Clearwater's HRECOS Teacher Tutorial

Hudson River Environmental Conditions Observation System

The goals of this tutorial:

- Familiarize teachers with the HRECOS system on the river and online with interactive “Tasks”

- Extend *Clearwater*’s education program by making connections between sailing and classroom experiences

- Give teachers tools to expand on existing curriculum to create their own lessons and research projects

What is HRECOS?

Hudson

River

Environmental

Conditions

Observing

System

HRECOS is a network of water quality data monitoring sites on the Hudson River that report live and historical conditions. Parameters are immediately available for public use and presented in easy to access formats.

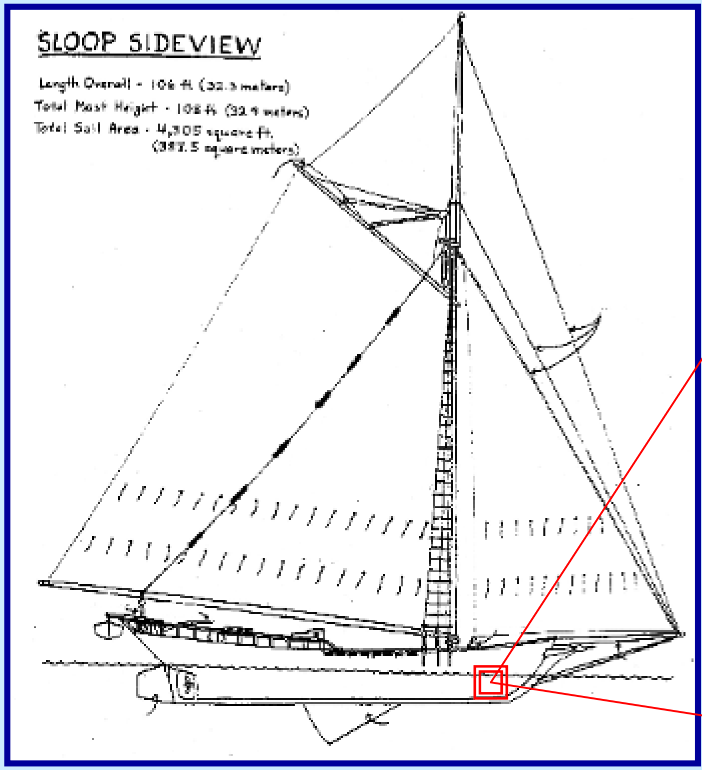
The Hudson River Sloop *Clearwater*

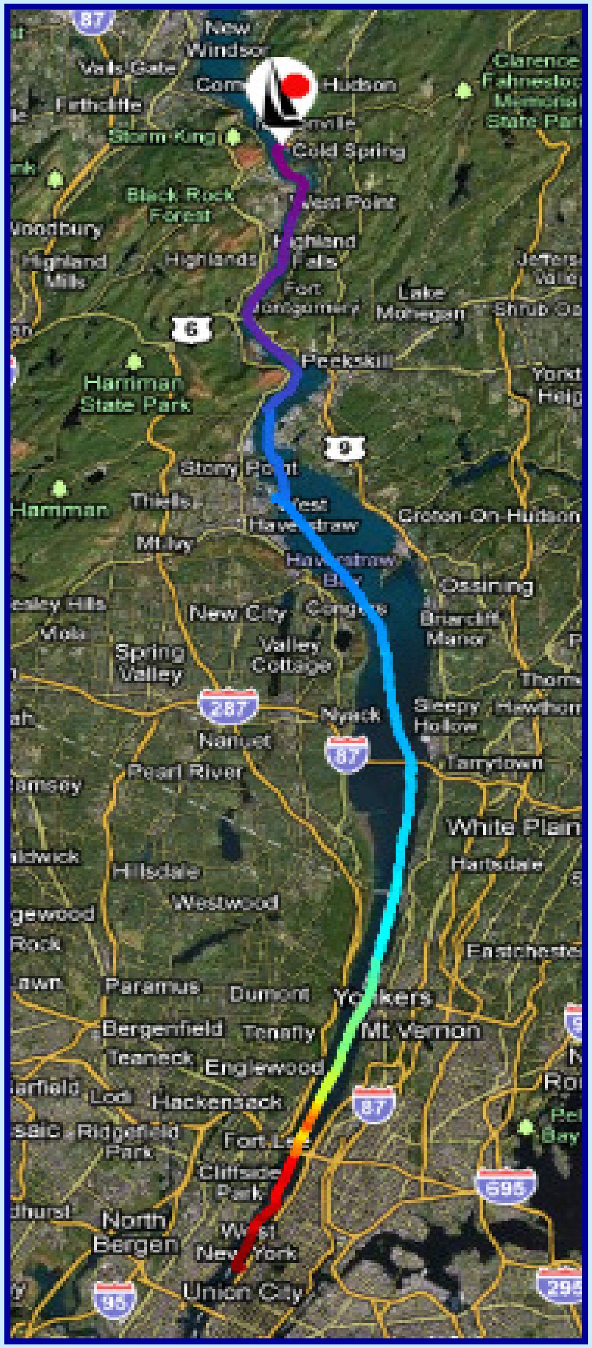
Built in 1969, this tall-ship by a group led by the folk musician Pete Seeger has been highly instrumental in both historic and environmental education.

As part of its mission in spreading awareness, the non-profit *Clearwater* organization has entered a collaboration with the Hudson River Environmental Observations System (HRECOS), and has installed a water quality sonde meter.

HRECOS sonde onboard *Clearwater:*

The water quality sonde meter installed in the Bo’suns’ locker draws in river water to collect real-time data and immediately sends it to the HRECOS website.

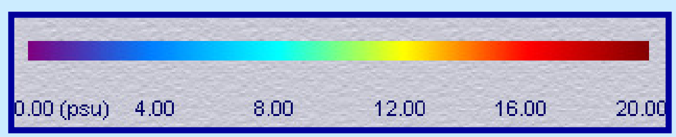




www.HRECOS.org

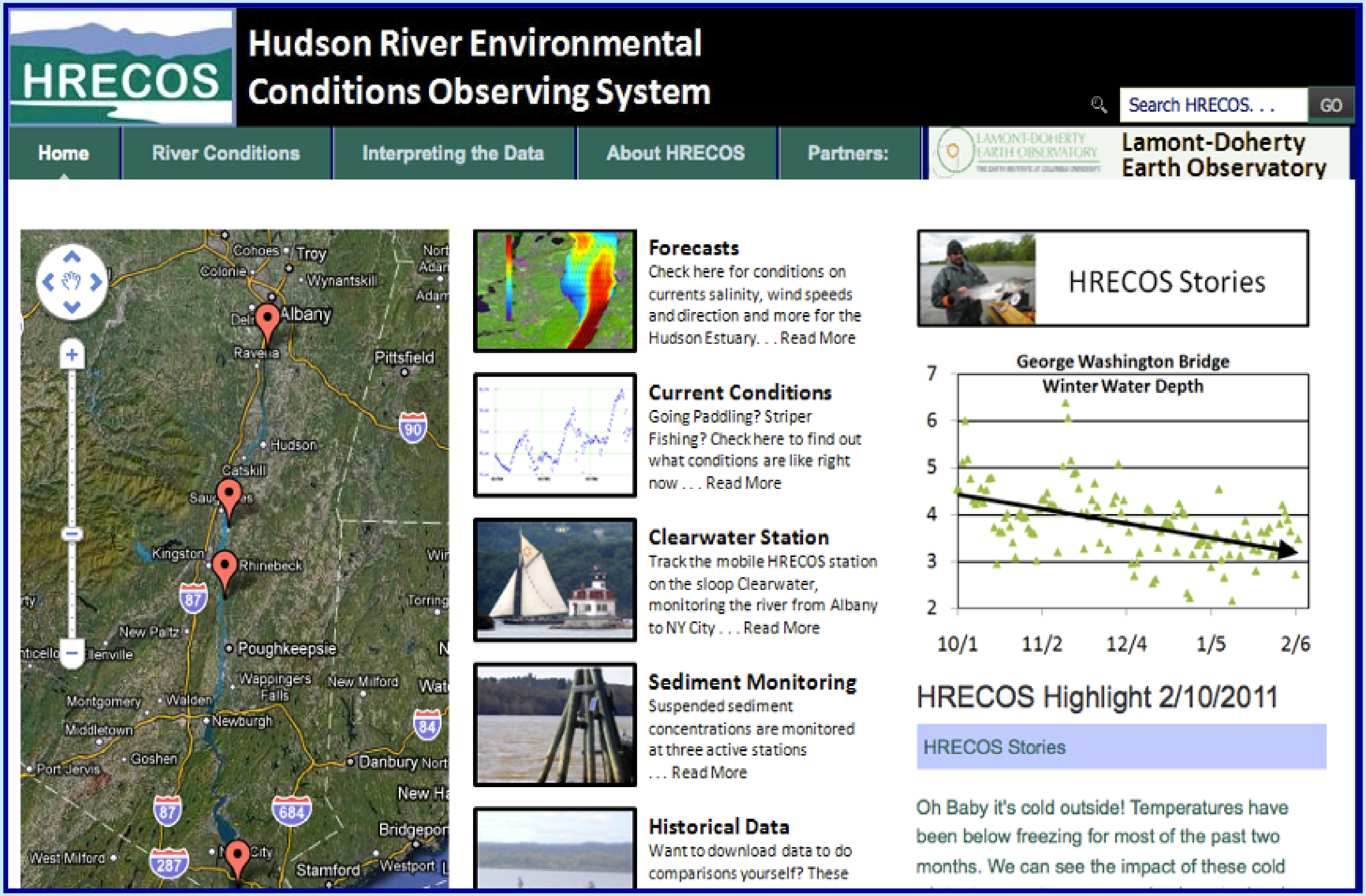
The user-friendly HRECOS website presents easily accessed data that can be manipulated in the form of visual charts and graphs showing important variances in water quality parameters as the river changes in real time.

