Top 5 Weather Events of 2011 across the North Country

From devastating flooding to record breaking snows, 2011 was a year of particularly active and tragic weather across Vermont and northern New York. At Burlington International Airport, it was the wettest year on record with 50.92" of precipitation. Burlington also had its 3rd snowiest winter on record with 128.4". In addition, Burlington experienced 11 out of 12 months of above normal average monthly temperatures with the months of November and December as much as 5 degrees above normal. The greatest snowstorm occurred on March 6-7th when 25.8" fell at Burlington, which was 3rd greatest snowstorm in history. The greatest 24-hour single day rainfall was 3.38" associated with Tropical Storm Irene on 28 August 2011. The combination of above normal snow pack and record breaking rainfall caused several historical flooding events across our region. They include the heavy convective rainfall and flooding event on April 26th-27th, followed by a record Lake Champlain stage of 103.27 feet on 6 May 2011 breaking the previous record by over a foot. Another heavy convective rainfall episode on May 26th- 27th brought more flooding, followed by the historic and devastating flooding from Tropical Storm Irene on August 28th.

An informal poll of the staff at the National Weather Service in Burlington was conducted to determine the Top 5 weather events of 2011. Subjective factors going into the ranking included both the meteorological significance of the event as well as its overall public impact. A retrospective look back at each of the Top 5 events follows.

#5: Weather Event of 2011:April 26th-27th Flooding

On April 26th the combination of much above normal temperatures, record snow melt in the mountains, and several lines of showers and thunderstorms caused major flooding across northern New York into central and northern Vermont. Numerous roads from Essex County, New York to Essex County, Vermont were closed due to flooding, with several reports of bridges being washed away. The total damage caused by the flooding in Vermont was 6 million dollars, while figures in Essex County, New York were near 4.5 million dollars.

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Figure 31 shows a surface map on 26 April 2011 at 2100 UTC, along with a composite radar image. This clearly shows several areas of low pressure along a surface warm front, which was draped across the North Country, along with periods of showers and embedded thunderstorms.

Temperatures on the 26th and 27th were well into the 50s and 60s across the region, which helped in thunderstorm development and caused rapid snow melt in the mountains, leading to this widespread flooding event.

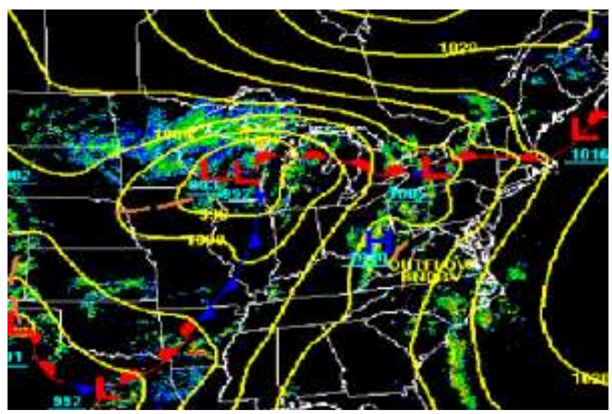

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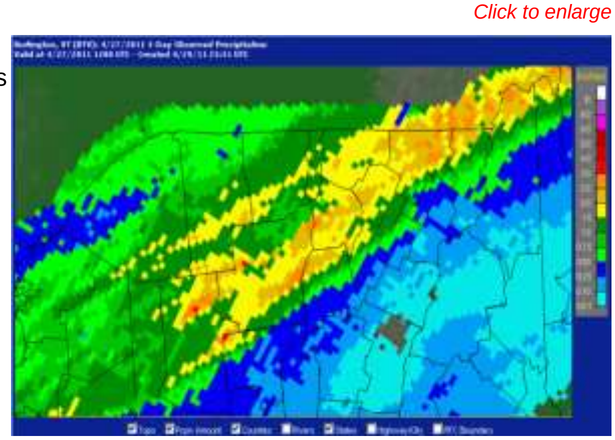
Figure 32 shows the 24 hour storm total precipitation across northern New York into Vermont, with many areas receiving 1 to 3 inches of rainfall. The heaviest amounts were from the High Peaks of Essex County, New York into central Lamoille County, Vermont.



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Meanwhile, Figure 33 shows a 6 hour composite radar loop across the region, with numerous lines of showers with embedded thunderstorms impacting the North Country. The white crosses in figure 33 below indicate lightning, while the brighter oranges and reds show areas of moderate to heavy rainfall, with very high rainfall rates.

This heavy rainfall and abundant snowmelt caused widespread river flooding to occur with The Lamoille River at Johnson, Vermont recording its 4th highest level of 16.97 feet on the morning of April 27th. Figure 34 below shows the hydro-graph of the Lamoille River at Johnson, Vermont from April 25th through April 30th. The peak of 16.97 feet was above major flood stage and caused significant flooding, per figure 35 showing the Grand Union in Johnson, Vermont on April 27th.

Overall, snowmelt from an above normal snowpack and daytime high temperatures in the 50s and 60s, combined with very rainfall to produce a significant flood event across the region. Late in the day on the 26th into the early morning hours of the 27th thunderstorms repeatedly moved over the North Country, dumping additional heavy rainfall on already saturated soils and swollen rivers and streams. Flash flooding during the overnight hours late on the 26th quickly transitioned into river flooding by the morning of April 27.

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#4: Weather Event of 2011: The March 6-7, 2011 Winter Storm

The winter storm that occurred on March 6-7, 2011 was a record-setting winter storm for March. While heavy snow would be one of the primary impacts from this storm system, significant ice jam-related flooding would also develop along several rivers in Northern New York and Vermont. Thus, this particular event was a multi-faceted one as it involved impacts from both winter weather and localized flooding. There were as many as 10,000 power outages across the state of Vermont and resulted in one fatality in the town of Danville, VT [Source: Burlington Free Press, Burlington. Accessed December 27, 2011.]

