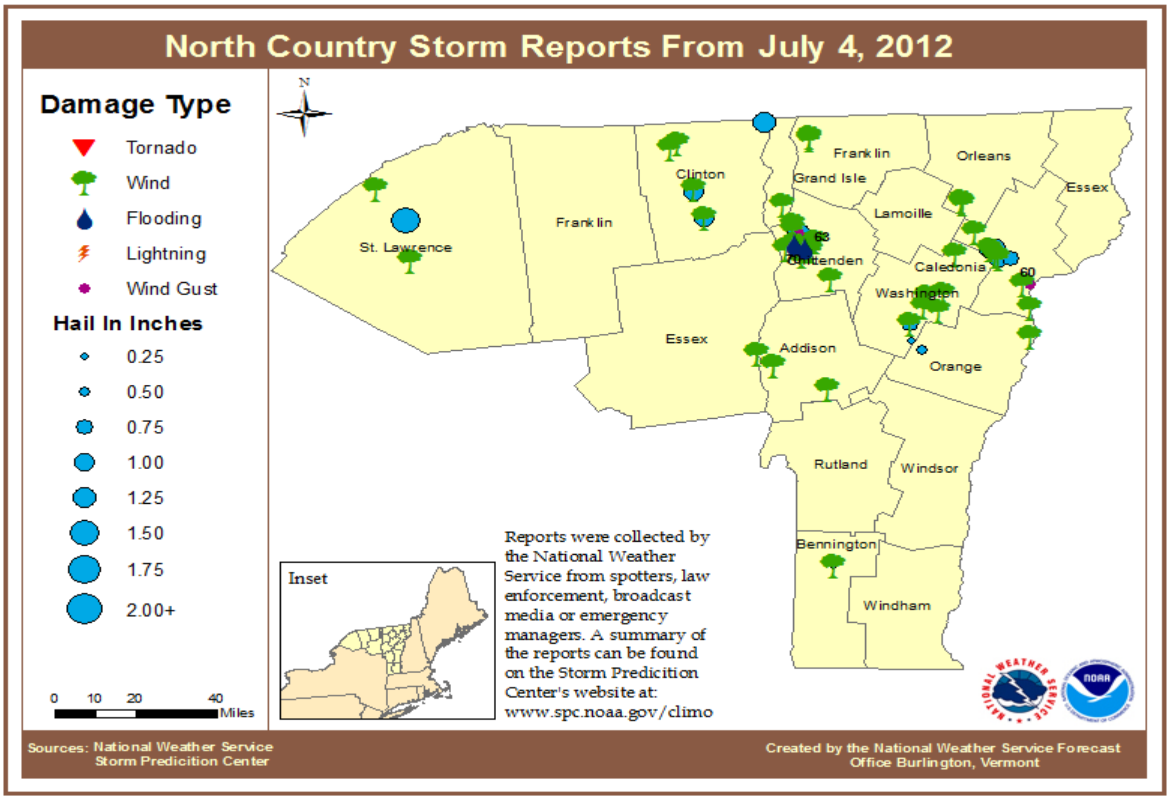
The Independence Day 2012 Severe Weather Event

Introduction

A significant severe weather event impacted the North Country on the Fourth of July holiday, 2012, with numerous reports of damaging winds. Figure 1 below shows the Local Storm Reports across the North Country. The vast majority of severe weather from this event came from damaging winds, including a measured 63 mph wind gust at Burlington International Airport and a 75 mph wind gust at Diamond Island. Large hail occurred less commonly. Some of the largest hailstones were located in northern New York, including tennis ball size hail (2.5" in diameter) in Peasleeville, NY and ping-pong ball size hail (1.5" in diameter) in Canton, NY.



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Synoptic Overview

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Figure 2 shows the surface analysis for 2100 UTC July 4th, 2012. A surface low was positioned in central Quebec north of Montreal. Its associated surface warm front lifted northeastward into Maine through the day, with the North Country firmly entrenched in the "warm sector" where dewpoints rose into the mid to upper 60s.

A surface cold front extended southwestward from the low center into southern Ontario. The severe thunderstorms on July 4th developed along and ahead of the surface cold front.

