The Four Seasons

National Weather Service Burlington, VT

VOLUME V, ISSUE III

WINTER 2018-19

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Letter from the Editors

Welcome to the Winter Edition of The Four Seasons, a quarterly newsletter issued by the National Weather Service in Burlington, VT. In this edition, we'll look at the Snow Squall Warning. We'll also look back at the Late Nov heavy snow event as well as the record cold throughout Nov. You'll get to "Meet a Forecaster" once again and see some of our forecasters reaching out to the next generation of future scientists. We then have a refresher on how to submit storm reports for upcoming snowfall before finally covering our Winter Weather Workshop.

We hope you enjoy the newsletter and thank you for reading!

The National Weather Service 'Snow Squall Warning'

- Peter Banacos

Blinding snow. Gusty winds. Snow covered and icy roads. Such are the conditions experienced during snow squalls (Figure 1) - short-lived convective snow events often organized ahead of arctic fronts traversing the northern tier of the United States. While snow squalls typically last less than one hour and produce only a dusting to 2 inches of snowfall in most situations, their rapid onset and intensity can cause a disproportionately high impact to motorists, especially for those caught unaware that such conditions are expected. The poor weather and road conditions - and driver apprehension - brought about by snow squalls yields an increased risk for multi-vehicle accidents, especially for fast-moving traffic on highways and interstates. Such accidents and highway pileups have been documented in dozens of cases

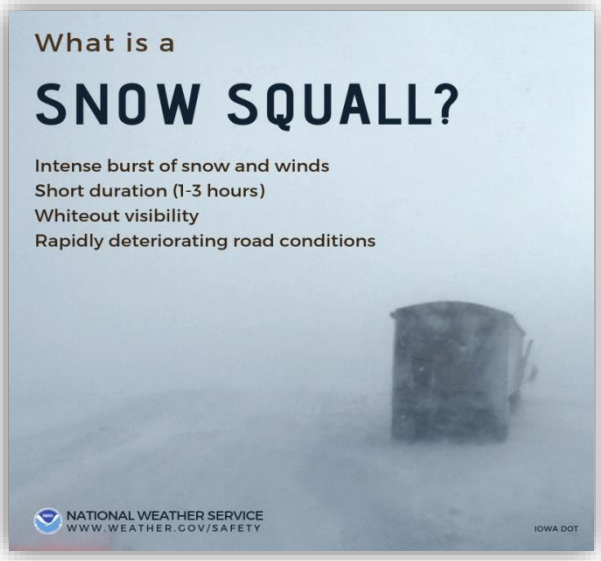

Figure 1: Characteristics of a snow squall

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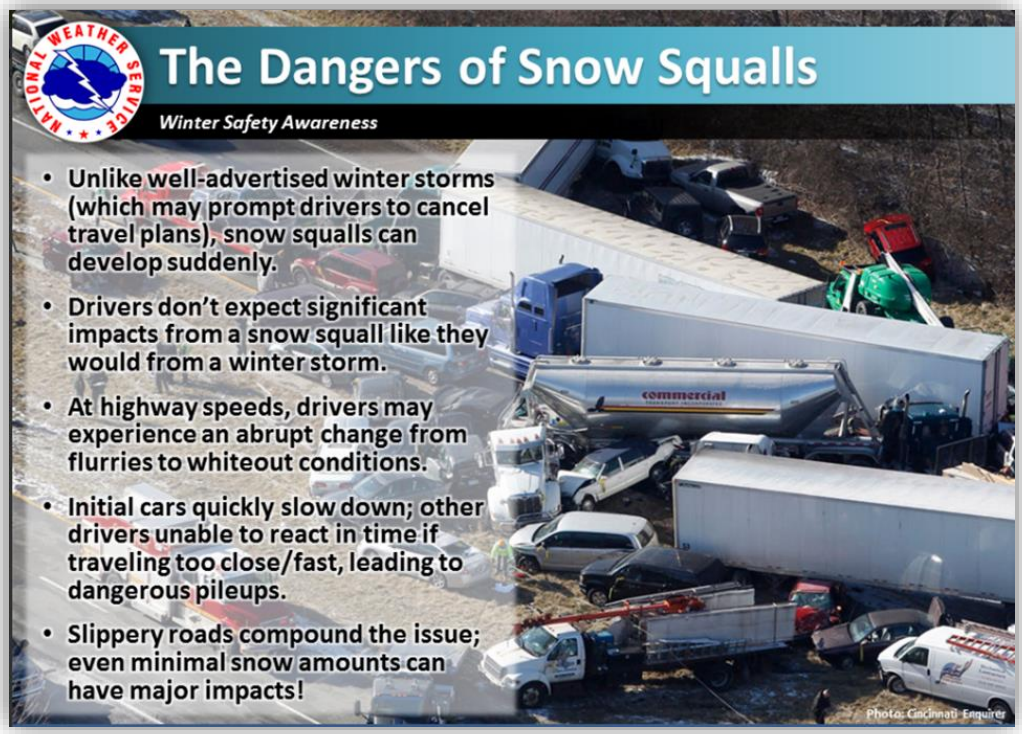

Figure 2: A Social Media slide explaining the traditional dangers associated with snow squalls.

across the United States over the past decade, tragically resulting in numerous injuries, fatalities, and millions of dollars in economic loss (Figure 2).