This winter storm would result in several records being broken. It produced the largest 24-hour snow accumulation for any day in March (dating from 1888-2011) at Burlington International Airport, with a 24-hour total of 17.1". The storm total accumulation of 25.8" at Burlington during this event was the highest snow accumulation during the 2011 winter season, and it was so much that it placed this storm as the 3rd most of all-time at Burlington, eclipsing the infamous Valentine′s Day Blizzard of Feb 14th-15th, 2007.

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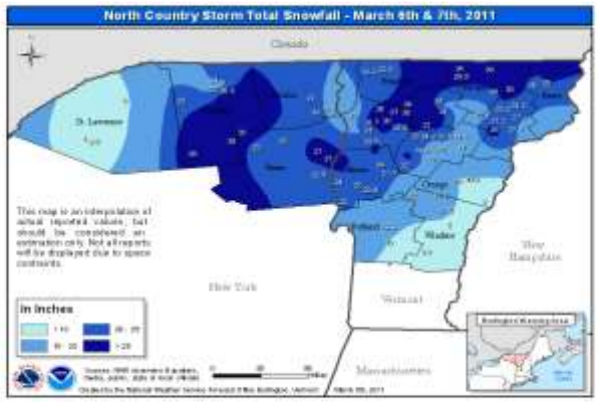

Figure 27 shows a map of storm total snowfall produced by the National Weather Service (NWS) Weather Forecast Office (WFO) in Burlington, VT. The heaviest amounts of snow fell across the northern Adirondacks and Clinton and Essex Counties in New York, the northern Champlain Valley and across much of northern Vermont and the Northeast Kingdom.

One and a half to nearly 3 feet of snowfall were common across this area. Snow amounts were lower across in the St. Lawrence Valley of New York as this region was further away from the heavier precipitation; amounts were also lower in southern Vermont due to snow mixing with sleet and rain for periods during the storm resulting in lower totals.

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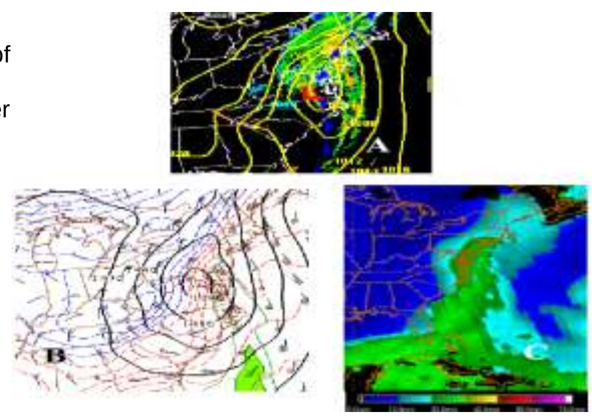

Figure 28 shows several features that contributed to the heavy precipitation associated with this event, taken as of 7PM March 6th, 2011. Figure 28(a) shows an area of surface low pressure (indicated by the red L) located over central Virginia. This low would eventually follow along the cold frontal boundary that extends from the center of the low northeastward across the mid-Atlantic and into interior New England during the evening and into the morning hours of March 6th-7th. Composite radar imagery shows a large plume of heavy precipitation (indicated by darker green, yellow, and orange colors in Figure 28(a)) across a large portion of the U.S. East Coast that would also shift northward with time. Figure 28(b), on the lower left side of figure, displays a map of the 850-hPa (~5000ft) geopotential height (solid black lines), temperature (dashed color lines), and wind barbs. The blue-dashed temperature lines outline areas where the temperatures at 850-hPa were at or below 0°C. Note the sharp temperature gradient indicated by the tightly packed temperature contours over central and southern Vermont; the heavier snows as indicated in Figure 27 would be located just to the west of this strong temperature gradient. Figure 28(c), in the bottom right of the figure, shows a map of satellite-derived precipitable water, which is a measure of moisture in the atmosphere. Note the plume of deep moisture (green colors in Figure 28(c)) that extends along the East Coast from all the way into the northern tropics. This moisture would be transported by southerly winds of 45-50 knots (shown in wind barbs in Figure 28(b)) into the North Country, which provided an ample source of moisture for significant heavy wintry precipitation.

Figures 29 and 30 show photographs of some of the heavy snow left behind by this significant storm system across the Burlington, VT area.

Click to enlarge

Click to enlarge

#3 Weather Event: May 26th-27th Flash Flooding and Severe Weather

On 26 May 2011 the first significant severe weather outbreak of the 2011 season occurred, along with devastating flash flooding across portions of northern New York and most of central and northern Vermont. A very warm and moist air mass was in place across most of the North Country with temperatures in the 80s and surface dewpoints in the mid to upper 60s. This very unstable environment along with a stationary front draped across the region helped to produce strong to severe thunderstorms across the North Country during the afternoon and early evening hours on 26 May 2011, which transition into a significant flash flooding event during the overnight hours.

This severe weather event included numerous reports of severe and damaging thunderstorm winds of greater than 60 mph, along with several report of large hail, with baseball size hail reported near Duxbury, Vermont. Furthermore, the thunderstorms were accompanied by very heavy rainfall amounts of 3 to 5 inches with localized radar estimates near 7 inches across central Vermont, which caused significant flash flooding. Many roads were washed out and several rivers reached moderate to major flood stage as a result of the heavy rainfall. Most of the severe weather reports were concentrated along and south of a Star Lake, New York to Canaan, Vermont line, associated with several long-tracked miniature supercells, which continued into New Hampshire and Maine. Meanwhile, locations across central and northern Vermont were hardest hit with flash flooding on the evening of 26 May 2011. Some of the most significant damage from flash flooding occurred from Barre to Saint Johnsbury, Vermont.

