The Four Seasons

National Weather Service Burlington, VT

VOLUME VII, ISSUE III

FALL 2021

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Letter from the Editors

Welcome to the Fall 2021 edition of The Four Seasons, a quarterly newsletter issued by the National Weather Service in Burlington, VT. It was a quiet weather season here in the North Country marked by mild conditions - see the article on late first frost/freeze for more. Overall, the theme for this month is taking the reader back in time and to other parts of the world given the lack of active weather. Check out the story of our incident meteorologists supporting wildfire containment efforts, a look back at Tropical Storm Irene, and a summary of precipitation patterns over the past year. Thanks for reading and have a wonderful holiday season!

Remembering Tropical Storm Irene

-Nichole Hammond

Ten years ago, the North Country and its people were forever changed when Tropical Storm Irene struck northern New York and Vermont, producing abundant rainfall and devastating flooding.

Flooding in Wilmington, Vermont. Photo by Burlington Free Press.

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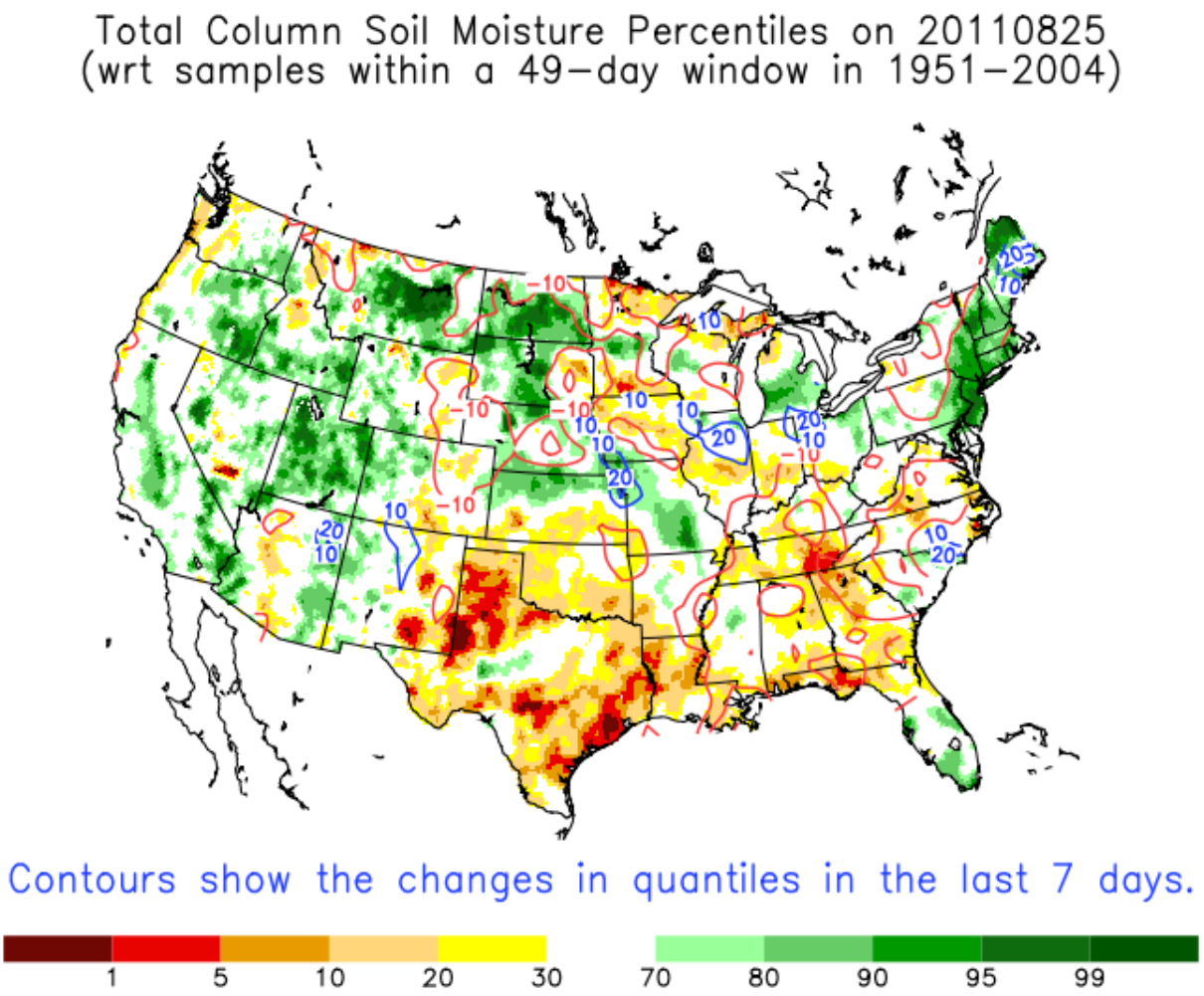

Soil moisture profiles on August 25th, 2011. Source: Princeton University Land Surface Hydrology Research Group.

