The Four Seasons

National Weather Service Burlington, VT

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FALL 2022

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Letter from the Editors

Welcome to the Fall 2022 edition of The Four Seasons, a quarterly newsletter issued by the National Weather Service in Burlington, VT. As we approach Thanksgiving, we want to express our thanks for your interest in learning about the weather in northern New York and Vermont. We're always learning ourselves, and our meteorologists have dived into three different weather events of recent months in this edition of the newsletter. We also have a reminder of upcoming SKYWARN training sessions and an update on staffing here at NWS BTV. Please enjoy and look forward to our snowy season!

Review of the July 21, 2022 Widespread Severe Event Across Vermont

-Rebecca Duell and Matthew Clay

July 21st, 2022 was one of the most active severe days across the BTV forecast area in over 4 years with 15 warnings and over 30 reports of severe weather reported to the National Weather Service. This event is very unique given that northern New York saw very little thunderstorm activity while Vermont had numerous long tracked supercells move through the state. Anomalously warm temperatures in the middle of

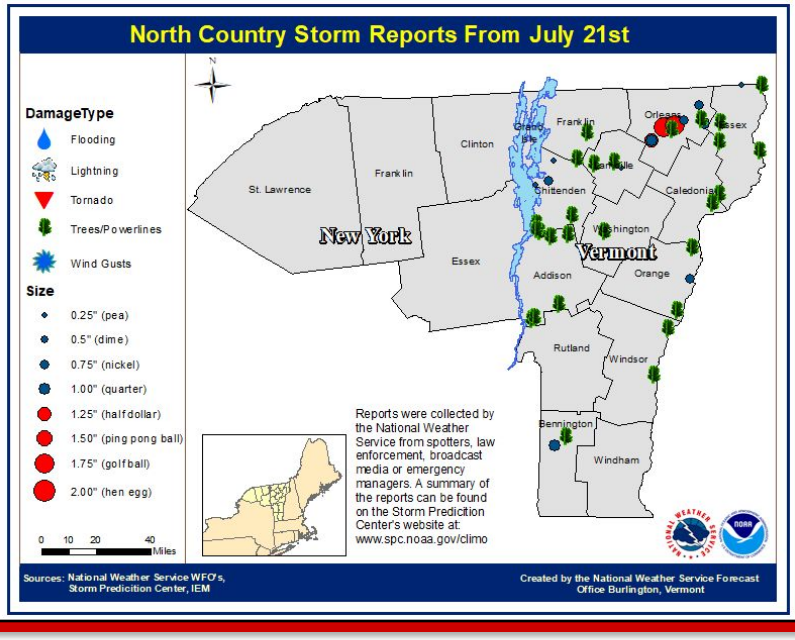

Image 1: Severe reports received for 21 July 2022. Especially noteworthy is the widespread tree damage across Vermont as well as the large hail reports in Orleans County, VT.

…Continued from Page 1

a 6 day heat wave yielded impressive amounts of instability across the region, adding fuel for the storms and resulting in a very active severe day for Vermont. Almost every county in Vermont reported wind damage (see Image 1 for map), and several supercells tracking across the state dropped very large hail in addition to the damaging winds.

Part I: Environmental Analysis

Surface analysis from the morning of the severe event (Image 2) showed a low pressure system centered just south of James Bay, with our forecast area solidly within the warm sector of the cyclone. A cold front was analyzed to our west as of 12Z (8 AM EDT), with a pre-frontal trough evident ahead of the cold front (not shown on WPC analysis). Temperatures stayed very warm overnight, with many 12Z observations reporting temperatures already in the mid to upper 70s and dewpoints in the upper 60s to around 70. Within the primed unstable atmosphere, the main forcing mechanisms for several rounds of thunderstorms that day were expected to be the prefrontal trough, which was set to move through mid-day, and eventually the cold front passage that would occur later into the afternoon/early evening.

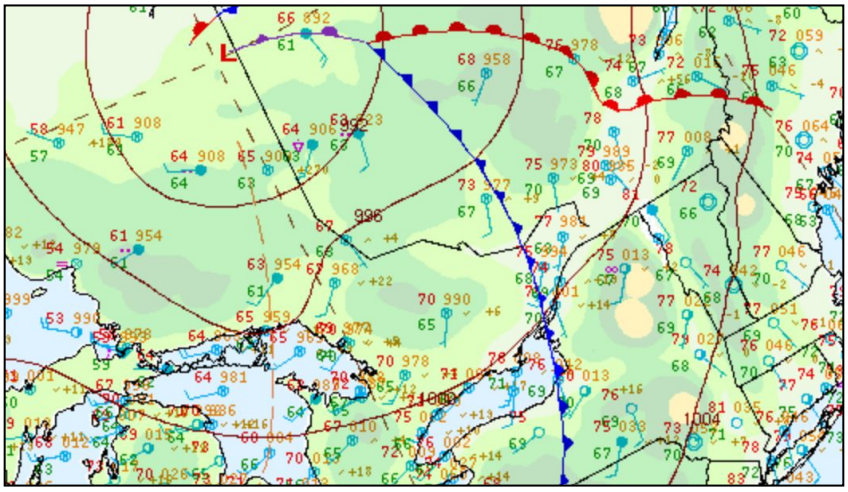

Image 2: Weather Prediction Center (WPC) Surface Analysis from 1200 UTC on 21 July 2022.

The High Resolution Ensemble Forecast (HREF) 1600 UTC (Coordinated Universal Time) ensemble mean Surface Based CAPE (SBCAPE) (Image 3, next page) showed a relatively wide corridor of 1000 to 2000+ J/kg SBCAPE extending from eastern New York through much of New England within the warm sector of the Canadian cyclone. This is on the higher side for what we usually see for our severe weather events in the North Country, and keyed forecasters in on the potential for a very active day with no shortage of instability in the area. Lack of (or questionable) sufficient instability can oftentimes be a limiting factor for severe events in our area, so given the strong instability present on this day, confidence was higher than normal for an active day across our forecast area. Indeed this primed atmosphere is evident on the 1800 UTC NAM 3 km sounding for Burlington initialized at 12Z (Image 4), which showed forecast CAPE values of right around 2000 J/kg, precipitable water values of 1.73 inches, and even enough veering in the low-levels to potentially support an isolated spin up.

