

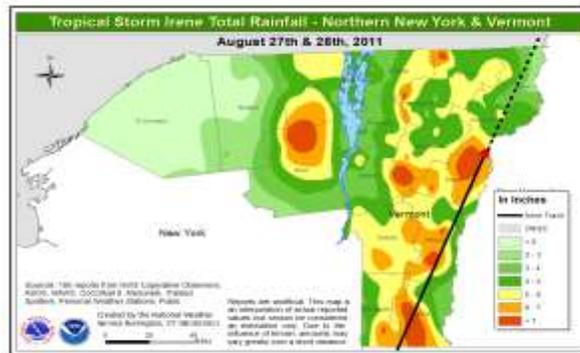
# Preliminary Hurricane/Tropical Storm Irene Weather Summary for the North Country

Hurricane/Tropical Storm Irene moved across coastal New Jersey, New York, western-southern New England and eventually the Connecticut River Valley of Vermont during August 28th, 2011. In Vermont and Northern NY, Irene delivered copious amounts of rainfall which produced deadly record flooding resulting in several deaths and historical road, home, and infrastructure damage. Also, the combination of flooding and damaging winds left at least 50,000 customers without electricity. The widespread deadly flooding across Vermont is likely the second greatest natural disaster in the 20th and 21st century (November 1927 Flood, being 1st) for Vermont.

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Figure 1 shows the 4-8 inches of rainfall that occurred from Irene and its storm track. The higher rainfall amounts occurred west of the storm track with local maxima over the mountains.

[Table 1](#) shows the actual rainfall amounts and [Table 2](#) shows a partial list of storm reports.



## Storm Track

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Figure 2 shows the track of Irene from the tropics to New England which was similar to Hurricane Floyd which produced similar rainfall amount, but because it was dry, less flooding. Tropical Storm Irene developed in the Lesser Antilles during the evening of August 20th and proceeded northwest crossing Puerto Rico on August 21st as it strengthened into a minimal Category 1 Hurricane (75 mph) on the morning of August 22nd. Hurricane Irene continued to travel just north of the Dominican Republic as it strengthened into a Category 2 storm during the evening of August 22nd. While moving across the Turks and Caicos Islands on August 23rd and 24th, Irene intensified into a Category 3 storm. Now classified as strong Category 3 hurricane (120 mph), Irene then passed through the southern and Eastern Bahamas on August 24th and 25th, before moving north-northeast paralleling the southeast coast of the United States until the morning of August 27th.

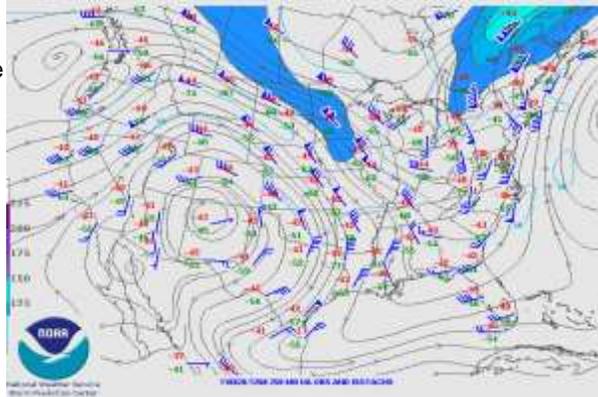


By mid-morning on August 27th, Hurricane Irene came ashore just east of Morehead City, NC as a Category 1 (85 mph) storm and proceeded north-northeast across eastern North Carolina and then paralleled the mid-Atlantic Coast until making landfall near Atlantic City, NJ during the early morning of August 28th. Irene passed just east of New York City, NY as a minimal hurricane (75 mph) during the mid-morning hours of August 28th, before weakening to a tropical storm (60 mph) near Carmel, NY at midday. Tropical Storm Irene then moved northeast to near Great Barrington, MA by 2 pm EDT and was located along the Vermont/Massachusetts border just south of Halifax, VT at 5 pm with sustained winds of 50 mph. Finally, Irene proceeded to track along the Connecticut River Valley of Vermont before exiting the state near Canaan around 10 pm EDT.

## Jet Stream

Figure 3 shows that Irene's storm track was largely determined by the jet stream winds in the upper atmosphere 20,000-34,000 ft above the ground. These winds steered the storm right up over the east coast of the U.S.

As Irene moved into the northeast U.S. she was influenced by jet stream wind speeds of over 100-150 mph (shaded blue) over eastern Canada which enhanced the rainfall rates over the North Country.



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## Satellite

Figure 4 shows the infrared satellite imagery Saturday night and Sunday. The colors in the imagery show the temperatures at the top of the clouds which were as cold as -40 to -60 degrees Celsius.

Generally speaking the colder the tops of the clouds, the taller the cloud and heavier the rainfall on the ground below.



