



**National Estuarine
Research Reserve System**

Estuary Data Mystery

Title: How did Superstorm Sandy affect water conditions?

Reserve, State: Jacques Cousteau Research Reserve, New Jersey

SWMP Stations: Water Quality (WQ) Buoy 126 and Meteorological Station (MET) at Nacote Creek

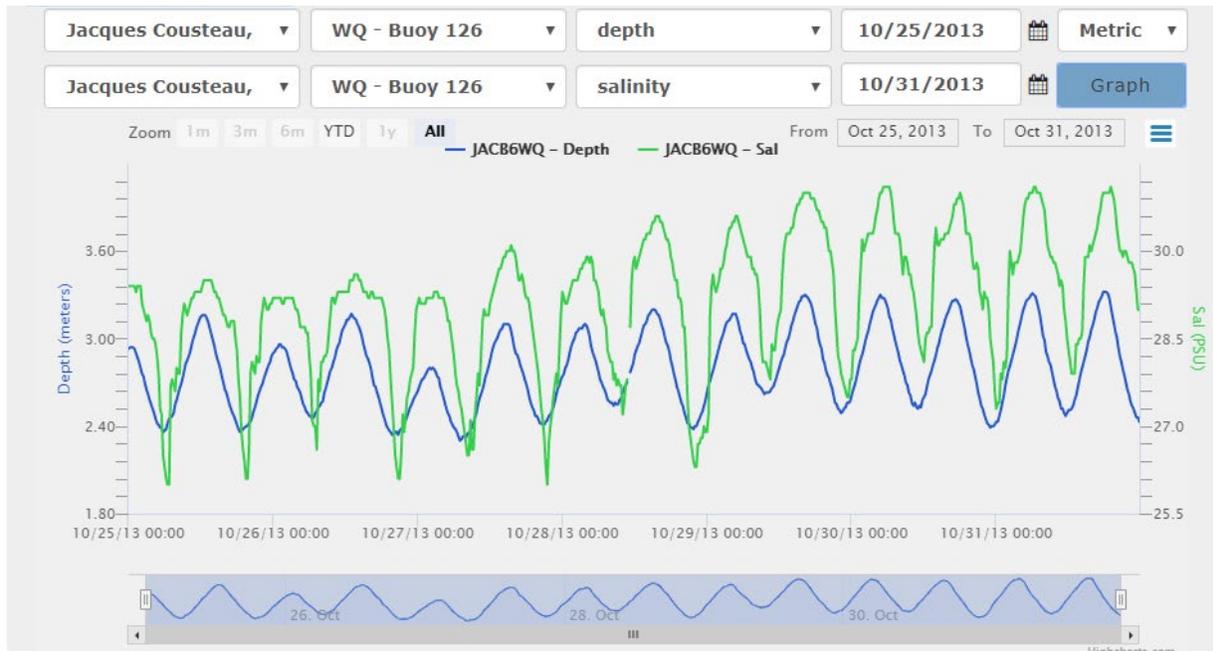
Parameters: Salinity, depth, wind speed, precipitation, and barometric pressure