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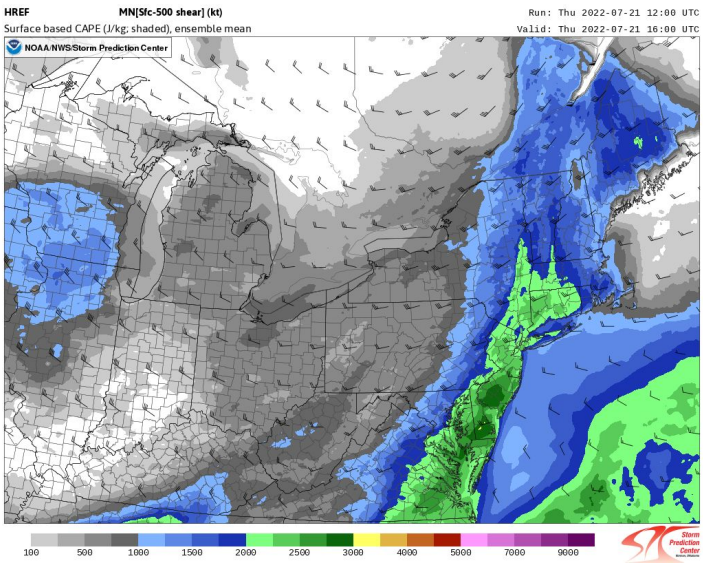

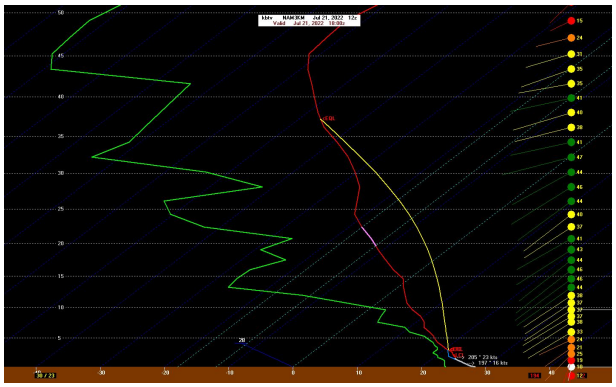

Image 4: (Above) NAM 3 km sounding for Burlington valid at 1800 UTC 21 July 2022 initialized at 1200 UTC

Image 3: (Top left) High Resolution Ensemble Forecast (HREF) ensemble mean Surface Based CAPE forecast for 1600 UTC 21 July 2022, initialized at 1200 UTC.

Part II: Radar Analysis

Multiple rounds of thunderstorms were observed throughout the day on July 21, 2022. The environment during the morning hours remained conditionally unstable as we had around 40 knots of 0-6 km bulk shear observed from the KCXX radar and 1500 to 2000 J/kg of CAPE based on RAP analysis. By 11:30 AM, the first supercell of the day formed over Lyon Mountain, New York and tracked eastward as it crossed over Lake Champlain into South Hero, Vermont and ultimately moved into Franklin County in Vermont where reports of wind damage were received about an hour after the storm first formed. A second supercell formed a little after noon near Mount Mansfield and drifted eastward. This long tracked supercell produced widespread wind damage and copious amounts of hail across the Northeast Kingdom of Vermont, with the largest hail stone measuring 1.75" or about the size of a golf ball before crossing into New Hampshire

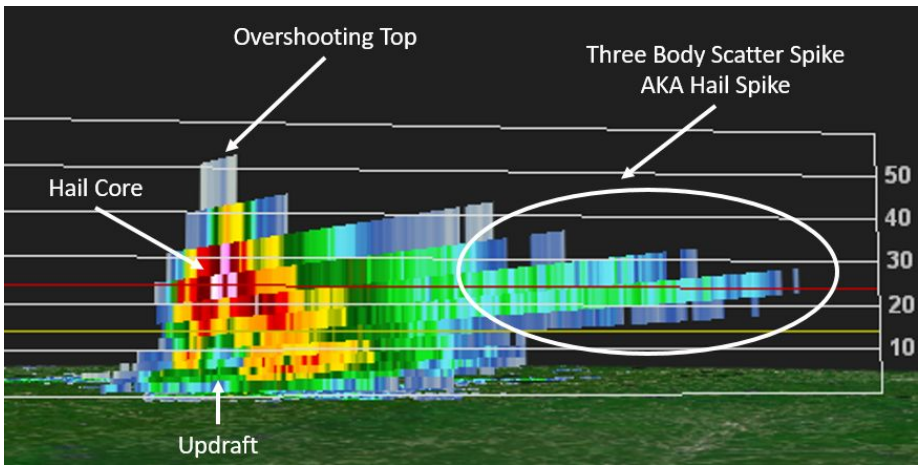

Image 5: KCXX radar Cross-section at 12:28 PM EDT of the supercell near Albany, VT. A deep bounded weak echo region (BWER) was noted, indicating the presence of a strong updraft. This storm led to multiple golf ball sized hail reports with radar max estimated size of hail (MESH) of 3.25 inches.

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where even more damage was reported. While brief, the storm did have a strong low level rotation which prompted a tornado warning. Images 5 and 6 show the classic supercell structure of the second supercell right before it dropped golf ball sized hail over Albany, VT at 12:28 PM. Pictures of the severe hail from Albany and Irasburg in Vermont can be seen in images 7 and 8.

