The Four Seasons

National Weather Service Burlington, VT

VOLUME VI, ISSUE III

FALL 2019

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Letter from the Editors

Welcome to the Fall 2019 Edition of The Four Seasons, a quarterly newsletter issued by the National Weather Service in Burlington, VT. As we bid farewell to summer and tumble towards winter we take a look back at a significant severe weather event on July 30th and highlight a rare large hail occurrence from October 1st in Massena, NY. We'll show you a peak inside the diverse backgrounds of NWS Burlington's staff members and how to customize the "My Forecast" element on our webpage. In addition, we showcase our participation in an exercise by Vermont Emergency Management, as well as some changes which have occurred recently at NWS Burlington. Thanks for reading and we hope you enjoy the newsletter.

July 30th Severe Weather Event - Summer Time Thunderstorms that Produced Localized Hurricane Force Wind Gusts

-Robert Haynes, Brooke Taber and Matthew Clay

On 30 July 2019, a cold front and associated pre-frontal trough interacted with very warm surface temperatures in the middle 80s to lower 90s. The addition of dewpoints well into the 60s allowed Convective Available Potential Energy (CAPE) to reach 2000 J/kg. Along with the heating, moisture, and the cold front, several subtle features present enabled storms to become severe with a few strong enough to produce hurricane force wind gusts. This event downed several trees and power lines, especially across the Champlain Valley (Figure 1).

Pre-Storm Environment

The jet stream is an important feature when considering any weather event. Its location impacts the level of upper divergence available to growing thunderstorms and the orientation and speed of the jet acts as a source of shear. This enhances storm development and organization. The orientation of an upper trough impacts storm development as well with two quadrants providing favorable upper divergence – the right entrance region and the left exit region. Figure 2 contains a chart of the 300 hPa and 500 hPa analysis from the Storm Prediction Center. Shaded in blue is a jet streak in the upper levels, and the yellow contours show the North Country to be in a region of upper divergence. The trough axis is negatively tilted, which means that the axis is oriented from southeast to northwest with the base of the trough located near the Appalachian Mountain Range and the northern extent over the Hudson Bay.

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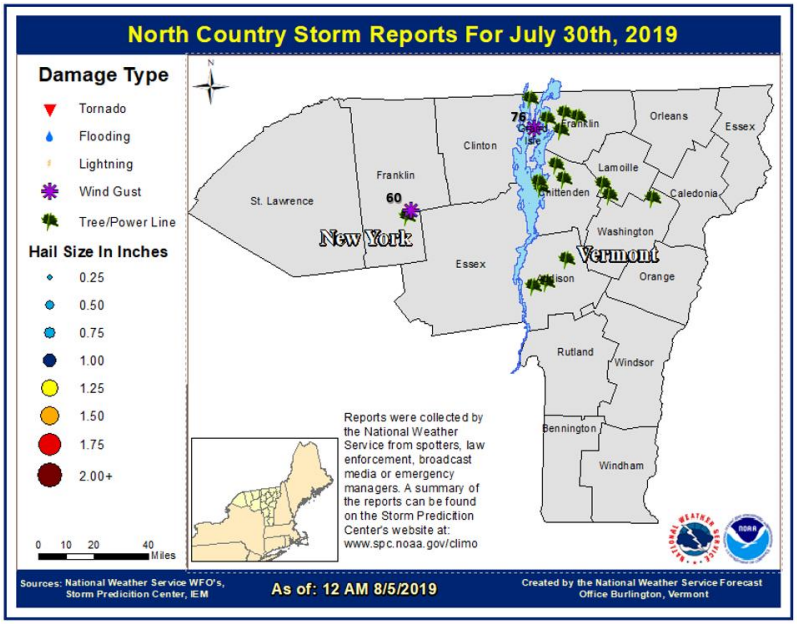

Figure 1 (above): *Storm reports received across the North Country for 30 July 2019.*

Thus, the winds aloft were more southerly than westerly. This is important when thunderstorms develop, as the hanging tops of thunderstorms will move in the direction of those winds aloft. Westerly winds aloft blow the overhang tops of a thunderstorm ahead of storm, which stabilizes the air downstream. The relative lack of westerly winds aloft on July 30th resulted in storm tops lifting into Canada as opposed to propagating downstream over the North Country.

Another important aspect to the development of severe storms on July 30th was the presence of dry mid-level air and high lapse rates greater than 7° C/km in the lower part of the atmosphere. As moist air lifts into the atmosphere within a thunderstorm, the entrainment of dry mid-level air promotes downdrafts. High low-level lapse rates, or temperatures that rapidly decrease with height, indicates instability. If the atmosphere were stable with lapse rates that are low, winds descending from the mid-levels would decelerate as they approach the surface.