The year 2011 began as an unusually wet year, and by August, soil moisture profiles were anomalously high across much of Vermont. These conditions set the stage for Tropical Storm Irene to have a big impact upon the North Country.

The wind and rain began early on Sunday, August 28th, turning to heavy, torrential rainfall by daybreak. Flood Warnings were issued in earnest across southern Vermont as several rounds of heavy rain continued to fall, overwhelming area waterways. The hardest hit areas were across the eastern Adirondacks in New York and southern and eastern Vermont where 4 to 7 inches of rainfall fell. It wasn't long before severe flooding ensued in which people were trapped in homes, and bridges and roads were washed away. Several rivers reached record crests.

Aside from the heavy rain, damaging winds left at least 50,000 people without power. Meanwhile, some towns were totally isolated in the Green Mountains and had to rely on the heroic efforts of the Vermont National Guard and good samaritans from surrounding communities for help.

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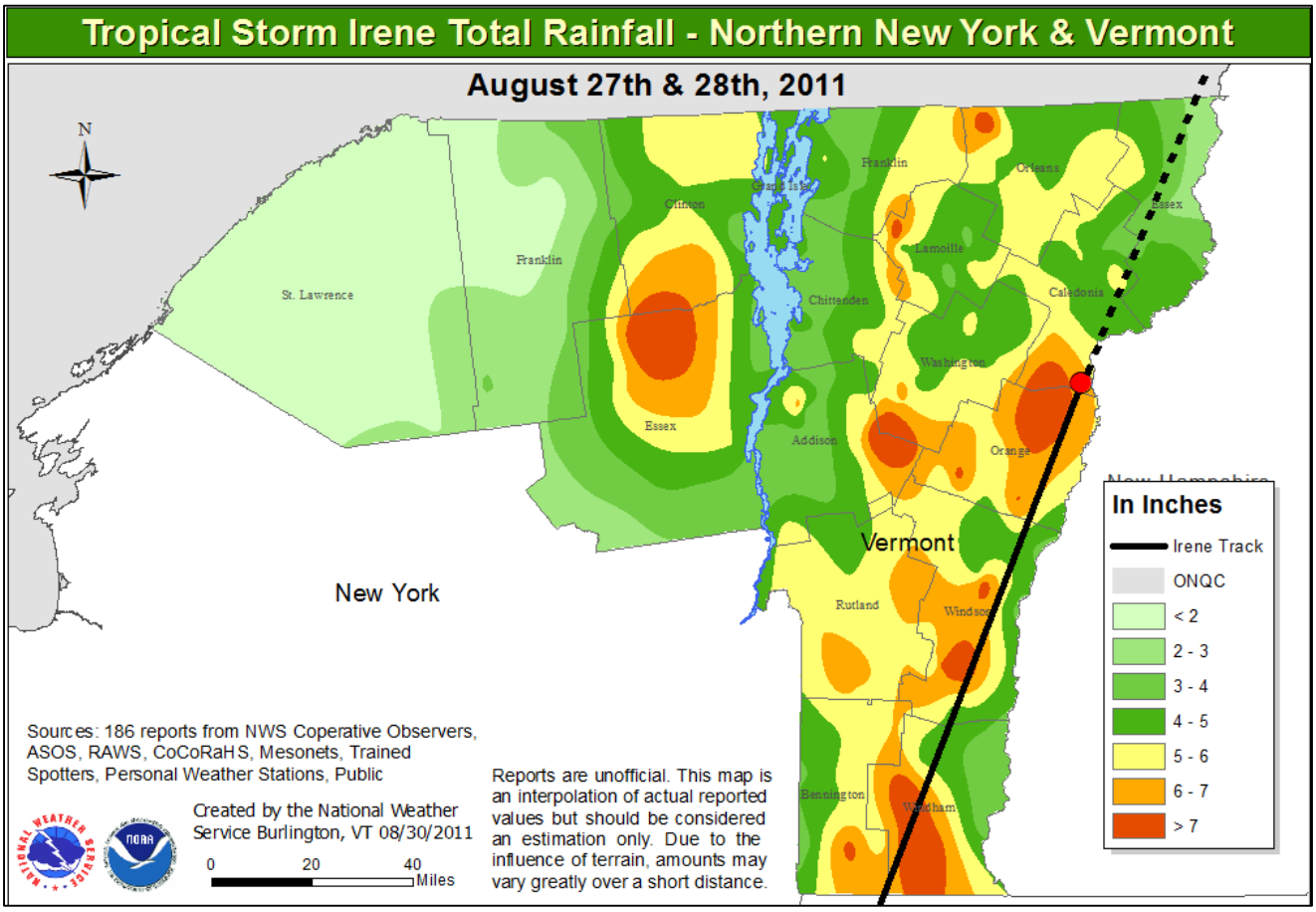

Total rainfall on August 27-28, 2011 and the track of Tropical Storm Irene.