Start and End Dates: October 28 to 30, 2012

Data: Available and easy to graph at nerrsdata.org

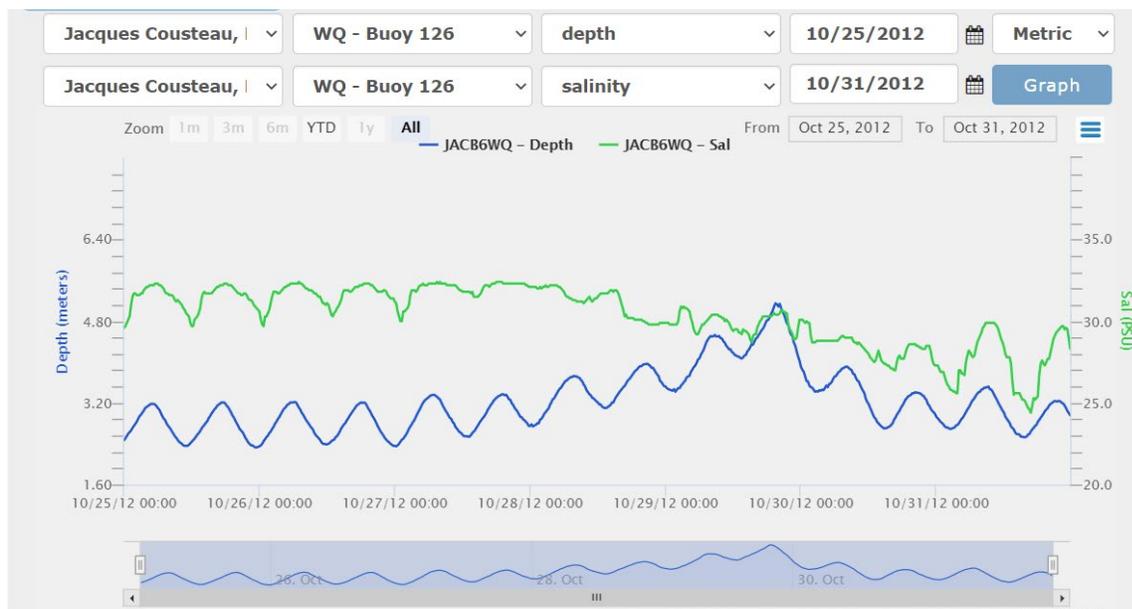
Investigate This: At the Jacques Cousteau Research Reserve, one of our System-Wide Monitoring Program (SWMP) stations, Buoy 126, is placed within Great Bay, not far from Little Egg Inlet, which connects to the Atlantic Ocean. Typical or “normal” depth and salinity readings at SWMP station 126 for late October (in this case from 2013) can be viewed in **figure 1**. What observations can you make from figure 1?

Figure 1: Typical conditions in late October for salinity and depth at Buoy 126 SWMP station (Salinity = Green Depth = Blue)



Around October 28, 2012, the research reserve received some interesting salinity and depth readings from the Buoy 126 station. From October 28 to 30, the salinity readings spiked and depth was at a record high. **See figure 2.** What could cause the depth and salinity to increase? A high tide perhaps?

Figure 2: Salinity and depth at Buoy 126 SWMP station for late October 2012 (Salinity = Green Depth = Blue)



Use supporting data from **figures 3, 4, and 5** to determine the cause of these phenomena. Have students record observations from all graphs. The data in the graphs are clues to help solve this Estuary Data Mystery!

Figure 3: Lunar calendar for 2012

2012 Lunar Phases — Mystic Island (America/New_York) Time					
 New Moon	 First Quarter	 Full Moon	 Third Quarter	Lunation	
	Jan. 1, Sun 01:16 AM	Jan. 9, Mon 02:32 AM	Jan. 16, Mon 04:09 AM	1101	
Jan. 23, Mon 02:41 AM	Jan. 30, Mon 11:11 PM	Feb. 7, Tue 04:56 PM	Feb. 14, Tue 12:05 PM	1102	
Feb. 21, Tue 05:37 PM	Feb. 29, Wed 08:23 PM	Mar. 8, Thu 04:41 AM	Mar. 14, Wed 09:27 PM	1103	
Mar. 22, Thu 10:39 AM	Mar. 30, Fri 03:42 PM	Apr. 6, Fri 03:20 PM	Apr. 13, Fri 06:51 AM	1104	
Apr. 21, Sat 03:20 AM	Apr. 29, Sun 05:58 AM	May 5, Sat 11:36 PM	May 12, Sat 05:48 PM	1105	
May 20, Sun 07:48 PM	May 28, Mon 04:16 PM	June 4, Mon 07:11 AM	June 11, Mon 06:42 AM	1106	
June 19, Tue 11:03 AM	June 26, Tue 11:30 PM	July 3, Tue 02:51 PM	July 10, Tue 09:49 PM	1107	
July 19, Thu 12:24 AM	July 26, Thu 04:56 AM	Aug. 1, Wed 11:27 PM	Aug. 9, Thu 02:56 PM	1108	
Aug. 17, Fri 11:54 AM	Aug. 24, Fri 09:54 AM	Aug. 31, Fri 09:57 AM	Sept. 8, Sat 09:16 AM	1109	
Sept. 15, Sat 10:10 PM	Sept. 22, Sat 03:42 PM	Sept. 29, Sat 11:18 PM	Oct. 8, Mon 03:34 AM	1110	
Oct. 15, Mon 08:02 AM	Oct. 21, Sun 11:33 PM	Oct. 29, Mon 03:50 PM	Nov. 6, Tue 07:36 PM	1111	
Nov. 13, Tue 05:08 PM	Nov. 20, Tue 09:32 AM	Nov. 28, Wed 09:47 AM	Dec. 6, Thu 10:32 AM	1112	
Dec. 13, Thu 03:42 AM	Dec. 20, Thu 12:19 AM	Dec. 28, Fri 05:22 AM		1113	

