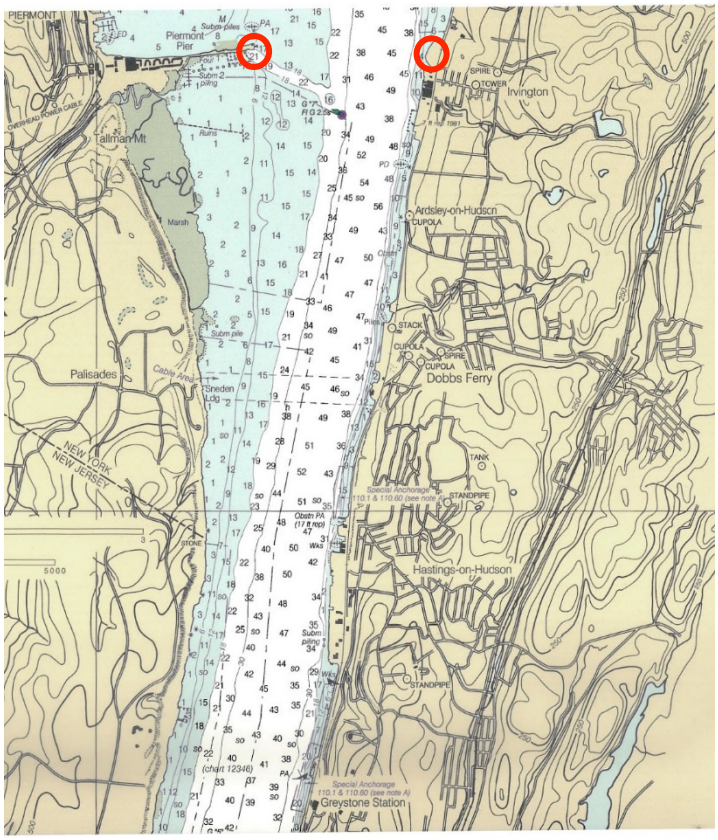
Turbidity in the Tappan Zee – A Day in the Life Data Story

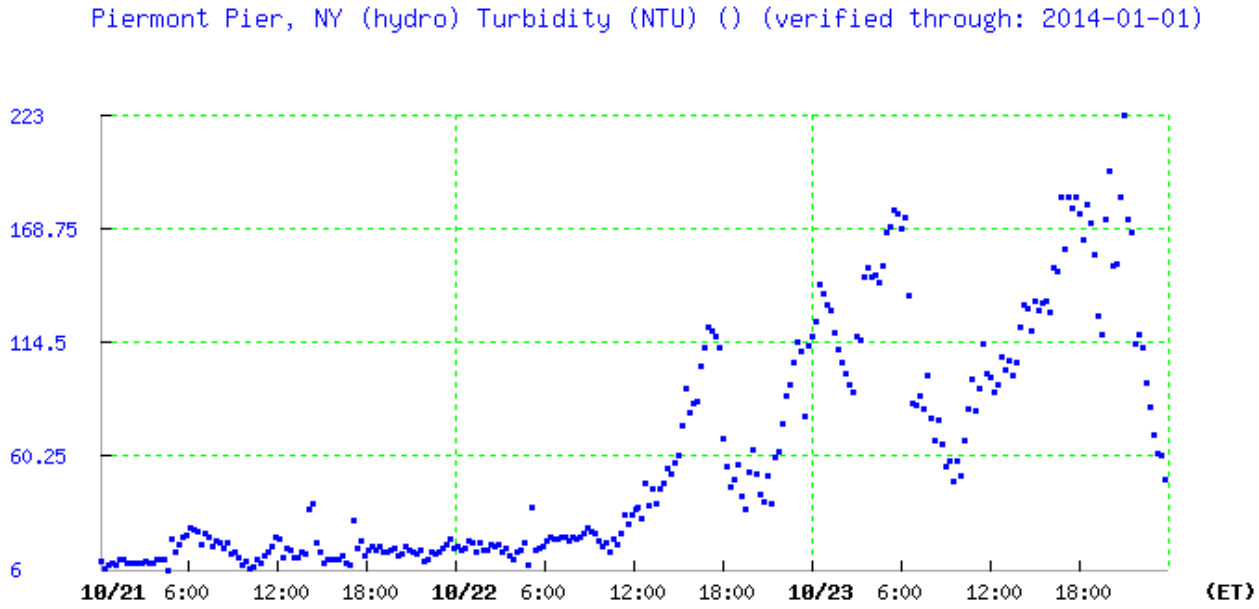
Going north from Hudson River Mile [HRM] 23 at Sneden's Landing, the Hudson Estuary widens into a reach of the river known as the Tappan Zee. The river also becomes shallower here: the western portion of the Tappan Zee is less than 15 feet deep, mostly much less. Two of our Day in the Life sampling sites are directly across from one another in the Tappan Zee at HRM 25 – the Piermont Pier in Piermont on the west side of the river and Mathiessen Park in Irvington on the east.