Sadly, six lives were lost as a result of Tropical Storm Irene and many injuries were reported. In addition, 3,500 homes were damaged or destroyed, 20,000 acres of farmland flooded, and over $700 million in damages occurred. It was a storm to be remembered, and ultimately, the severity and coverage of the flooding would rank as the second worst in recorded history for the state of Vermont. Only the Great Vermont Flood of November 3-4, 1927 was more severe.

Our hearts go out to those who lost loved ones and other North Country residents who were impacted by this devastating storm.

To learn more about Tropical Storm Irene and the impact it had upon the North Country, please view our Story Map at https://storymaps.arcgis.com/stories/a596e2f186394d3d9c285e71e5e2f460.

St. Johnsbury, Vermont Sets Latest First Freeze on Record

Records at the site date back to 1894

-Pete Banacos

Prolonged cloudy and damp conditions led to a climatologically late arrival of frost and freeze conditions across Vermont and northern New York this fall. We define the "first freeze" as the first occurrence of a 32°F temperature at a given site. Across the North Country, the first freezes typically occur in at least three stages, and usually under clear, calm and dry conditions associated with high pressure. Climatologically, freezing temperatures arrive first across the Adirondacks and far Northeastern Vermont (early to mid September), followed by the St. Lawrence Valley and portions of Vermont away from Lake Champlain (late September to early October). The moderating influence of relatively warm lake waters means the first freeze arrives latest for sites near Lake Champlain (early to mid October). This regional variability in first freeze dates is evident in the climatological survey shown in Fig. 1. A complete look at the WFO Burlington first freeze climatology is available here: https://www.weather.gov/btv/climoFreeze.

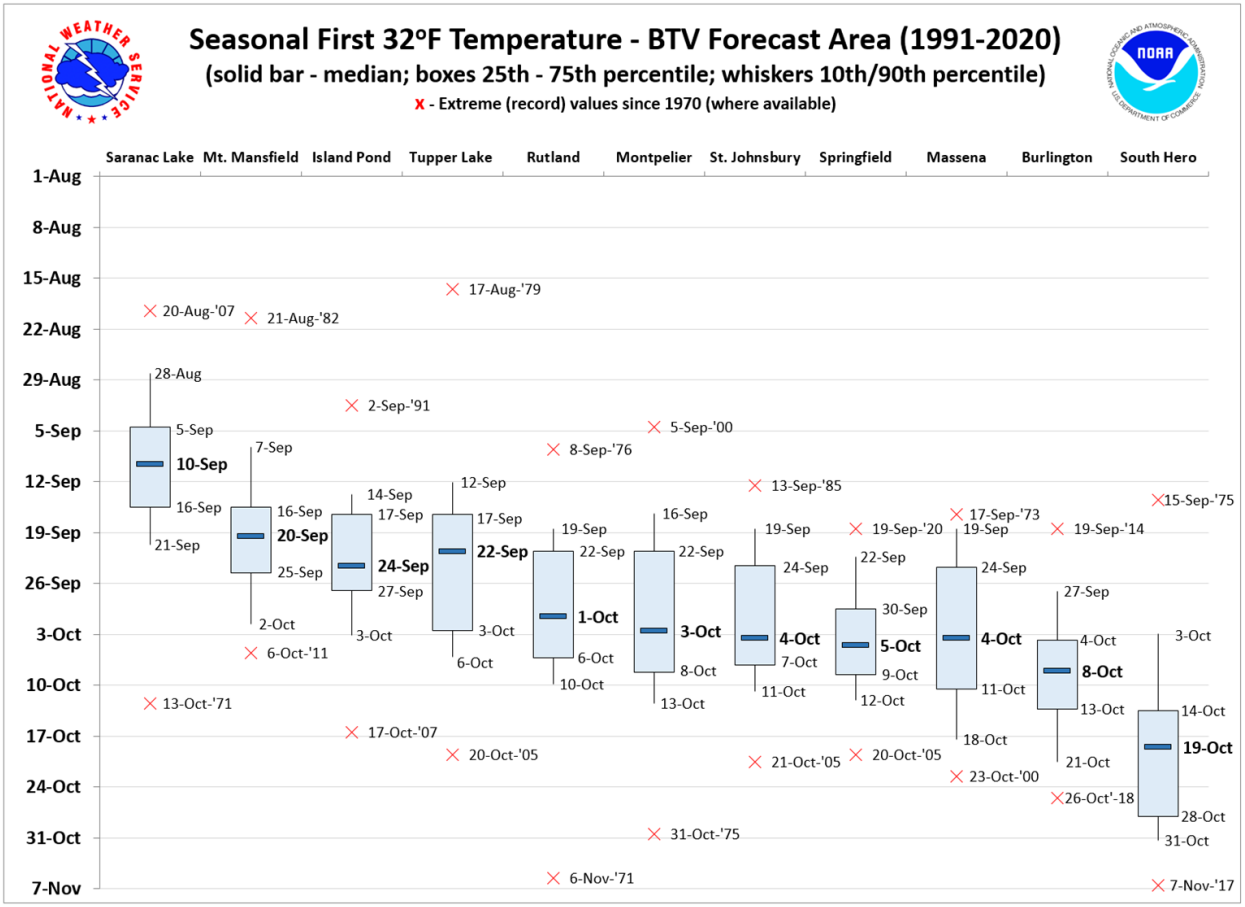

Figure 1. Box and whisker plots of the first fall freeze for various locations in the WFO BTV forecast area, based on 1991-2020 climatology. The horizontal line within each box represents the median first freeze date. The boxes represent the middle 50 percent of freeze dates. The end of each whisker indicates the 10th and 90th percentile dates. Extreme values back to 1970 (where available) are noted by the "X" above and below each individual plot.