Figure 4: Barometric pressure relative to water depth in late October 2012 from Buoy 126 and Nacote Creek meteorological station

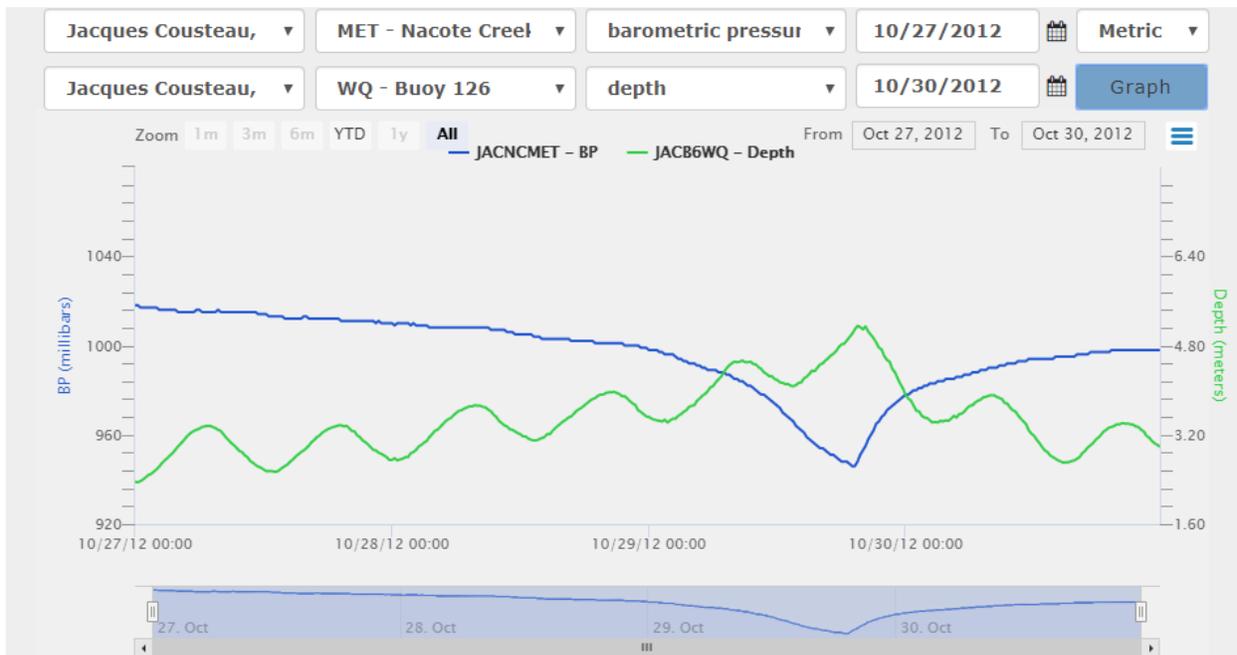
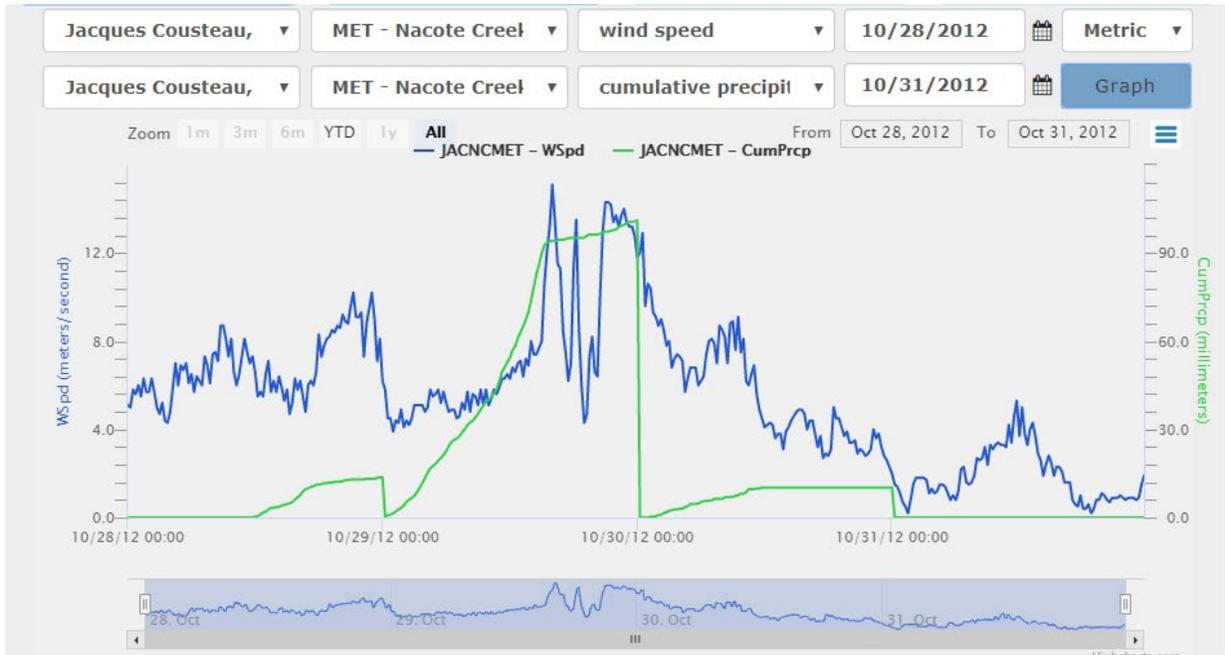