An increased research emphasis into the meteorological and non-meteorological factors contributing to high impact snow squalls, and emerging mobile technologies to convey life-threatening information to travelers, have put the National Weather Service (NWS) in a strengthened position to fully message the hazard posed by snow squalls, with the goal of mitigating the effect these systems have on society. In the past, snow squall hazards conformed only marginally to the NWS product suite, with the modest snowfall amounts not even rising to the level of a winter weather advisory (4 inch per 12 hour threshold across Vermont and northern New York). Likewise, the time scale of severe winter conditions is brief with a snow squall, on the order of an hour. This is unlike a typical large-scale winter storm that can last the better part of a day or longer, when the public would expect Winter Storm Warnings. Lastly, the risk posed by snow squalls varies widely, with little or no risk for those stationary at home or work, to a high risk for those on high speed highways.

Heretofore, Special Weather Statements (SPSs) were issued by National Weather Service forecast offices to highlight the threat posed by snow squalls. However, the SPS does not fully leverage the NWS dissemination system to get the message out about potentially life-threatening travel conditions in snow squalls. Emerging technologies in motor vehicles and via cell phones - including Wireless Emergency Alerts (WEA) - are also triggered from official NWS warnings, and allow potentially life-saving information to reach the traveling public directly. While the SPS remains an option for weaker events, the goal of mitigating highway accidents and pileups associated with well-organized snow squall required a new approach aligned with a true warning product.

For winter 2018-19, the National Weather Service has officially debuted the Snow Squall Warning. Issued similar to Severe Thunderstorm or Tornado Warnings, the Snow Squall Warning covers small areas (county scale) expected to experience visibility at or below one-quarter mile visibility in heavy snow along

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with gusty winds lasting up to one hour. The goal of the Snow Squall Warning is to better warn drivers of potentially life-threatening travel, in hopes of achieving reduced travel speeds and safe driving for the rapidly changing weather and road conditions, or avoidance of travel when the worst conditions are expected. In addition to warnings, longer lead time products are also needed to convey the threat of snow squalls (Figure 3). In conjunction with the more strategic messaging at longer time scales - including NWS briefings to state and local partners, and use of social media - the Snow Squall Warning allows the public and decision makers to know when and where the most severe conditions are imminent or occurring.

On Wednesday, November 21, 2018, the first significant snow squall event since implementation of the Snow Squall Warnings took place across the North Country. A total of 6 Snow Squall Warnings were issued by NWS Burlington during the late morning through the mid-afternoon hours, as an arctic front approached from the eastern Great Lakes and southeastern Ontario, and traversed northern New York and Vermont. Two bands of snow squalls became organized near and ahead of the cold front, resulting in rapidly changing winter driving conditions (Figure 4). Visibility as low as one-eighth mile was reported at the Burlington International Airport, along with wind gusts of 40 mph.

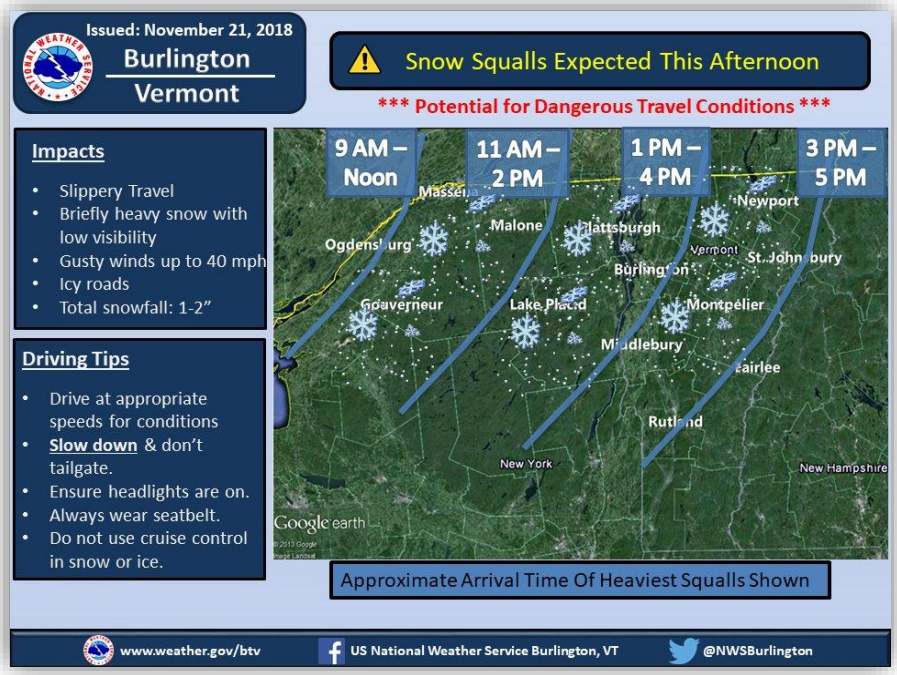

Figure 3 (above). Social Media slide posted at 8:40AM EST on 21 November 2018 in advance of the snow squall threat, indicating potential timing, impacts, and driving tips. In addition to warnings, longer lead time products are also needed to convey the threat of snow squalls.

Figure 4: Vermont Agency of Transportation Webcam showing I-89 in Williston, VT on 11/21/2018 at 12:02 PM before a snow squall (left image) and at 12:28 PM during the snow squall (right image). Note the drastic reduction in visibility during the squall.

