The Four Seasons

National Weather Service Burlington, VT

VOLUME XI, ISSUE III

FALL 2023

Table of Contents

Letter from the Editors

Welcome to our fall newsletter. At the time of this writing, it has been a generally mild season with unusually late and infrequent freezing temperatures. The sooner we leave stick season into snowy season, the better for most of us. We have a fun story of a chance meeting of one of our forecasters and one of our volunteer observers! We will also dig into some changes for Lake Champlain. We will also talk about the record heat we saw in Oct. After we share our visit to USCG Burlington. Next is a deep dive into the heavy rainfall on Oct 7th. Lastly, we say goodbye to our ESA, John Compo.
We hope you enjoy!

Click here to provide feedback on the newsletter!

COOP Observer Dave Leidy Saves Local Meteorologist -Jessica Storm

Averill COOP Observer Dave Leidy and BWS Burlington Meteorologist Jessica Storm

What do off-duty meteorologists do for fun? Well, many things, but one thing I enjoy personally is to find unique events across the forecast area. For example, the Moose Festival in Canaan, Vermont, quite the drive up from the Burlington area, about 2 hours and 40 minutes. I started my journey to Canaan directly following a midnight shift here at the office, which us meteorologists frequently work. My neighbor and friend, Alison Jones, drove us both out to the Northeast Kingdom after my shift (in case I needed a nap, of course). The festival was a blast, full of moose calling contests and maple syrup, and the weather was beautiful. But the more eventful part of our day started on the way home.

…Continued from Page 1

"The check engine light is on," Ali noticed from the driver's seat. We had just left Canaan and were traveling westbound on VT 114, bordered by trees on both sides. At one point, we could even see Canada across Wallace Pond, and our phones reported absolutely no cell service, which was an unfortunate sign while the check engine light was on. Luckily, we spotted a small store and gas station, labeled Lake View Store, and pulled in. In addition to a quaint, old-style gas pump, there was a gorgeous wooden shed with the word "Averill" inscribed upon it.

I knew Averill, a small town with a population consistently under 50 people, mainly because the National Weather Service had a COOP (Cooperative Weather Observing Program) observer there, named Ed Chester, who would call us without fail every day to give his report. Since last summer, Ed has stepped down as observer and the new observer typically submits their reports online.

Inside the Lake View Store, we were greeted by two friendly German Shepherds and a quiet man behind the cash register. We shopped around, got a few candies, and returned to address the car situation. When Ali started her car again, we felt the car shudder and shake as it rumbled before the engine shut off completely. Seeking a phone to borrow to call a tow, Ali went back into the Lake View Store. She returned with the man behind the cash register, whose name we learned was Dave.

"It's good you stopped here," Dave told us gravely. "There's not much else around. The town of Averill has a population of twelve."

"You must know Ed then," I said, name-dropping the only Averill resident I knew.

"Yes, I took over for him taking weather observations," Dave said.

Ali and I were shocked, and I revealed to Dave that I was a National Weather Service meteorologist in Burlington. What were the odds that we happened to break down right at the new Averill NWS observer's shop?

Dave was extremely helpful in getting us out of our predicament, from letting us borrow his phone for tows, rides home, and mechanics, to recruiting his fellow Averill residents to push Ali's car away from the road. We finally got the car towed back to Canaan, the nearest mechanic we could find, and bid farewell to Dave. We'll never forget that he saved the day!

Lake Champlain Datum and Flood Stage Changes

- John Goff

This October an important change occurred at four primary Lake Champlain gauges which involved a switch to an updated geodetic vertical datum and corresponding adjustments to flood stage levels. A datum is a standard position, or level (i.e. a starting point) from which measurements are taken. These datums can be used to measure the height (altitude) and depth (depression) above and below a given zero reference level, often mean sea level (mountain summit, lake level, etc.). In these cases, the datums are referenced as Geodetic Vertical Datums. For example, the stage, or level of Lake Champlain is reported as an elevation above mean sea level (96 feet, 98 feet, 100 feet, etc.).

Commonly used vertical datums in North America are the National Geodetic Vertical Datum of 1929 (NGVD29) and the North American Vertical Datum of 1988 (NAVD88). In October, NWS Burlington in partnership with the United States Geological Survey (USGS) changed the geodetic vertical datum from NGVD29 to NAVD88 on Lake Champlain due to NAVD88 being a more accurate measure of true mean sea level. Many lake and river gauges around the country have already changed to NAVD88.

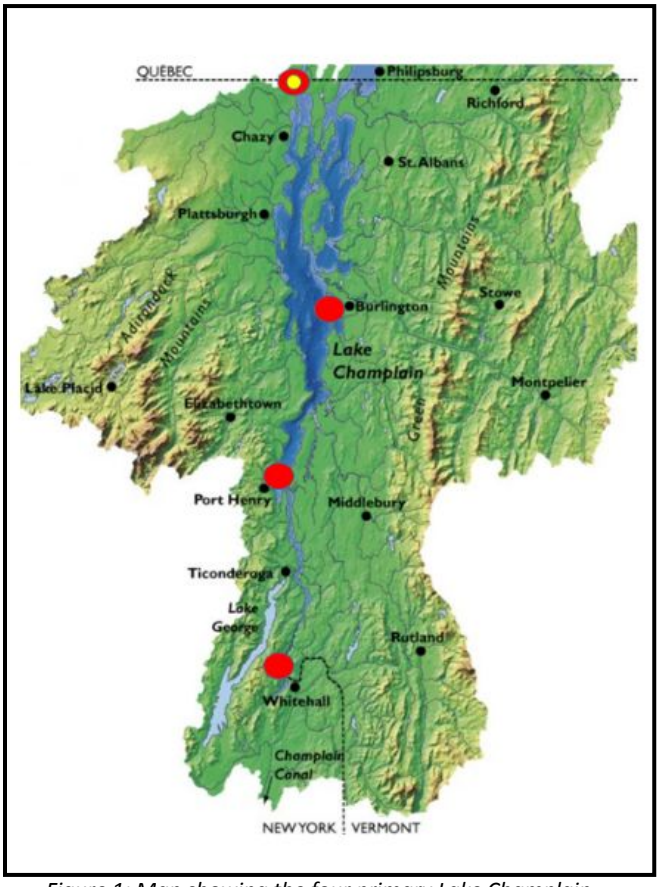


Figure 1: Map showing the four primary Lake Champlain gauges

As a result, lake levels are reading slightly lower than what they were under the old NGVD29 datum for all four gauges. These updated offsets are shown below, all of which are fractions of a foot. For example, a level of 99.0 feet at Rouses Point within the old NGVD29 datum system will now become 98.57 feet under NAVD88, or a slight negative offset of -0.43 feet.