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Of particular note was this year's record latest first freeze at one of our longest running cooperative observing stations in St. Johnsbury, Vermont, which occurred on October 23, 2021. While Figure 1 only shows record values back to 1970, a complete look at the period of record confirms that the latest first 32°F in the autumn at St. Johnsbury occurred on October 21, 2005. Weather observations at the Fairbanks Museum in St. Johnsbury date back to March 1894.

Here's a look at some other first freeze dates for fall 2021 (at right) :

Site	2021 First Freeze Date
Burlington, VT	October 24th
Massena, NY	October 22nd
Montpelier, VT	October 23rd
Morrisville, VT	October 22nd
Plattsburgh, NY	October 23rd
Saranac Lake, NY	September 20th
Springfield, VT	October 24th

Two National Weather Service Incident Meteorologists from Burlington, VT Provided Weather Support to Western Wildfires This Summer

-Eric Evenson and Brooke Taber

A prolonged and historic drought across the western United States has resulted in another very active fire weather season, with nearly 6 million acres burned and over 45,000 fires through late September 2021. The ten year average for the number of fires is 45,790 and for acres burned is 6.2 million. The first National Weather Service Burlington, Vermont (NWS BTV) Incident Meteorologist (IMET) deployment occurred in mid July and was to the Granite Pass Complex in western Montana. This complex consisted of 4 different fires (Shotgun Fire, Boulder Creek Fire, BM Hill Fire, and Lolo Creek Fire) and was located about 35 miles southwest of Missoula, Montana. The 4 fires combined to burn roughly 6000 acres, before containment occurred in late August. Meanwhile, the second NWS BTV IMET was deployed to the Rough Patch Complex in southwest Oregon in mid August. This complex also consisted of four fires: Chaos, Little Bend, Buckhead, and Near Minky, which has burned over 50,000 acres to date.

The Granite Pass Complex was ignited by a series of lightning strikes on 7 July 2021 near the vicinity of Lolo Pass on the Idaho/Montana border in the Nez Perce-Clearwater and Lolo National Forests. The fuels were a combination of mixed conifer stands with brush and grasses in the understory, along with areas of heavy dead and down material.

A large ridge of high pressure dominated the weather across western Montana during mid to late July, which provided the region with critically low relative humidity values and very warm temperatures. A dry cold front on the 25-26 July 2021 produced breezy conditions with very low relative humidity values, causing increased fire behavior and significant fire growth of 2000 to 4000 acres in a 36 to 48 hour period. As monsoonal moisture developed, afternoon showers and thunderstorms occurred over the complex and produced several rounds of widespread wetting rainfall, which really helped with fire suppression activities.

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The map below (figure 1) shows the location of the Granite Pass Complex, with the red line and associated red shading outlining the fire footprint. Figure 2 below shows a type 1 Chinook Helicopter (lower left) and active fire/smoke burning along Route 12 near the Idaho/Montana border (lower right).