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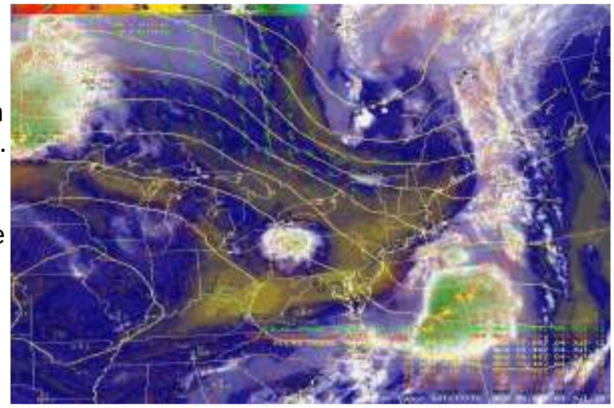
The water vapor satellite imagery and Rapid Refresh (RAP) model from 1640 UTC to 2301 UTC on July 4th is shown in Figure 3. A potent upper-level trough is located across northeastern Quebec as shown in the 500-mb height contours.



The tightly-packed 500-mb height contours are indicative of a strong 500-mb jet that would move across the North Country. The 500-mb jet enhanced the vertical wind shear (shown later in this section) and supported severe thunderstorm development.

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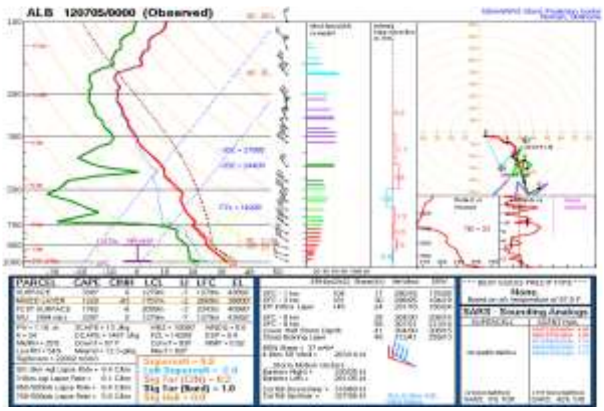

Figure 4 shows the upper-air sounding from Albany, NY from 0000 UTC July 5th, 2012. The sounding was taken after most of the severe weather had occurred across the North Country. However, with no intermediate sounding taken between 1200 UTC July 4th and 0000 UTC July 5th, 2012, this sounding is most representative of the thermodynamic environment in which the storms developed. The surface air mass was warm and humid, as indicated by surface temperatures in the upper 80s and dewpoints in the upper 60s to around 70. This produced a large amount of instability in the atmosphere with an observed surface-based CAPE of 3397 J/kg. Click here for a definition on CAPE. Instability of this magnitude is rare for the North Country and helped to "fuel" the severe thunderstorms that would develop. Typically, CAPE values of 1000-2000 J/kg are often sufficient for severe thunderstorms to develop.

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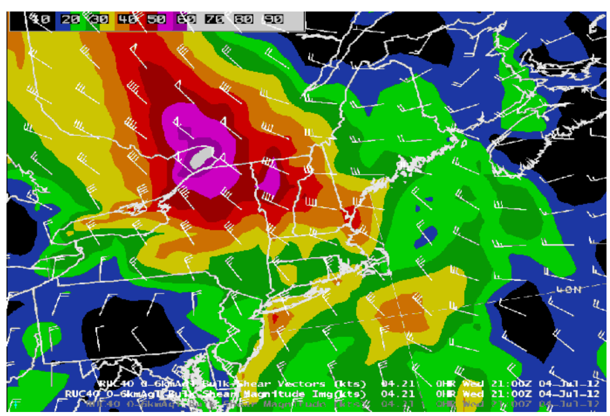