Table 1: New North American Vertical Datum (NAVD88) offsets as compared to the older National Geodetic Vertical Datum of 1929 (NGVD29)

	GAGE ZERO	
GAGE SITE	**NGVD29 (FT)**	**NAVD88 (FT)**
Rouses Point, NY (forecast point)	0	-0.43
Burlington, VT	0	-0.60
Port Henry, NY	0	-0.60
Whitehall, NY	0	-0.53

Continued from Page 3

With the slight downward adjustments to lake level on all four gauges, a slight change to flood stage levels was also needed. This past spring, NWS Burlington hosted two informational webinars for core partners at the town, state and federal level addressing the datum change and soliciting feedback on what adjusted flood levels should be. A 75-day notice was also highlighted on NWS Burlington's public facing web page soliciting feedback on this topic. In the end, and for the sake of simplicity, all flood levels were lowered by one half foot. Those are shown in figure 2 below for reference.

FLOOD CATEGORY	OLD LEVEL (NGVD29, FT)	NEW LEVEL (NAVD88, FT)
ACTION/BANKFULL	99.5	99.0
MINOR	100.0	99.5
MODERATE	101.0	100.5
MAJOR	101.5	101.0

Figure 2: Comparison of new and old flood stage levels for Lake Champlain. All levels are identical for all four primary gauges.

Given these changes, communities will need to change expectations slightly. While the new levels are slightly different than in the past, flood impacts at minor, moderate and major levels will now occur at slightly lower levels. However, the actual impacts at those levels will remain unchanged. For example, if have a known water mark on your property at the 100 foot level (old minor flood stage threshold), that mark would now be reached around 99.5 feet.

Record Breaking October Heat

- Matthew Clay

The first week of October in 2023 will be a week that we will remember for quite some time as numerous record high temperatures were observed between October 3rd and October 6th. While it wasn't technically a heat wave which is defined as 3 or more consecutive days of 90 degree or warmer weather, it likely felt like one as 3 consecutive days of 80 degrees + weather was observed. Not only were many daily records broken, several all time monthly high temperature records were also broken and/or tied. See **Figure 1** below to see a list of all records broken/tied across the North Country.

Burlington International Airport

Date	New Record	Previous Record
10/3/2023	84°	82° in 1891
10/4/2023	86° *	82° in 1891
10/5/2023	83°	82° in 1926

Massena

Date	New Record	Previous Record
10/3/2023	83°	83° in 1953
10/4/2023	86° *	82° in 1951

Montpelier

Date	New Record	Previous Record
10/4/2023	84° *	80° in 2017

Saranac Lake

Date	New Record	Previous Record
10/4/2023	85°	80° in 1951

New Monthly All-Time Warmest Temperatures

Location	New Record	Old Record
Burlington	86°	85° in 1947/1949
Montpelier	84°	84° in 1949
Massena	86°	85° in 1949/1991

Figure 1. A look at all of the records set or tied across the North Country between October 3rd and October 6th. Many sites hit new record daily high temperatures while 3 sites hit new warmest October temperatures on record.

Let's go ahead and take a look at the big picture and see how this anomalously warm period of weather came to be. In order to do this, we need to look at the atmosphere as a whole and not just at the surface. One way to do this is to analyze the geopotential heights at numerous levels throughout the atmosphere. Geopotential height is simply the approximate actual height of a pressure surface above mean sea-level; high values indicate high pressure/ridge while low values indicate low pressure/trough. Anomalies are some of the best ways to look at how normal or abnormal an air mass can be. As you can see in **Figure 2** (next page), we had anomalously high heights at the 850 mb and 500 mb levels (very common heights for meteorologists) indicating an anomalously strong ridge of high pressure existed across the region. Air in a high pressure regime compresses and warms and dries as it descends which can also be referred to as subsidence. This leads to a stable air mass with little cloud cover which also allows for good warming due to incoming solar radiation.

…Continued from Page 5

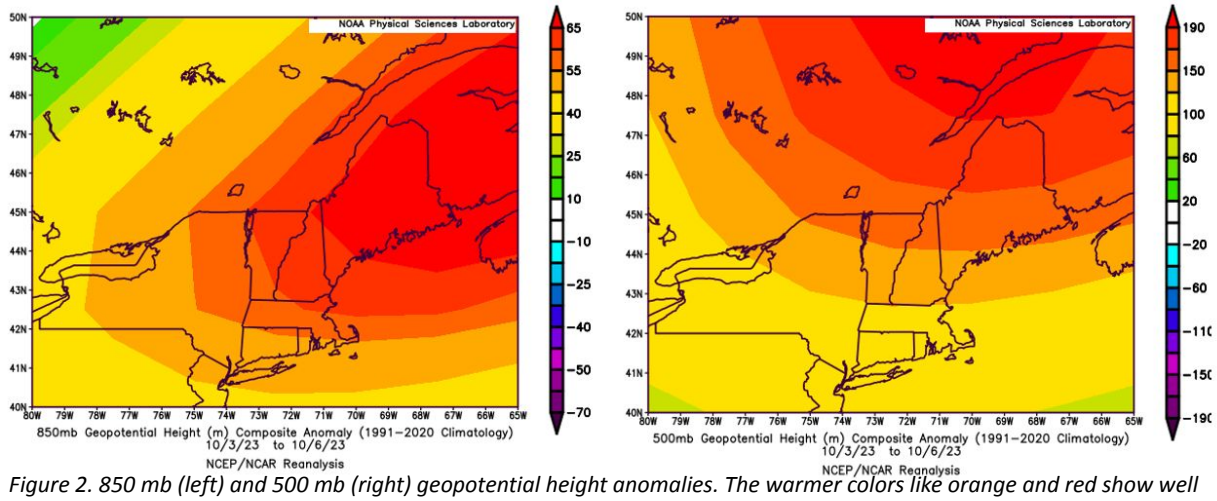


Figure 2. 850 mb (left) and 500 mb (right) geopotential height anomalies. The warmer colors like orange and red show well above normal values indicating a ridge of high pressure aloft.

Let's go ahead now and look at the temperature anomalies at both the 850 mb and 500 mb levels. In **Figure 3** we can see that temperatures at both levels were well above normal. We tend to see record temperatures more common in instances where the entire column of the atmosphere is above normal versus when just one layer is above normal.