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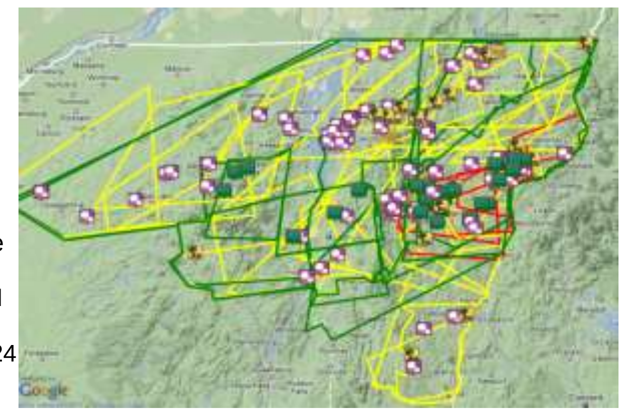

Figure 14 shows a Google Map display of the damaging wind, hail, and flash flooding which occurred during this event. The white balls indicate hail reports, the orange trees show areas of thunderstorm wind damage, and the green water icons represent areas of flash flooding. The yellow parallelograms in the image show thunderstorm warnings, while the green colored boxes are flash flood warnings and the red color polygons are where tornado warnings were issued. Click here for a complete listing of all severe weather and flash flood reports across Weather Forecast Office (WFO) Burlington, VT forecast area. Click here for a list of 24 hour rainfall amounts across northern New York and most of central and northern Vermont.

Click to enlarge

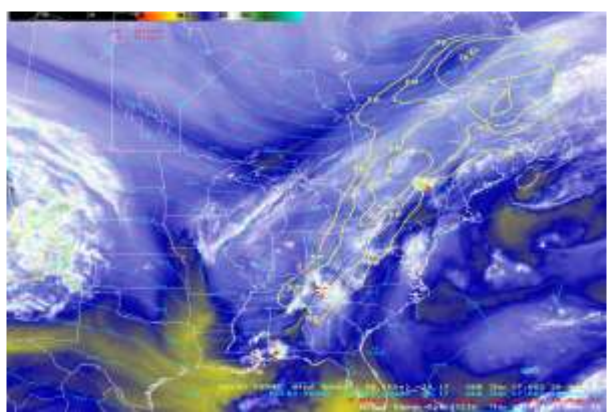

Figure 15 shows an eastern United States water vapor loop from 1640 UTC (Universal Time Constant: i.e., EDT plus 4 hours) to 2310 UTC on 26 May 2011, along with 500 hPa (20,000 feet above the ground level) heights (blue lines), wind speeds 50 knots or greater at 500 hPa (yellow lines), and 5 minute lightning (red). This water vapor loop clearly shows several rounds of abundant deep layer moisture moving from the Ohio Valley into the Northeast, which helped to produce convection with localized very heavy rainfall. In addition this shows a strong shortwave trough across the western Great Lakes and northern Mississippi River Valley, along with a right rear quadrant of a 500 hPa jet streak across western New York. These two features and associated cool pool aloft helped enhance upper level divergence and aided in the vertical development of thunderstorms. The closed height contours over the western Great Lakes into the Mississippi Valley, suggests very strong jet stream winds aloft, helping to promote strong updrafts for long-lived thunderstorms.

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Figure 16 shows a surface analysis along with a radar composite image on 26 May 2011 at 2100 UTC. This analysis indicates a stationary boundary from western New York into northern Vermont, with several waves of low pressure riding along this boundary. This boundary combined with these areas of low pressure helped to produce several rounds of thunderstorms, with localized very heavy rainfall. The stationary boundary separated a warm moist air mass to the south, compared to a cool and drier air mass to the north. This strong baroclinic zone helped to enhance numerous rounds of training showers and strong to severe thunderstorms across the North County on 26 May 2011.

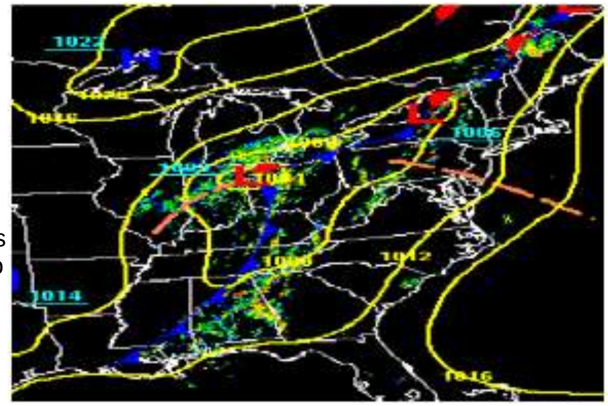

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Figure 17 is a Northeast region composite reflectivity mosaic from 1806 UTC to 2354 UTC on 26 May 2011, along with surface observations plotted in white. This loop shows the widespread areal coverage and intensity of the storms from eastern Lake Ontario into much of northern New York and Vermont during this severe weather outbreak. In addition, the radar loop shows multiple long tracked supercell thunderstorms across the region, several of which affected the WFO BTV forecast area. The brighter yellows, reds, and purple colors in the radar loop indicate very strong thunderstorms with intense rainfall rates, along with the capability of producing severe hail.

Lamoille County Storm near Johnson, Vermont (Damaging Winds):

Click to enlarge

In addition, to the supercell thunderstorms which occurred across our region on 26 May 2011, further north across central and northern Vermont, a bow-like line segment developed and created damaging straight-line winds from near Johnson to North Hyde Park. Figure 18 is the KCXX 1.3° base reflectivity near Johnson, Vermont at 2218 UTC on 26 May 2011, which clearly shows a bow-like reflectivity structure. The weaker 20 to 30 dBZ returns (light green) near North Hyde Park, Vermont suggests a descending rear flank downdraft jet was present and capable of producing damaging thunderstorm wind gusts of 60 to 70 mph, based on the velocity values.