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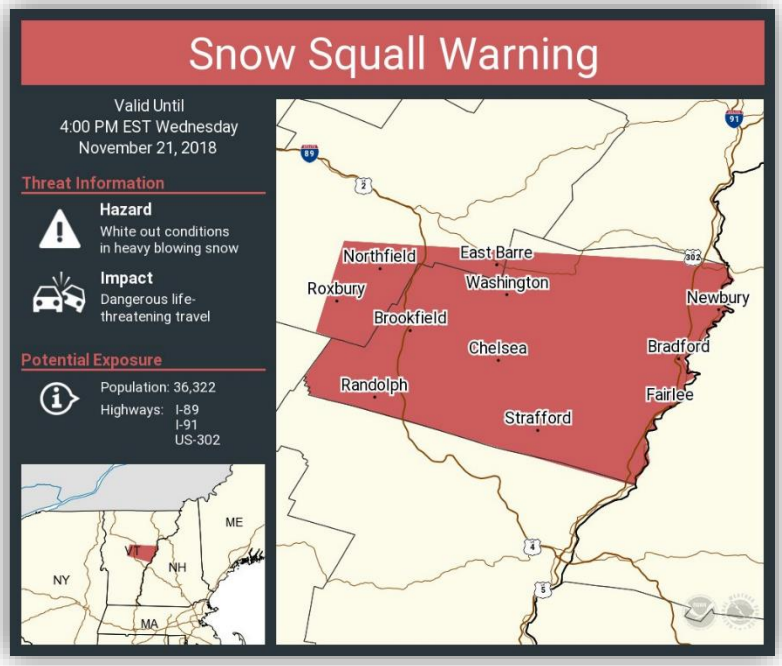

Figure 5. A Snow Squall Warning polygon issued on 21 November 2018 for portions of Washington and Orange counties in east-central Vermont. These graphics are available as warnings and are issued in real-time on our Twitter page, @NWSBurlington.

An example of a Snow Squall Warning polygon from November 21st is shown in Figure 5. Overall, the 21 November event was well-forecast with timely warnings. No significant accidents were reported, despite the event occurring on a very busy travel day leading up to Thanksgiving.

The use of Wireless Emergency Alerts (WEA) for delivery of Snow Squall Warnings and other critical warnings is occurring gradually depending on wireless carrier. WEA should be more fully implemented for snow squalls warnings by mid 2019. With mobile phone pairing and other vehicle technologies, the Snow Squall Warning will be increasingly available directly to drivers, in addition to being delivered via NOAA weather radio, and on some highway variable message boards. For more information on WEA, see the Federal Communications Commissions (FCC) website at:

https://www.fcc.gov/public-safety-and-homeland-security/policy-and-licensing-division/alerting/general/wireless

Ways to receive a Snow Squall Warning:	
NOAA Weather Radio	Broadcast Media
On our website: weather.gov/btv	Variable Highway Message Boards (in some areas)
Mobile: mobile.weather.gov	Wireless Emergency Alerts (future)
Twitter (@NWSBurlington)	Emergency Alert System (future)

The Widespread Power Outage and Tree Damage, Heavy Wet Snowfall Event of 27-28 November 2018

-Brooke Taber

A widespread heavy wet snowfall occurred across northern New York into all of Vermont from November 27th through November 28th. This complex area of low pressure produced storm total snowfall accumulations from 4 to 8 inches across the Saint Lawrence, Champlain, and parts of the Connecticut Valleys, while the mountains of northern New York and Vermont received from 10 to 20 inches. The snow to liquid ratios were around 8 to 1, meaning 1 inch of liquid resulted in 8 inches of snow, given the near freezing temperature profiles. This caused widespread power outages, with over 110,000 customers losing power during the event across the North Country. Figure 1 (right) shows the North Country storm total snowfall ending on 28 November 2018.

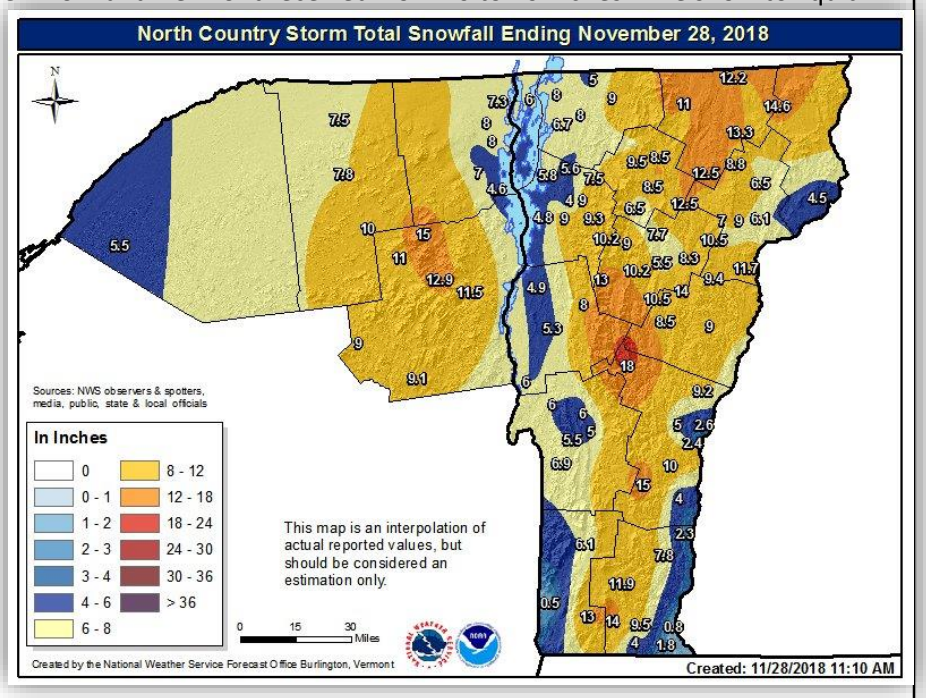

Figure 1 (above). North Country storm total snowfall ending on 28 November 2018 at 11:10 AM

The complex temperature profiles associated with low pressure tracking across the Mid-Atlantic States into eastern New England made for a challenging forecast, as a degree or two warmer would have resulted in mostly a cold rainfall. Figure 2 shows the 27 November 2018 observed 7 AM sounding from Gray, Maine, which was representative of conditions in Vermont and northern New York. This vertical temperature profile indicated a nearly isothermal layer from the surface through 10,000 feet above ground level of readings near freezing. The combination of cool east to northeast winds of 40 to 50 knots below 4,500 feet and strong rising air parcels helped to cool the column just enough to produce a heavy wet snowfall across the North Country, as low pressure slowly tracked into the Gulf of Maine. The observed sounding also exhibited deep layer moisture was available through 25,000 feet, which produced storm total precipitation amounts of 0.50 to 1.50 inches.