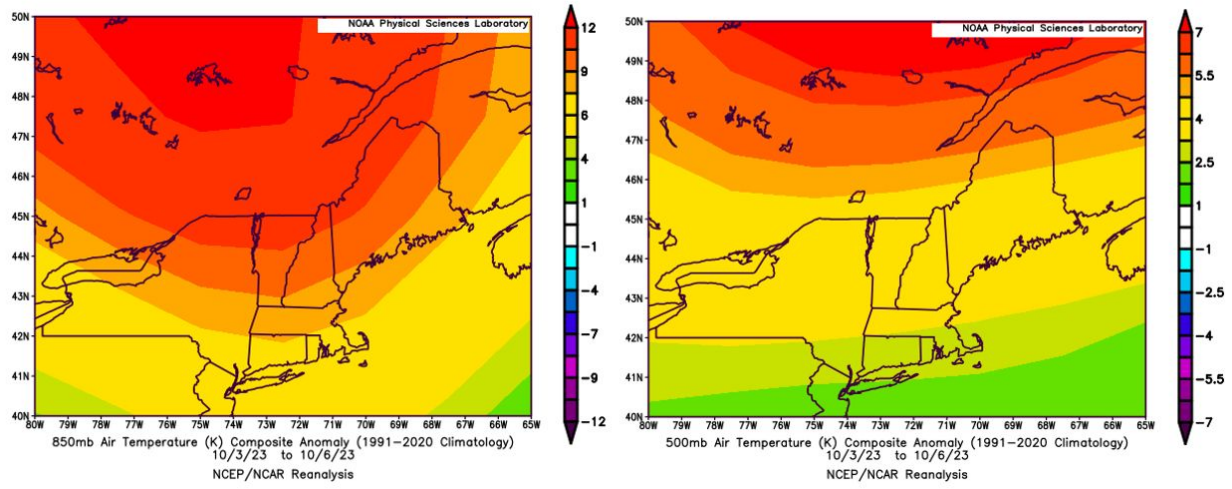


Figure 3. 850 mb (left) and 500 mb (right) temperature anomalies. The warmer colors like orange and red show well above normal values indicating a very warm air mass aloft.

When it came to forecasting this anomalous warmth, our forecasters were well on top of it. Several days out, the signals of well above normal temperatures were present on all ensemble members (NAEFS, GEFS, ECMWF ensembles) with the anomalously high geopotential points and abnormally warm air aloft. We are able to make use of such ensemble data regularly to help predict when significant weather events like heavy rain, record warmth, record cold, and even heavy snow events. You can see the ensembles that we saw several days out below in **Figure 4.**

…Continued from Page 6

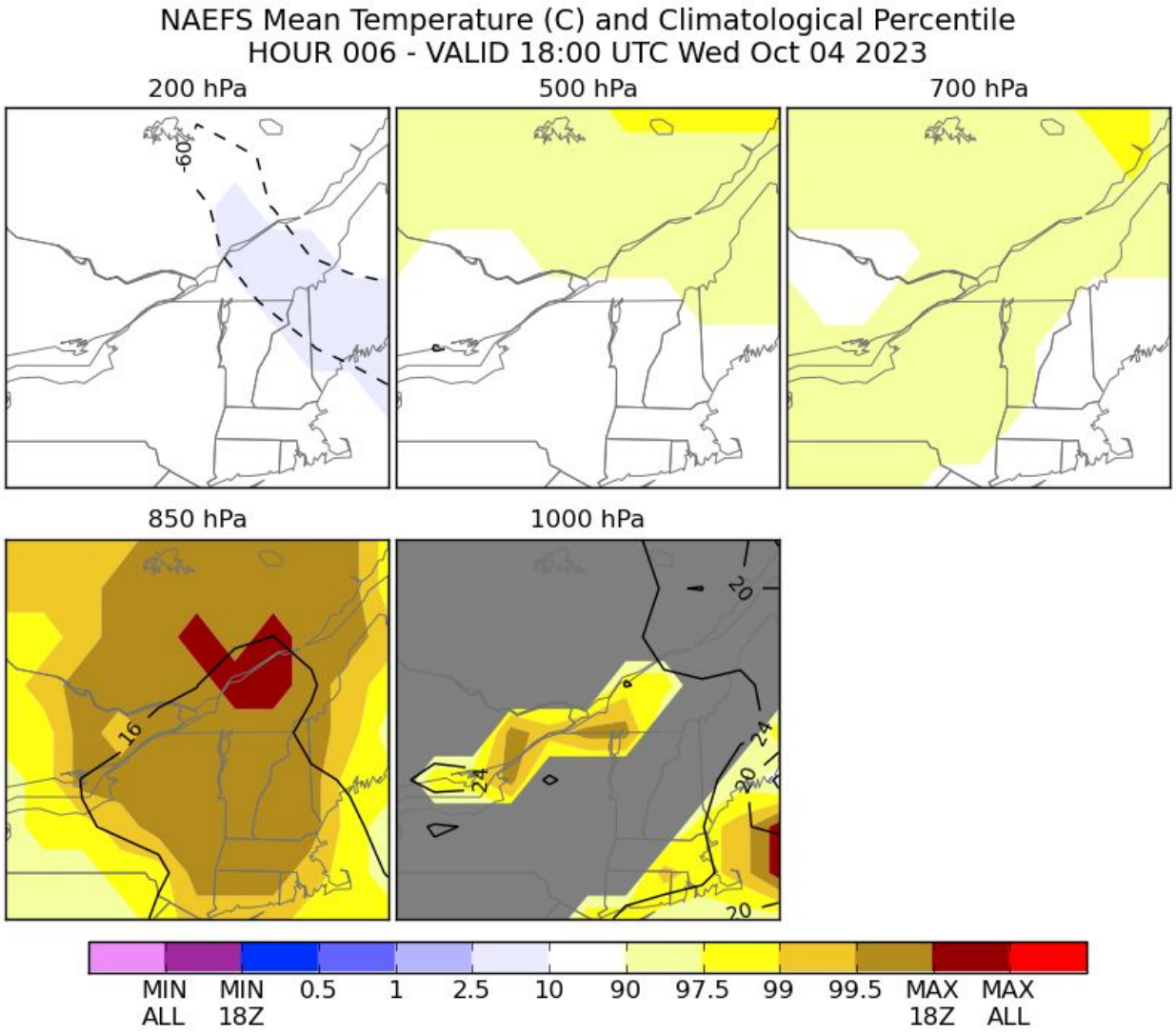


Figure 4. A composite showing the North American Ensemble Forecast System (NAEFS) mean temperature and climatological percentile at different pressure levels. Above normal temperature percentiles (anomalously warm temperatures) are denoted by yellow, orange, and red. This is a forecast, not actual observed values.

Aviation Forecasting at National Weather Service Office in Burlington Vermont

- Brooke Taber

Did you know that the National Weather Service Office in Burlington (BTV), Vermont issues Terminal Aerodrome Forecast (TAF) for seven sites across our forecast area of responsibility. These 7 airport sites include; Patrick Leahy Burlington International Airport (KBTV), Edward F. Knapp State Airport in Barre/Montpelier (KMPV), Northeast Kingdom International Airport in Newport (KEFK), Rutland Southern Vermont Regional Airport near Rutland (KRUT), Plattsburgh International AIrport (KPBG), Adirondack Regional Airport near Saranac Lake (KSLK), and Massena International Airport (Richards Field) in Massena (KMSS). A customs facility constitutes an international airport, if you were wondering. The map below shows the locations of Weather Forecast Office (WFO) BTV 7 TAF sites.