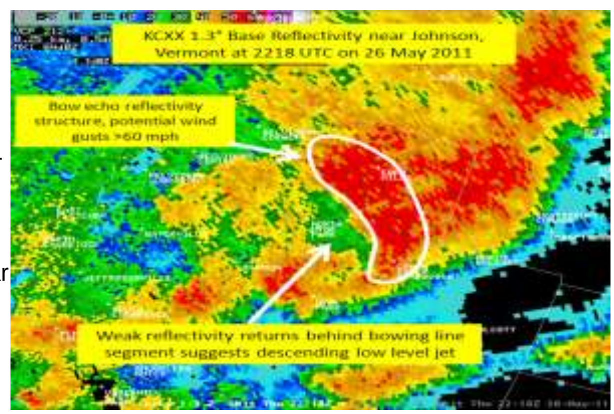

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Figure 19 is the KCXX 1.3° base velocity near Johnson, Vermont at 2218 UTC on 26 May 2011, which clearly shows the descending rear flank downdraft jet of 55 to 65 knots. The highest velocity values at this time were located near North Hyde Park, Vermont, just behind the bow-like reflectivity structure. Damaging winds did occur from this storm from Johnson, Vermont into North Hyde Park, and continued toward Island Pond as the storm raced northeast at 40 to 50 mph. Also, when storms move very fast, they have a higher potential to produce wind gusts greater than 60 mph, as a rule of thumb.

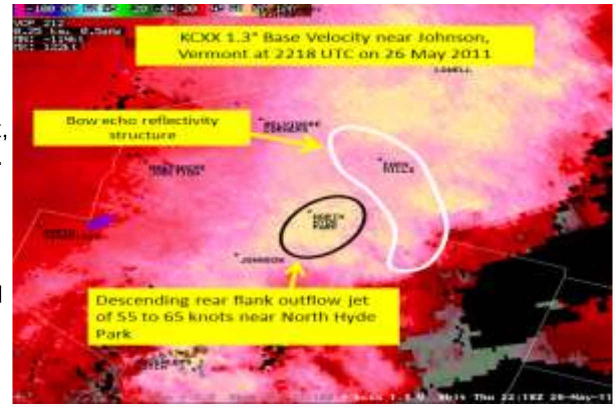

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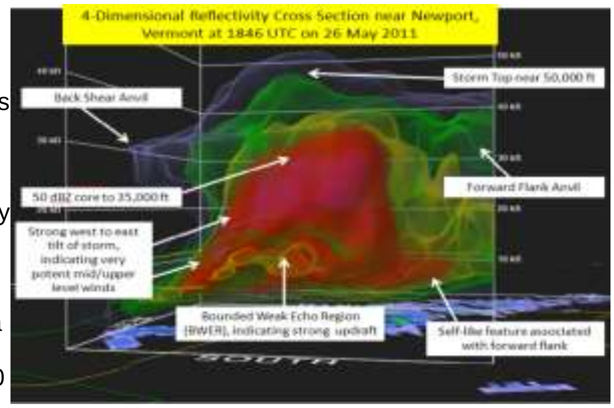
Figure 20 is a special 4-dimensional look into a supercell thunderstorm near Newport, Vermont on 26 May 2011 at 2218 UTC, using GR2Anlyst. This software program used by NWS meteorologists, shows the 4-dimensional structures of storms, and helps in the warning decision process. This storm near Newport was very well organized with a defined Bounded Weak Echo Region (BWER), suggesting very strong updraft and the potential for large hail, especially when the storm collapses. This storm did produce 1 inch diameter hail near Newport, along with some gusty winds. Also, from Figure 20 you can see a strong west to east tilt, a result of strong westerly mid and upper-level winds. The storm top was near 50,000 feet, with both a forward and back-sheared anvil structure present, along with a >50 dBZ core to 35,000 feet.



Hydro:

As the threat for severe thunderstorms dissipated on the evening of May 26th, our attention quickly turned to the potential for life-threatening flash flooding across the eastern Adirondacks into most of central and northern Vermont. The combination of a stationary boundary across the region and numerous thunderstorms training over the same areas, produced widespread rainfall amounts of 2 to 4 inches with isolated amounts over 6 inches in a 6 to 8 hour period. This rainfall in a short period of time caused extensive widespread flash flooding from Barre, to Saint Johnsbury, Vermont and many communities in between. Numerous roads and culverts were washed out and many residents and businesses received significant flood damage during the event, especially in the city of Barre. In addition, several rivers including the Winooski, Passumpsic, and Mad had very sharp rises and quickly rose above flood stage.

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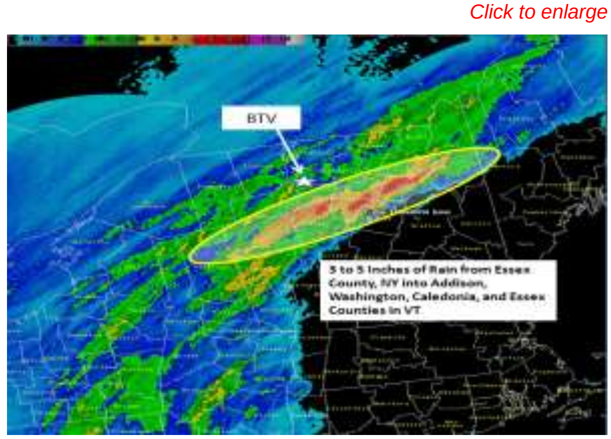
Figure 21 shows the 24 hour Northeast Mosaic storm total precipitation from 12 UTC on 26th to 12 UTC on 27 May 2011. The yellow area is storm total radar rainfall estimates of 2.5 to 5 inches, while the red suggests rainfall amounts between 5 and 7 inches. From the image you can see the highest radar estimate rainfall occurred from Essex County, New York into Addison, Washington, Caledonia, Orange, and Essex Counties in Vermont during the event.