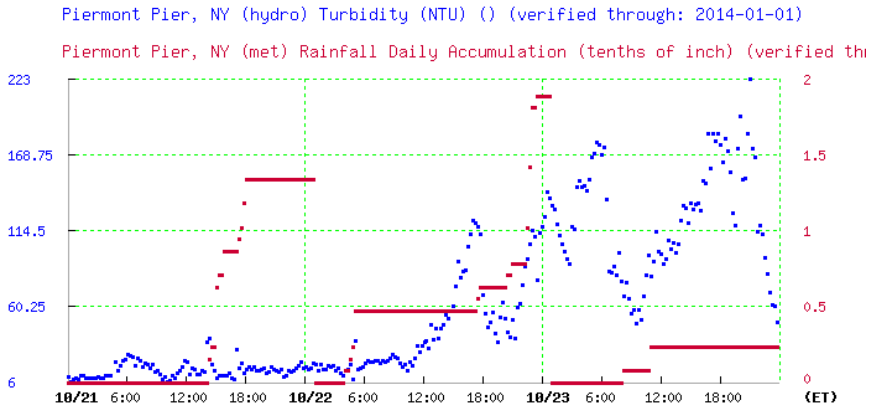
Pearl River and Tappan Zee High School students sampled at the Piermont Pier on Tuesday, October 21, while Irvington High School and Middle School students sampled at Mathiessen Park two days later, on Thursday, October 23.

When comparing their data on the Day in the Life website, the results for some parameters are very different. Turbidity is an example. At both sites, students used turbidity tubes, recording how clear the water was by measuring (in centimeters – cm) the depth at which they could see the black and white pattern at the bottom of the tube. Readings at Piermont on October 21 ranged from 24.8 to 42 cm, but two days later readings by the Irvington Middle School students were only 4.9 to 5.8 cm, meaning the water was much muddier at Irvington. Why were the turbidity readings so different?

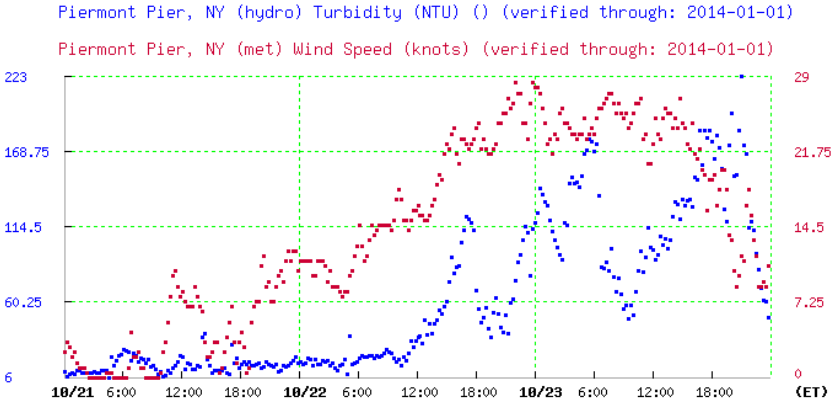
The Hudson River Environmental Conditions Observing System [HRECOS] has a station at the Piermont Pier, where it measures water and weather conditions 24 hours a day, 7 days a week. Here is a graph showing turbidity readings from that station. The units – NTUs – are an electronic way of measuring turbidity. The higher the number, the muddier the water. Does this graph show the same change in turbidity that the students observed?