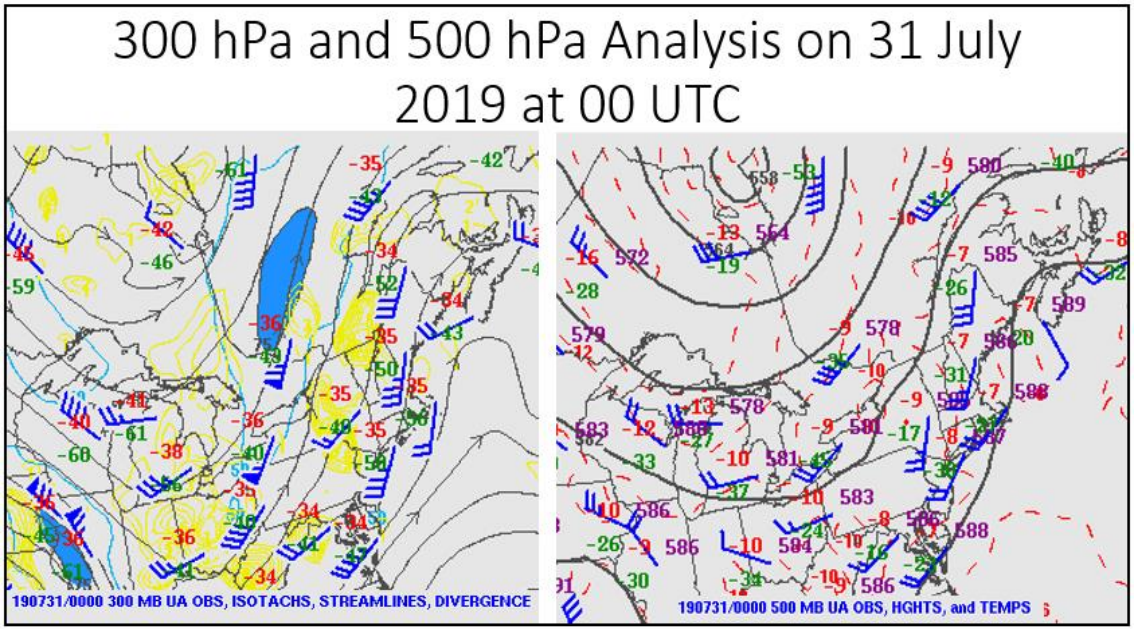

Figure 2: *The 300 hPa (left) and 500 hPa (right) upper air analysis on 30 July 2019 at 8:00 PM. Isotach (dark blue >75 knots, lighter blue >100 knots, and lightest blue >125 knots, streamlines (black), wind barbs, (plotted in blue, 1 pennant=50 knots, 1 barb=10 knots, 1/2 barb=5 knots), 500 hPa heights (black lines), and temperatures (dotted red).*

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In this case on July 30th, the high lapse rates allowed downdraft winds approaching the surface to accelerate. The combination of dry-mid level air and surface to 3 km lapse rates of around 8.0° C/km were supportive of storms capable of strong downdraft winds (Figure 3).

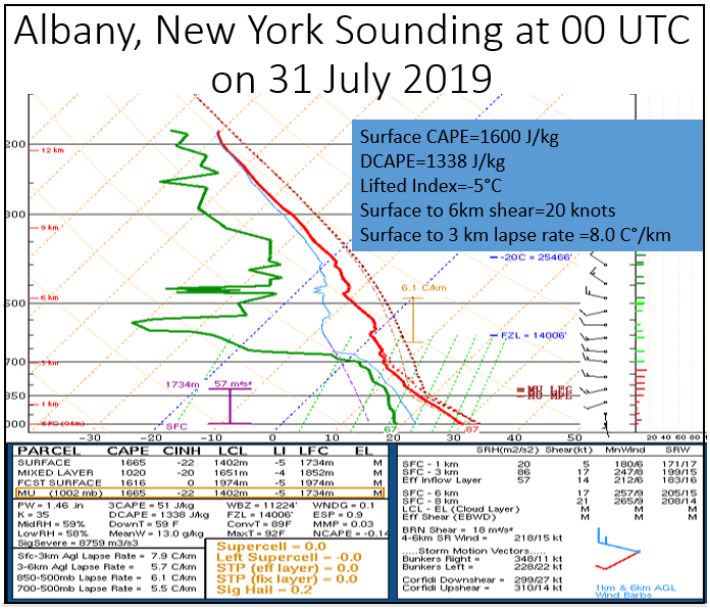

Figure 3: *Upper air sounding from Albany, NY at 8:00 PM on 31 July 2019. The y axis is the pressure level and the x axis is the temperature. The green line indicates dewpoint and the red line indicates temperature. Note the dry air present between 700 and 500 hPa.*

