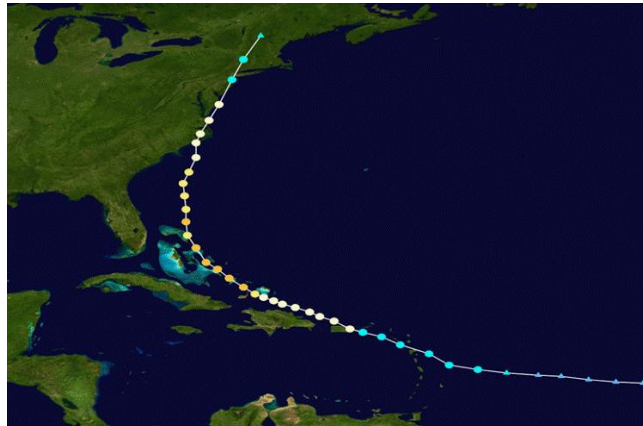




## Level 2: Hurricane Irene's Impacts on the Hudson River

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Track of Hurricane Irene, August 20 through 29, 2011 (Source: National Hurricane Center)

**\*Note: Data and Metadata referenced in this file are from** “Hudson River Environmental Conditions Observing System”. 2011. Various stations. Accessed August 18th, 2017. <http://www.hrecos.org/>.

### ❖ Background Information:

Hurricane Irene caused extensive flood and wind damage as it traveled across the Caribbean and up the East coast of the United States. The Hurricane made landfall in the United States near Cape Lookout, North Carolina on August 27th, 2011 and was downgraded to a Tropical Storm by the time it hit the New York City region on Sunday, August 28th, 2011.

While the damage in the New York City area was much less than what the government predicted and prepared for, the amount of rainfall in the Northeast *was* excessive and caused significant flooding. The Hudson River Valley received some of the highest rainfall levels associated with Hurricane Irene. Some of this rainfall entered the ground as groundwater, and much of it ran off into local tributaries that carried this water into the Hudson River. In the Hudson Valley, buildings flooded and roads were washed out.

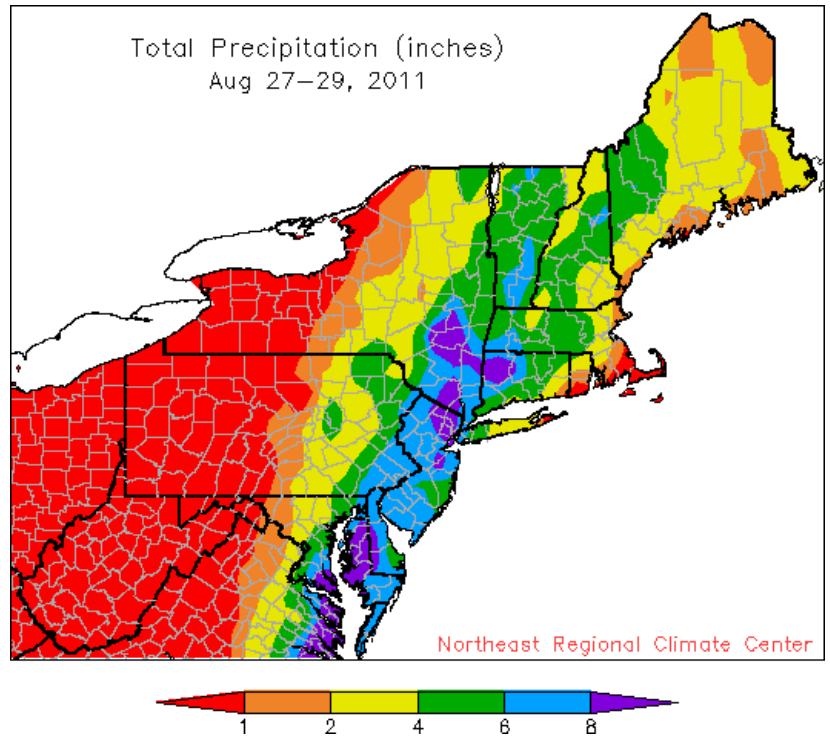
Greene County Route 42 between Lexington and West Kill (September 2011)



Using data from the Hudson River Environmental Conditions Observation System (HRECOS) you can track the storm and its effect on the river. HRECOS uses automated sensors to record real-time data on Hudson River conditions (temperature, dissolved oxygen, etc) and weather (rainfall, wind speed, etc.) You may want to compare this dataset to our related dataset on Hurricane Sandy to examine how hurricanes can affect the river differently through oceanic storm surge or watershed flooding.

❖ **Dataset Variables:**

- **Date** - Day and time of sampling.
- **Depth (feet)** - A measure of water depth above sensor, which is an indication of tide and rainfall.
- **Rainfall Daily Accumulation (inches)** – The amount of rain that cumulatively fell over a 24 hour-period. The data points you see in this dataset show the daily total up to that hour of the day. The count resets every day at 1:00 AM EST.
- **DO (ppm)** – The amount of oxygen dissolved in the water measured in parts per million.
- **DO Saturation (%)** – The amount of oxygen dissolved in the water compared to the amount it could hold when it is at equilibrium with the atmosphere. This is dependent on temperature.
- **Turbidity (NTU)** - The amount of suspended particulates in the water measured in nephelometric turbidity units. This helps us to see how cloudy the water was.