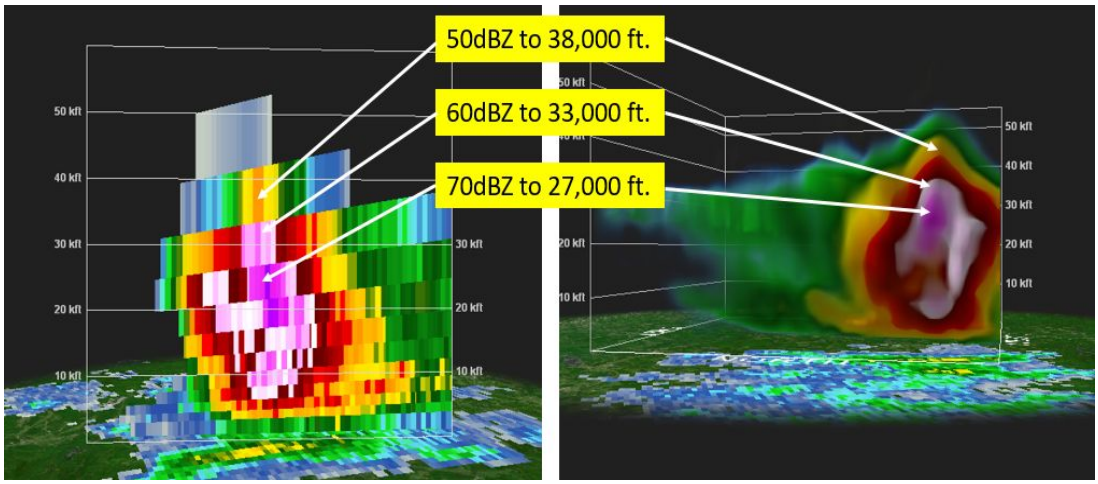

Image 6: (Above) KCXX radar comparison between a 2-D cross section (left) and 3-D cross section (right) for the Albany, VT storm at 12:28 PM ET. Very impressive signatures were noted due to the strong and persistent updraft. A core of 70 dBZ reflectivity was noted up to 27,000 feet, indicating very large hail.

Image 7 and 8: (Left) Pictures of the severe hail in Albany, VT courtesy of Lorri LePage via Facebook. Hail up to golf ball size was reported with this storm.

Part III: Summary

This severe event was highlighted by multiple long tracked supercells that brought widespread wind damage to the North Country. While we lacked the surface forcing to produce more widespread thunderstorm activity, the environmental conditions were still very favorable for storms that did form to quickly become strong to severe. The combination of 1500-2500 J/kg of CAPE and deep layer shear upwards of 50 knots allowed for the supercells that did form to have persistent mesocyclones which allowed for the unusually large hail and widespread wind damage. It's not every day that we see 90 degree temperatures coupled with 70 degree dew points while also having favorable upper level flow for thunderstorms. A look back at reanalysis data shows that many times that we are 90 degrees or warmer across the North Country that we have both high pressure at the surface while having upper level ridging which stunts the formation of thunderstorms.

Review of the Widespread Wind Damage in the Champlain Valley on August 30th, 2022

Widespread wind damage occurred across portions of the Champlain Valley on August 30th, 2022 with areas of northern New York getting hit particularly hard. During this event, we saw a long-lived, microburst-producing storm that produced widespread wind damage beginning in Moriah and Westport in Essex County before crossing Lake Champlain and causing additional damage to Burlington, Milton, Colchester, and St. Albans. Several mesonet sites in Essex County, NY, and at Diamond Island reported measured wind gusts between 52 and 57 mph as the storm began to move over Lake Champlain between 4:45 and 4:55 PM. The net result of this severe storm led to the declaration of a State of Emergency for Essex County. Hundreds of trees were uprooted or snapped from Moriah to Westport to Essex. In addition to the tree damage in Westport, 45 power poles were broken and needed to be replaced with numerous power lines also needing to be replaced. You can view a map of wind damage and wind gusts in Figure 1 below.

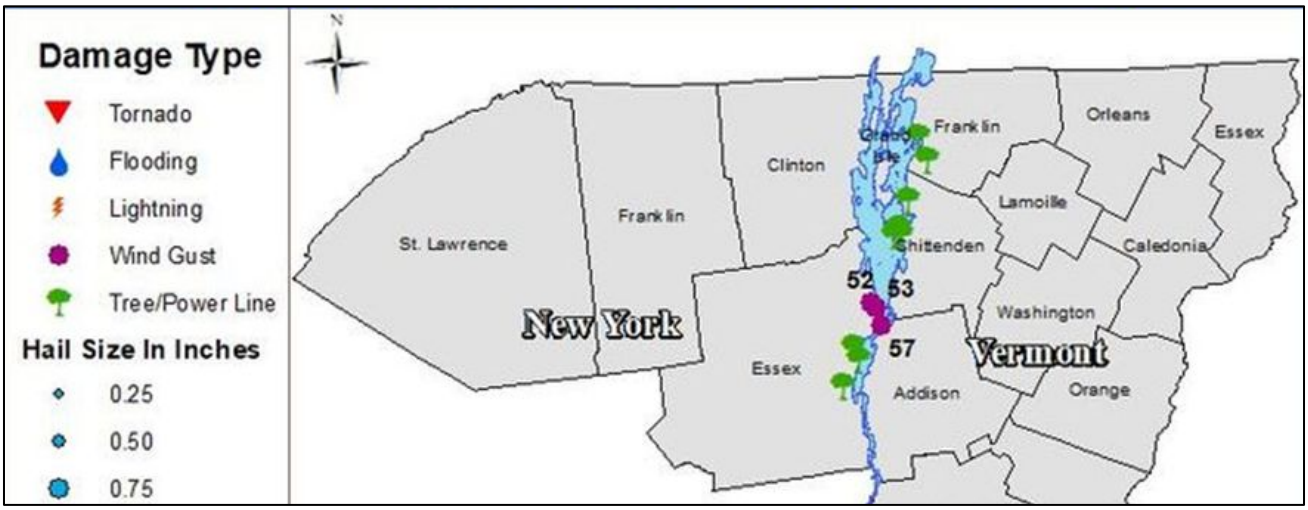

Figure 1. Wind damage and measured wind gust reports received for August 30th, 2022.