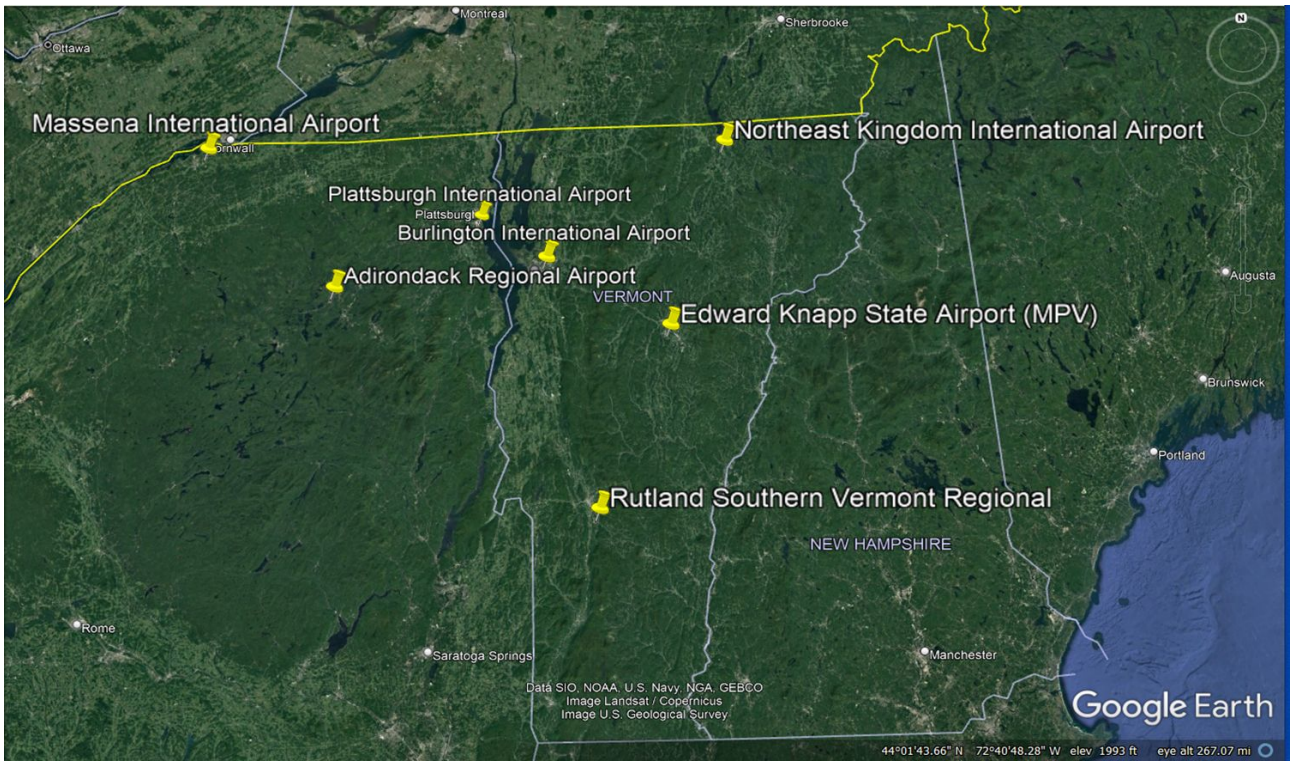


Figure 1: The location of the Weather Forecast Office, Burlington, VT seven TAF sites.

The primary purpose of the TAF is to communicate critical weather information to key decision makers for flight planning and aircraft movement within the National Airspace System. Furthermore, TAFs are a key decision making tool for all pilots, which include during pre-flight planning pilots use the information in the TAF to decide whether they can fly in the first place and whether they can land safely at the end of the flight. In addition, based on expected conditions in the TAF pilots must plan for alternative landing sites and carry additional fuel, if adverse weather is anticipated at their landing site.

…Continued from Page 8

TAFs are issued at least four times a day, every six hours for the airfields listed above and apply to a 24 hour forecast period for weather conditions within approximately 5 statute miles of the terminal. The primary issuance times are 0000, 0600, 1200, and 1800 UTC (Universal Time Constant). For Eastern Daylight Time (EDT) subtract 4 hours (i.e. 1800 UTC is 200 PM EDT). The TAF includes a forecast of the following meteorological elements: surface winds (speed and direction), surface visibility, weather (snow, rain, thunderstorm, fog, hail, sleet, etc), obstructions to vision (if any), sky conditions (clouds and associated heights above ground level (AGL)), and low level wind shear. The table below is the TAF forecast for KBTV from 1200 UTC on 13 June to 1200 UTC on 14 June 2023. From the table below you can see the initial TAF forecast is for a west winds at 9 knots (27009KT), surface visibility to be > 6 statute miles (P6SM) in a light rain shower (-SHRA), with sky conditions of broken 5000 feet AGL (BKN050) and overcast at 7000 feet AGL (OVC070). There is a TEMPO group between 1200 and 1300 UTC indicating the potential for brief 2SM +SHRA BR (heavy rain shower with mist) BKN009 OVC023 (broken at 900ft AGL and overcast at 2300ft AGL).

```
KBTV 131123Z 1312/1412 27009KT P6SM -SHRA BKN050 OVC070
      TEMPO 1312/1313 2SM +SHRA BR BKN009 OVC023
     FM131300 15005KT P6SM -SHRA OVC030
     FM131600 22005KT P6SM OVC030
     FM140000 00000KT P6SM BKN050
     FM140400 00000KT P6SM VCFG SCT003 BKN090=
```

Figure 2: TAF forecast for KBTV from 1200 UTC on 13 June to 1200 UTC on 14 June 2023.

TAFs are a critical part of the duties and responsibilities of the forecasters at the National Weather Service, including the office here in Burlington, VT. The TAF forecast is extremely important to aviation decision makers for planning purposes, while providing details of expected weather conditions for a specific terminal area. Given the complex terrain, proximity to many bodies of water, and highly variably and constantly changing weather conditions of the North Country, forecasters at WFO BTV have some of the most challenging TAF sites in the country. These challenges include widespread winter storms with heavy snowfall, locally dense fog, gusty downslope winds, strong thunderstorms with heavy rainfall, and sudden snow squalls, just to name a few weather events that can have a significant impact on aviation across our region. Forecasters at WFO BTV continue to improve the products and services we provide to our aviation community, while building relationships for future success.

US Coast Guard and National Weather Service Burlington meeting

-Seth Kutikoff

In late August, new Senior Chief of the USCG station Burlington Nick McGowan met with NWS Burlington's Science and Operations Officer Pete Banacos and myself, Recreation team lead, to review operations to better serve each other's interests. Generally, a mutually beneficial relationship exists given shared interest in public safety on Lake Champlain year round. Following this meeting, our partnership is primed to be reinvigorated which will help with situational awareness of weather conditions on the lake.