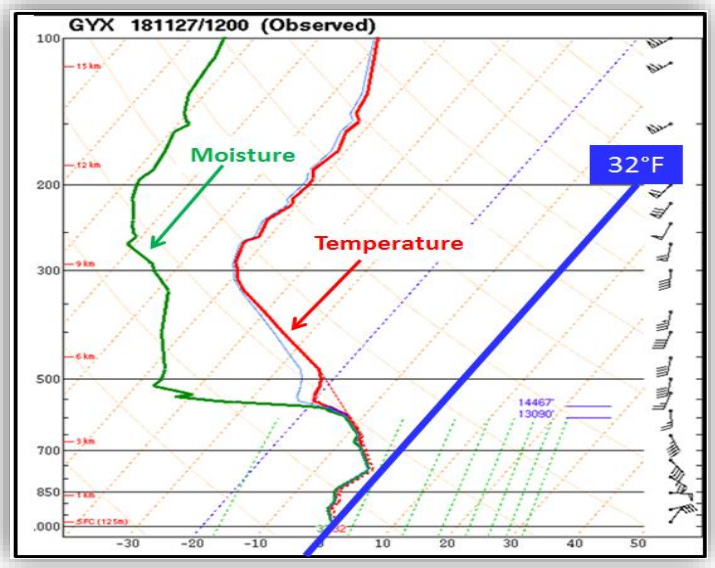

Figure 2. Observed sounding from Gray, Maine on 27 November 2018 at 7 AM

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Figure 3 below shows the evolution of a complex area of low pressure from 7 PM on November 26th to 1 PM on November 27th, along with the areas of light to moderate precipitation rotating across the Northeast United States. A 996mb primary area of low pressure tracked across the eastern Great Lakes, while a 992mb low developed near New York City and intensified to 988mb over Portland, Maine by 1 PM on November 27th. The counter-clockwise circulation advected deep Atlantic moisture into central and northern New England, resulting in a prolonged heavy wet snowfall event. As low pressure slowly lifted toward the Canadian Maritimes, a favorable upslope flow developed from the northern Adirondacks into the mountains of central and northern Vermont on the 28th. This helped to generate additional snowfall accumulations across the mountains, before finally tapering off.

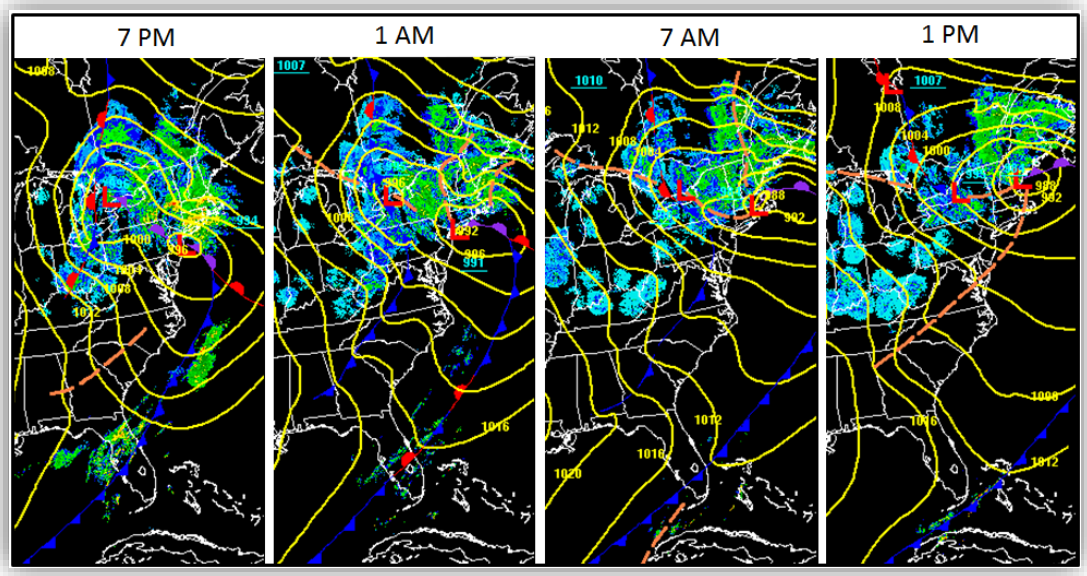

Figure 3. Surface and radar evolution from 26 November at 7 PM to 1 PM on 27 November 2018

This long duration heavy wet snowfall event produced over 110,000 power outages across northern New York into Vermont, along with widespread tree damage. Some of the hardest hit areas across the higher terrain of central and southern Vermont were without power for almost a week, utility companies worked around the clock to restore power. Snowfall in the valleys generally ranged between 4 to 8 inches, while the mountains saw 10 to 20 inches of heavy wet snow, with 26 inches at Woodford and 24.7 near Rochester, Vermont.