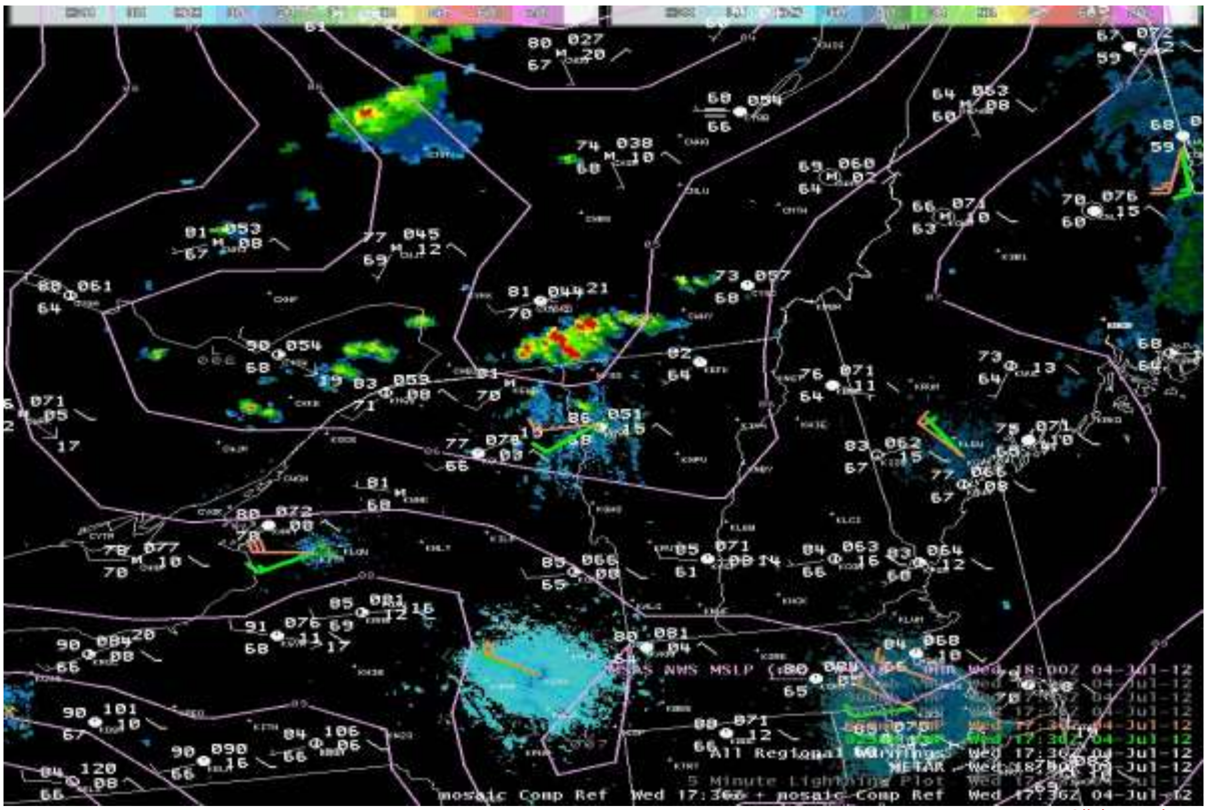
Figure 5 shows the 0-6km wind shear analysis at 2100 UTC July 4th, 2012. The magnitude of the wind shear through a deep layer of the atmosphere is an important parameter to analyze in looking at the severe thunderstorm environment. Sufficient instability and strong vertical wind shear (greater than 40 knots) can lead to long-lived, persistent updrafts, even favoring supercells.

In Figure 5, we see values across the North Country well in excess of 40 knots, and in most cases were in the 45 to 55 knot range. The enhanced 0-6km wind shear was due to the strong mid and upper level winds, as was shown in Figure 5.

Radar Anaylsis (Overview)

In this section we will discuss three large complexes of storms which moved across the North Country on 4 July 2012, and produced significant severe weather. Figure 6 below shows a composite radar mosaic loop from 1736 to 2356 UTC on July 4th. The strongest storms have dark red and/or purple colors in the images, which is associated with very strong reflectivity cores of 60 to 70 dBZ. These strong cores represent very heavy rainfall and the potential for hail.

The first significant bow echo type storm approached the Northeast Kingdom of Vermont at 1900 UTC and tracked southeast into the Connecticut River Valley by 2130 UTC. Click here for additional information on bow echo thunderstorms. The next supercell thunderstorm developed across the Saint Lawrence Valley at 2030 UTC and tracked southeast into the western Adirondack Mountains by 2130 UTC. A supercell is a thunderstorm that is characterized by the presence of a mesocyclone; a deep, continuously-rotating updraft, along with very heavy rainfall. Supercells are the least common type of thunderstorm and have the potential to be the most severe. Supercells are often isolated from other thunderstorms, and can dominate sensible weather conditions up to 20 miles (32 km) away. The final complex of storms approached the northern Champlain Valley at 2215 UTC and tracked southeast into the central Champlain Valley, including the Burlington and Colchester areas around 2320 UTC, then weakened across central Vermont by 2356 UTC on July 4th. Each system produced widespread thunderstorm wind damage and/or large hail, which impacted the citizens of the North County during the afternoon and evening hours of July 4th.