Concluding Remarks

Scattered showers and storms developed throughout the day, with a couple storms producing hurricane force winds gusts. One storm developed near Willsboro and over Lake Champlain. As it moved across around 3:40 PM, the radar in Colchester reported velocities of 65 knot (about 75 mph) inbounds just 200 feet above ground level (Figure 4). These winds came ashore across Burlington's New North End continuing northeast into Milton. Several downed trees and power lines came down as a result of these winds (Figure 5). Another storm in Grand Isle moved over the North Hero Bridge Project, which reported a wind gust of 76 mph as it moved toward Franklin County, Vermont. Other storms continued to develop across the Champlain Valley, and several thousand people lost power in the Champlain Valley for the duration of the event on a hot and humid day. Fortunately, the passage of the cold front brought some cooler temperatures and relief from the humidity.

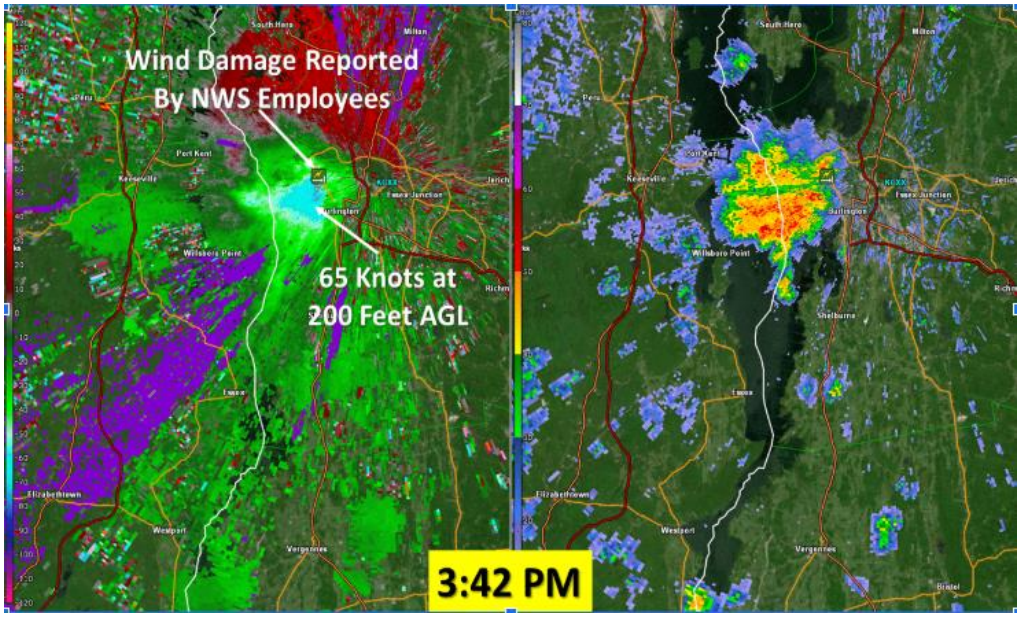

Figure 4: *KCXX 0.5 degree scan velocity (left) and reflectivity (right) at 3:42, as a strong storm produced wind damage across the New North End in Burlington into Colchester and eventually into Milton. Note the 60-65 knot winds measured by the radar just a few hundred feet off the ground.*

October 1, 2019 Severe Event with 2" Hail at Massena

-Robert Haynes and Rebecca Duell

On Tuesday, October 1st, showers and thunderstorms developed through much of the day across Northern New York and the Northeast Kingdom that resulted in large hail and minor river flooding. One storm produced significant, egg-size hail (approximately 2") at Massena, NY around 1:53 PM EDT: unusual given the time of year. Based on a severe climatology study for our local area from 1955-2016 (LaRocca 2018), the 2-inch hail size would be in the upper echelon of recorded hail reports across the St. Lawrence Valley.