Now, let's look into how the data can be accessed through the HRECOS website.



Hudson River Environmental Conditions Observing System

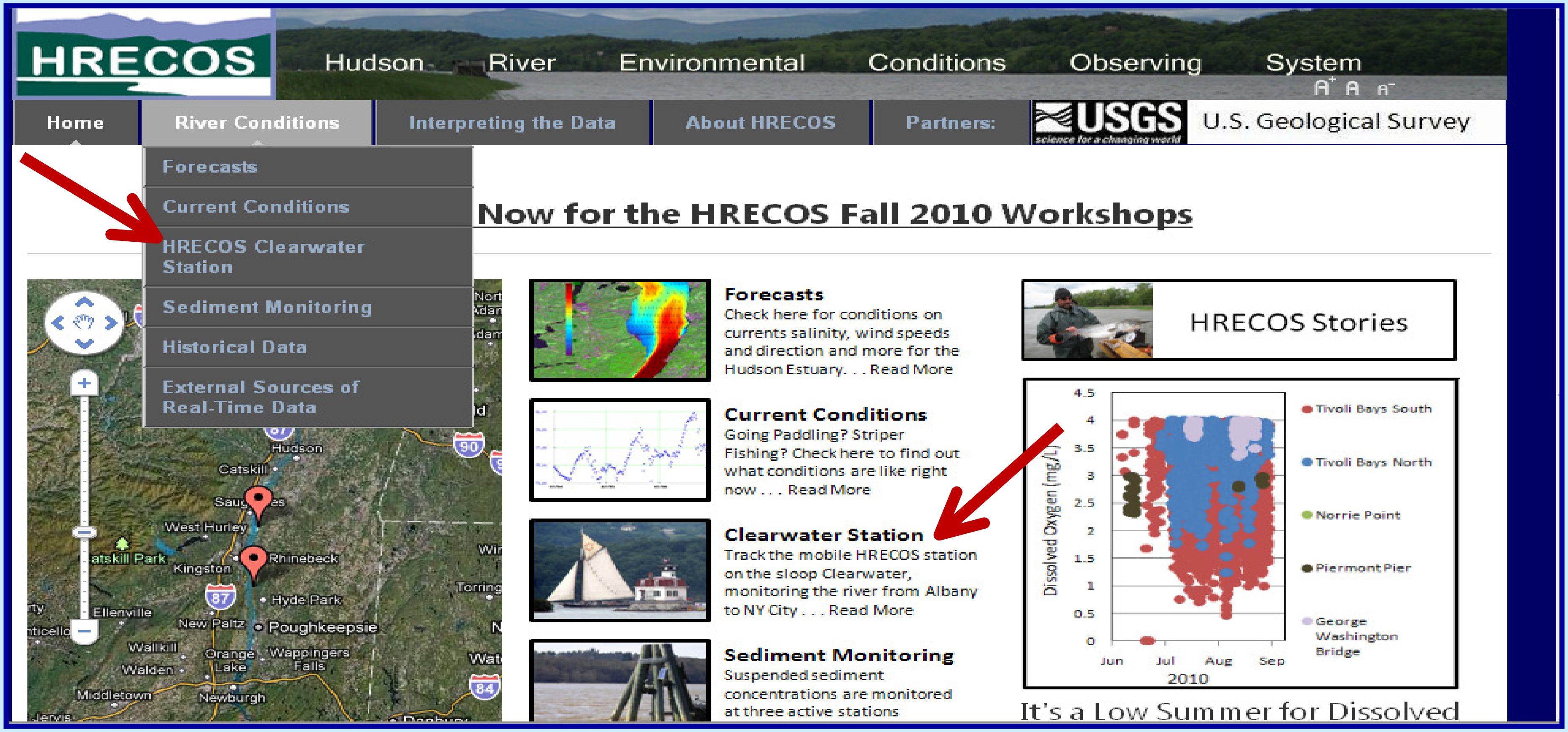
www.hrecos.org



Finding *Clearwater*

You can gain access to the data collected aboard the *Clearwater* in two ways

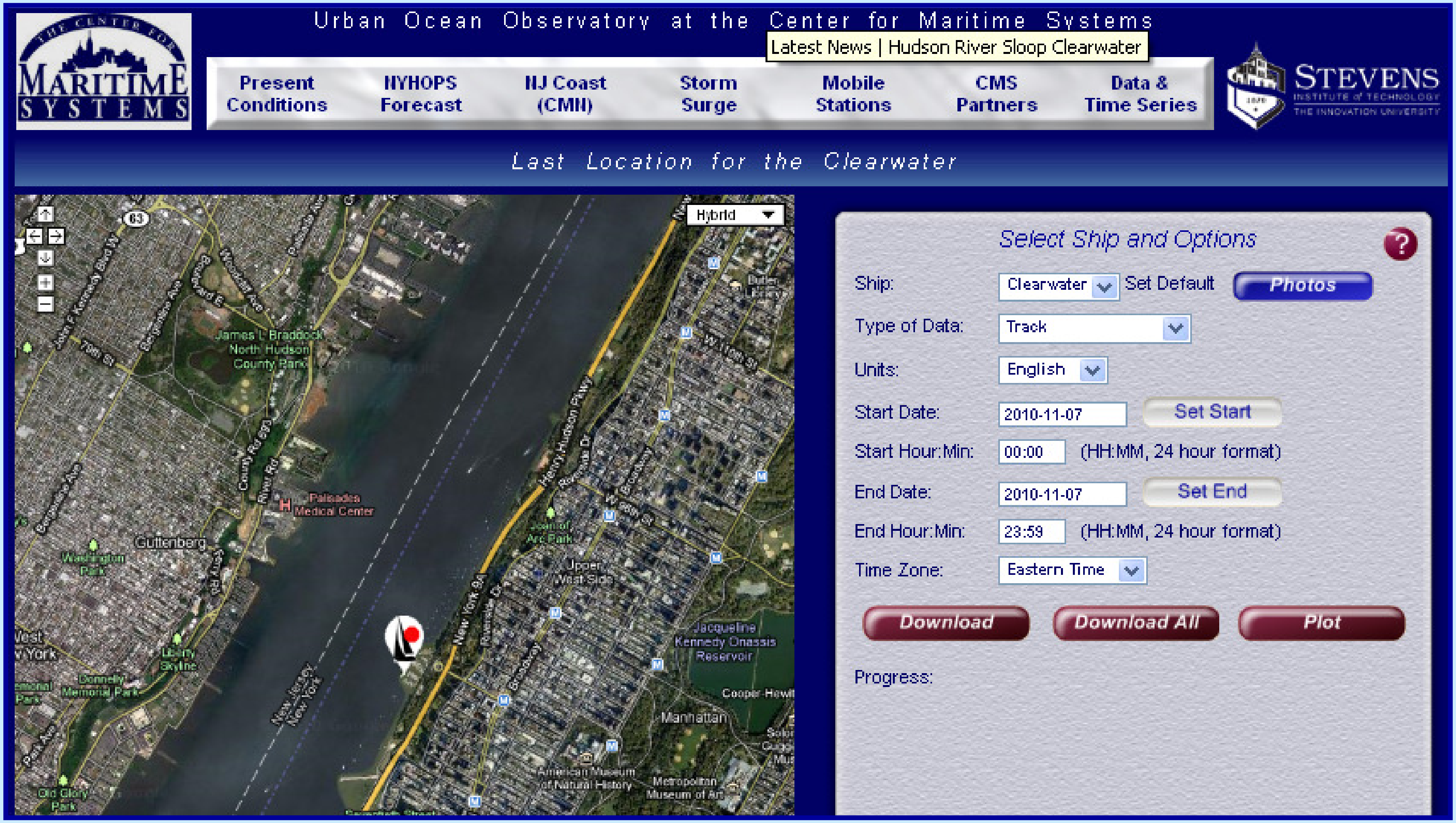
1. Click on "**HRECOS Clearwater Station**" within the drop-down menu of the "River Conditions" tab:
2. Or by directly clicking on the "**Clearwater Conditions**" link:



HRECOS: Mobile *Clearwater* Station

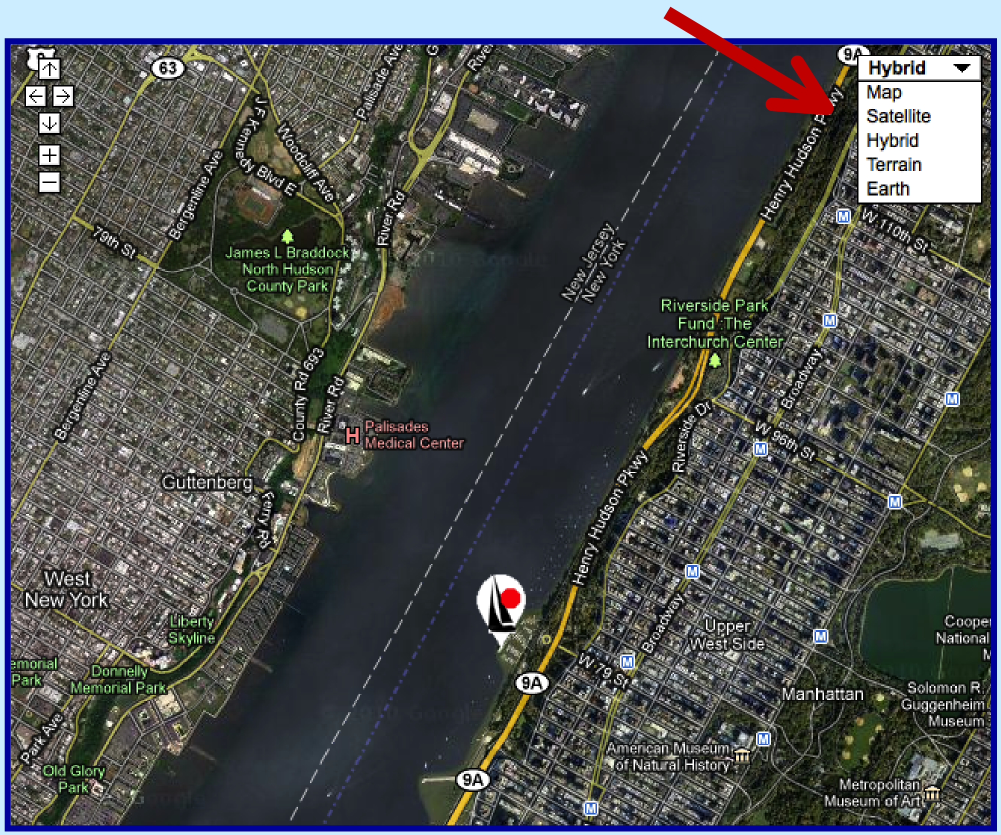
Tested Parameters:Track, Dissolved Oxygen, Salinity, Turbidity, Water Temp.

Range: The Hudson River between New York Harbor and Albany



Viewing the Data:

On the site, you will see a map tracking *Clearwater* and the Hudson River water parameters. There are different ways to view the map. In the upper right corner of the map is a drop-down menu for visualization preferences. By default, it is set to “Hybrid”, which incorporates features from the other options.



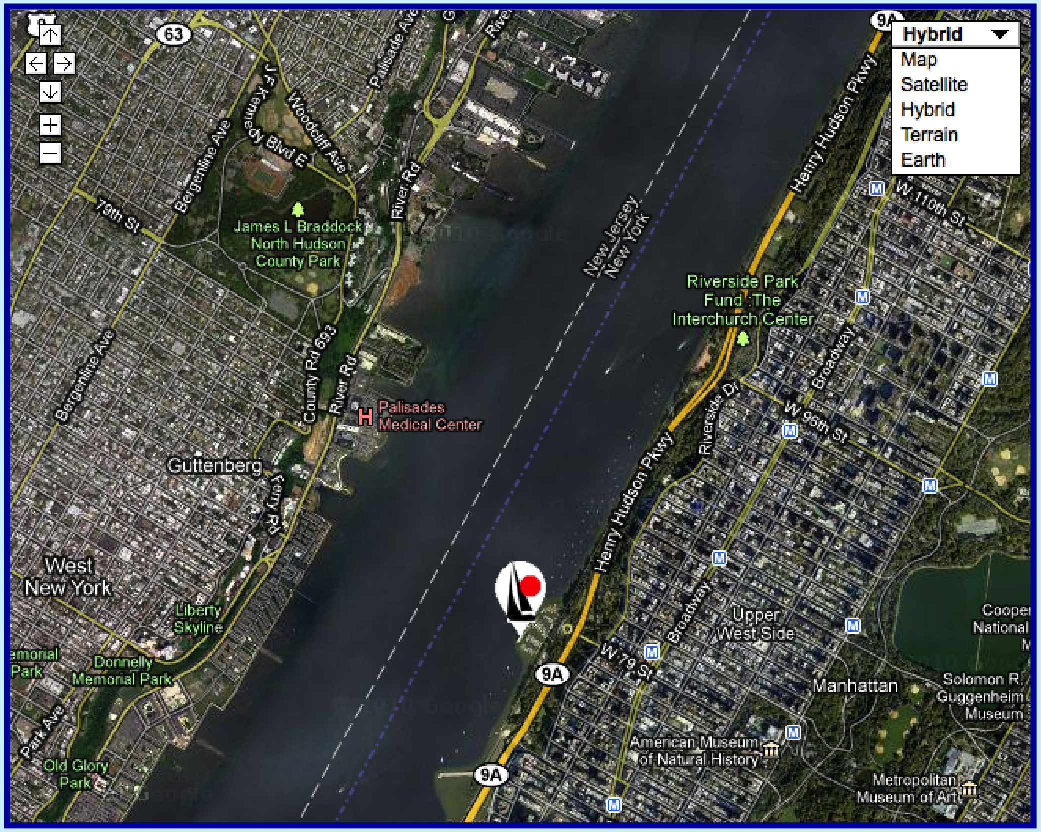
The full list of possibilities:

- Map
- Satellite
- Hybrid
- Terrain
- Earth

Choose your preference!

Viewing the Data:

In the upper left corner you will see arrows used to navigate and to zoom in and out on specific locations



Familiarize yourself with these options, so that you can become comfortable with the map viewing tools you can use.

Clearwater Sails and Collects Data:

The boat sails daily with students from various docks on the Hudson.

To access historical or real-time data from a specific date, it will be helpful refer to the *Clearwater* sailing schedule. You will be accessing data collected while students are fishing, sailing and navigating aboard the boat!

Clearwater's Sail Schedule:

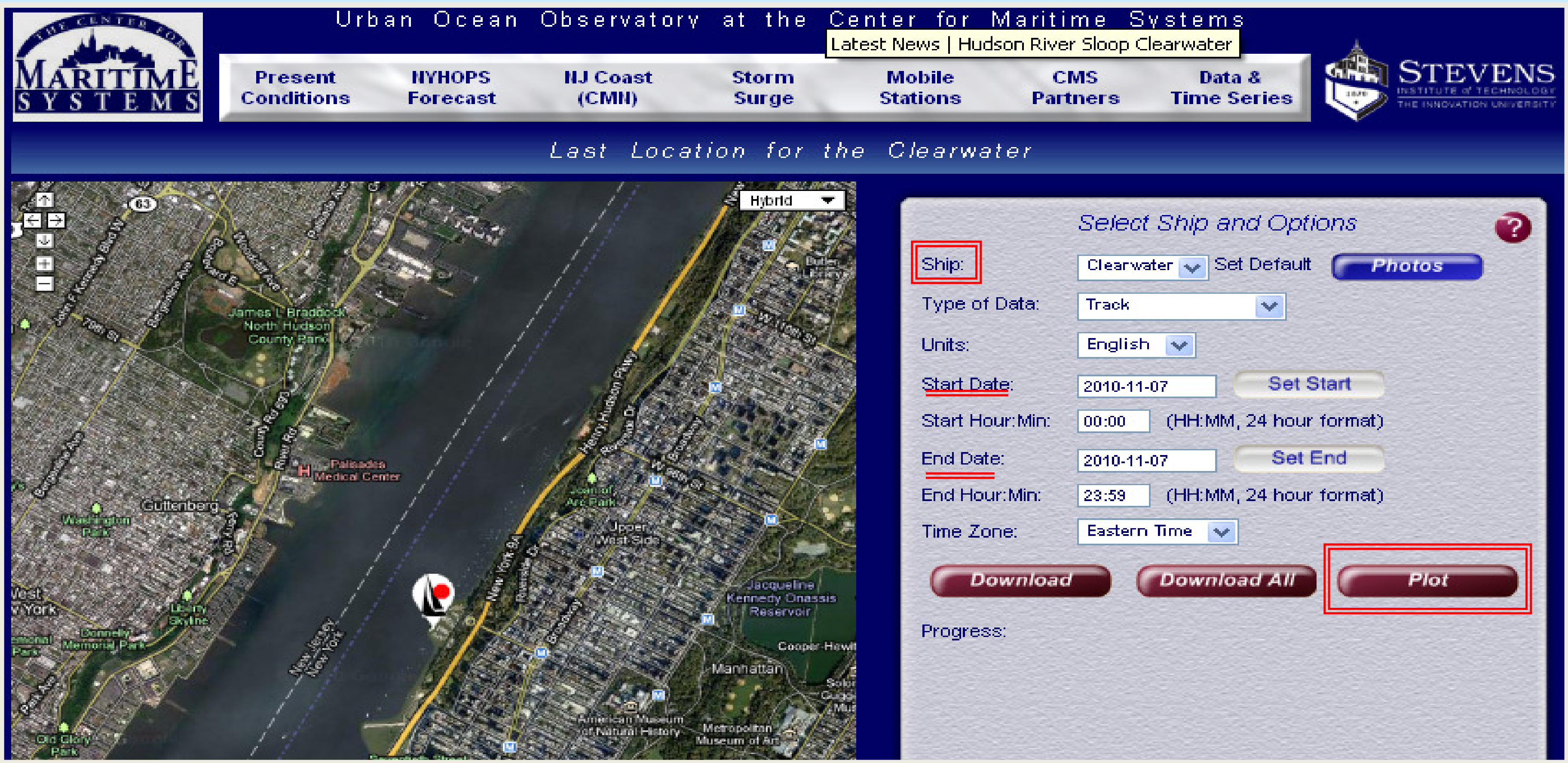
http://www.clearwater.org/come-sailing/sail-schedule/

The schedule can be a valuable tool if you are looking for significant historical data for our curriculum or to create your own. Here you can see what time the boat will leave/return to the dock, who will be aboard and from which town it will sail.