As a regular course of operations, NWS Burlington issues marine forecasts for Lake Champlain. When expected winds are expected to reach 25 knots for several hours within the next 12 at forecast issuance time, we also issue a Lake Wind Advisory and provide a marine weather discussion. This product triggers us to call the Coast Guard, and we will talk to them about wave and wind conditions each shift in which the Lake Wind Advisory is in effect and when we take the Advisory down.

Looking to enhance our coordination, we offered our aid for their SAR (search and rescue) efforts to provide spot forecasts as needed. If they quickly gather detailed wind information at the reported location, critical time may be saved when responding to an incident. During the winter, and especially after ice forms on the lake, cold water/ice-related incidents increase based on reported drownings on the lake per local research by student volunteer Dakota Wiley.

We learned that USCG Burlington can get very busy since they do 51% of all northern New England Coast Guard search and rescue cases. They'll typically go out on the water in the vessel shown (below left), but under larger wave conditions such as 5 feet, the larger vessel in the picture (below right) allows them to more safely navigate. They are required to have three officers go out on the water with one staying at the station in case of emergency, and given their limited staffing, this requires significant resources.

October 7th, 2023 Heavy Rainfall Event

-Robert Haynes

A slow moving front tracked east across northern New York on October 6th, which did not depart the region until early October 8th. Strong frontal forcing enhanced precipitation which developed due to a broad area of high pressure in the Canadian Maritimes and increasing easterly flow ahead of post-Tropical Storm Philippe. This front approached after record breaking warmth and very dry weather, with the Patrick Leahy International Airport recording an all-time record for the month of October broken on October 4th of 86 degrees. Plattsburgh, New York recorded the wettest calendar day in its period of record at 3.94 inches of rain on October 7th. Antecedent dry conditions precluded widespread flood impacts, but portions of northern New York observed some street flooding and minor flooding along the East Branch of the Ausable River. For this analysis, we will explore more of the meteorological factors and context of the event that kept flooding minimal.

Synoptic Meteorology

500 hPa heights (20,000 feet above ground level) indicated a deep full latitude trough over the central Great Lakes at 12 UTC on 07 October 2023, which became negatively tilted as several potent shortwaves rounded the trough base. When a system is this deep and closed off at all levels of the atmosphere, movement is generally slow and impacts such as heavy rainfall can linger for multiple hours, especially along a slow moving cold front.

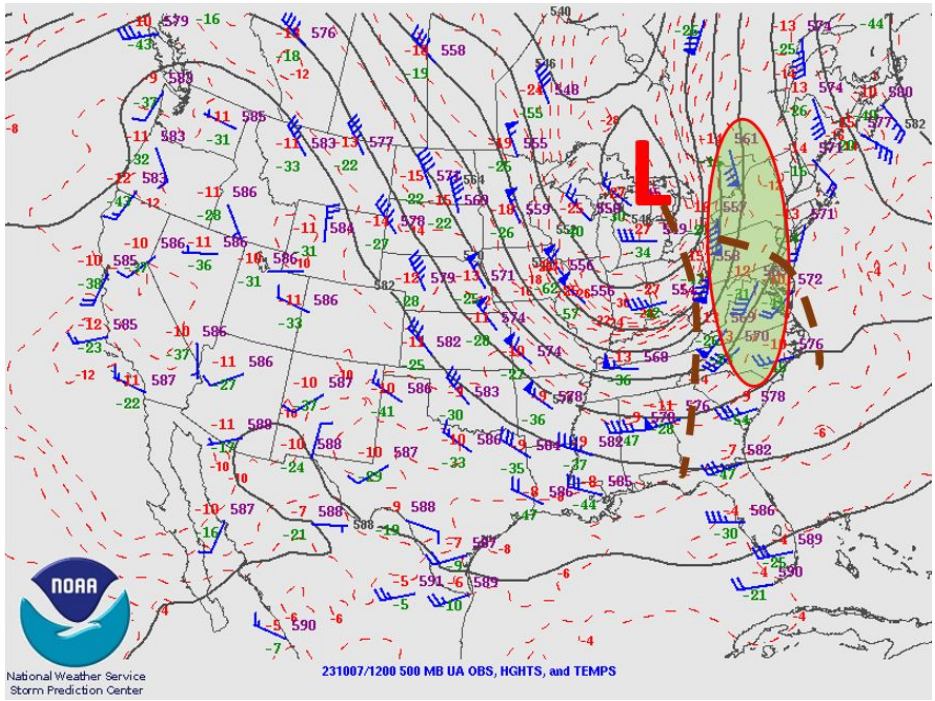


Figure 1: The 500 hPa (20,000 feet above ground level) upper air height analysis on 07 October 2023 at 12 UTC. Wind barbs, (plotted in blue, 1 arrow=50 knots, 1 barb=10 knots, 1/2 barb=5 knots), 500 hPa heights (black lines), and temperatures (dotted red).

Another feature that helped to produce moderate to heavy rainfall across our forecast area was a dual structure of the 250 hPa jet. Figure 2 below shows the 250 hPa jet analysis at 12 UTC on 07 October 2023, which indicates a right rear quadrant of the polar jet with winds of 90 to 120 knots. Meanwhile, a weaker subtropical jet was racing across the lower Ohio Valley into the central Appalachian Mountains. These jets would provide favorable upper level divergence, which combined with a slow moving surface cold front and associated low level convergence contributed to moderate to heavy rainfall.