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Champlain Valley (Widespread Wind Damage)

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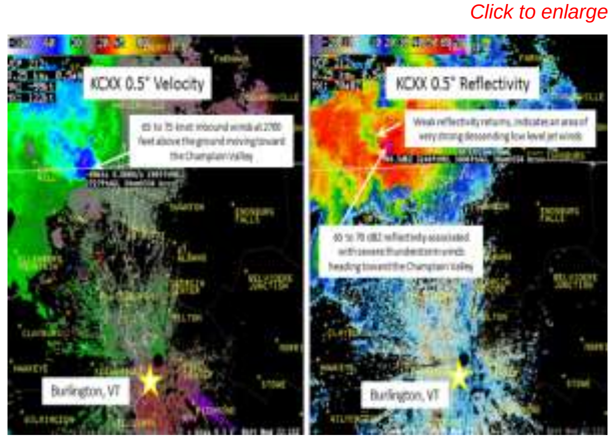

A large complex of storms developed across southern Canada and approached the northern Champlain Valley by 2215 UTC. This large area of storms impacted the Champlain Valley between 2215 UTC and 2356 UTC and produced significant/widespread damaging thunderstorm winds. A measured wind gust to 63 mph occurred at the Burlington International Airport, and a 70 mph wind gust occurred at Mallets Bay in Colchester, VT. Figure 7 shows the KCXX 0.5° velocity (left image) and 0.5° reflectivity (right image) at 2215 UTC on 4 July 2012. The dark blue on the 0.5° velocity image (lower left) shows a large area of 65 to 75 knots of inbound winds at 2700 feet above the ground moving toward the Champlain Valley. The 0.5° reflectivity (lower right) shows a core of 60 to 70 dBZ returns associated with very heavy rainfall and strong winds. The weaker reflectivity on the backside indicated an area of very strong descending low level jet winds. This signature combined with the very strong velocities, produced the damaging thunderstorm winds across the Champlain Valley on 4 July 2012.

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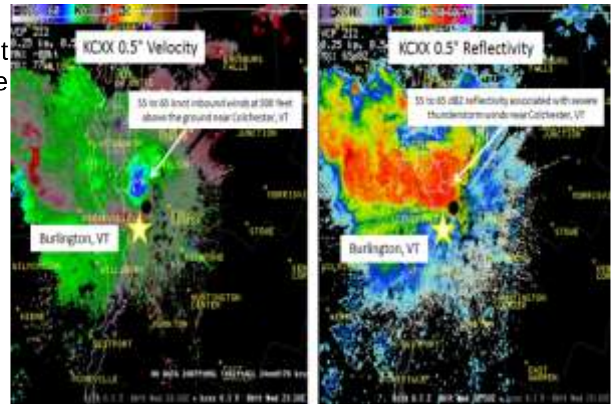

Figure 8 shows KCXX 0.5° velocity (left) and 0.5°reflectivity (right) on 4 July at 2310 UTC, right before the 63 mph wind gust was observed at the Burlington International Airport. Note the very strong inbound (moving toward the radar) winds of 55 to 65 knots (dark blue) approaching Burlington, Vermont. Radar indicated these very strong thunderstorm winds were only 500 feet above the ground and were brought to the surface by the very heavy rainfall, causing widespread wind damage in Burlington and Colchester. In addition to the very strong thunderstorm winds, a period of very heavy rainfall occurred, which caused minor flooding on Pine Street and other poor drainage areas in the Burlington region. The reflectivity image (lower right) shows a large area of 50 to 60 dBZ, indicating very heavy rainfall in a short period of time associated with this complex of storms. The KCXX radar had very good sampling of the strong winds, as the thunderstorm complex was tracking toward the radar, located in Colchester, Vermont.

Northeast Kingdom (Widespread Wind Damage and Large Hail)

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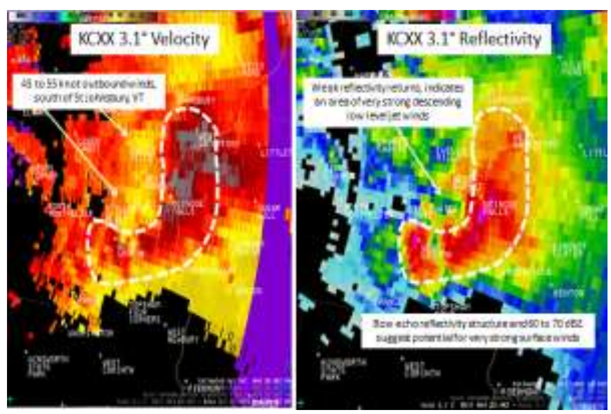

Figure 9 shows the KCXX 3.1° velocity (left) and reflectivity (right) at 2048 UTC on 4 July 2012. A bow echo reflectivity structure was present across central Caledonia County, which caused widespread thunderstorm wind damage. Furthermore, a descending low level jet was present, given the limited reflectivity returns behind the initial line of storms. The 3.1° velocity image shows values between 45 and 55 knots, which supported damaging thunderstorm surface winds. The combination of distance from the radar, low level beam blockage caused by the Green Mountains, and storm motions perpendicular to the radar beam, created very poor radar sampling of this storm. In addition, the distance from the KGYX radar in Gray, Maine and the height of the White Mountains, resulted in poor radar sampling from KGYX radar. This storm produce widespread trees and power lines down across the Northeast Kingdom of Vermont, with surface winds estimated at 70 mph in Walden, Vermont.