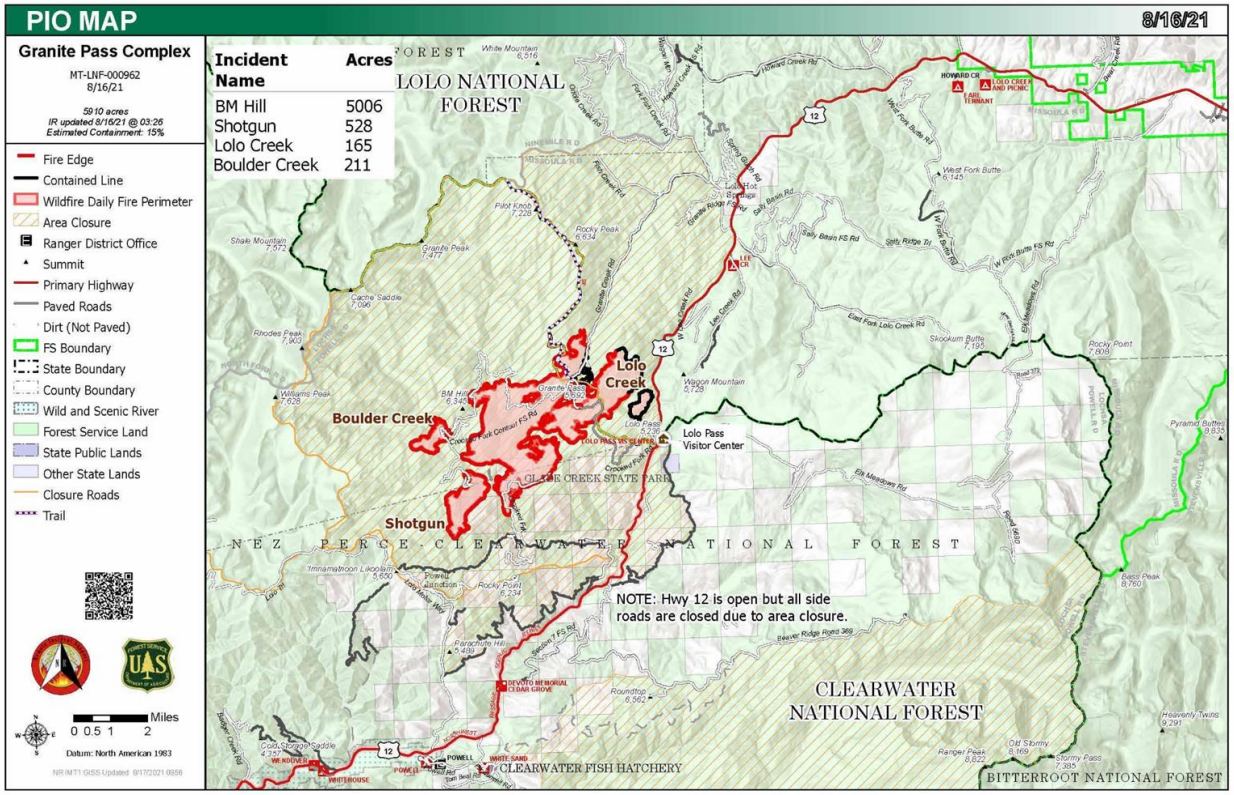

Figure 1: Map showing the Granite Pass Complex; the red line and red shading outlines the fire footprint as of 26 August 2021.

Figure 2: Chinook Helicopter utilized on the fire parked at the Missoula Airport (left image) and active smoke and fire near Route 12 associated with the Granite Pass Complex (right image). Photos taken by Brooke Taber (NWS BTV IMET).

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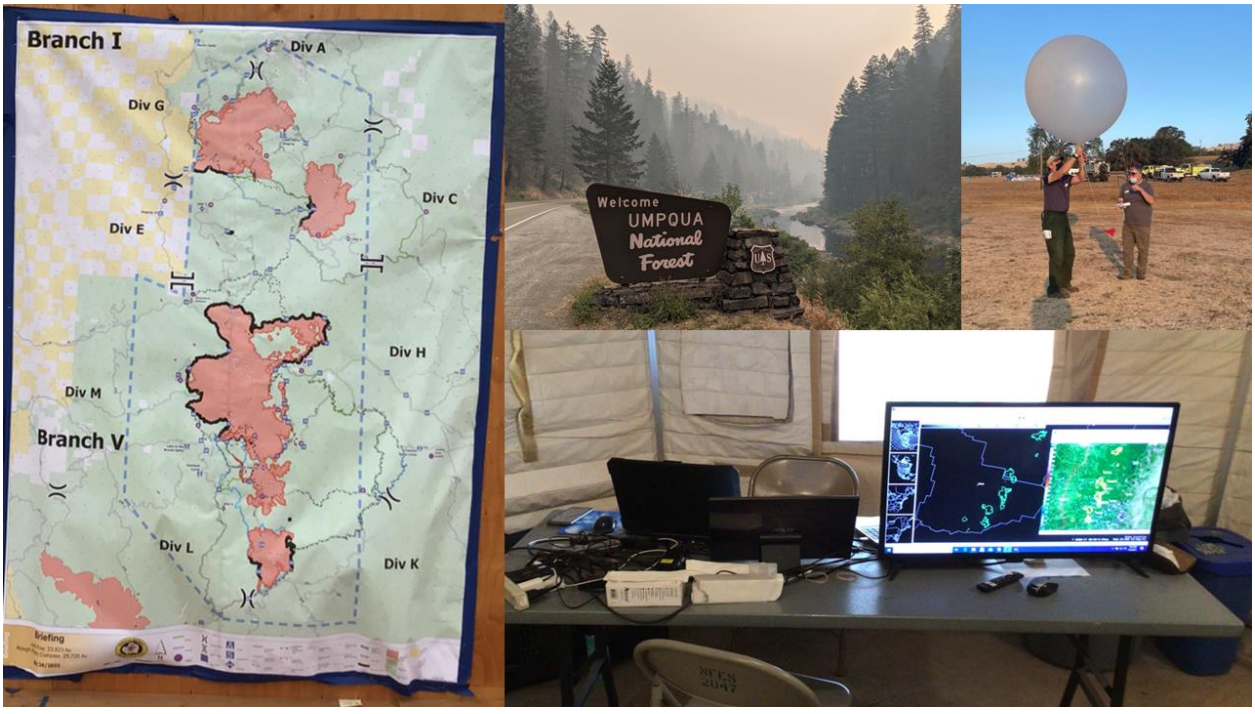
The Rough Patch Complex in southwest Oregon was also the result of numerous lightning strikes on 29 July 2021. Smoke was an issue as fires were burning in steep terrain that made it difficult for fire crews to safely access those areas. The incident relied heavily on aviation support to help with firefighting operations and thus timing when the smoke might clear the area was critical. Immediately located next to our base camp was the helibase, where many of the helicopters were located and ready to support operations once the smoke cleared. A typical weather pattern that was observed in late August and early September was a light northeast wind over the fires along with good humidity recovery at night. This resulted in the fires to smolder all night and produce more smoke and the northeast winds would move the smoke directly over all the fires. It was not until midday that the winds would switch to the northwest and move the smoke away from the western and northern portions of all the fires. The air would clear enough for the helicopters to finally provide support late in the day and into the evening hours. While the smoke would clear at the higher elevations, unfortunately the lower valleys and drainages would never scour out and visibility would generally be less than a mile in smoke where many of the crews were working. Some of the tools used at this incident to help with the weather forecasting included several portable observing weather stations to gather temperature, humidity, and wind data, the launching of several weather balloons, and monitoring satellite and radar data for new fire starts and the movement of smoke. As of this writing in late September the Rough Complex Complex was only about 50 percent contained and will likely continue through a good part of October before full containment. The image collage below shows a map on the left of the fires (red shaded areas) associated with the Rough Patch Complex, a typical view of the smoky conditions, a launch of a weather balloon, and our workstation to monitor weather conditions and prepare weather forecasts.