Figure 4. Pictures showing the damage from the heavy wet snowfall. Photos courtesy of Green Mountain Power.

November's Record Cold Spell

-Matthew Clay

Many will remember how fall was rather short-lived, with winter seemingly developing in the blink of an eye. While November as a whole wasn't top 10 warmest or coldest on record, there was a period of weather on November 22nd and 23rd that cracked some daily records. As a matter of fact, most climate sites in our forecast area set the earliest sub-zero temperatures ever recorded. Table 1 and Table 2 show some of the daily records that were broken on both the 22nd and 23rd with an asterisk denoting the periods that set the earliest sub-zero temperatures on record.

Site	New Record Low	Previous Record Low
Massena, NY	-3° F *	0° F (1972)
Saranac Lake, NY	-4° F	-2° (2000)
Montpelier. VT	0° F	2° F (1964)
Plattsburgh, NY	1° F	6° F (1972)

Table 1 (above). Records set on the morning of November 22nd. Note: Massena hit their earliest sub-zero temperature on the 22nd.

Site	New Record Low	Previous Record Low
Burlington, VT	-1° F *	2° F (1972)
Plattsburgh, NY	-5° F *	6° (2000)
Saranac Lake, NY	-20° F	-11° F (1932)
Massena, NY	-9° F	0° F (2000)

Table 2. Records set on the morning of November 23rd. Note: Burlington and Plattsburgh hit their earliest sub-zero temperature on the 23rd.

With this extreme of a cold spell very rare so early in the season, we received numerous inquiries as to the cause. November, overall, was a good bit below normal due in large part to an arctic trough that remained well entrenched across the Great Lakes Region and New England. While we had periods of warmer and near-normal temperatures, we continued to have an open feed to very cold Canadian air. In the case of November 22nd and 23rd, a very cold air mass developed over Interior Canada, in an ideal location for northwesterly flow aloft to drive the colder air southeastward. Figure 1 shows composite mean 500 mb geopotential heights across New England for November 21st through 23rd, showing some rather impressive low values.

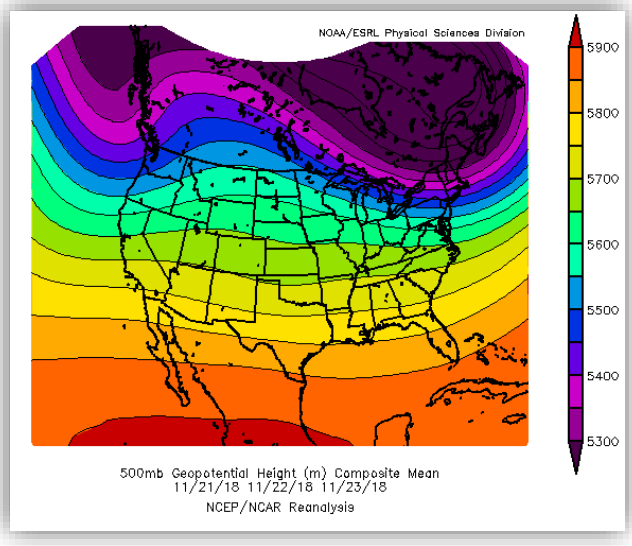

Figure 1. Composite mean 500 mb geopotential heights (m) from November 21st -23rd, 2018 using the NCEP/NCAR Reanalysis Dataset.*

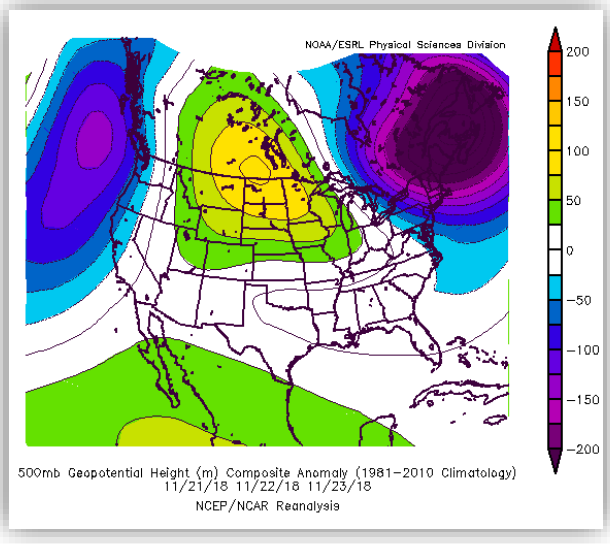

Figure 2. Composite anomaly 500 mb geopotential heights (m) from November 21st – 23rd, 2018 using the NCEP/NCAR Reanalysis Dataset*

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Looking at the anomalies for the time period of November 21st through the 23rd (Figure 2, previous page), we notice that the 500 mb heights over northern New England were anywhere between 150 to 200+ meters below normal for this time of the year. This can correspond with an atypically cold air mass over the region.