						KINGSTON
10	11	12	13	14	15	16
VOLUNTEER TRAINING DAY KINGSTON	9:00-12:00 Available Charter KINGSTON	9:00-12:00 Tech Valley HS HUDSON	9:00-12:00 TBA Cairo-Durham CATSKILL	9:00-12:00 Doane Stuart HUDSON	9:00-12:00 Eagle Point ES RENSSELAER	AM Available Charter RENSSELAER
	1:00-4:00 Available Charter KINGSTON	1:00-4:00 Available Charter HUDSON	1:00-4:00 TBA Cairo-Durham CATSKILL	1:00-4:00 Glens Falls HUDSON	1:00-4:00 Available Charter RENSSELAER	1:00-4:00 Girl Scouts NENY RENSSELAER
	CATSKILL			RENSSELAER		

Once you have determined a desirable day:

1. Under Ship select “Clearwater”
2. Enter “Start Date” and “End Date” (YYYY:MM:DD)
3. Select Plot to make sure that your data is available. The track (pictured below) should begin immediately.



Trouble Shooting:

The schedule is generally posted well in advance but occasionally due to weather or other unforeseen circumstances there may be last minute changes.

Occasionally, data may be temporarily unavailable due to a malfunction.

You can be sure that the engineer onboard busily repairing the problem.

Tested Parameters

There are four hydrological parameters that the sonde system allows *Clearwater* to measure.

- Salinity – practical salinity units (psu)
- Dissolved Oxygen (D.O.) – parts per million (ppm)
- Turbidity – Nephelometric Turbidity Units (ntu)
- Surface Water Temperature – Fahrenheit (F)

These parameters can either be spatially or temporally dependent which will affect your data-processing. Meaning, some parameters are better examined over space and others over changes in time.

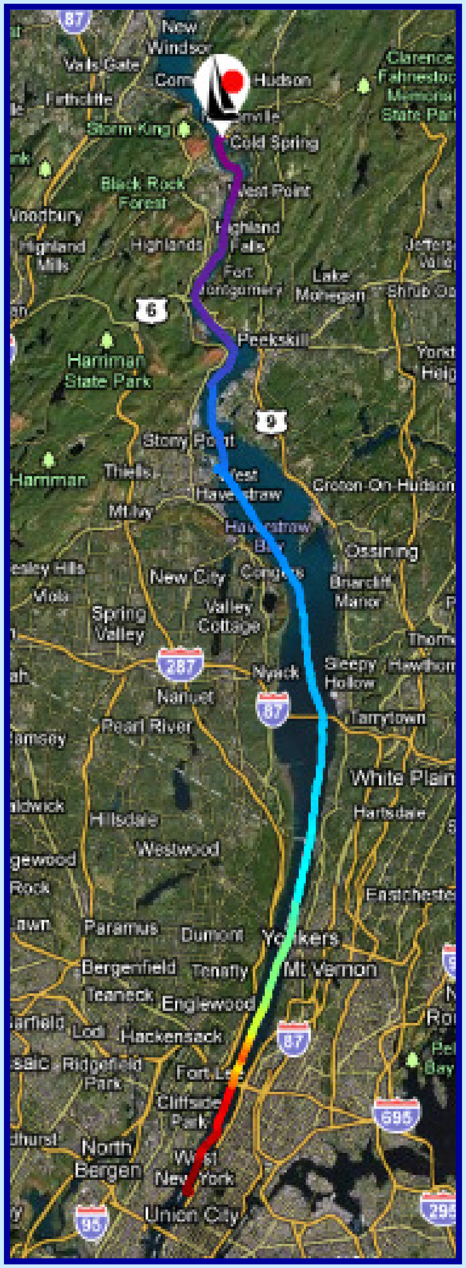
<u>Time Versus Space</u>

Salinity is spatially dependent on a large scale—that is, measured values will depend on the location at which the data collection occurs.

The data is more easily visualized when the boat is moving up or down the river in long transits.

(such as the one on pictured to the right)

Let's take a look at August 8th, 2010 during which the *Clearwater* transited from Manhattan to Cold Spring.