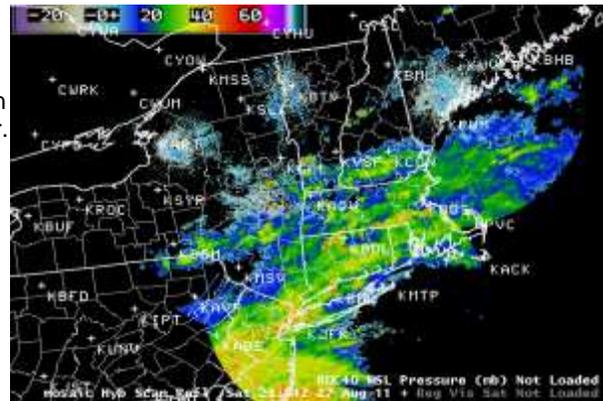
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## Radar, Rainfall and Record Flooding

As was seen in Figure 1, much of the area was affected by widespread tropical rainfalls of 4 to 8 inches with the heavier amounts over the steep mountain slopes resulting in widespread severe flash flooding especially in central and southern Vermont.

Figure 5 shows the lower level radar reflectivity from Saturday night Aug 27th into Sunday evening Aug 28th. Bands of heavier tropical rain from Irene can be seen moving into the Northeast and are indicated by the brown and red colors with rainfall rates of 1 to 2 inches per hour.

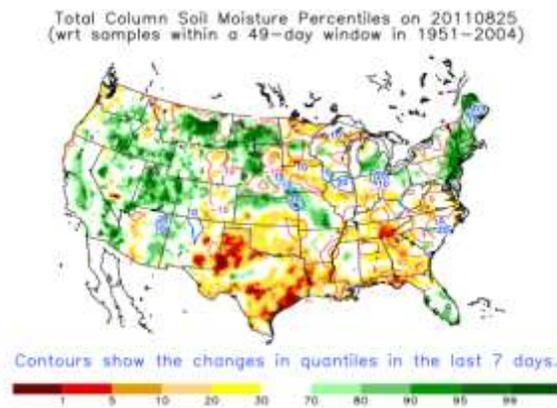
The heaviest rains can be seen moving up through Vermont focused on the Green Mountains and in New York in the Catskills and Adirondack mountains.



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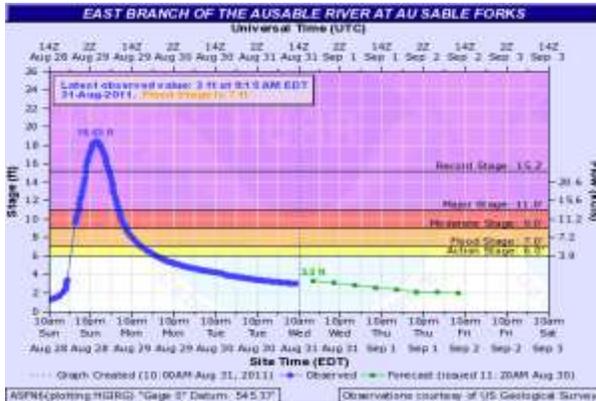
Another reason for the extreme flooding in Central and Southern Vermont was that the soil moisture content was abnormally high in those areas and a bit less in northern VT as seen in Figure 6 (courtesy of Princeton University Land Surface Hydrology Research Group).

Preceding Irene, on Aug 25th, the green shaded areas shows that southern Vermont and New England had moistures much higher than normal while northern New England and northern New York (in white) were closer to normal.



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Several rivers reached record crests as displayed in the NWS Advanced Hydrologic Prediction System(AHPS): Ausable River @ Ausable Forks NY (Figure 7) exceeded the old record by over 3 feet, Otter Creek @ Center Rutland VT (Figure 8) exceeded the old record by almost 4 feet, Putnam Creek @ Crown Point NY (Figure 9), Mad River at Moretown VT(Figure 10), and the Dog River @ Northfield Falls VT (Figure 11) reached 12.26 feet (.6 ft above the record) before the gage stopped recording.



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Crests on the Winooski River in Montpelier VT (Figure 12) were the second highest on record (1927 flood being the record), and coincidentally exceeding the previous second highest crest that was set back in May, and resulted in flooding in downtown portion of the city.

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Numerous communities suffered significant road/bridge washouts or severe flooding that resulted in them being cut-off and isolated in the Green mountains. Figure 13 from VTRANS shows roads that were closed or damaged. At least 250 roads were closed due to flooding damage or downed trees across the region.

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At the height of the storm, about 50,000 customers were without power across Vermont. 6 bridges were washed away, including historic covered bridges in Quechee & Windsor VT. Train tracks were washed out in Northfield VT and Rutland VT. Power lines and fiber optic communications lines were also cut. Leaking propane tanks were seen flowing down the Ottauquechee River in Woodstock VT, where the river was about 10 feet over its banks.