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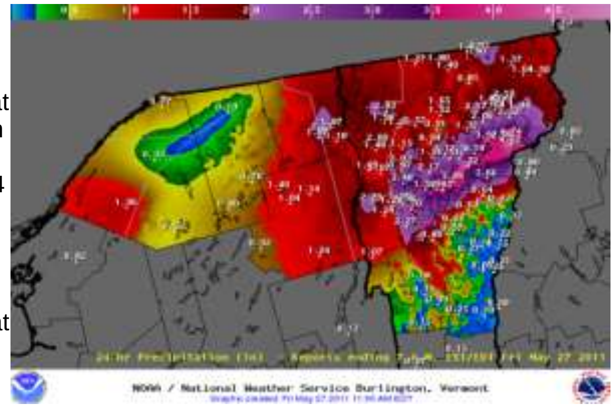

Figure 22 shows the 24 hour precipitation (inches) observed from 12 UTC on 26th to 12 UTC on the 27th of May across our forecast area. The highest official observation came from the Plainfield, Vermont Coop at 5.22 inches in 24 hours located in eastern Washington County, Vermont. From the map you can see many locations receiving 2 to 4 inches (purple/pink) in the 24 hour period across most of central Vermont and parts of the Champlain Valley from the training thunderstorms. Click here for a complete listing of 24 hour rainfall reports across the region. A couple of the higher 24 hour rainfall amounts included 4.75 inches at the Saint Johnsbury Museum in Caledonia County, 4.15 inches 1 mile north of Northfield, and 4.06 inches in Danville, Vermont on 27 May 2011. This heavy rainfall in a short period of time associated with powerful thunderstorms caused major flash flooding across central Vermont.

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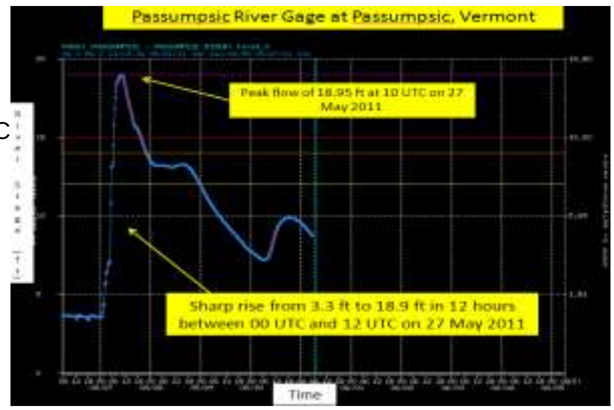

The heavy rainfall quickly produced flash flooding and flowed into many of the streams and rivers across the region. Figure 23 shows the hydro graph on the Passumpsic River, at Passumpsic, Vermont. This clearly shows a significant rate of rise between 00 UTC and 12 UTC on 27 May 2011 at the gage of over 10 feet. The gage started with a reading of 3.3 feet, but quick rose to a maximum reading of 18.95 feet at 10 UTC on 27 May 2011, which is just below major flood stage of 19 feet. This sharp rise caused significant flooding in the Passumpsic River Valley during the event. Also, the hydro graph showed very sharp rises on the Mad River at Moretown, Vermont. In addition, the Winooski at Essex Junction reached flood stage during the event, which caused some flooding in the Winooski River Valley from Montpelier to Colchester, Vermont.

Conclusion/Pictures:

The high instability values along with moderate deep shear produced an environment favorable for thunderstorm development during the afternoon and evening hours on 26 May 2011 across the WFO BTV forecast area. In addition, the amount of available moisture in the atmosphere and placement of the low-level and upper level jet features along with the present of a stationary boundary, helped to produce vertically tall thunderstorms capable of very heavy rainfall. Several rounds of thunderstorms first developed across the Saint Lawrence Valley and northern Adirondack Mountains, and then tracked east into the Champlain Valley, then into central and northern Vermont. These long-tracked supercells produced large diameter hail at several locations across the North Country, along with numerous reports of trees and power-lines down, from winds up to 70 mph. The highest concentration of damage occurred from Johnson to Island Pond, Vermont, with another maximum area of damage in the South Duxbury to Plainfield to Lunenburg, Vermont areas. Meanwhile, the greatest flash flooding occurred from Barre to Saint Johnsbury, Vermont. The following pictures were taken by Scott Whittier from WFO BTV during a storm damage survey in the areas of maximum damage.

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#2 Weather Event: Lake Champlain Record Flooding

The National Weather Service Burlington, Vermont #2 event is the record flooding which occurred on Lake Champlain from April 13th through June 19th. The combination of record amounts of snowfall during the winter months and a record amount of rainfall in the spring of 2011 resulted in the highest lake level ever at 103.27 feet on 6 May 2011. This broke the previous record of 101.86 feet on 27 April 1993 by 1.41 feet and was an astounding 3.27 feet above flood stage. This record breaking lake level caused significant damage to lake side houses, impacted numerous roads near the lake, including Route 2 and Route 78 through the islands, and closed many marinas and beaches for the start of the summer season.