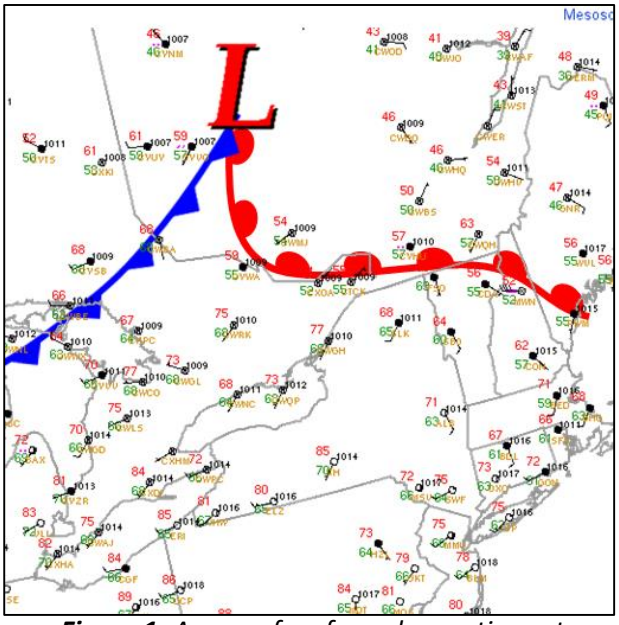

Figure 1: *A map of surface observations at 1800Z (2:00 PM) with frontal analysis.*

The synoptic weather pattern was favorable for producing moderate to locally heavy showers and thunderstorms. A deep layer ridge was positioned across the Southeastern United States where high temperature records would be recorded. Meanwhile, a low pressure system that caused an early season blizzard across portions of the Intermountain West lifted over the Great Lakes into Ontario Province, Canada. Further south, Tropical Storm Narda moved into the Gulf of California in the Eastern Pacific. The upper jet stream efficiently transported moisture from Narda up to the low pressure system across Canada, setting the stage for a wet day across the Northeast. Precipitable water values increased to roughly 1.5"-1.75" over the North Country - well above normal for the beginning of October.

Showers and thunderstorms developed along a warm frontal boundary that remained stalled near the International Border and along eastern VT (Figure 1). Easterly winds in the northern St. Lawrence River Valley converged with southwest winds advecting a summer-like air mass, with portions of the New York warming into the 80s. Temperatures north of the warm front remained below 60 due to the cool, easterly flow under ample cloud cover. Strong frontogenetical forcing was continually reinforced through the showers and thunderstorms that developed until the low passed east.

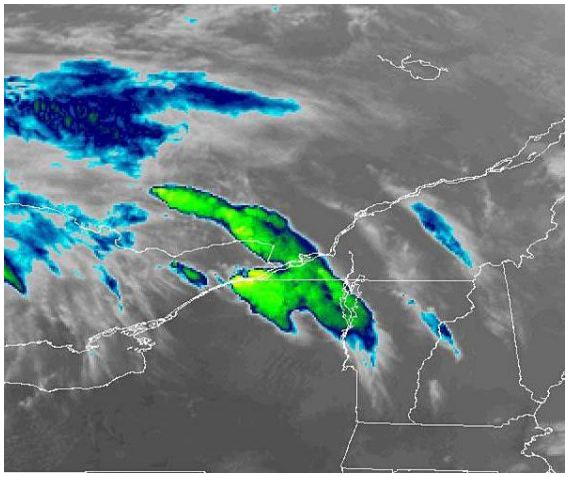

Figure 2: *Satellite Imagery from GOES-R on the IR channel at 1746Z (1:46 PM EDT).*

With the summer-like air mass moving into the St. Lawrence Valley, the atmosphere was becoming increasingly unstable, with CAPE (Convective Available Potential Energy) values rising to over 1000 J/kg present in the region. Convection initiated along the warm front near Ottawa, moving southeast under northwesterly flow aloft. Against the southwest flow near the surface, this indicated good directional shear along the St. Lawrence Valley (not shown). The developing thunderstorms can be seen in satellite imagery at 1746Z (1:46 PM EDT) on the infrared channel (Figure 2). The yellow coloring indicates the taller thunderstorms developing over Massena, New York.

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When looking at RAP forecast soundings for Massena (KMSS) during the event (Fig. 3), several features stand out when evaluating the severe hail potential of the environment. A 45 kt southwesterly low-level jet resulted in a strong low-level temperature inversion during the morning hours that initially limited instability during the event. However, once the surface temperatures warmed to the mid 60s by the early afternoon, instability began to rapidly increase. In addition to surface warming, notable cooling can be observed in the 400 mb to 700 mb layer during the day, and lapse rates increased to over 6.5 C km^{-1}. The steepened mid-level lapse rates are favorable for the development of large hail because it results in large CAPE within the hail growth zone (-10 to -30C). One factor that limited potential hail size during the event was the relatively deep warm cloud layer (wet bulb zero heights between 11.5 and 12k ft). When falling through deep warm cloud layers, large hail has more time to melt before reaching the surface than within shallower warm cloud layers, so it's relatively rare to get large hail reported at the surface in these situations.