A broad area of instability developed across the Northeast during the early afternoon hours with a localized maximum of instability within the Champlain Valley. Prior to the development of this instability, a broad area of convective inhibition (CIN) was present across the Champlain Valley. The presence of this CIN delayed the onset of convection ahead of the surface trough allowing for destabilization to occur. As we start to see convective available potential energy (CAPE) values approach or exceed 2000 J/kg, this begins to enter the upper echelon for CAPE values typically observed in the Northeast. In addition to this instability, we saw deep layer, surface-6km shear values of 30-35 knots beginning to overspread northeastern New York into the Champlain Valley by 20 UTC/4PM EDT. The presence of 30-35 knots of deep-layer shear likely contributed to convective organization, and the small-scale bow echo producing areas of wind damage over a stretch of over 50 miles.

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The 12Z/8 AM EDT NAM3 sounding seen in Figure 2 shows the classic tell-tale signs for the potential for wet microbursts. There are two main areas of focus for wet microbursts with the first focus being the low level lapse rates. When looking at the model sounding, you'll notice very steep low level lapse rates that are near or super adiabatic (temperatures cooling greater than 9.8 degrees C/km) through the first 5,000 ft. The next feature we will look at is the area of drier air between 5,000 and 12,000 ft. As rain and hail fall through this layer, evaporative cooling is likely to occur which will eventually choke off the updraft from a storm. In some cases, as occurred on August 30th, you can get a lot of rain droplets and hail suspended just above the updraft. Once the updraft weakens, the downdraft begins to take place. The density of all this suspended moisture allows for the air to descend rapidly and lead to a wet microburst.

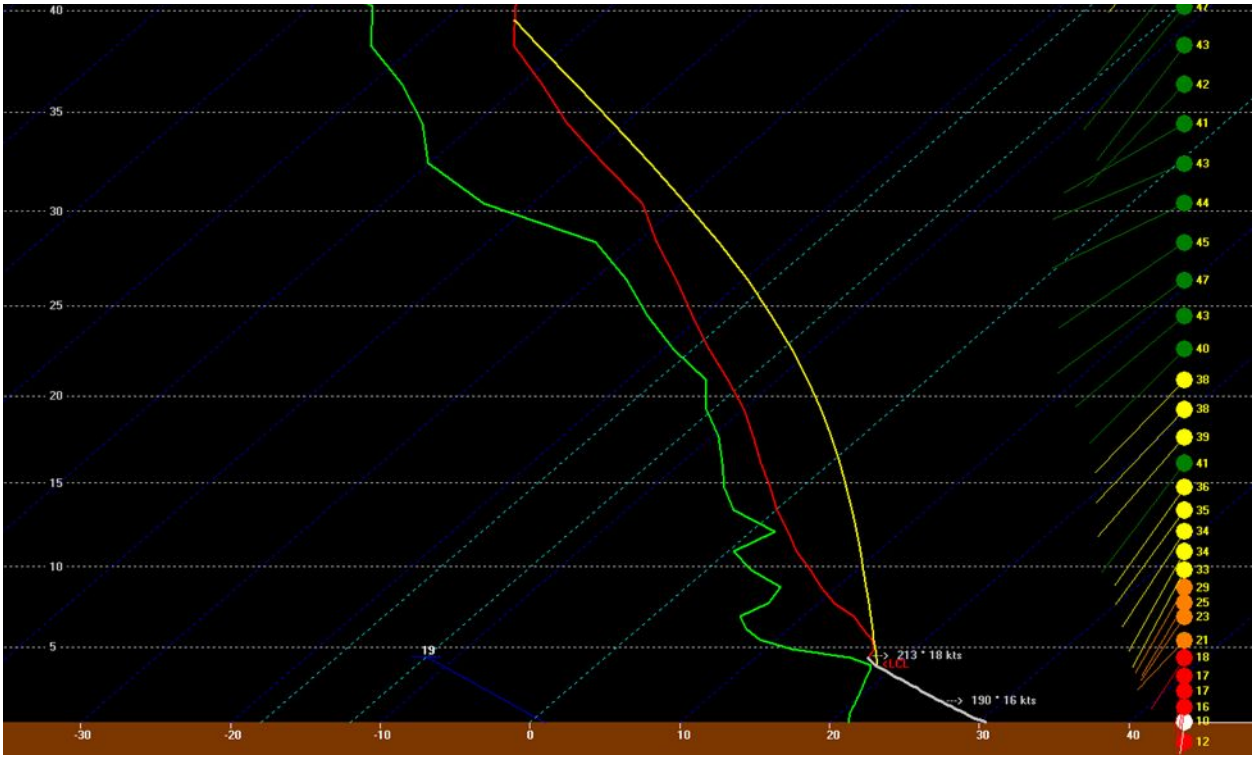

Figure 2. NAM3 model sounding at 18 UTC/2 PM EDT for Burlington, Vermont. You'll notice the steep surface-based lapse rates and a pronounced dry layer above 800 mb.

After a quiet morning and early afternoon period, storms quickly began to develop across central and northern New York as the pre-frontal trough moved across the Adirondacks and into the Champlain and Hudson Valleys. We will be focusing on in this write-up is the storm that tracked over 50 miles across northern New York into northwestern Vermont which led to widespread wind damage in a narrow swath from Moriah, NY all the way to St. Albans in Vermont. A narrow axis of greater instability developed just in the lee of the Adirondacks, and the surface trough provided just enough surface convergence to get storms to develop. A strong thunderstorm quickly developed with a strong inbound velocity signature observed by the KCXX radar in Colchester, VT. This area of strong winds became increasingly expansive as it moved through the towns of Moriah and Westport in New York where extensive tree damage and some damage to property were observed. As the storm continued to track to the northeast towards Essex, a wet microburst developed and was sampled well by radar.

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Image 3 shows a closer look at the winds near Westport. Multiple sites in and around Essex measured wind speeds of 52-57 mph as this storm passed by but it looks like the strongest winds missed the measuring sites by just a few miles.