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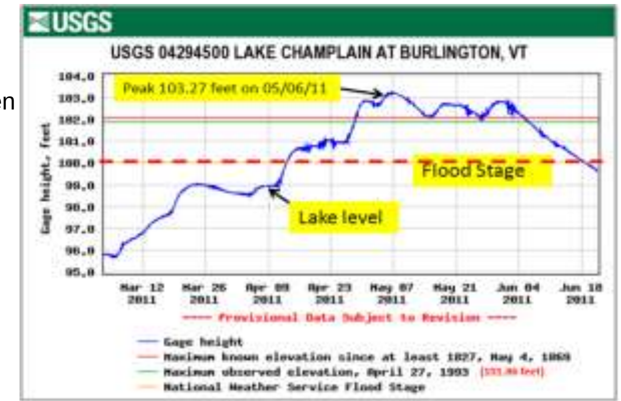
Figure 7 shows a graph of Lake Champlain lake level from 12 March through 18 June 2011, along with flood stage (red dotted line), and a plot of maximum know elevation (red line), and maximum observed stage (green line).

From the graph you can see the peak stage of 103.27 feet on 6 May 2011 was much higher than the previous record flood stage of 101.86 feet on 27 April 1993.



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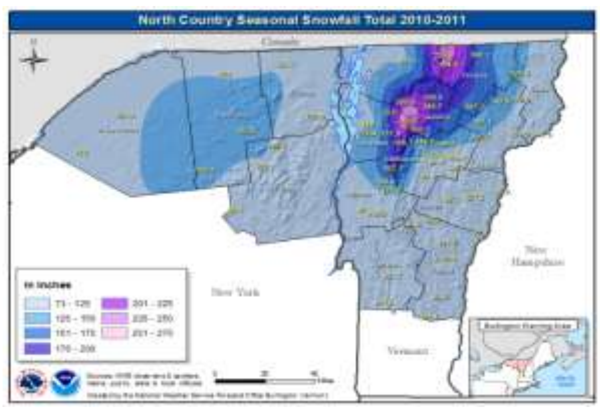
In this section we will examine the causes, which resulted in the record Lake Champlain flooding during the spring of 2011. Figure 8 shows the North Country seasonal snowfall totals for 2010 to 2011. During the winter of 2010-11, Burlington received its 3rd snowiest winter ever with 128.4 inches, which would eventually melt and have significant impacts on Lake Champlain. Meanwhile, seasonal snowfall totals observed atop Mount Mansfield were 252.7 inches with 223 inches falling at North Underhill, Vermont. This much above normal snowfall created snow depths in the mountains between 4 and 8 feet, with total water equivalent values between 10 and 20 inches. Figure 8 shows the 2010 to 2011 snowfall across the North County, with over 200 inches falling in the central and northern Green Mountains of Vermont.



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The next image (figure 9) shows the snow water equivalent on 15 March 2011 from the National Operational Hydrologic Remote Sensing Center. This image shows the snow pack on 15 March 2011 held between 15 and 25 inches of water in northern Adirondack Mountains in New York and between 20 and 30 inches in the central and northern Green Mountains in Vermont. Meanwhile, the snow pack held between 4 and 8 inches of water across the Champlain Valley. This large amount of water in the snow pack, combined with record amount of spring rainfall, resulted in the worst Lake Champlain flooding in history.

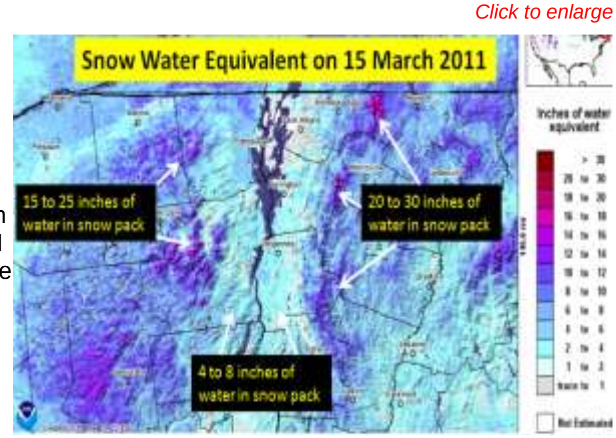

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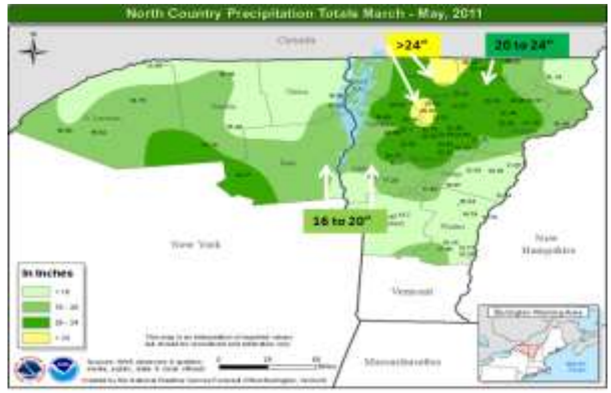
Figure 10 shows the record amount of rainfall which occurred across northern New York and most of central and northern Vermont between March and May of 2011. This map shows over 24 inches of rain fell across the mountains of central and northern Vermont, with 28.29 inches falling atop Mount Mansfield, Vermont during this 3 month period. In addition, in the Champlain Valley, Burlington, Vermont received a record 19.84 inches. All these factors from record amount of snowfall during the winter months, followed by record amount of rainfall during the springtime had significant impacts on Lake Champlain, and ultimately caused historic and long duration flood even on Lake Champlain.



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Furthermore, several strong southerly wind events on 23 April and 5 May 2011 produced significant wave action, and additional storm surge flooding along the south facing shorelines. Meanwhile, several northerly wind events occurred, causing additional surge flooding on the north facing shorelines on 9 May and 1 June of 2011. Lake Champlain was above flood stage for 67 days straight, reaching a peak stage of 103.27 feet on 6 May 2011. This long duration event damaged hundreds of houses along the shoreline (Fig. 11), nearly made the U.S. Route 2 Causeway to the Champlain Islands impassable (Fig. 12), and caused significant erosion along the causeway and bike path (Fig. 13).