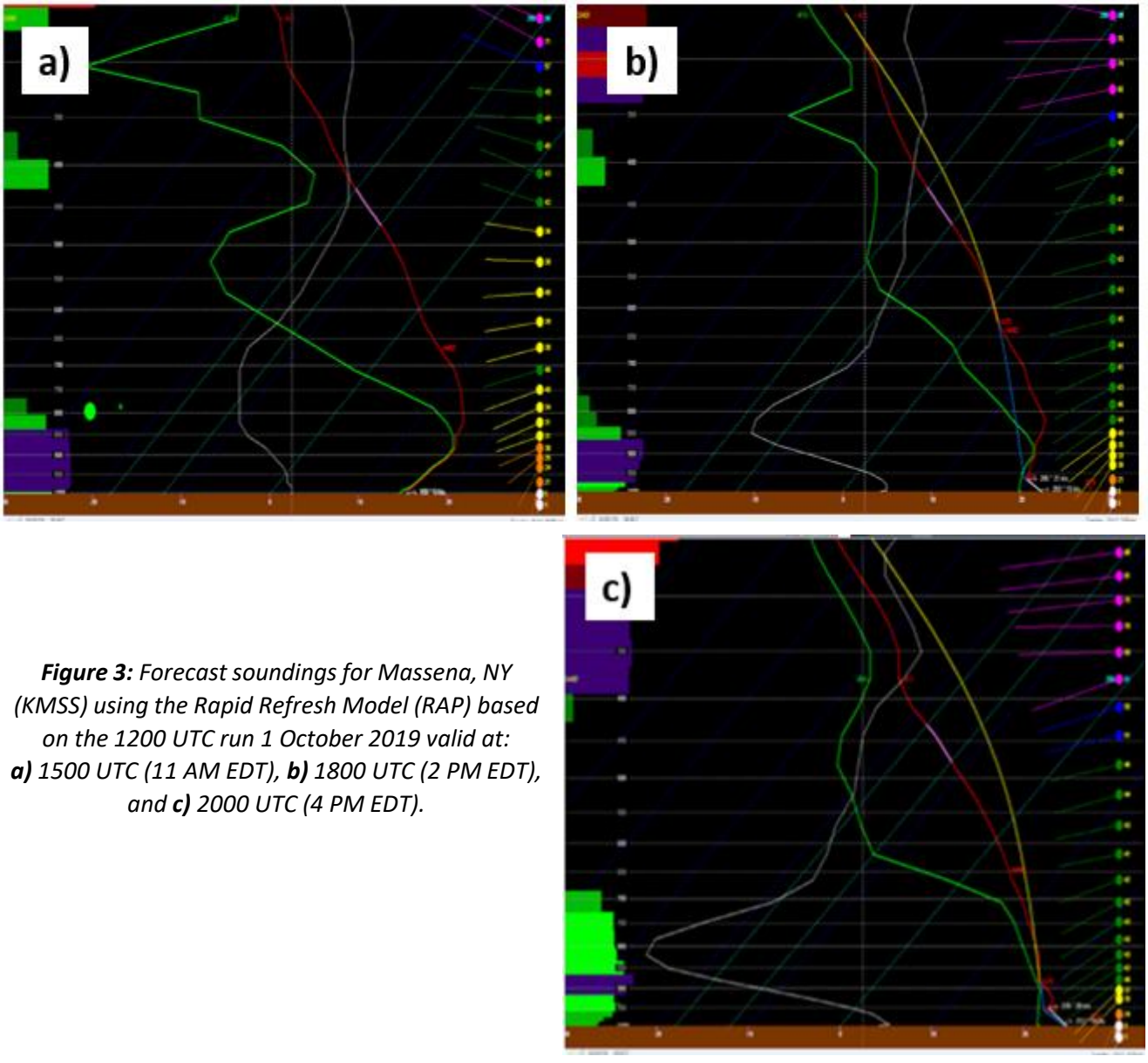

Figure 3: *Forecast soundings for Massena, NY (KMSS) using the Rapid Refresh Model (RAP) based on the 1200 UTC run 1 October 2019 valid at:* ***a)*** *1500 UTC (11 AM EDT),* ***b)*** *1800 UTC (2 PM EDT), and* ***c)*** *2000 UTC (4 PM EDT).*