❖ **Dataset Timeframe:**

This dataset contains data collected at 15 minute intervals by the Hudson River Conditions Observing System (HRECOS) from 8/25/2011 until 9/5/2011.

❖ **Data Collection Methods:**

The Hudson River Conditions Observing System (HRECOS) operates a number of hydrological and meteorological monitoring stations in and near the Hudson River. The monitoring stations use multi-probe sondes to collect continuous data every 15 minutes for many variables, such as water temperature, dissolved oxygen, turbidity, and salinity.

❖ **Locations:**

From North to South, this dataset includes results from the Port of Albany, Norrie Point and Piermont.



The meteorological monitoring station at Port of Albany. Source: HRECOS

➤ **Monitoring Stations:**

**Port of Albany NY**

42.61954 N, 73.75890 W

The Albany HRECOS station is mounted on the concrete piling on the western shoreline of the Hudson River at the Port of Albany, just to the south of the Cargill Grainery. The channel depth at this location is 32 feet.

**Norrie Point NY**

41.831876 N, 73.941606 W

Norrie Point Hydrological Station is located at the headquarters of the Hudson River National Estuarine Research Reserve within the Margaret Lewis Norrie State Park, operated by the Taconic Region of New York State Office of Parks, Recreation, and Historic Preservation.

**Piermont Pier NY**

41.043 N, 73.896 W

Piermont station is located on the end of Piermont Pier, which is owned and operated by the village of Piermont. The pier stretches one mile out into the Hudson River and is regularly used by the public for recreation. The pier is located just north of the tidal Piermont salt marsh. *Note: The Piermont hydrological station was offline for repairs during Hurricane Irene so we only have data from the meteorological station (rainfall).*

❖ **Source of Datasets:**

- Hudson River Environmental Conditions Observing System (HRECOS)

<http://hudson.dl.stevens-tech.edu/hrecos/d/index.shtml>

❖ **Inquiry Idea Starters:**

*Here are some sample questions you could ask using these data. These are just suggestions and we hope you'll come up with many interesting questions of your own.* The questions are organized into categories with variables listed for each. Additional data and graphs can be obtained through HRECOS and the teacher materials associated with this dataset.



- **Evidence of storm (Rainfall and Depth)**
  - How do rainfall levels vary over the days before, during and after the storm?
  - How does water depth vary over the days before, during and after the storm?
- **Impact of storm (D.O. and Turbidity)**
  - Do dissolved oxygen and turbidity correlate at sites along the river?
  - At which locations do dissolved oxygen and/or turbidity change the most during the storm?
- **Recovery after storm (D.O. over time)**
  - Do D.O. levels from years before and after the storm show evidence of Submerged Aquatic Vegetation (SAV) being washed away during Hurricane Irene?
  - Can D.O. levels demonstrate recovery of SAV over time?
- **How does this extreme weather event compare to other extreme weather events?**

If students want to compare Hurricane Irene to Hurricane Sandy, there is an additional dataset and background information sheet for Hurricane Sandy.

#### ❖ **Additional Resources:**

- Hurricane Irene Graphics Archive from NOAA's Hurricane Center (animations of the Hurricane track)
  - [http://www.nhc.noaa.gov/archive/2011/graphics/al09/loop\\_S.shtml](http://www.nhc.noaa.gov/archive/2011/graphics/al09/loop_S.shtml)
- An interactive graphic showing flooding, power failures, rainfall and damage from Irene
  - <http://www.nytimes.com/interactive/2011/08/27/us/preparations-for-hurricane-irene-and-reports-of-damage.html?mcubz=0>
- Watch an animation of Irene and the impact on storm surge on the Hudson River. Pay close attention to the amount of water flowing south after the hurricane passes.
  - <https://vimeo.com/48249903>
- Watch an animation of the cross-section from the Troy Dam to The Verrazano Bridge showing the river velocity and salinity.
  - <https://vimeo.com/48250992>
- Here's a blog post from Dennis Suszkowski of the Hudson River Foundation about impacts of Hurricane Irene and Lee that were observed through HRECOS. It includes some interesting graphs of river conditions.
  - <http://bit.ly/2iCJea5>
- Download archived or real-time hydrological and meteorological data from the Hudson River through HRECOS (Hudson River Environmental Conditions Observing Systems)
  - <http://www.hrecos.org/index.php>

❖ **References:**

US Department of Commerce, NOAA, National Weather Service. **“Hurricane Irene August 26- 27, 2011.”** National Weather Service, NOAA's National Weather Service, 12 Jan. 2016, [www.weather.gov/mhx/Aug272011EventReview](http://www.weather.gov/mhx/Aug272011EventReview).

**“Recovery Is Slower in New York Suburbs.”** The New York Times, 28 Aug. 2011, [www.nytimes.com/2011/08/29/nyregion/wind-and-rain-from-hurricane-irene-lash-new-york.html?mcubz=0](http://www.nytimes.com/2011/08/29/nyregion/wind-and-rain-from-hurricane-irene-lash-new-york.html?mcubz=0).