Might rain or wind have caused the change in turbidity? How? Here are HRECOS graphs plotting rainfall accumulation (the highest level reached each day) and wind speed along with the turbidity measurements.



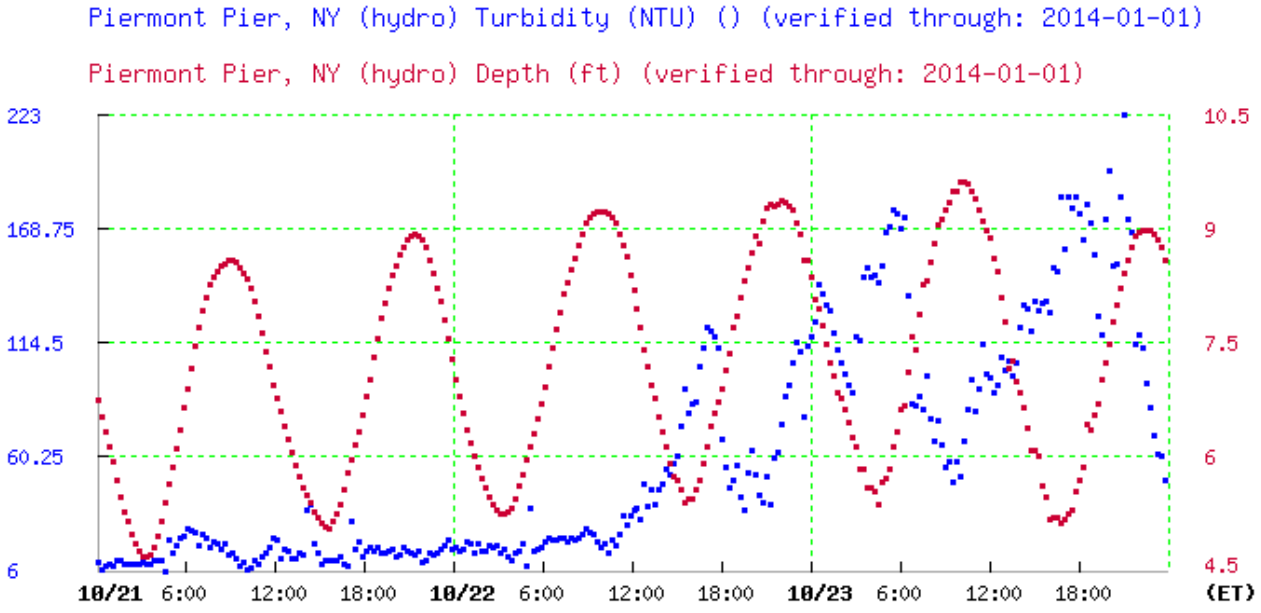
Do you think that rainfall or wind was more likely to have caused the increased turbidity?



There was rain on all three days, but not that much – no more than two/tenths of an inch. The rainfall peaks don't correspond to the turbidity peaks. However, the wind reached speeds of 20 to 29 miles per hour by October 23. What effect might these strong winds have had in the shallow waters of the Tappan Zee?

Challenge question

Note that turbidity didn't steadily increase. It peaked around 17:00 hours (5:00 p.m) on October 22, then dropped, then peaked again around 05:00 hours (5:00 a.m) on October 23, dropped again, and reached another peak around 18:00 hours (6:00 p.m.). Why did the turbidity rise and fall in that pattern?



The daily cycle of tides has a similar pattern. Plotting water levels with turbidity, it's evident that turbidity rises when the tide is falling, and decreased when the tide is rising. Why?

The turbidity peaks and troughs are related to tides, but not directly to the rise and fall of the water. Rather, they are linked to the direction of the current. On a falling tide, the ebbing current brings water south from the Tappan Zee, where the wind has stirred up bottom sediments in the shallow water. On a rising tide, the flooding current brings water north from the Hudson south of Sneden's Landing. There the greater depth of river prevents the wind from stirring up the bottom sediments and muddying the water.