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#1 Weather Event: Tropical Storm Irene (Sunday, 28 August 2011)

Tropical Storm Irene produced catastrophic river and flash flooding across Vermont and portions of northern New York on Sunday, 28 August 2011. The flood waters resulted in 3 fatalities in Vermont and 2 others in Clinton County, New York, and a scale of devastation not seen across the region since the epic floods of November 1927. Nearly a dozen Vermont communities were isolated for days due to the loss of numerous roads and bridges. Nearly 2000 road segments were damaged, with 118 sections of state roads and 175 local roads completely washed out. Among nearly 300 damaged bridges, several iconic covered bridges were heavily damaged or completely destroyed in Vermont, including the antique 160-foot Bartonsville Bridge which spanned the Williams River in southern Vermont since 1870 before being swept downstream in the storm. Over 800 homes and businesses, and several rail and major telecommunication lines were damaged or destroyed by fast-moving flood waters.

Damage from Irene resulted in a Major Federal Disaster declaration for all of Vermont except Essex and Grand Isle counties, and much of eastern New York, including Clinton and Essex counties served by WFO Burlington, Vermont. The hardest hit areas were Essex County in New York, and central and southern sections of Vermont. Monetary damages - while still not finalized - were estimated between $175 and $250 million in insured losses and needed repairs to public infrastructure.

Irene began as a strong tropical wave coming off the west coast of Africa on 15 August, but would not become a named storm until nearly reaching the Leeward Islands late on August 20th (Fig. 1, first point at 00 UTC on August 21st). Irene strengthened to a hurricane on August 22nd, and briefly reached major hurricane status (Category 3) late on August 24th as it moved northwestward across portions of the Bahamas. A minimum central pressure of 942 mb was attained east of Florida on August 26th as the storm made a northward turn on the western periphery of the subtropical ridge, though the eyewall structure of the hurricane was never quite as organized once the tropical cyclone moved north of the Bahamas. That said, Irene maintained a very large circulation and hurricane strength until nearly reaching Cape May, New Jersey at 2 am on 28 August. The tropical storm then accelerated northward across New York City and western Massachusetts during the daylight hours on 28 August, and then across the upper Connecticut River Valley during the late evening hours (Fig. 2). The storm then became extratropical as it exited the United States along the border of Vermont and New Hampshire.

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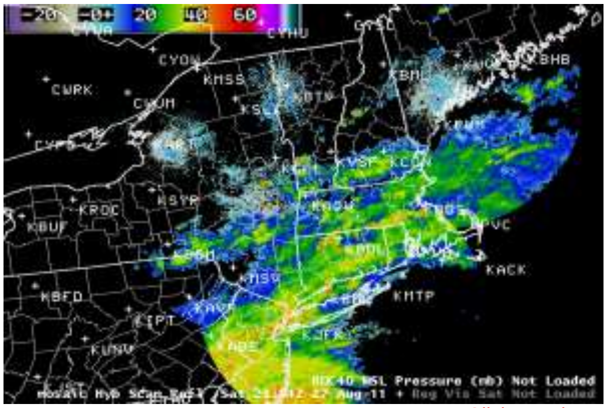
Wind impacts were not particularly significant from Irene, though channeled north flow across Lake Champlain resulted in 50+ knot gusts at Colchester Reef and some minor damage to boats on the lake. Over-land gusts of 58 mph and 51 mph were observed by ASOS at Plattsburgh and Burlington, respectively. Rainfall was copious, with widespread 4-7" amounts over a period of only about 12 hours. Orographic ascent with low-level east and southeast winds in advance of the tropical cyclone center (Fig. 3) contributed to the highest rainfall totals along the eastern slopes of the Green Mountains and Adirondacks with isolated amounts around 8" (Fig. 4). Some of the higher point amounts included 8.15" in South Lincoln, 7.86" in Ludlow, and 7.72" in Groton.



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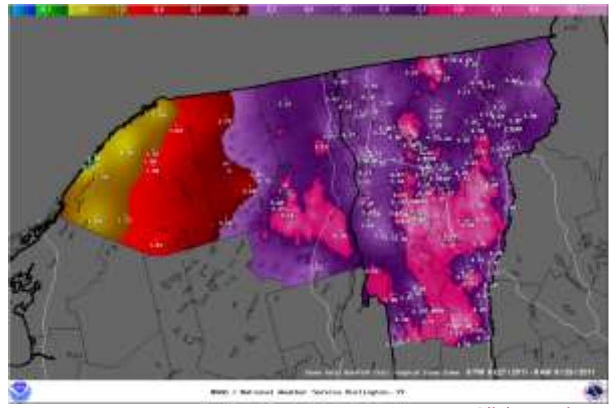

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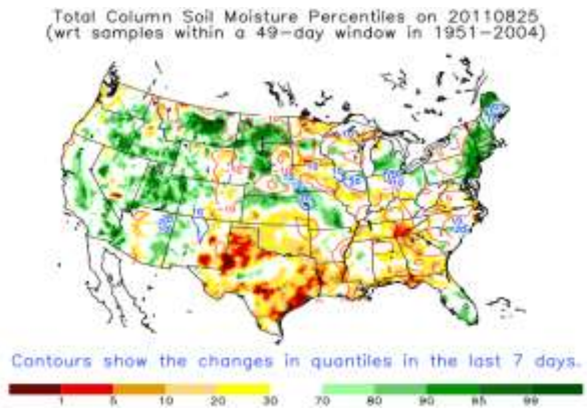

While all rivers in Vermont went above flood stage, the most severe and locally record flooding took place across central and southern sections of Vermont where antecedent soil conditions were the wettest (Fig. 5). This allowed a higher percentage of the falling heavy tropical rain to go into runoff, yielding the most severe flooding. Following significant spring flooding in the Champlain and northern Vermont river basins (e.g., see write-ups on the 26 April and 26-27 May flood events), portions of northern Vermont were actually drying out in the weeks preceding Irene, while several thunderstorm episodes maintained the wetter soil conditions across the southern half of the state. This resulted in some north-south disparity in flood impacts despite similar rainfall totals along the Green mountain spine.