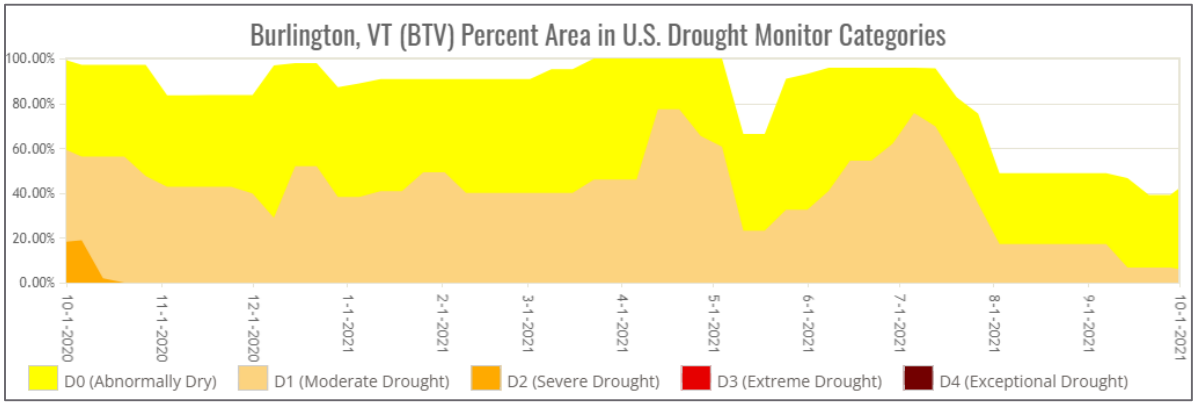


Water Year 2021 Summary

-Seth Kutikoff

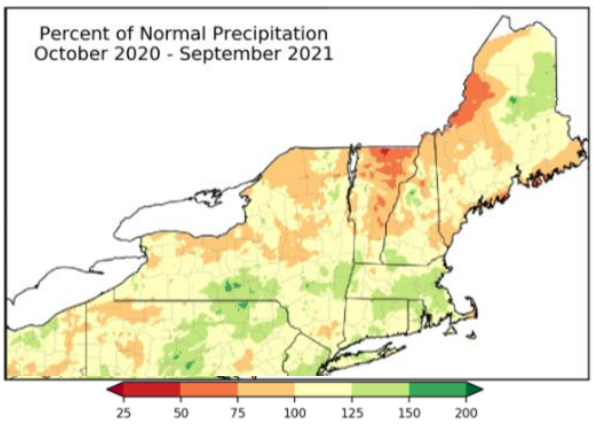
Regional View

A large portion of the North Country spent the whole water year in either abnormally dry or moderate drought conditions exiting a hot and dry 2020 summer. Cool and wet July conditions helped end drought conditions is some areas, although resumption of dry conditions in August occurred.



Time series of the U.S. Drought Monitor in the North Country depicting extent of weekly drought categories during Water Year 2021. Y-axis shows percent area of the region with D0, D1, and D2 conditions and x-axis shows the date.

Rounds of heavy rain largely stayed to our south during the summer where above normal precipitation was observed. The map below shows precipitation during Water Year 2021, which was less than 75% of normal across most of northern Vermont east of the Champlain Valley. Slightly above normal precipitation was observed in portions of the eastern Adirondacks and adjacent southern and western Vermont.



Precipitation departures from normal are based on COOP data and interpolated at a 4 x 4 km resolution.