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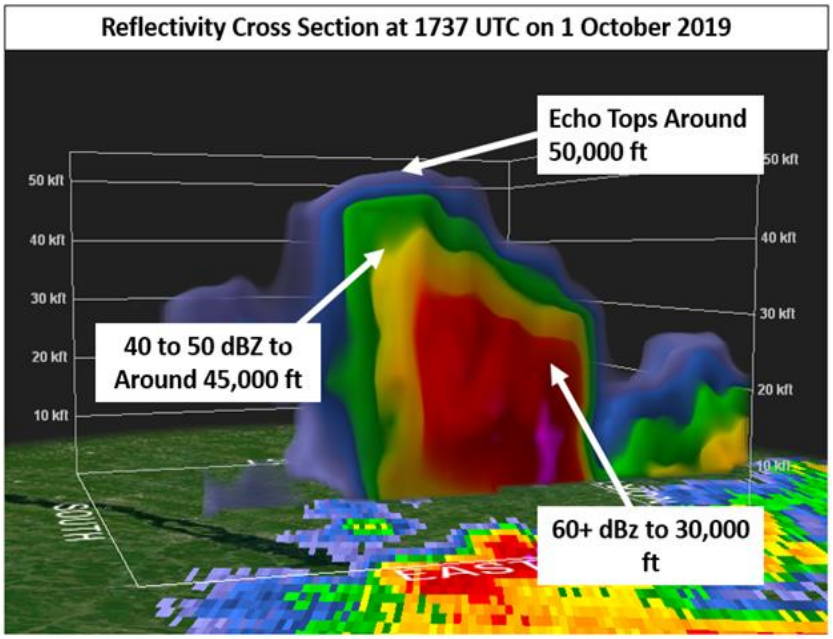


***Figure 4**: KTYX reflectivity cross section over the Saint Lawrence Valley as the storm approached Massena at 1737 UTC on 1 October 2019.*

Among the storms that were developing near Ottawa and approaching the Saint Lawrence Valley, one particular storm stood out as it approached the International Border. This storm had higher echo tops than the surrounding storms and had signs of a mid-level mesocyclone on radar. Figure 4 shows the core of the storm as it approached Massena from the west. The storm had echo tops to around 50,000 ft, 40 to 50 dBZ heights of around 45,000 ft, and 60+ dBZ heights of 30,000 ft. In addition to the impressive core of the storm, radar imagery showed signs of mid-level rotation (Fig. 7). The mid-level rotation visible indicates that a rotating updraft is present within the storm, which allows for prolonged hail growth within the core of the storm. Sure enough, between 1:49 and 1:55 PM EDT, two hail reports were received in the Massena area, including a report and pictures of some 2 inch hailstones (Figure 8).