...Continued from Page 11

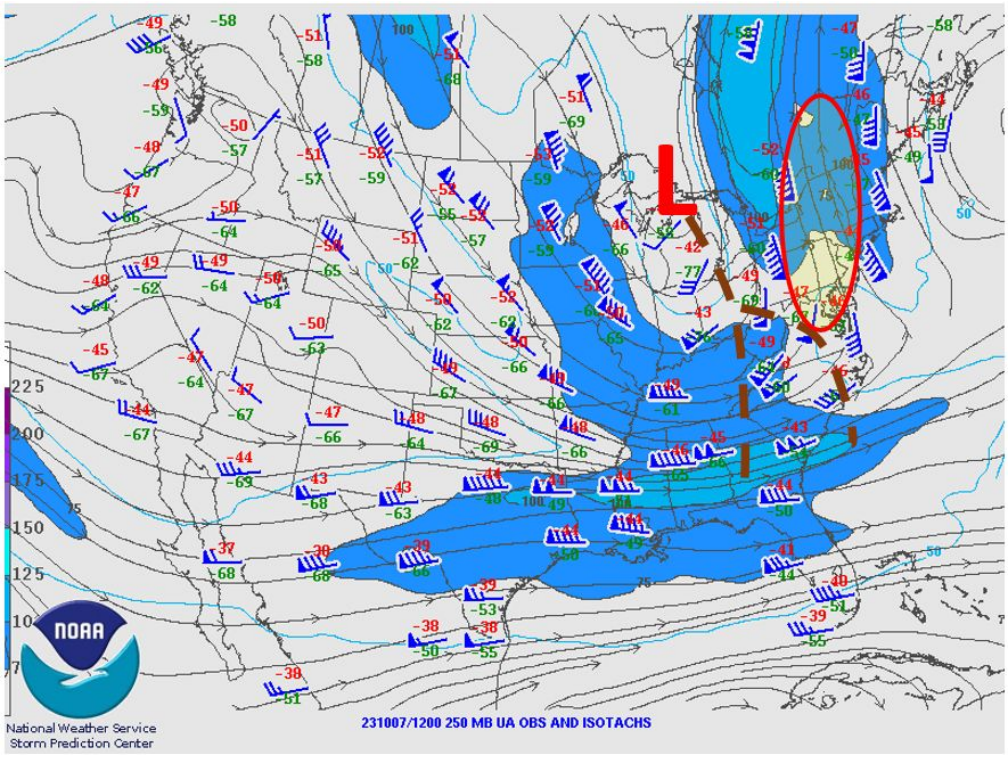


Figure 2: The 250 hPa upper air analysis on 07 October 2023 at 12 UTC. Isotach (dark blue >75 knots and lighter blue >100 knots, streamlines (black), wind barbs, (plotted in blue, 1 pennant=50 knots, 1 barb=10 knots, 1/2 barb=5 knots).

The precipitable water (PW) analysis showed a sharp west to east gradient across the Northeast United States. Values across our region ranged from around 1.0 inch across the western St. Lawrence Valley to 1.4 inches over the northern Champlain Valley at 17 UTC on 07 October 2023. PW values of 1.4 inches were near 200% of normal for early October and the presence of rich moisture resulted in moderate to heavy rainfall, especially as forcing from ascent increased.

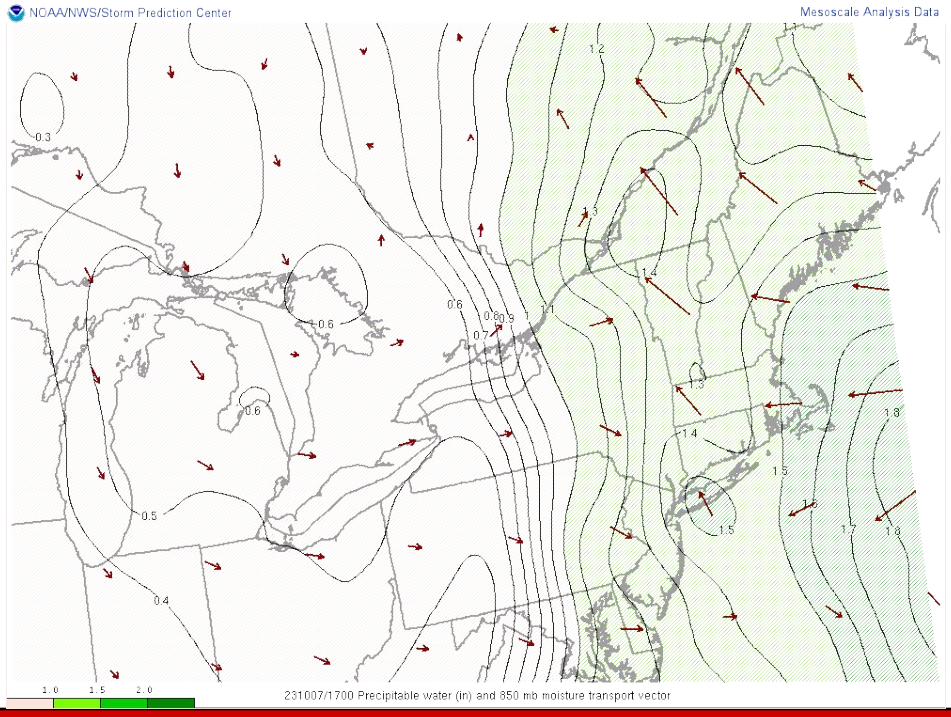


Figure 3: The Storm Prediction Center (SPC) mesoanalysis precipitable water black line (inches) (light green color filled >1.0 inch and darker green color filled >1.50) and 850 hPa moisture transport vector (orangish-brown arrows) on 07 October 2023 at 1700 UTC. The SPC mesoanalysis uses the Rapid Refresh (RAP) model 1-hr forecast in conjunction with surface observations as its basis.

…Continued from Page 12

In addition to the slow progression of synoptic features, post tropical cyclone Philippe was lifting northwest towards the Maine Coast, steered by a high latitude block. Enhanced easterly flow in the low-levels between Philippe and the deep layer high positioned near Newfoundland enhanced convergence along the boundary. Deeper moisture with PW values of 1.8-1.9 inches associated with post tropical cyclone Philippe stayed offshore, but curved back into eastern Canada and portions of eastern Maine.

Due to severe impacts from the Great Vermont Flood of 10-11 July 2023, many were concerned with the potential for renewed flooding. However, unlike the recent historic flood event, precipitable water and instability were lower for this October 7th event. Additionally, central Vermont had observed heavy rainfall just three days prior to the Great Vermont Flood of July 2023, while this event featured dry weather two weeks prior to this event. In comparison with 10-11 July 2023 floods, there was a smaller forecast rainfall footprint, and maximum rainfall forecast totals were likely to fall across climatologically less reactive river basins. Eastern Vermont was at lower risk for heavy rainfall comparatively. So from the perspective of flooding or flash flooding, the environmental factors that contributed to the significant impacts in the Great Vermont Flood of 10-11 July 2023 were not present.