What is a Water Year

Rather than use a calendar year, meteorologists typically use seasons as a convenient three month period to divide up the year, such as providing a seasonal outlook. This practice, which includes winter that consists of December, January, and February will fall across two calendar years. Along those lines, a common practice coming from the hydrological world is to define a "water year" from October through September. This helps confine precipitation that falls as snow into a single year in which the period ends, so that Water Year 2021 amounts to all of the precipitation that fell between October 1, 2020 and September 30, 2021.

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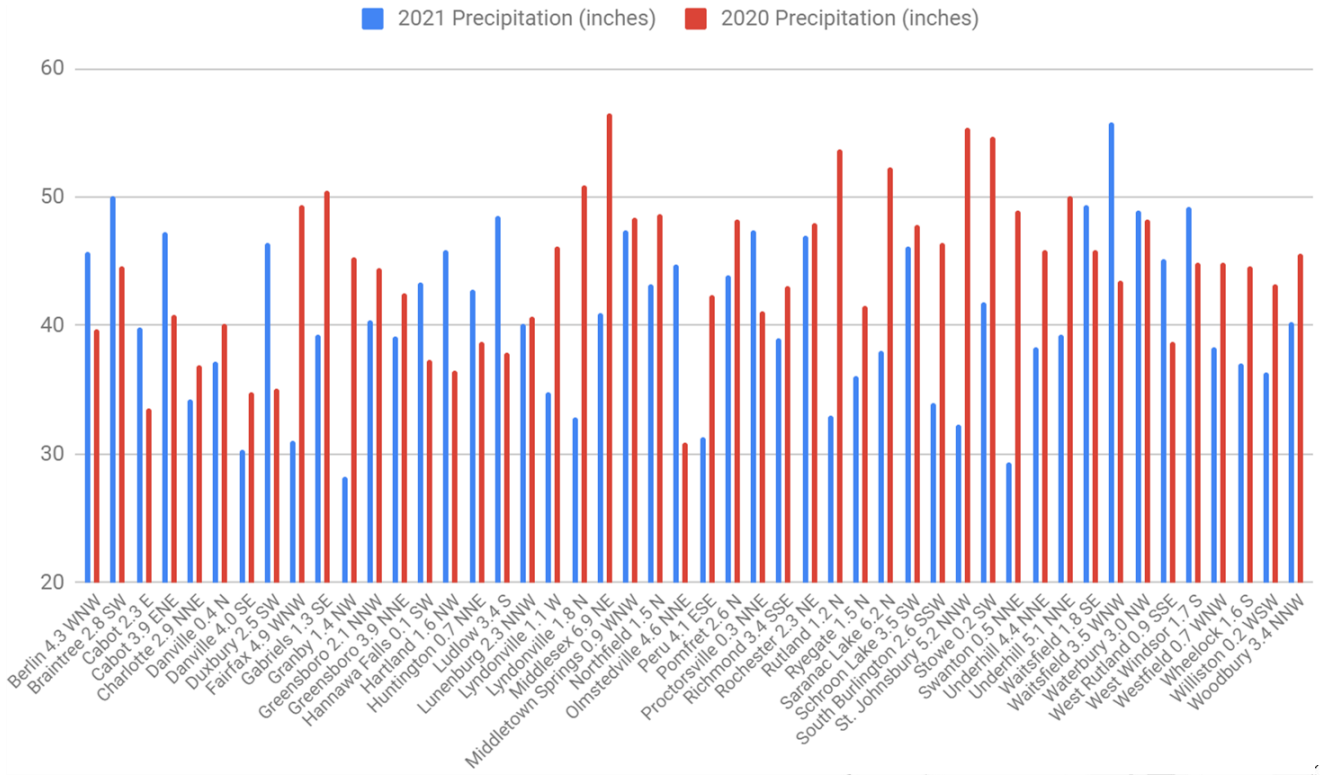
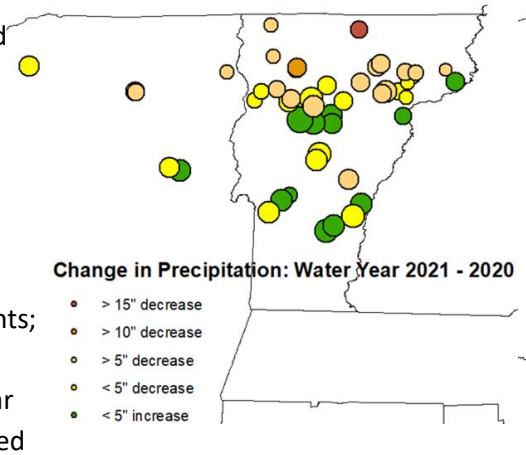
Local View