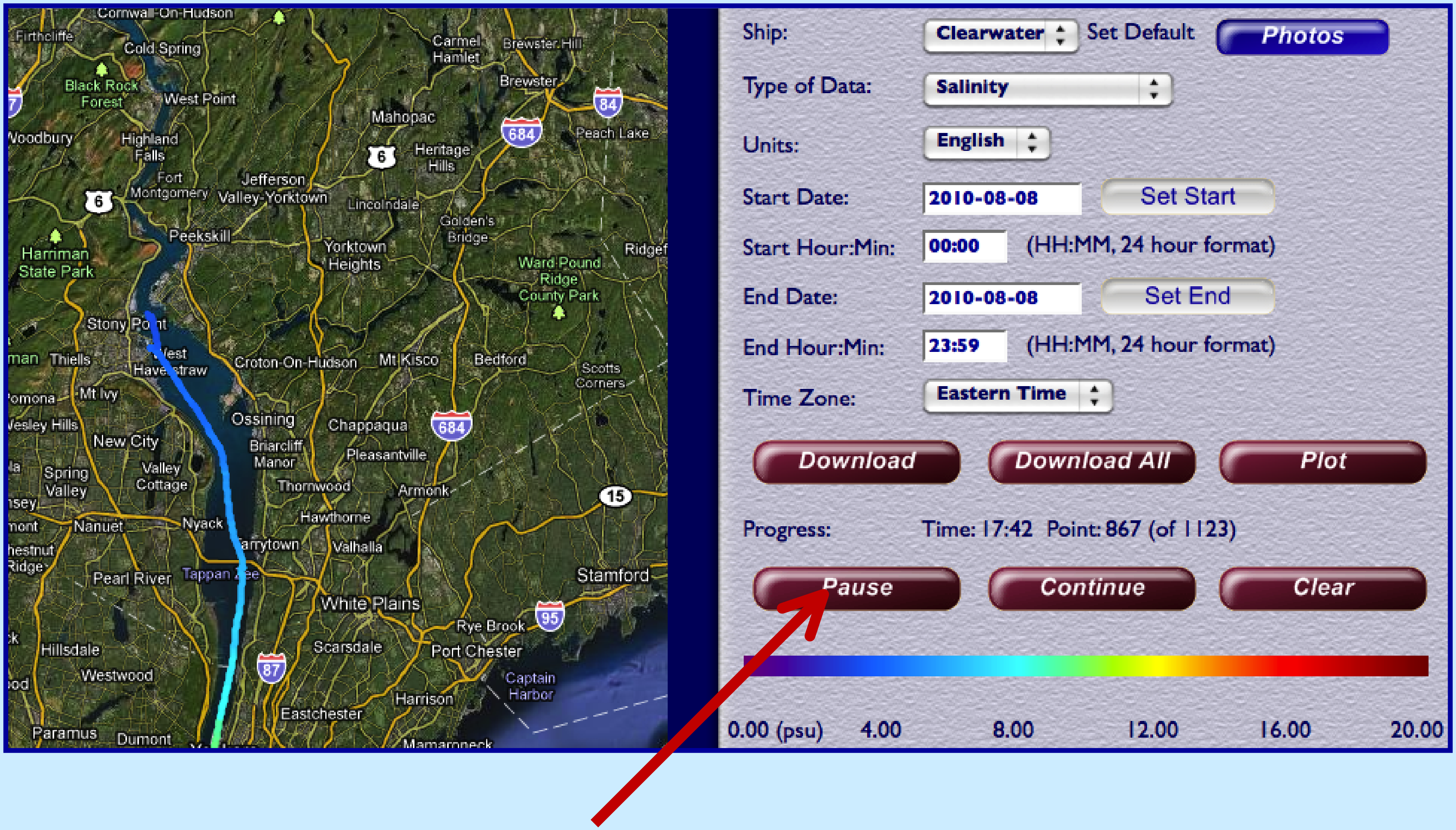


Salinity

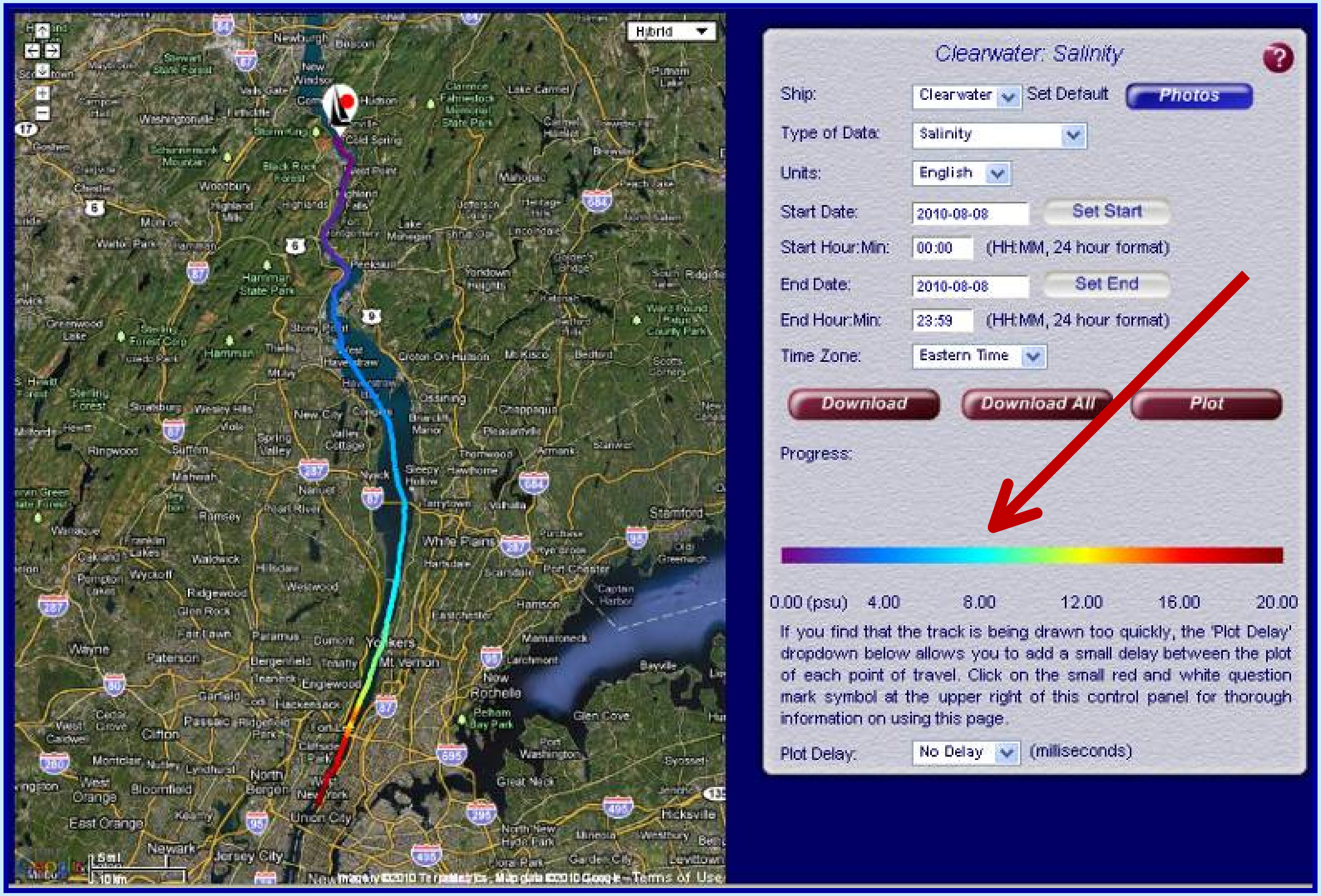
Task #1: Time to try it yourself!

1. www.hrecos.org
2. Under “Ship”, select *Clearwater*
3. Select “Salinity” under the Type of Data drop-down menu
4. Units: English
5. Change the dates appropriately (2010-08-08)
6. Start Hour:Min 00:00
7. End Hour:Min: 23:59
8. Time Zone: Eastern Time

...and plot! Note that as the track is, you have the option of pausing or continuing the plot.



The resulting map should look like this:

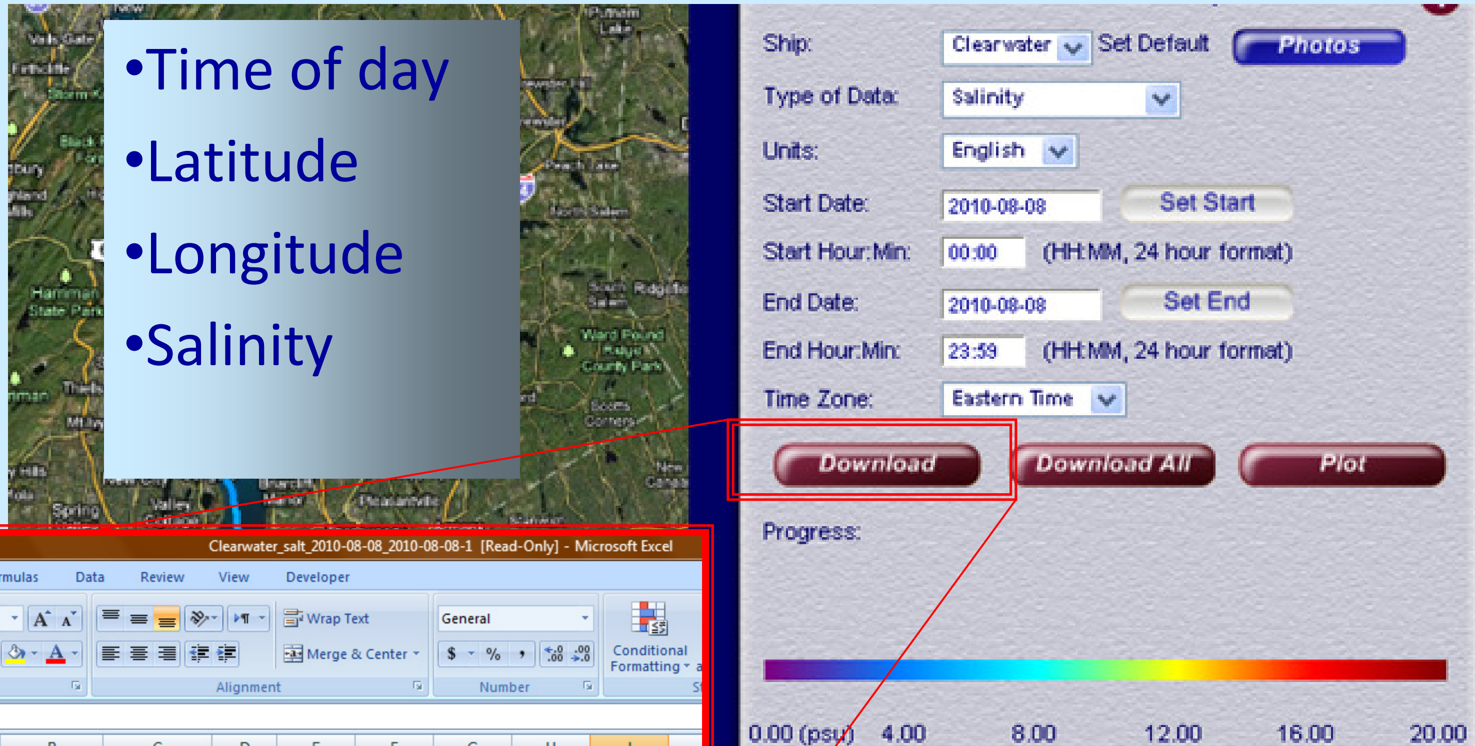


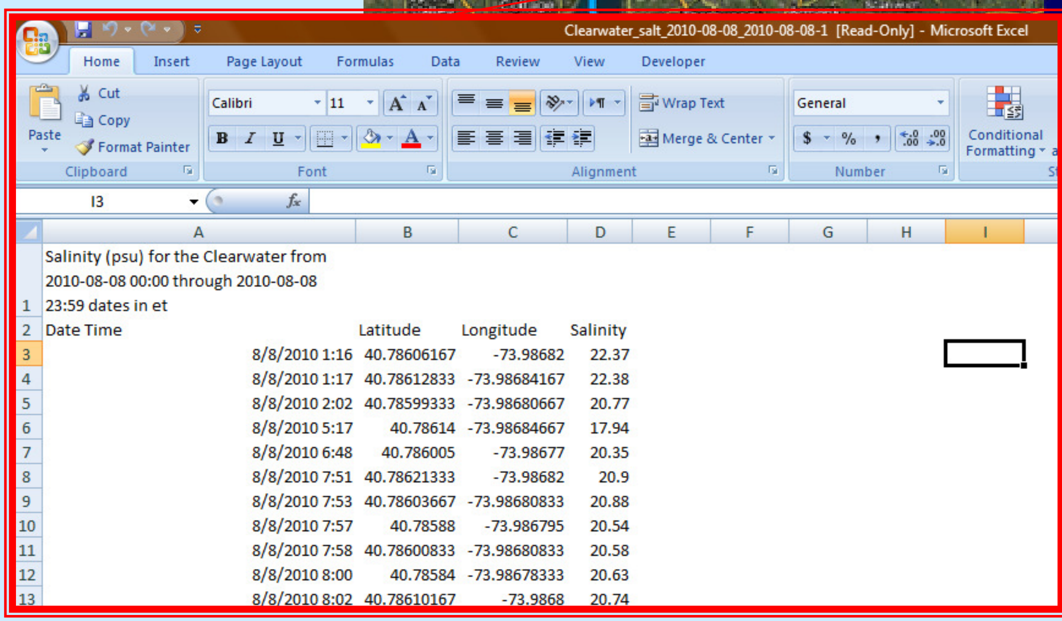
Note the Unit Scale for this parameter. (0.00 - 20.00 psu) This changes depending upon the lowest and highest readings detected for the selected time period.