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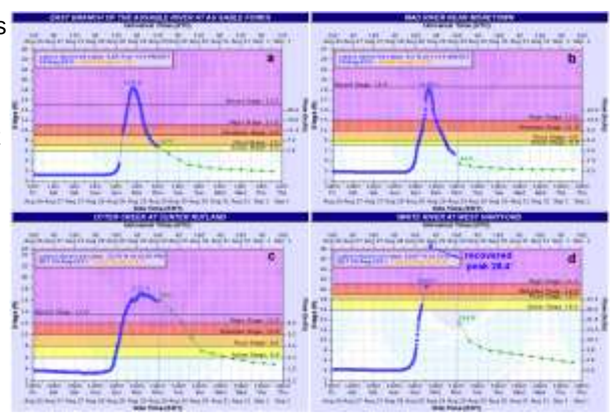
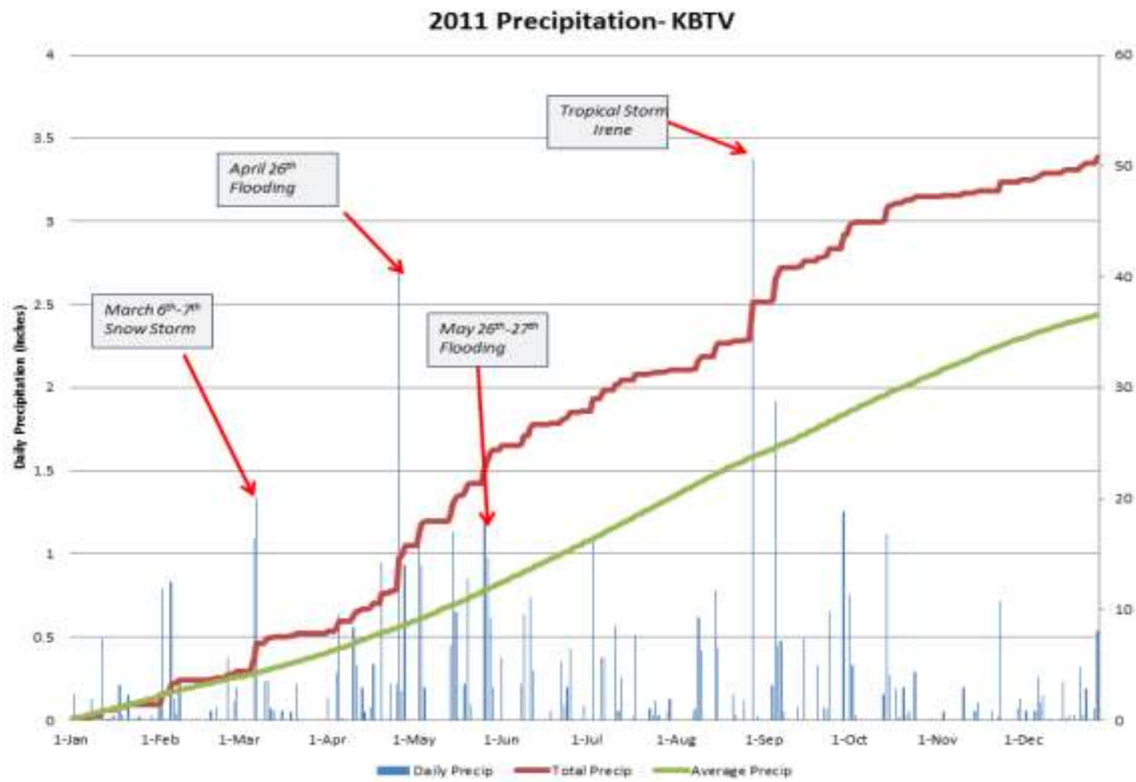


A selection of hydrographs is shown in Figure 6. River gages show steep rises of 14-24 feet over a period of just 6-12 hours from base levels to historically near-record and record crests. Record crests were recorded at the East Branch of the Ausable River at Ausable, NY (Fig. 6a), the Dog River at Northfield Falls, VT, the Otter Creek at Center Rutland, VT (Fig. 6c), and the Bouquet River at Willsboro, VT. A near-record crest was observed along the Mad River at Moretown, VT (Fig. 6b). Power was lost to gage houses in some cases due to the flood waters. However, via high-water marks and other post-event analysis methods, the recovered crest of 28.4 feet at West Hartford (per USGS) (Fig. 6d) is just below the all-time record crest of 29.3 feet set on 4 November 1927.

Honorable Mention: 2011 Record Rainfall at Burlington, Vermont

Each one of these individually noteworthy events contributed to yet another historical event; a record year for precipitation at Burlington International Airport (KBTV). Burlington received 50.92 inches of total precipitation, breaking the old record of 50.42 inches set back in 1998, and blowing away the yearly average precipitation of 36.82 inches. On the graph below, both the average and total precipitation are plotted, as well as each daily observation. Four out of the top five events can easily be seen on the graph, all contributing to this record year. And even though it's not specifically noted, the visibly large surplus in precipitation during the first half of the year over the region was the major facilitator for the other top event, the Lake Champlain flooding.



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