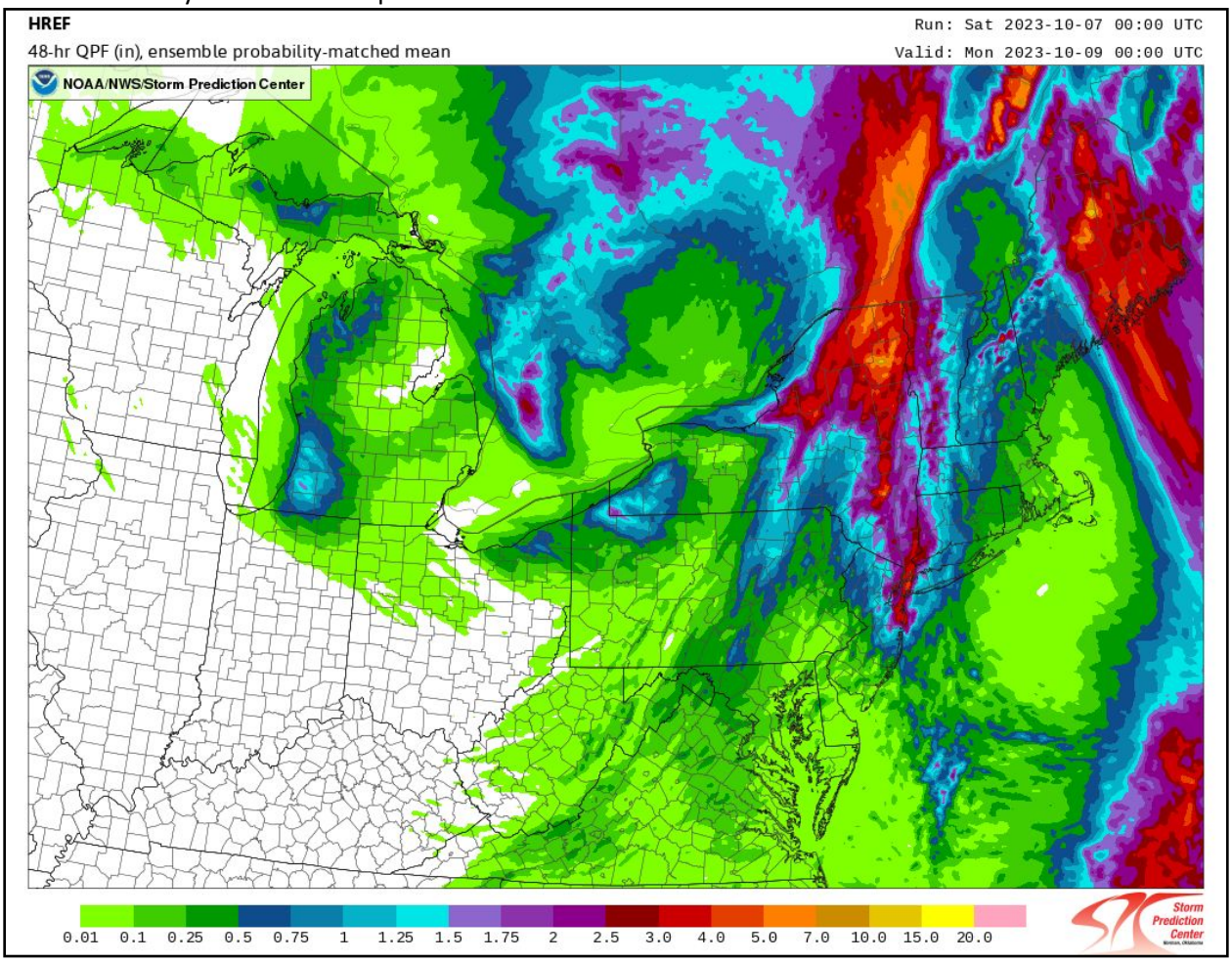


Figure 4: The Storm Prediction Center (SPC) High Resolution Ensemble Forecast (HREF) 48 hour ensemble mean of quantitative precipitation forecast (QPF) (inches) initialized on 07 October 2023 at 00 UTC, valid through 09 October 2023 at 00 UTC.

...Continued from Page 13

Forecasts from the HREF were excellent for the event. Observed rainfall amounts from 7 and 9 October featured an area of 2 to 4 inches of rain between the Adirondacks of New York into the Green Mountains of Vermont. Within that area were a number of locations that reported rainfall amounts up to 5 inches. Rainfall amounts gradually decreased outside of this region, with parts of the Northeast Kingdom in Vermont and the St. Lawrence Valley of New York observing less than 1 inch of rain (Figure 5).

At Plattsburgh, New York, a new calendar day precipitation record for its entire period of record (beginning 1945) was observed, with 3.94" recorded on 7 October. The period of heaviest rain was observed between late morning and early afternoon in the region, followed by steady light to moderate rain during the evening.

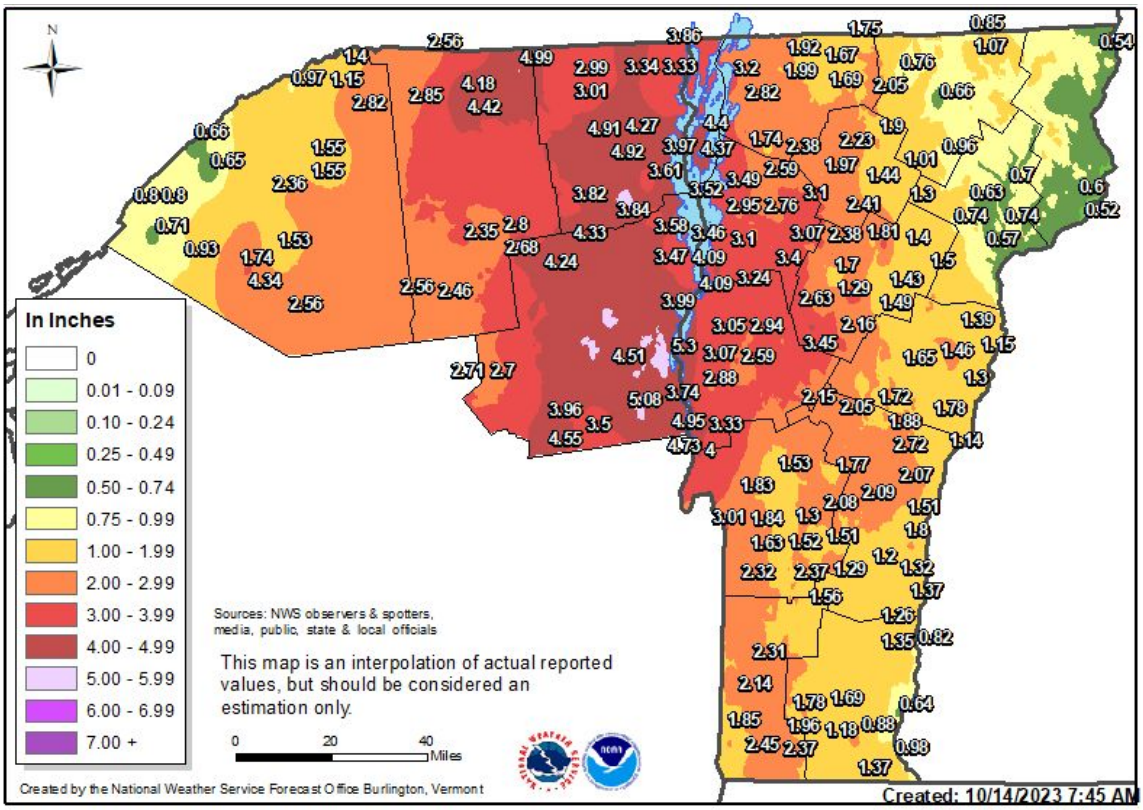


Figure 5: Observed storm total rainfall across the North Country from 7 October to 9 October 2023.