How to Access the raw Data:

Download will give you access to a spreadsheet

- Time of day
- Latitude
- Longitude
- Salinity

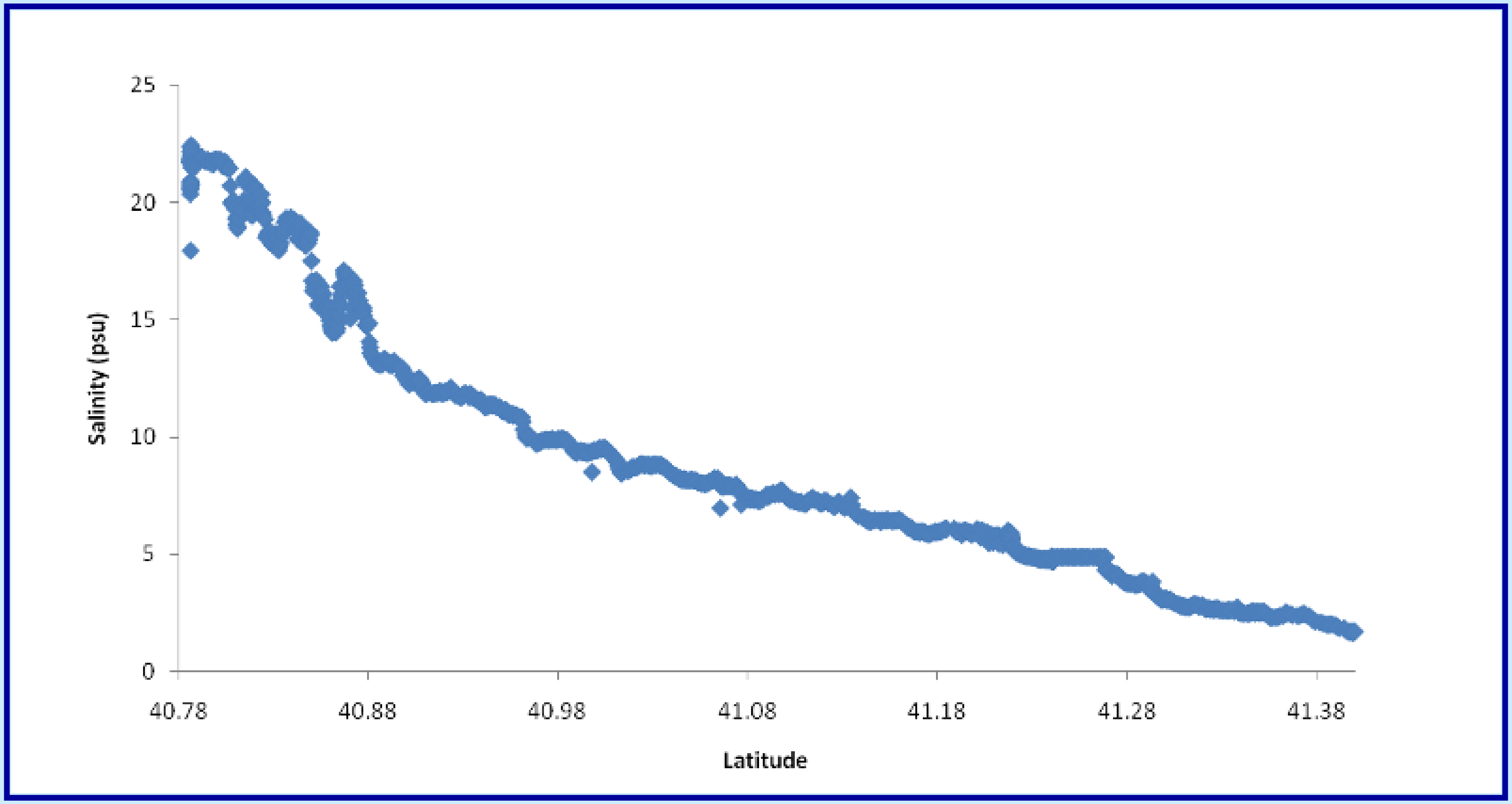




	A	B	C	D
1	Salinity (psu) for the Clearwater from 2010-08-08 00:00 through 2010-08-08 23:59 dates in et			
2	Date Time	Latitude	Longitude	Salinity
3	8/8/2010 1:16	40.78606167	-73.98682	22.37
4	8/8/2010 1:17	40.78612833	-73.98684167	22.38
5	8/8/2010 2:02	40.78599333	-73.98680667	20.77
6	8/8/2010 5:17	40.78614	-73.98684667	17.94
7	8/8/2010 6:48	40.786005	-73.98677	20.35
8	8/8/2010 7:51	40.78621333	-73.98682	20.9
9	8/8/2010 7:53	40.78603667	-73.98680833	20.88
10	8/8/2010 7:57	40.78588	-73.986795	20.54
11	8/8/2010 7:58	40.78600833	-73.98680833	20.58
12	8/8/2010 8:00	40.78584	-73.98678333	20.63
13	8/8/2010 8:02	40.78610167	-73.9868	20.74

Graphing Salinity v. Latitude

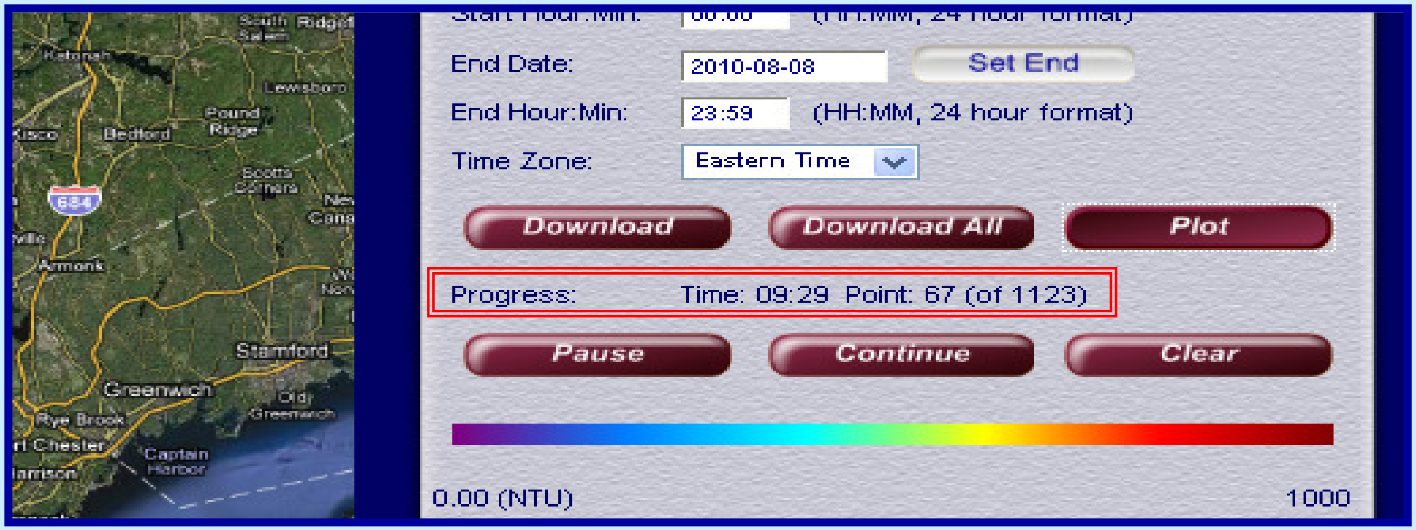
Another way to observe the definite decrease in salt concentration as the *Clearwater* sails to Cold Spring is graphically.



Specific Times

The previous example of *Clearwater's* August 8th transit did not specify a specific time period. We plotted from 00:00 to 23:59, a whole day!

The *Clearwater* crew do not sail for twenty-four hours straight. In fact, if you look carefully at the progress report during the day, sailing begins around 9AM and ends around 4PM.



In this case, setting the time to a full 24-hrs does not matter, if you need the whole sail.

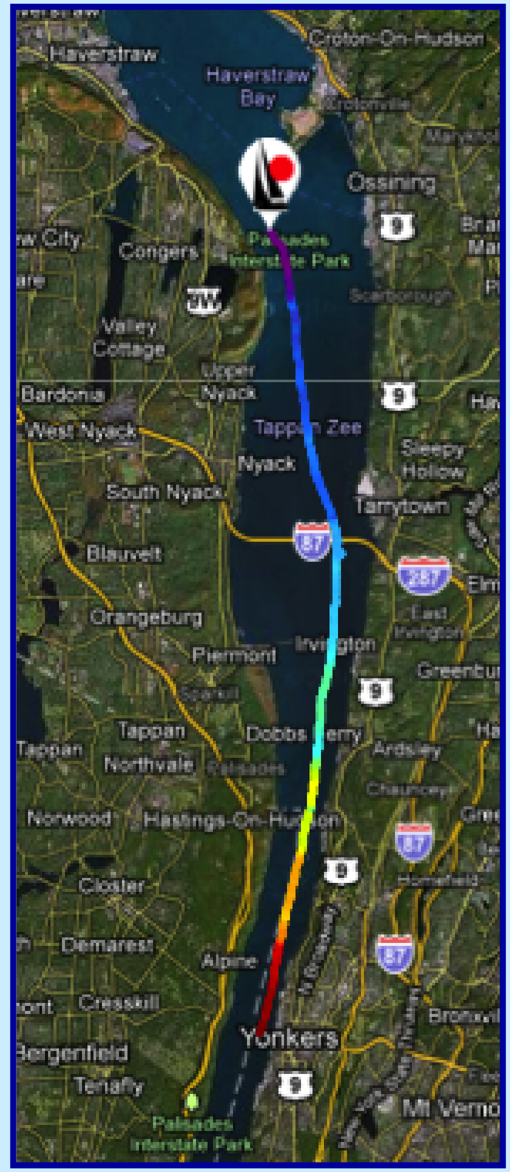
Task #2:

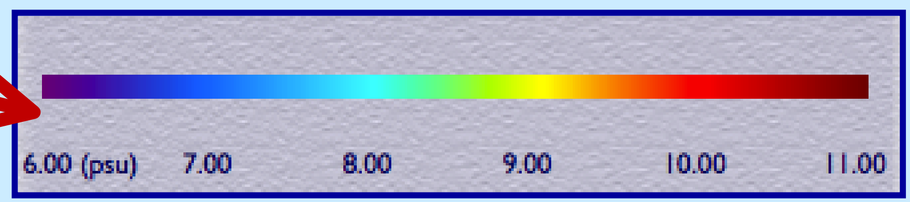
Let's look at salinity during a shorter period.