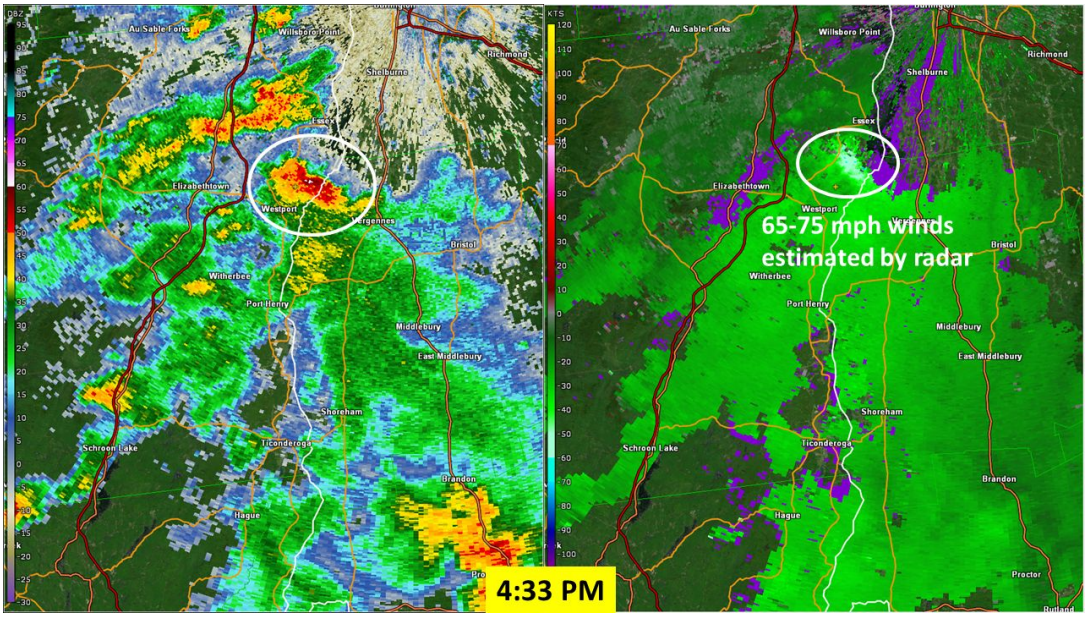

Figure 3. This is a snapshot of the storm just after it passed through Westport, NY. The KCXX radar shows an area of 65-75 mph winds measured by the radar which led to widespread tree and utility damage.

Figure 4. In Westport, NY, a photo by Steven Smith (left) shows trees and powerlines down and a photo by Arlene Phillips (right) shows trees down on a shed.

Microbursts aren't too uncommon in the North Country, with several seen throughout the severe season, but the amount of damage and long track of said damage is quite rare. While our office did not officially conduct a storm survey given the clear signs a wet microburst occurred, peak wind gusts up to 80 mph look possible near Westport and Moriah based on the damage to hardwood trees and utility infrastructure.

NWS Burlington, VT SKYWARN® Program

The NWS Burlington in Vermont is offering these online courses focused on winter season hazards and support your understanding of winter weather. We will host multiple sessions, and you are welcome to join whichever is most suitable to your schedule. This is a training session for those interested in becoming certified Skywarn® Spotters or are looking for a refresher. Registration is free and open to all.

We will use GoToWebinar for this series of Virtual Spotter Courses, and you may sign up here: https://attendee.gotowebinar.com/rt/165640753896720140

Session #1 will be held Sunday, November 13th from 6 PM to 7:30 PM EST

Session #2 will be held Tuesday, November 15th from 9:30 AM to 11 AM EST

Session #3 will be held Tuesday, December 6th from 3:30 PM to 5 PM EST

Note that times may change due to weather. Email updates will be sent to registrants if a change must be made. We will discuss the following topics:

- **What is Skywarn? What does it mean for us?**
- **Overview of Winter Weather Forecasts**
- **Precipitation Types and Measurements**
- **Safety and reporting winter weather**

You may contact our SKYWARN™ program leader Robert Haynes with any questions at robert.d.haynes@noaa.gov

A Review of the 13-14 October 2022 Heavy Rainfall and Gusty Wind Event across the North Country

-Brooke Taber

A complex storm system produced gusty south to southwest winds during the afternoon of October 13th, while periods of moderate to locally heavy rainfall occurred late on the 13th into the early morning hours on October 14th. A peak wind gust up to 48 mph was measured from the New York State Mesonet site at Malone, New York during this event, with some isolated power outages reported. Meanwhile, the combination of a slow moving cold front and weak surface low pressure developing along the boundary, helped to produce a widespread 1 to 2 inches of rainfall with isolated amounts near 3 inches. The heaviest rainfall occurred in the Green Mountains of north-central Vermont, where a Co-Op Observer 3 miles north of Smugglers Notch reported a storm total of 3.27 inches and a CoCoRaHS report of 2.87 inches was observed 3 miles northwest of Waterbury. The widespread rainfall did cause some minor flooding near Newport Center, VT, along with many sharp rises on streams and rivers, with the Missisquoi River at North Troy and Barton River at Coventry both reaching action stage. It was a good thing river levels and associated flows were below normal for mid October or we may have experienced more widespread river flooding issues. Figure 1 (next page) shows North Country storm total rainfall ending at 8 AM on 15 October 2022.