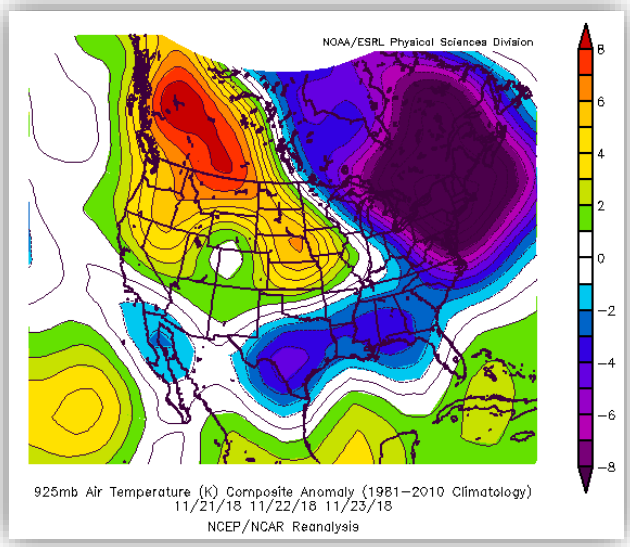

Figure 3. Composite anomaly 925 temperatures (K) from November 21st -23rd, 2018 using the NCEP/NCAR Reanalysis Dataset.*

While geopotential heights are a good indicator of how cold an air mass may be, it doesn't tell the full story; the low-levels of the atmosphere are an important piece of the puzzle as well. In the example of the 22nd and 23rd of November, 925 mb temperature anomalies between November 21st and 23rd (Figure 3) show atypically cold air in the lower-levels over the northeastern US and eastern Canada.

Given all the information from the 500 mb heights and 925 temperatures, all signs would point to a very cold air mass. In addition, in the case of the 22nd and 23rd, winds were very light and skies were clear under high pressure (Figure 4). Under clear skies and calm winds, the surface can radiate out and cool off very efficiently, which is exactly what happened during this rare November event. Further aiding the extreme cold was an early snowpack that was well over 2 inches above daily norms for much of the forecast area (Figure 5). Snowpack reflects more of the sun's energy than it absorbs, so a common theme for our coldest nights is a good snowpack, and this outbreak was no exception.

** Images in Figures 1, 2, and 3 provided by the NOAA-ESRL Physical Sciences Division, Boulder Colorado from their Web site at https://www.esrl.noaa.gov/psd/*

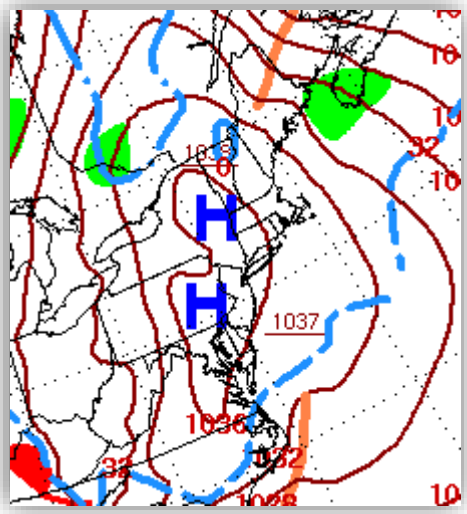

Figure 4. Surface Weather Map at 7 AM EST on November 23, 2018, showing strong high pressure over the area. Weather map courtesy of the Weather Prediction Center http://www.wpc.ncep.noaa.gov

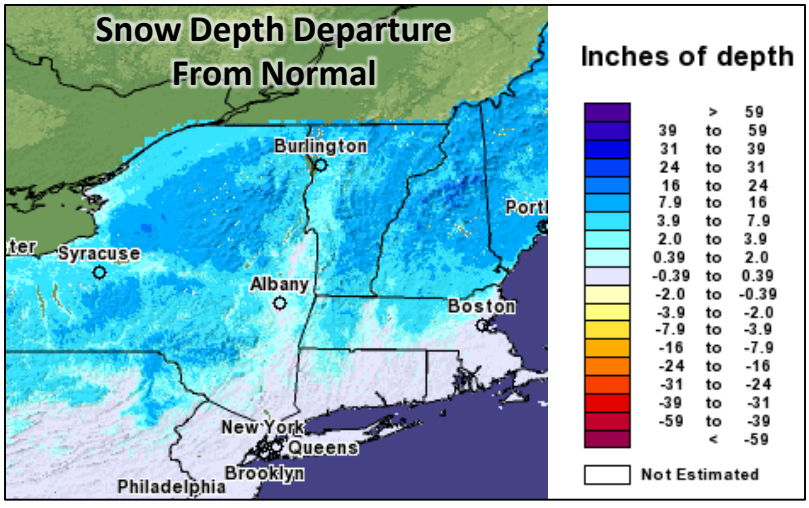

Figure 5. Modeled snow depth departure from normal for November 23, 2018. Image courtesy of National Operational Hydrologic Remote Sensing Center (NOHRSC) https://www.nohrsc.noaa.gov

Meet A Meteorologist:
Robert Haynes

How and when did you become interested in meteorology?

It's hard to pinpoint an exact when, because I have always been interested in meteorology. As a kid, I would sit at the window to watch it rain, and I never wanted it to stop. Anything on TV related to weather, and I would intently watch for the next chance for rain.

Do you have a favorite type of weather?

Any kind of heavy rain or heavy snow is great. They are usually associated with strong weather systems that are eye-catching on satellite, but I really enjoy the sound of heavy rain or the crackling of melting snow.

What has your path to get into the NWS looked like?

I received my Bachelor's and Master's Degree at Georgia Tech. My goal was always to reach the NWS, so I dedicated most of my time and research to understanding atmospheric dynamics and how to forecast. I worked with several excellent mentors who helped me understand numerical weather prediction and utilize ensemble forecast systems, and I spent time applying this to winter forecasting in the Southeastern US. I also volunteered at the National Weather Service in Peachtree City, where I participated in local research and launched radiosondes into the atmosphere.

It did take some time before I arrived in Burlington once I finished my degree. I took an opportunity with Florida Power and Lights as a contract meteorologist after Hurricane Irma impacted Florida. Working with them was a great experience, and it helped me understand the importance of messaging and how the weather forecast affects decision making. I am very grateful for the time I got to spend there. The National Weather Service was always my goal, though, so once I received the job offer, I said my farewells and rushed northwards to Burlington.