Saint Lawrence Valley (Wind Damage and Large Hail)

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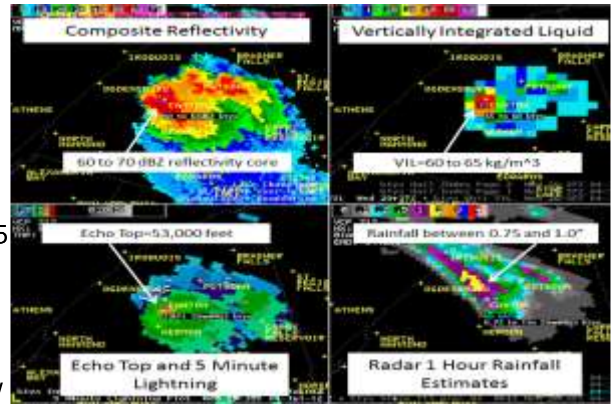

Figure 10 shows a 4 panel display from the KTYX radar at 2037 UTC on 4 July of the following radar products: composite reflectivity (upper left), vertically integrated liquid (upper right), echo top (lower left), and one hour radar estimated rainfall (lower right). This shows a strong reflectivity core of 60 to 70 dBZ, Vertically Integrated Liquid (VIL) values between 60 and 65 Kg/m^2, and an echo top (ET) of 53,000 feet.Click here for a detailed definition of VIL. These very large reflectivity and VIL values suggest the potential for large hail, which occurred with 1.50" diameter hail in Canton, New York at 2035 UTC. In addition to large hail, several trees and powerlines came down assocaited with this supercell in central Saint Lawrence County. KTYX radar estimated one hour rainfall rates of 0.75 to 1.0 inches, associated with this supercell, but some hail contamination led to radar over-estimating the actual amounts.

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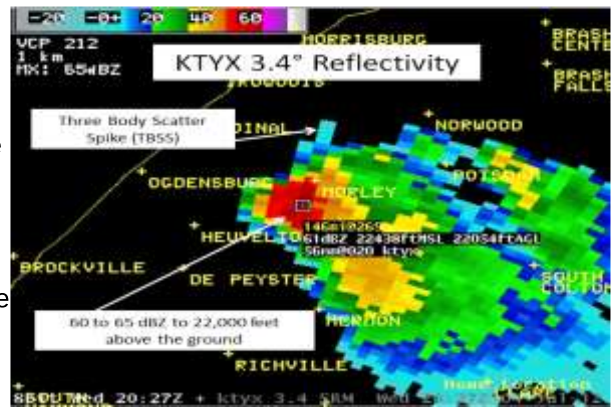

Figure 11 shows the KTYX 3.4° reflectivity at 2027 UTC on 4 July 2012. This image shows a very solid core of 50 to 60 dBZ to 22,000 feet above the ground, suggesting a very strong updraft with significant radar returns much above the freezing level. This combined with the three-body scatter spike (TBSS), indicated the storm was capable of producing very large hail.

Click here for more information on TBSS. Hail the size of ping bong balls occurred in Canton, New York at 2035 UTC. This storm quickly tracked southeast toward the western Adirondack Mountains and weakened by early evening on 4 July 2012.

Event Summary

The severe weather events that occurred, even on any other summer day, would have made this event a significant one. However, the fact that the severe weather happened on the Fourth of July holiday, when many citizens outside enjoying holiday festivities, made this event even more significant. A hot and humid afternoon produced a large amount of atmospheric instability, values which are seldom seen across the North Country. Strong mid and upper level winds helped to enhance vertical wind shear, which allowed the severe thunderstorms that would develop to become organized and more persistent. Two well organized clusters of severe thunderstorms with widespread damaging winds occurred, one across northeastern Vermont and the Northeast Kingdom, and another that marched southward from Quebec and through the Champlain Valley of New York and Vermont. An isolated supercell also formed and moved across central St. Lawrence County, producing large hail and a couple of reports of trees down across parts of the county.

Photos and Storm Damage

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