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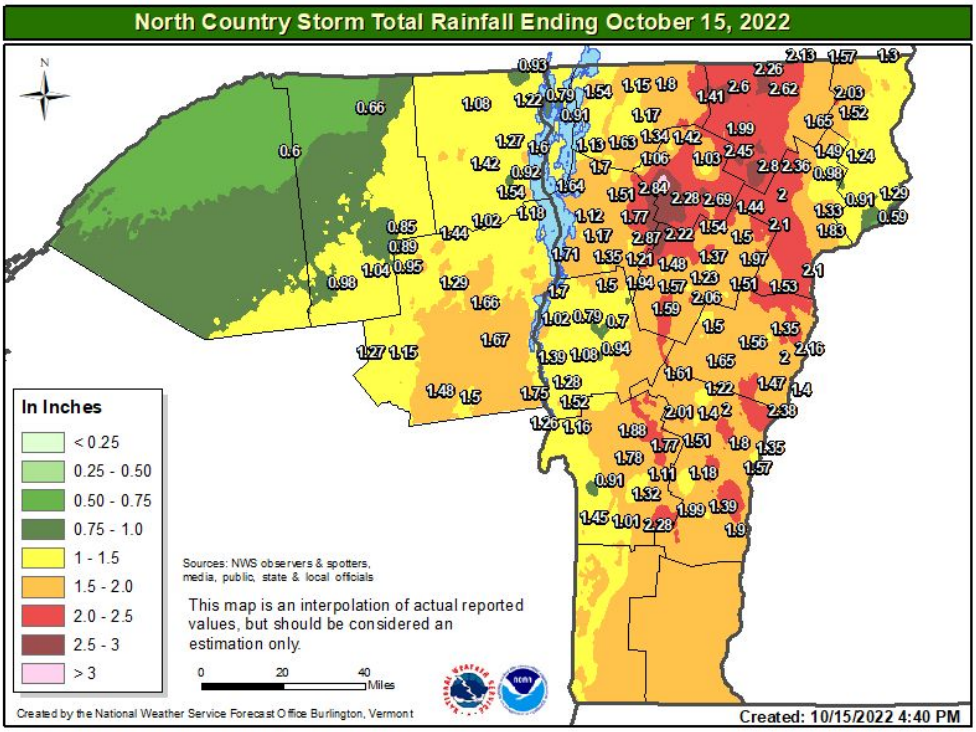

Figure 1: North Country storm total rainfall ending 15 October 2022 at 8 AM.

The surface analysis at 2 PM on 13 October 2022 (Figure 2) showed a well-defined cold front approaching the Saint Lawrence Valley, with strong southerly flow ahead of this boundary. The strong southerly flow helped to advect rich sub-tropical moisture into the region, resulting in moderate to heavy rainfall developing along the boundary from the eastern Adirondacks into most of central and northern

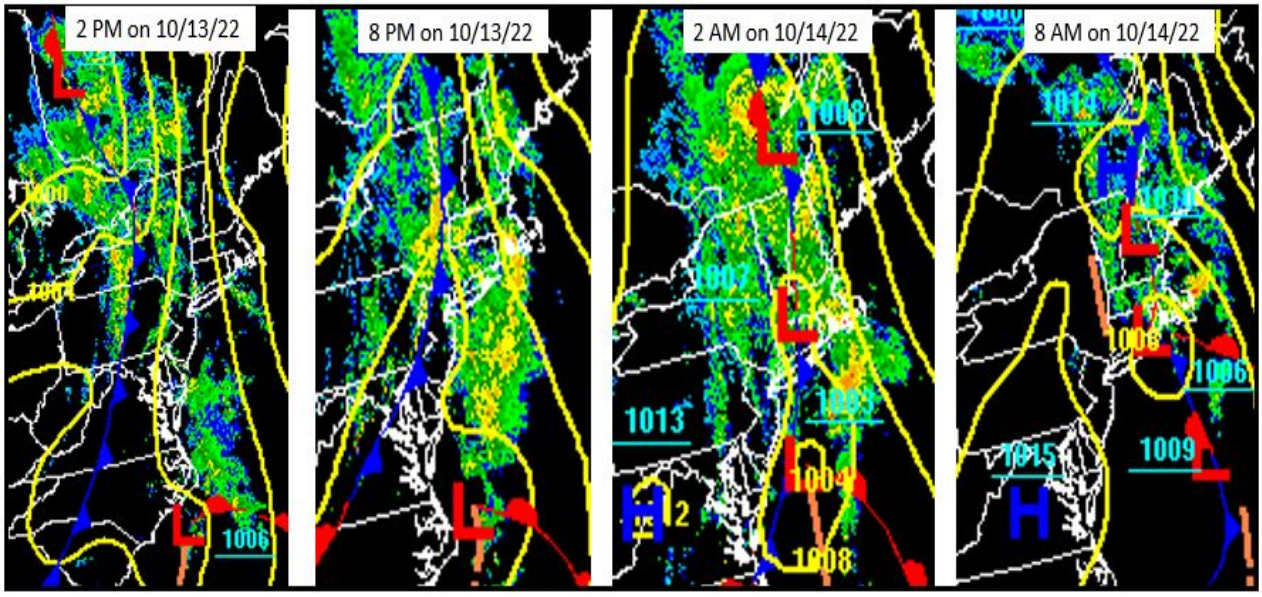

Figure 2: Surface analysis and composite radar reflectivity from 2 PM on 13 October to 8 AM on 14 October 2022 (6 hour intervals).

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Vermont. In addition, note how slowly the boundary moved from the Saint Lawrence at 2 PM on October 13th to the Connecticut River Valley by 8 AM on the 14th. The sharp convergence associated with the boundary and weak surface low pressure developing across western New England and tracking into the Connecticut River Valley, helped to enhance the rainfall across Vermont on the early morning hours of October 14th. The yellow and orange colors in the image below indicates areas of moderate to heavy rainfall with hourly rates observed in the 0.25 to 0.75" range. Figure 2 below highlights the surface features and associated evolution from 2 PM on the October 13th thru 8 AM on the 14th of October.

Figure 3 (below) is Multiple Radar Multiple Sensor (MRMS) composite reflectivity image at 2:30 PM on 13 October 2022, clearly highlighting the position of a surface cold front with a shallow low top line of showers with embedded gusty winds and brief heavy rainfall. At 2:30 PM this fine line of showers were located across western Saint Lawrence County and extended into the Tug Hill Plateau area just east of Lake Ontario. Localized wind gusts 40 to 50 mph occurred along and just ahead of this line of showers, along with sharply falling temperatures. For example, ahead of the front conditions at Ogdensburg International Airport were a temperatures of 63°F, dewpoint of 59°F and breezy southwest 10 to 20 mph with gusts up to 30 mph. As the front passed, temperatures fell to the lower 50s with a peak wind gust of 45 mph at 2:15 PM on the 13th at Ogdensburg. A similar type scenario played out across much of the Saint Lawrence Valley and northern Adirondack Mountains with the frontal passage. However, the threat for gusty winds decreased as the system entered the Champlain Valley, due to the stabilization of the low levels of the atmosphere.