What part(s) of moving to Vermont were you most excited about?

The most exciting part was the prospect of something new. I was born in Florida and raised in Georgia, so moving some place so different was appealing (and I get to keep to a relatively wet climate here in Vermont).

How has your first winter up north been so far?

I like snow quite a bit, but when it comes to traveling in it, I only had the dreadful Atlanta "Snowpocalypse" in 2014 to draw experience from. All in all, the fantastic work done by road crews has prevented me from experiencing that again, and I have found it manageable. I am pretty optimistic about it, but I have definitely had to invest in more chap stick than ever before.

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What's your favorite part of working for the NWS? Most challenging?

My favorite thing about the NWS is that each day is somewhat different. Some days are spent focusing on watching hourly weather trends, some days are spent forecasting the next several days, others are spent collecting data and doing research, while others may be spent outside of the office meeting our observers or taking field observations. I like the large scope of the NWS and the varied set of responsibilities.

My favorite thing about the National Weather Service can also be the most challenging. Performing such a wide variety of tasks can make it difficult to focus in on one thing when there are so many other things that require attention.

What do you like to do in your free time?

That is one of the things I'm trying to figure out. I did martial arts and boy scouts as a kid, but now that I have begun to settle into my new home here in Vermont, I want to try out other hobbies. I'm not sure what exactly that is yet, and that is something I plan on exploring more in 2019. I do enjoy reading, and as part of the younger generation, I grew up with video games and still enjoy playing them from time to time. The trails in Vermont are wonderful, and I have spent some time hiking in and around the area. I look forward to trying my hand at some winter hobbies, but not ice skating – I am terrible at all manners of skating.

NWS Burlington Engages with Vermont Women Can Do STEM & Trades Conference

-Jessica Neiles

NWS Burlington meteorologists Jessica Neiles and Andrea LaRocca represented the NWS at a one-day career immersion experience for 9-12th grade girls and non-binary youths from across Vermont. The conference promotes Science, Technology, Engineering, and Mathematics (STEM) & Trade careers to young women and is organized by Vermont Works for Women. The conference was held on October 11, 2018 at Vermont Technical College in Randolph Center, VT. Over 500 young people attended the event, which has been held annually for the past 20 years. Vermont Works for Women has an emphasis on exposure to careers where women are underrepresented, including the skilled trades and STEM fields. Jessica and Andrea focused their learning session on hydrology and shared the Floodplain model, graciously on loan from the Northeast River Forecast Center (NERFC). The model helps students understand the critical role floodplains play in the life of a watershed and the impact of development and human activity in key areas. Through hands-on simulations the students worked together to find solutions to floodplain issues. Jessica and Andrea were very excited to interact with the young women and provide a fun learning opportunity at this event.

Jessica and Andrea ready to interact with students at the start of the conference.

We Love Your Winter Storm Reports!

-Eric Evenson and Rebecca Duell

Did you know that you can help be the eyes of the National Weather Service by submitting real-time storm reports? We rely heavily on our spotters and their submitted storm reports for ground truth, both to make adjustments to our forecast during an event if necessary, and to create storm total maps and after-event analyses that help us learn from events and better forecast in the future. Your reports are also distributed to the media and local and state agencies for their reports and analyses. We'd like to know about any weather that is impacting your community, and most often in the winter that comes in the form of snow reports or ice reports. See Figure 1 (below) for a review on how to properly measure snow using a snowboard. If you don't have a snowboard, you can easily make one by painting a board of wood white (to best reflect the sun and prevent excess melting).

Figure 1. Six Steps for Properly Measuring Snow

Once you've taken your measurement, the next step is to report it. You can always call our office at (802) 863-4279, but the easiest way to submit a storm report is online through our storm reporting page. You can access it directly by using the following link: **https://weather.gov/btv/stormreport** or go to our website at weather.gov/btv and look for the Submit Storm Report icon underneath and to the right of our forecast map on the main page of our website.

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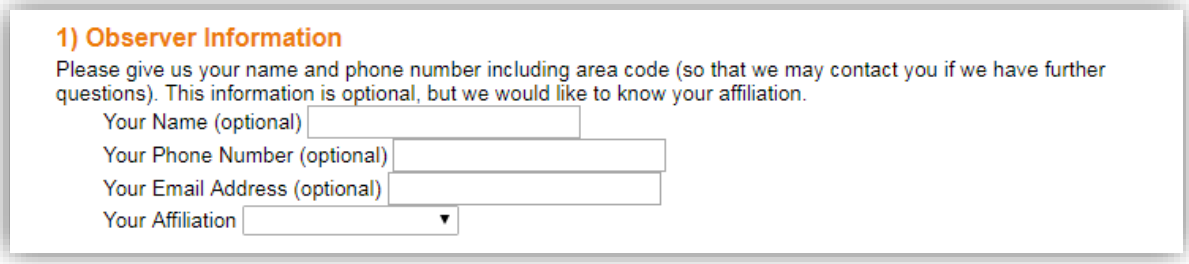
In the first section your personal information is optional, but we would appreciate knowing your affiliation.



1) Observer Information

Please give us your name and phone number including area code (so that we may contact you if we have further questions). This information is optional, but we would like to know your affiliation.