1. Change the hours to:

Start Time:	12:00
End Time:	15:00

2. Note that the color-coded unit scale has changed from a range of 0.00—20.00 psu to 6.00—11.00 psu.



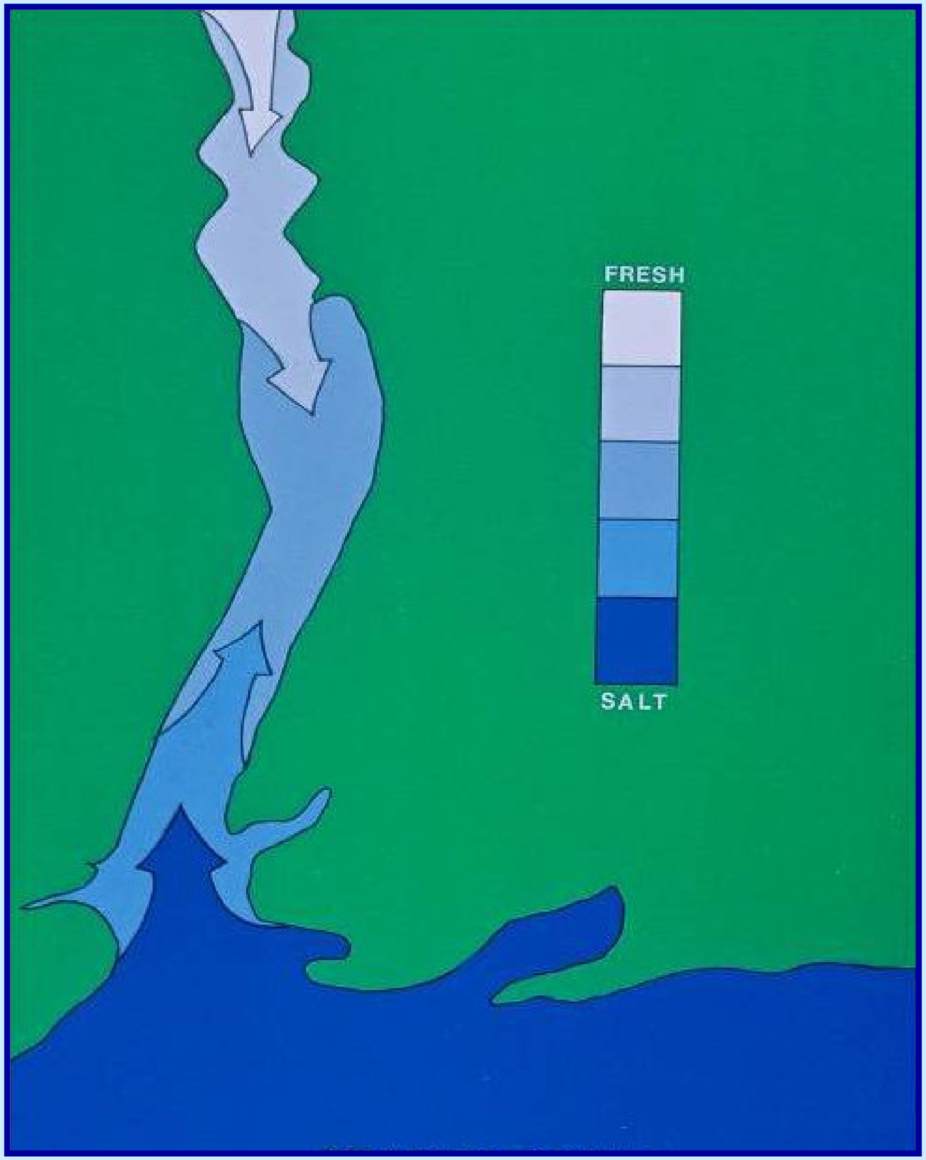


Salinity measures are great for understanding the effects of the river's tides and currents, and allows you explore many questions with students:

Why does salinity decrease with latitude?

How is this important to the Hudson River's role as an estuary?

How does it affect the life cycles of fish and other organisms in the river?

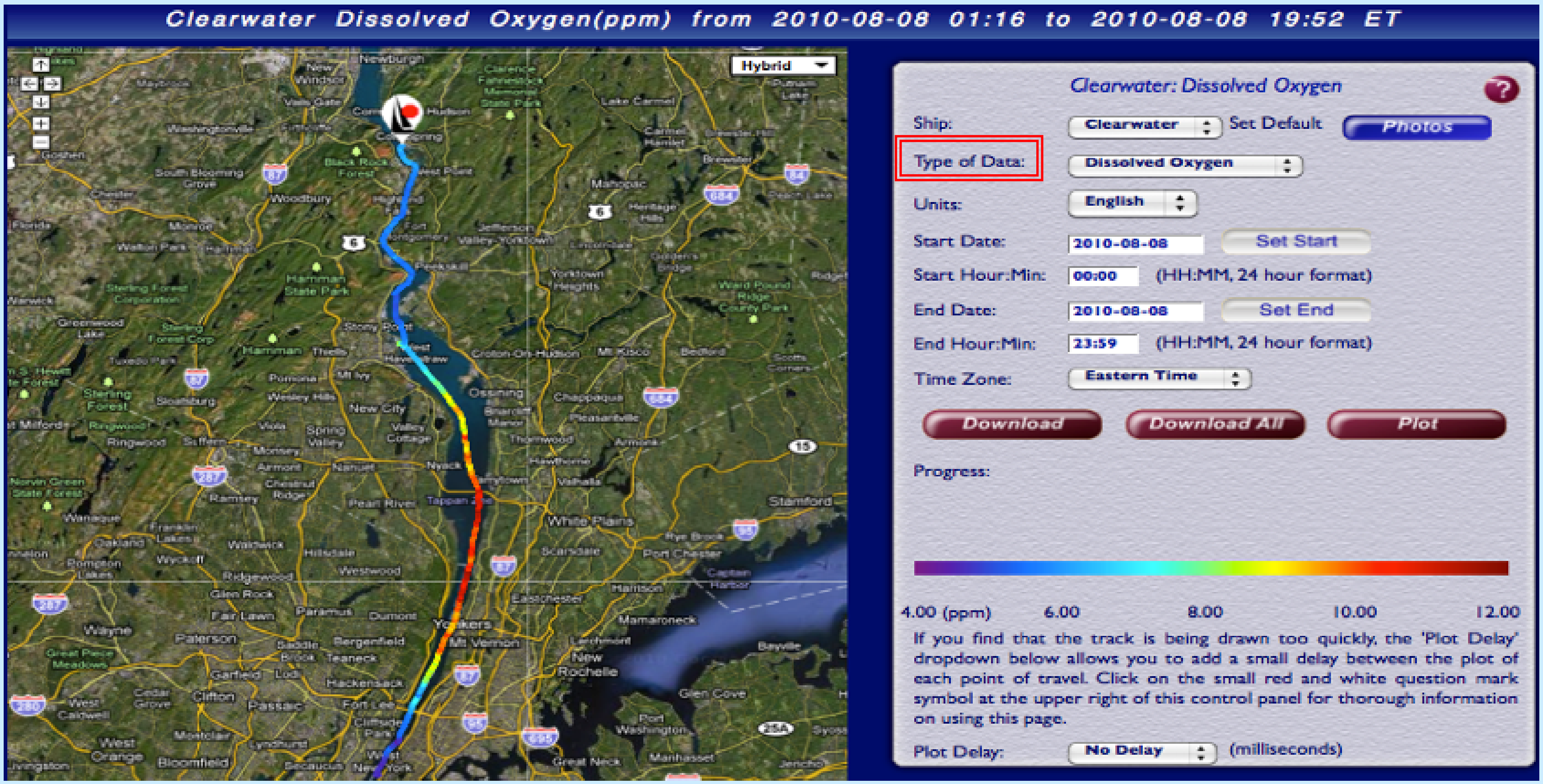


Muh-he-kun-ne-tuk, the river that flows both ways, with opposing saltwater and freshwater currents.