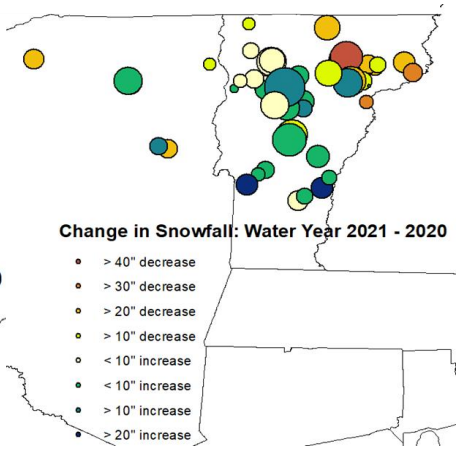
A Water Year 2021 summary of precipitation was analyzed for CoCoRaHS stations which reported precipitation covering at least 335 days in both 2020 and 2021. At 32 of the 48 stations, precipitation in 2021 was less than 2020. The remaining 16 stations were largely in central and southeastern Vermont, except Olmstedville, NY. Largest percent decreases (of 37 to 42%) were observed at 5.2 miles NNW of St Johnsbury, 0.5 miles NNE of Swanton, 1.4 miles NW of Granby, 4.9 miles WNW of Fairfax, and 1.2 miles N of Rutland.



Dot maps of precipitation and snowfall (normalized by days covered by observations) for these locations show the change from 2020 to 2021 water years. The **color** categories are based on reported precipitation amounts; cooler (warmer) colors show 2021 was a wetter (drier) year than 2020. Size of dots is based on the number of days with precipitation. Larger dots indicates more frequent measurable precipitation or snowfall.



Precipitation change year to year reveals a general north to south distribution. Only substantially drier year on year conditions were observed in the northern Greens among these stations.



As snowfall is more variable than precipitation, some neighboring stations show a different year on year trend. Snowfall over the central and southern Greens increased compared to 2020 while less snow was observed in northeastern Vermont.

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Water Year 2021 precipitation (in inches), including departures from normal over several time periods, is shown for selected climate sites, sorted by observed precipitation in the first column.

Total Precipitation	Station	State	County	September	August to September	July to September	April to September	January to September	Entire Water Year
31.08	SARANAC LAKE ADIRONDACK REGIONAL AP	NY	Franklin	0.15	-0.3	0.42	-1.83	-3.88	**-5.53**
31.29	PERU 4.1 ESE	NY	Clinton	-0.04	-0.21	0.78	-3.19	-5.11	**-8.45**
31.56	BURLINGTON INTERNATIONAL AIRPORT	VT	Chittenden	-0.61	-0.36	1.77	-1.85	-3.72	**-5.97**
33.36	SAINT JOHNSBURY	VT	Caledonia	-1.17	-1.99	-0.91	-3.23	-5.91	**-6.94**
35.92	MONTPELIER AP	VT	Washington	-0.72	-0.79	1.83	-1.77	-4.26	**-2.78**
37.59	SUTTON	VT	Caledonia	-1.41	-1.42	-0.81	-6.13	-9.6	**-9.94**
38.11	MALONE	NY	Franklin	0.63	1.47	2.45	-0.29	-0.01	**-1.81**
38.13	CORINTH	VT	Orange	-1.46	-2.08	1.08	-3.29	-5.86	**-5.02**
39.31	UNDERHILL 4.4 NNE	VT	Chittenden	-1.14	-0.46	0.37	-2.65	-5.04	**-8.51**
40.35	GREENSBORO 2.1 NNW	VT	Orleans	-0.36	-0.28	0.01	-4.44	-6.82	**-7.04**
41.73	LAKE PLACID 2 S	NY	Essex	-0.77	0.19	1.35	-1.13	-1.63	**-2.03**
48.88	WATERBURY 3.0 NW	VT	Washington	-0.41	0.74	4.56	0.24	-2.11	**-1.84**

Changes At BTV - Welcome Back Marvin and Congrats John!

NWS Burlington is excited to welcome back Marvin Boyd who has been selected as our newest lead forecaster. Marvin originally hails from North Carolina and got his meteorology degree from North Carolina State University. Marvin is a former BTV'er, having been an Intern here in 2010-2011. Prior to that, Marvin was a Staff Sergeant in the USAF Reserve in South Carolina. Over the past 10 years, Marvin has served as a General Forecaster/Meteorologist at WFO Reno, NV and brings a wealth of operational knowledge. Marvin and his family are excited to return back to Vermont after their adventure out west in Nevada.

Congratulations to John Goff, our new Service Hydrologist. John has been a General Forecaster/Lead Forecaster for the past 21 years at NWS Burlington, most recently serving as the Hydrology Program Leader, and is excited for this new opportunity. John has lived in 9 different states and says the F-5 Xenia OH Tornado of 4/3/74, which hit 5 miles from his childhood home, helped spark his passion for meteorology. John holds degrees from Purdue University and North Carolina State University and started his NWS Career at WFO Corpus Christi as an Intern before moving to NWS Burlington. When not working, he loves spending time with family, playing piano, metal detecting, and kayaking.

The Four Seasons

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Contributors:

Peter Banacos, Science and Operations Officer
Eric Evenson, Lead Meteorologist
Nichole Hammond, Meteorologist
Brooke Taber, Lead Meteorologist

Editors:

Rebecca Duell, Meteorologist
Seth Kutikoff, Meteorologist
Andrea LaRocca, 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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