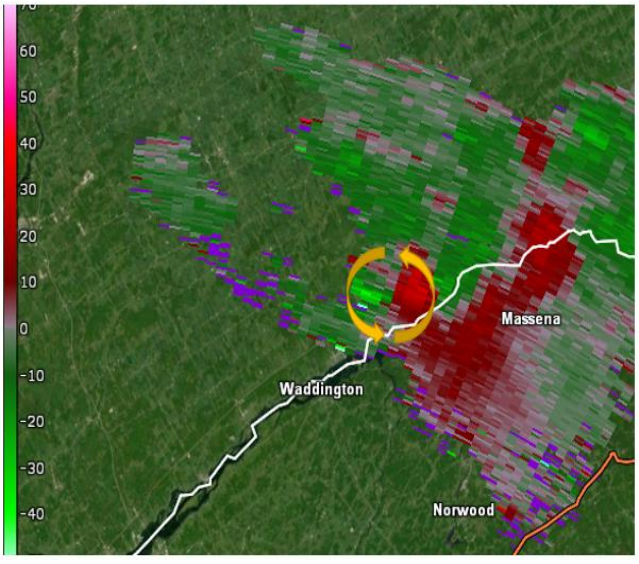


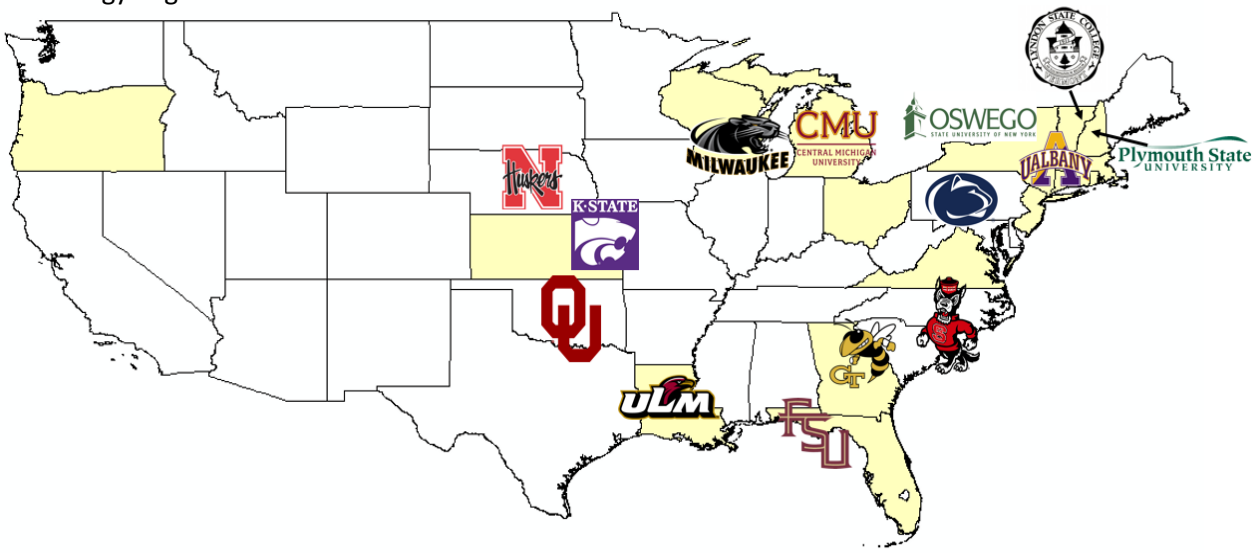
Figure 5: KTYX Storm Relative Velocity image at 1.3 degree tilt at 1737 UTC on 1 October 2019.

Figure 6: Approximate 2" hailstones that fell in Massena, NY shortly before 2 PM on 1 October 2019. Photo credit to Terry S.

Many Backgrounds, One BTV!

-Rebecca Duell

One of the more common questions we get asked (besides "what's the weather going to be?" of course!) is "Are you all local?" or "Did you all go to school around here?". You may be surprised at the answer. While we have all adopted Vermont as home (and many have lived here for multiple decades!) we're actually from all over the US. While our staffing numbers do fluctuate, we currently have 22 people employed here at the National Weather Service in Burlington. Of our 17 meteorologists employed at BTV, 5 are originally from New England, 5 are from New York and New Jersey, and the remaining 7 are from areas outside of the Northeast. We even have a surprisingly high number of southerners for such a northern office! The map below shows the home states of our employees shaded in yellow, as well as the schools we have our meteorology degrees from.

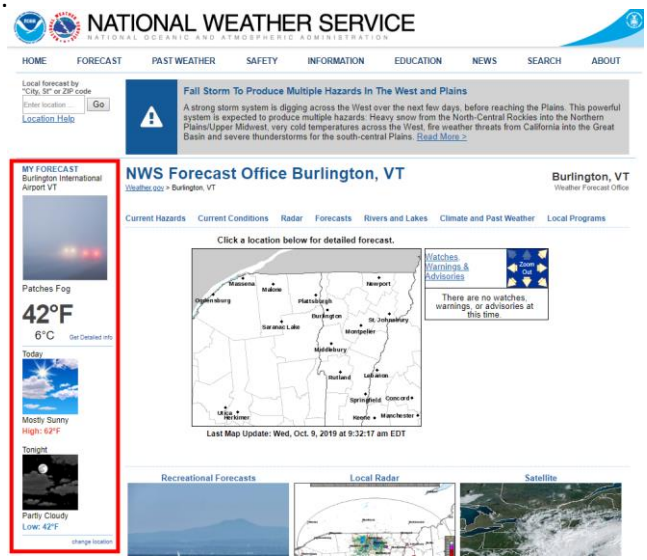


As an office, we have experience forecasting in over 20 states throughout the country as well as for the Storm Prediction Center, the Weather Prediction Center, River Forecast Centers, Center Weather Service Units, broadcast TV, and in the private sector. We also are proud to have four veterans in our office who have served and forecasted both in the US and overseas! From bombing lows in the Bering Sea to hurricanes along the Gulf Coast, from raging wildfires out west to tornadoes in the Central Plains, we've forecast it all. We each bring different backgrounds, different geographic experiences and our own unique forecasting specialties, coming together as a team to make the best forecasts possible for the people of the North Country.