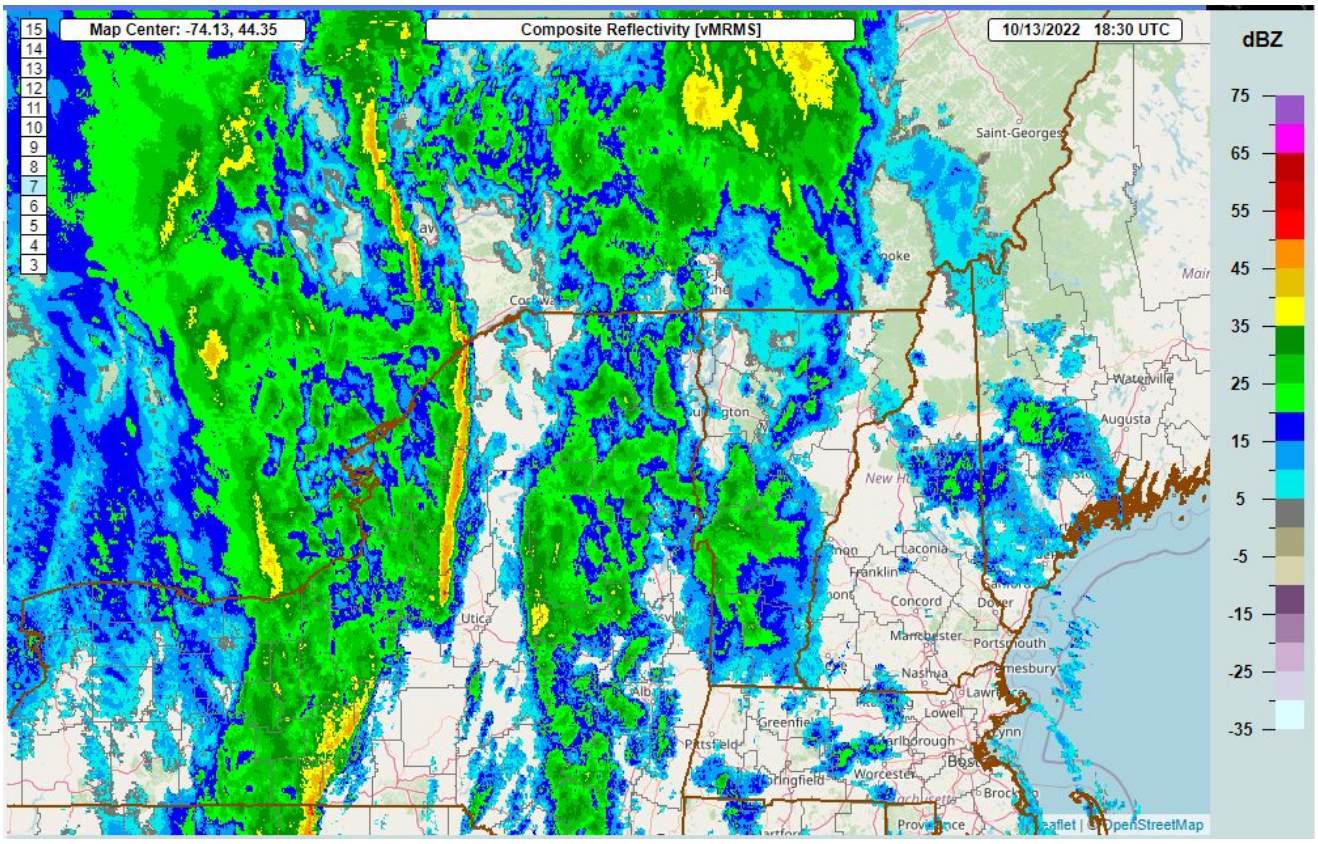

Figure 3: Multiple Radar Multiple Sensor (MRMS) composite reflectivity at 2:30 PM on 13 October 2022.

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The map below (Figure 4) shows the North Country maximum wind gusts on 13 October 2022. The strongest winds gusts of 40 to 50 mph occurred over the Saint Lawrence Valley and parts of the northern Adirondack Mountains, with the New York State Mesonet site at Malone, NY reporting a peak gust to 48 MPH. In addition, Massena, NY Automated Surface Observing Station (ASOS) reported at gust to 44 mph and the Louisville, NY mesonet site reported a peak wind of 47 mph. These gusty winds did produce isolated power outages on the 13th with up to 1000 people without power at one time during the event. Meanwhile, across Vermont peak wind gusts ranged mainly in the 30 to 40 mph range, with lighter winds across portions of central and southern sections.