Figure 6 below shows the hydrograph on the East Branch of the Ausable River at Ausable Forks (ASFN6) from 12 UTC on 7 October 2023 to 12 UTC on 12 October 2023. The East Branch of the Ausable River tends to be fast to respond to heavy rainfall. The river gage reported minor flood stage (7.0 ft) just before 20 UTC (4 PM EDT). The ASFN6 gauge crested at 8.85 feet at 06 UTC (2 AM EDT on October 8th), which was just below moderate flood stage (9.0 feet). River levels gradually receded below flood stage shortly after 1330 UTC (9:30 AM EDT) on October 8th. In addition to river flooding on the East Branch of the Ausable River, street flooding was reported in Essex County, New York during the evening hours of October 7th. In the region of heaviest rain, 4 towns reported road closures due to water on roadways (Schroon Lake, Ticonderoga, Moriah, andWestport). Street flooding was closely collocated with localized rainfall totals near or above 5 inches.

...Continued from Page 14

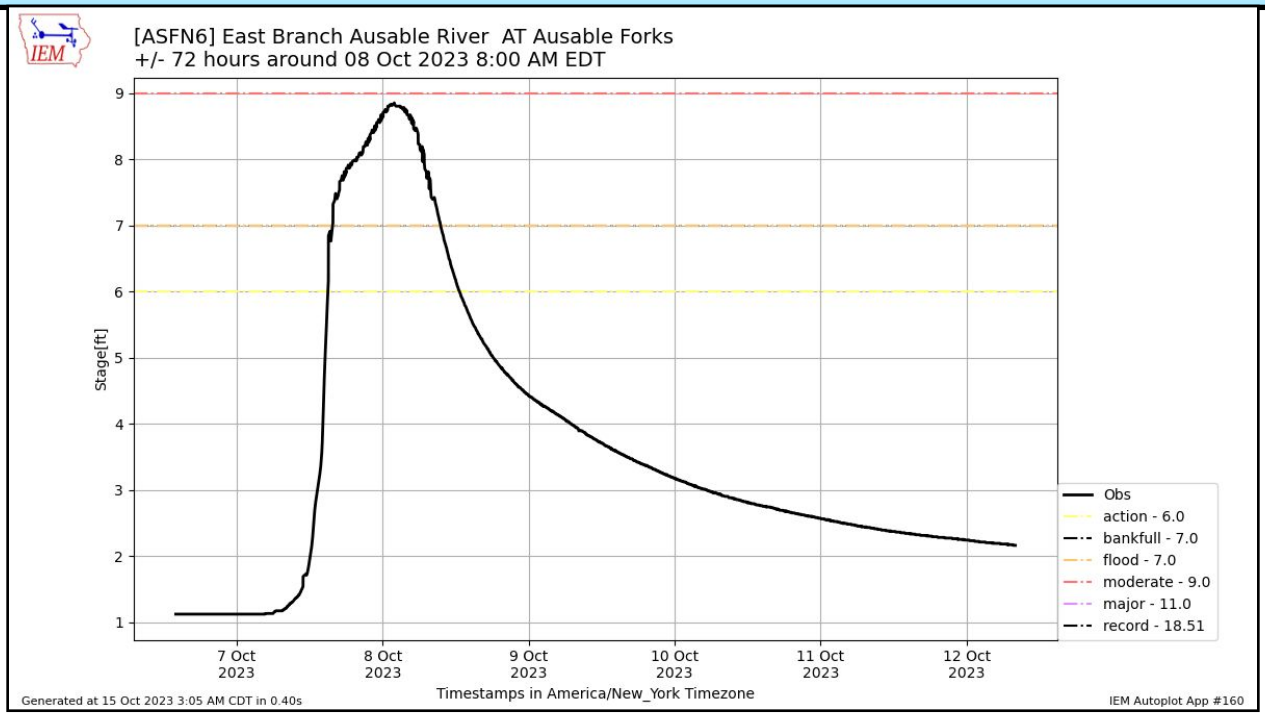


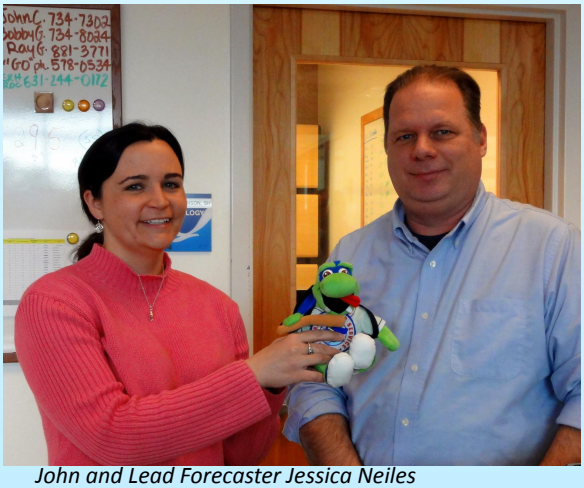
Figure 7: Hydrograph on the East Branch of the Ausable River at Ausable Forks in Essex County, New York between 7-12 October 2023.

A slow-moving, dynamic cold front brought a broad area of 2 to 4 inches of rain across Vermont and northern New York, locally up to 5 inches in parts of Northeastern New York from 6 to 8 October. The rainfall amount was record breaking in parts of the Champlain Valley, but the lack of consistent heavy rates and dry conditions prevented flooding. This event highlights the importance of context. The drier weather and the location of heaviest rain falling across less reactive basins precluded significant impacts. However, a number of street flood reports occurred across Essex County, New York and the East Branch of the Ausable River nearly reached moderate flood stage. Overall, this will be remembered for reinforcing New England's poor luck with weather during a weekend in 2023.

Changes at BTV: Good Luck, John Compo!

- Marlon Verasamy

Earlier this fall we said goodbye to our Electronic Systems Analyst (ESA), John Compo. John has spent just over 20 years at the NWS Burlington, and while not a meteorologist, his work here has been invaluable to the forecasters here everyday. John, in his position as ESA is in charge of the Electronic Technicians at NWS Burlington. He and his team oversee not just all the computers in our office, but takes care of everything from the NWS radar located in Colchester, various National Weather Service Radio Transmitters (NWR) across Vermont and Upstate New York, along with Automated Weather Observing Equipment at airports across the North Country and so much more. John's innovation and dedication to the team at NWS Burlington has been invaluable and we would not be the office we are today without him. We will miss him dearly. Luckily, he is only a phone call away as he has taken a position at NWS Eastern Region Headquarters in Long Island, NY. Best of luck, John!



John and Lead Forecaster Jessica Neiles

John workinging atop Mt. Mansfield

John and Electronic Technician Ray Grant

The Four Seasons

Volume XI, Issue III

Contributors:

Brooke Taber, Meteorologist
Jessica Storm, Meteorologist
Matthew Clay, Meteorologist
John Goff, Senior Service Hydrologist

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!

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

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

Follow us on Facebook and Twitter!
Check out our YouTube Channel!

US National Weather Service
Burlington, VT

@NWSBurlington

www.youtube.com/user/NWSBurlington