Customizing the "My Forecast" Option On the NWS Burlington Website

- Eric Evenson

Did you know you can customize the "My Forecast" option on the NWS Burlington website? You can and it is easy. Here is how it is done:



1 – Go to weather.gov/btv or weather.gov/Burlington and on the left side of the page, highlighted in the red box in the image here, is the My Forecast section.

2 – At the bottom of that box is a change location link. Go ahead and select. A green Customize Your Weather.gov box will appear (image below, left). You can now type in your city and state or use a zip code (image below, middle). Simply click the Get Weather button. Note you may see the image on the right asking you to select one of the matched locations. Go ahead and select the appropriate one for your location.

3 – You will now see the forecast for your location on the left side of the page. For this example we change the location from the Burlington International Airport to Rutland, Vermont.

4 – Note the "Get Detailed info" link to the right of the current temperature. Selecting that link will provide you with a detailed forecast for the location you set.

NWS Burlington Participates in Catastrophic Exercise with Vermont Emergency Management

-Matthew Clay and Rebecca Duell

Between October 23rd and 25th, the National Weather Service in Burlington sent 4 meteorologists to the Vermont Emergency Management Emergency Operations Center in Waterbury, Vermont. These meteorologists participated in the 2019 Vermont Catastrophic 4 Full-Scale Exercise (FSE) to provide real time weather information to emergency managers following a simulated significant tropical event similar to Tropical Storm Irene. The purpose of the exercise was to test the capabilities of the emergency management system within the state during a simulated event to ensure the best services can be provided in future events.

The role of the NWS in the Emergency Operations Center is to provide real-time weather information and to participate in situational update briefings. In these briefings, our meteorologists discuss any impactful weather expected while providing planning forecasts for future operational shifts. This particular exercise simulated recovery efforts after the tropical event, so the weather information provided would ensure that responders are kept aware of any potentially hazardous weather that would hamper response efforts or place first responders in harm's way.

Within this exercise, we were stationed with the Information Collection Unit where we worked with a team of situational awareness and information collection officials. The weather was quiet for this event but the exercise provided invaluable experience of how a full activation of an Emergency Operation Center works. The NWS works closely with Vermont Emergency Management on a regular basis, but these exercises allow face-to-face interaction that strengthens the critical working relationship between our two agencies.

Meteorologists Rebecca Duell (standing, maroon) and Matthew Clay (seated, blue) working with the Information Collection Unit at the Vermont Emergency Management Emergency Operations Center

Changes at BTV – Farewell Rob, Welcome Nichole and Seth!

Farewell and Good Luck, Robert Deal!

It with a heavy heart we bid farewell to Robert Deal as he heads off to NWS Mt. Holly (Philadelphia) to assume the position of Lead Forecaster at their office. Rob came to Burlington in the fall of 2015 from Lake Charles, LA, and was excited to finally forecast snow and experience the wonder that is a New England winter! A graduate of Florida State University, the only thing that could top Rob's love of weather was rooting for the 'Noles, no matter the sport. While here, his family grew as he and his wife Claire welcomed their son Langston and then daughter Lilian. We wish Rob, Claire and the entire Deal clan the best of luck in Philly. You will be missed and hope to see you down the road soon!

Welcome Nichole Hammond!

A graduate of SUNY Oswego and working towards her Masters at East Carolina University, Nichole joins NWS Burlington after a Pathways Student position at the Weather Prediction Center In Maryland. Nichole not only has a passion for hydrology, but outside the office has a passion for jazz and plays multiple instruments! Originally from the central New York State area, she is happy to be near the Adirondacks again and we're very happy to have Nichole as a part of the NWS BTV family!

Welcome Seth Kutikoff!

A graduate of Penn State, University of Nebraska and very close to completing his Ph.D. at Kansas State University, Seth joins NWS Burlington after serving as a Graduate Research Assistant for the Kansas State Climatologist as a part of his work for the University. In his spare time, Seth enjoys running (he's run over 20 marathons!), hiking and anything outdoors (he came to the right state). Originally from the Hudson Valley area of New York State, he is happy to be near his home state and we're very happy to have Seth as a part of the NWS BTV family!

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We Need Your Storm Reports!

Please report snowfall, flooding, damaging winds, hail, and tornadoes. When doing so, please try, to the best of your ability, to measure snowfall, estimate hail size, and be specific as to what damage occurred and when. We also love pictures!

For reports, please call:
(802) 863-4279
Or visit:
http://www.weather.gov/btv/stormreport

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