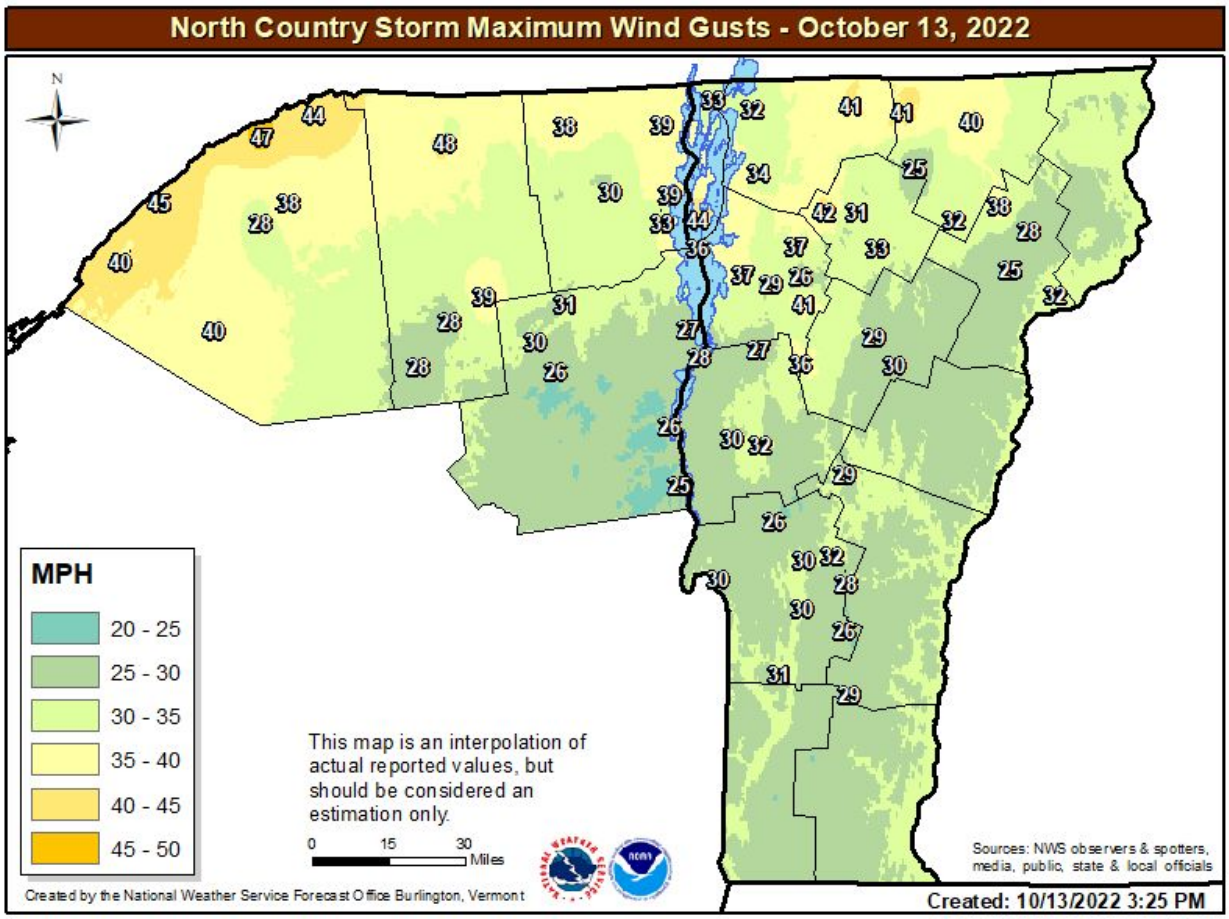

Figure 4: North Country storm maximum wind gusts on 13 October 2022.

Overall this system impacts across the North Country were minimal with some localized minor flooding from heavy rainfall and up to a 1000 people lost power over northern NY due to gusty winds. In general rainfall ranged between 1 and 2 inches with localized amounts near 3 inches from the eastern Adirondacks into central-northern Vermont, while the peak wind gusts were in the 40 to 50 mph mainly across northern New York.

Changes at BTV - Welcome Gabe and Brian, Farewell and Good Luck, Nichole!

Greetings from the new Meteorologist-In-Charge! I am one of two new members of the NWS Burlington team this fall. My family and I moved to Burlington in late August to start my new role as BTV's office manager, and we couldn't be more excited. My two young daughters are big fans of skiing in the winter and hiking in the summer and look forward to all things outdoors. After spending their entire lives in more arid environments, they have been shocked how gorgeous Vermont's tree lined hills and mountains are…and that was even before fall foliage hit!

My fascination with weather began in high school, leading me to pursue a degree in meteorology at Lyndon State in 2003. My professional career started in the far corner of the country working for the U.S. Army at the Yuma Proving Ground in Yuma, AZ. There I provided weather support to research and development projects ranging from NASA's Orion space capsule to precision guided mortars. Over the years, I transitioned into a more managerial role before accepting an offer to become the Meteorologist-In-Charge at the Denver Center Weather Service Unit. Life in a CWSU is a non-stop adventure providing real time weather briefings to FAA Air Traffic Controllers in an attempt to keep airplanes safe and minimize weather delays. Realizing the snow melts all too quickly in Colorado, I decided to return to Vermont and took this new opportunity with your local WFO.

I would also like to welcome Brian Gambero to our team as our newest Electronics Technician. Brian will be responsible for keeping our series of radar and other weather sensors working properly and is hopeful that we won't need to call him late at night too frequently. Brian is a lifelong Vermonter, born and raised in the Burlington area. He spent many years working for IBM and the Vermont Air National Guard. He "retired" from the Guard earlier this year, but was unable to stay away from the office, accepting a new role as a civil servant months later. Brian has been married for 38+ years and has 2 children and 1 grandchild.

- ***BTV Meteorologist-in-Charge Gabriel Langbauer***

Farewell and Good Luck, Nichole!

It will be hard for all of us here in NWS BTV to bid farewell to meteorologist Nichole Hammond as she embarks on her exciting new adventure to become a Hydrologist at the Mid-Atlantic River Forecast Center this December. Nichole came to us at NWS BTV in 2019 from the Weather Prediction Center, and has served as an operational forecaster with us for three years. While here, Nichole led the office Diversity and Inclusion Team, the Social Media Team, and was a member of the Hydrology and Leadership teams. We are so grateful for her many contributions to the office over the years, and we wish Nichole and her husband Trevor the best of luck in Pennsylvania! You will be very missed!

The Four Seasons

Volume VIII, Issue III

Contributors:

Gabriel Langbauer, Meteorologist-in-Charge
Matthew Clay, Meteorologist
Rebecca Duell, Meteorologist
Brooke Taber, Meteorologist

Editors:

Rebecca Duell, Meteorologist
Seth Kutikoff, Meteorologist
Marlon Verasamy, Observing Program Leader

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!

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National Weather Service Burlington, VT
Burlington International Airport
1200 Airport Drive
South Burlington, VT 05403
Phone: (802) 862 2475
www.weather.gov/btv
Email: btv.webmaster@noaa.gov

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