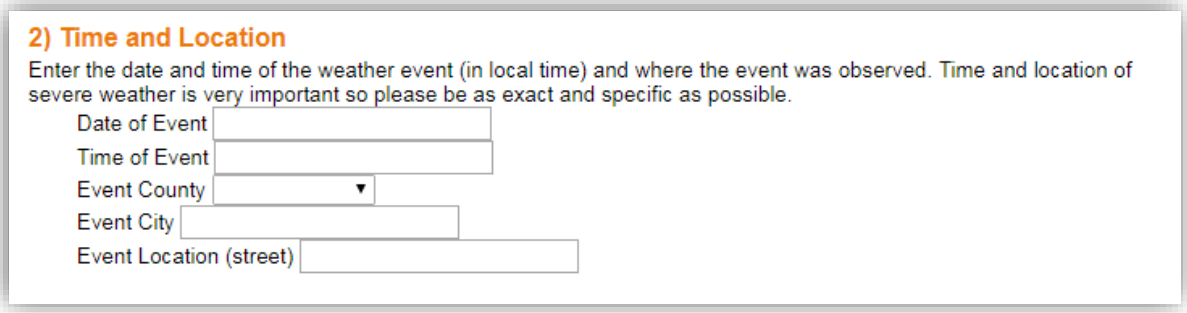
Your Name (optional)

Your Phone Number (optional)

Your Email Address (optional)

Your Affiliation

Next is the time and location of the report, which is very important to us.



2) Time and Location

Enter the date and time of the weather event (in local time) and where the event was observed. Time and location of severe weather is very important so please be as exact and specific as possible.

Date of Event

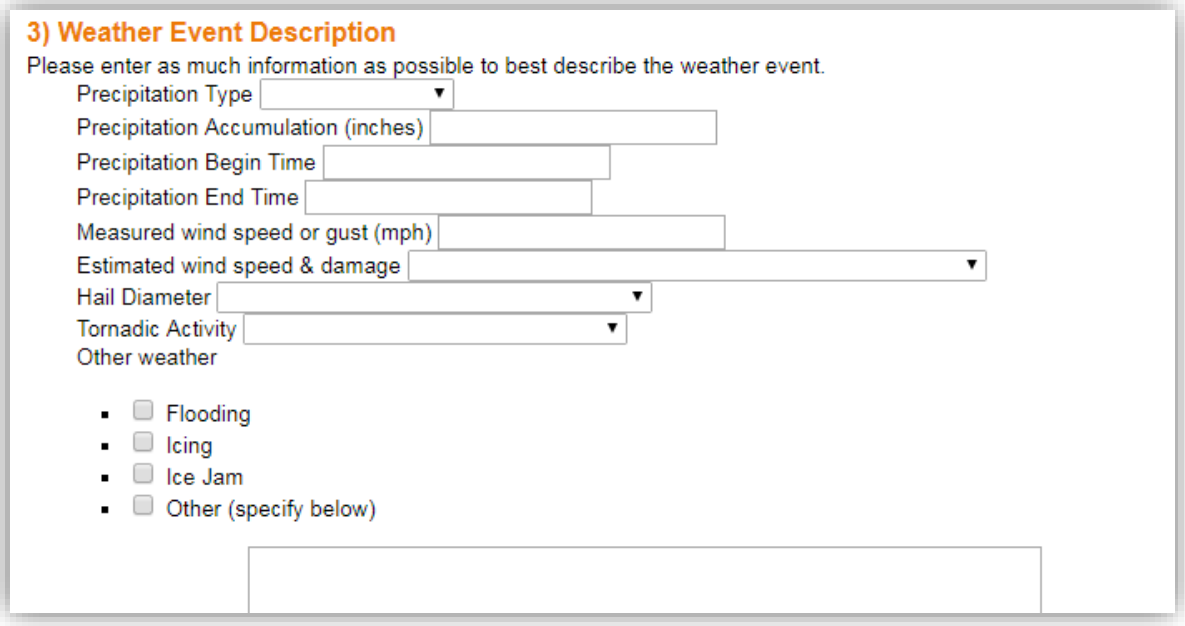
Time of Event

Event County

Event City

Event Location (street)

The weather event description section follows and we ask that you please enter as much information as possible to best describe the weather event.



3) Weather Event Description

Please enter as much information as possible to best describe the weather event.

Precipitation Type

Precipitation Accumulation (inches)

Precipitation Begin Time

Precipitation End Time

Measured wind speed or gust (mph)

Estimated wind speed & damage

Hail Diameter

Tornadic Activity

Other weather

- Flooding
- Icing
- Ice Jam
- Other (specify below)

Lastly go ahead and submit your report to us. Your valuable information will benefit us greatly as well as and the people we serve (the public, media, and local/stage agencies) across northern New York and Vermont. From all of us here at the Burlington NWS, thank you so much for all of your reports, and please keep them coming!

2018 Winter Weather Workshop

-Marlon Verasamy

In early December, the NWS Burlington Office held it's annual Winter Weather Workshop which included staff members of the NWS BTV crew, local media partners and local state meteorologists. The workshop is held to allow NWS BTV to discuss in depth significant winter weather events from years prior, review the prior winter's forecasts successes and failures, and look at new tools and techniques for the upcoming season to help forecasters deliver the best forecast possible.

Along with staff forecasters presenting throughout the day, forecasters from the Weather Prediction Center in Maryland and Lyndon State College also presented on topics such as national winter weather forecasting operations, predicting power outages with wet snow and/or ice storms, River Ice forecasting, and historically challenging snowfall forecasts for Vermont and Northern NY.

As in years past, the workshop was great opportunity to share knowledge amongst the staff and with our local media partners along with helping prepare everyone for the upcoming weather forecasting challenges this winter. A big thank you to all who presented and attended!

The Four Seasons

VOLUME V, ISSUE III

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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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