Figure 5: Precipitation and wind speed data in late October 2012 from Nacote Creek meteorological station



Explanation: In typical conditions, salinity increases and decreases in relation to the tide, since ocean water is entering and exiting the estuary. Yes, higher depth and salinity can mean a high tide is occurring. In the October 2012 case, it's much more extreme. Both parameters remained high, plus other events were occurring as well, such as a drop in barometric pressure and an increase in precipitation and wind speed. These clues are indicators of a storm that passed through the region.

Storm surge and windy and wet conditions are observed in these graphs. This was also a large storm. One clue is the wind speed, and you can even detect the eye of the storm in the data. Take another look at the graph with wind speed. See how it suddenly drops and then suddenly spikes back up? That's the eye of the storm! In addition to this meteorological event that took place, a lunar event was also happening—a full moon. The storm event was Superstorm Sandy, which made landfall on the New Jersey coast in late October 2012. The center of the storm passed over Atlantic City, New Jersey, just south of the Jacques Cousteau Reserve.

What makes this event significant or interesting to study? One of the contributing factors for Sandy's destructive power was the arrival of the storm during a rising full-moon tide, which meant the storm surge was stacked on top of an already extreme water level. For New Jersey,

the recorded storm surge from Sandy was over 13 feet (about 8 feet above the average high tide!). This was a wake-up call for the state, especially coastal communities, in terms of planning for weather events and coastal resilience. With sea-level rising at a rate of 0.2-0.5 inches per year in New Jersey, storm surge will only become more destructive for waterfront communities.

Extension Idea: Sea level rise and surge viewer: njfloodmapper.org. Users can plug in Superstorm Sandy conditions to view.