Dissolved Oxygen

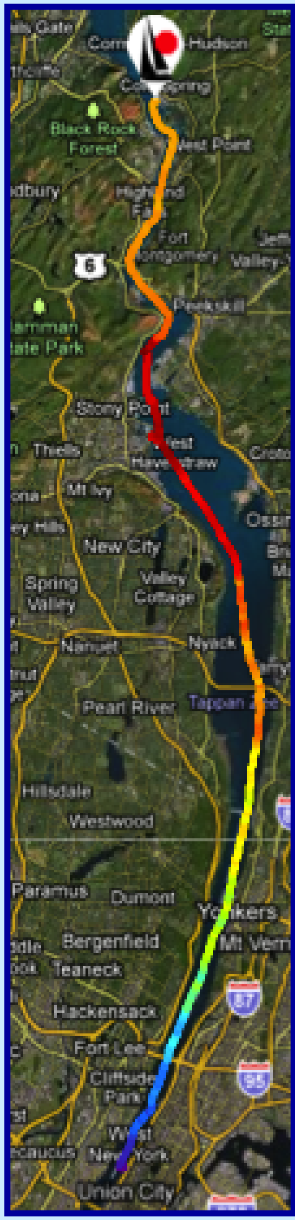
Task #3:

1. From Type of Data Select "Dissolved Oxygen"
2. Return the Start and End Times to 00:00 to 23:59

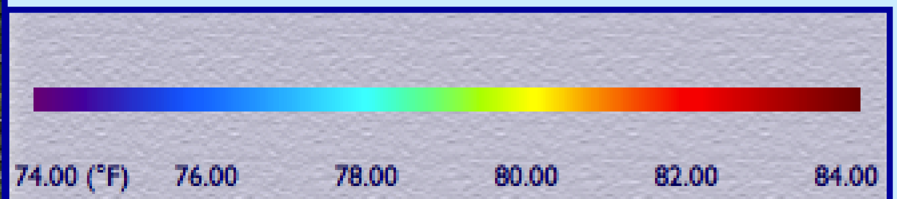


Note: units have now changed, from *psu* for Salinity to *ppm* for Dissolved Oxygen.

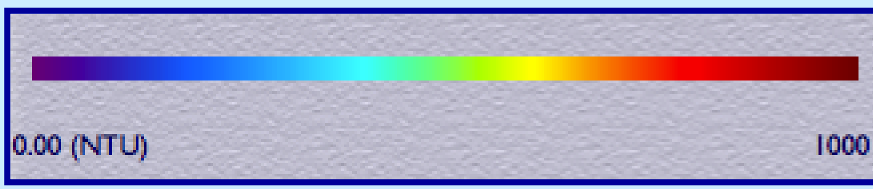
3. Repeat for Surface Water Temperature and Turbidity (compare your results)

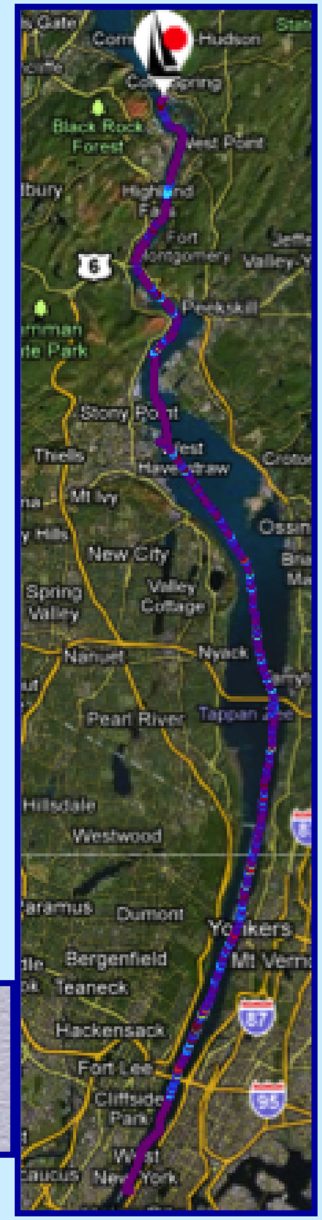


Surface Water Temp



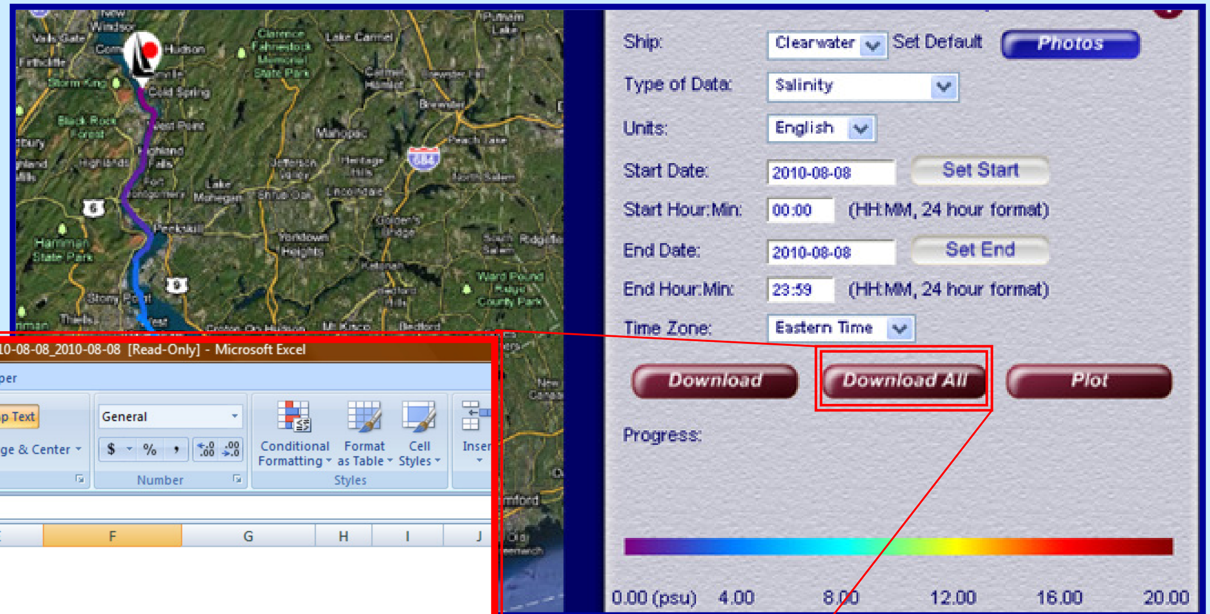
Turbidity

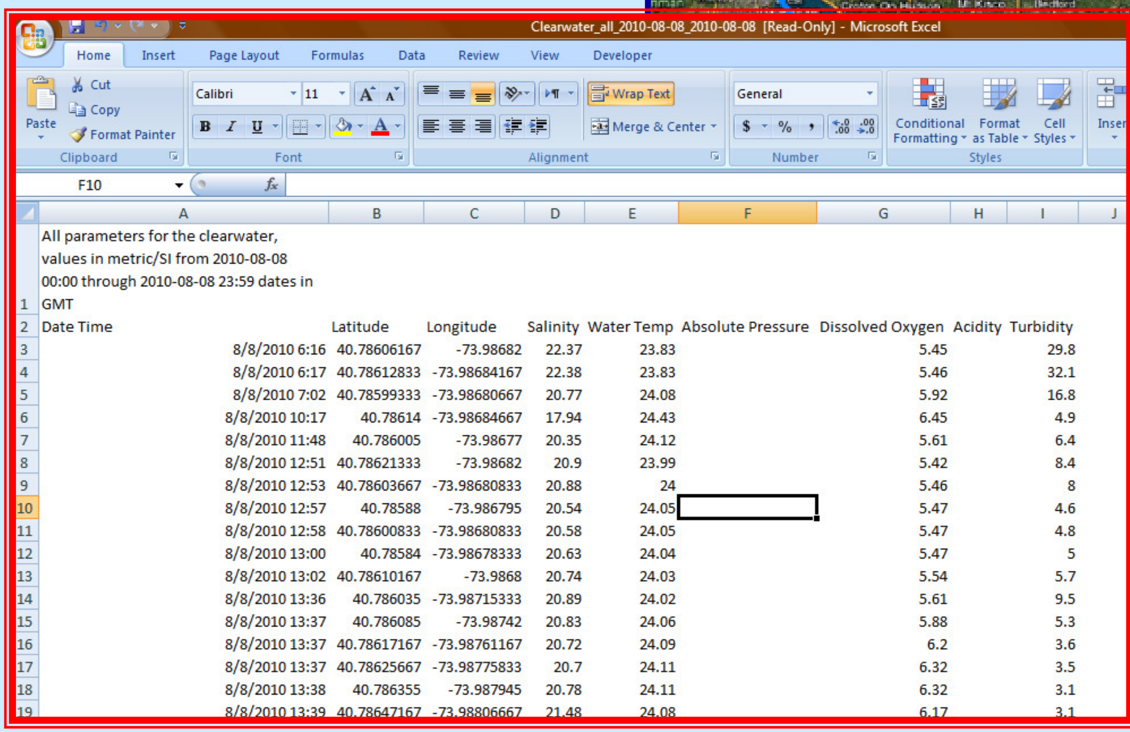




Comparing all Parameters

4. Download All gives access to a spreadsheet with all of the available parameters.





Clearwater_all_2010-08-08_2010-08-08 [Read-Only] - Microsoft Excel

All parameters for the clearwater, values in metric/SI from 2010-08-08 00:00 through 2010-08-08 23:59 dates in GMT

Date Time	Latitude	Longitude	Salinity	Water Temp	Absolute Pressure	Dissolved Oxygen	Acidity	Turbidity
8/8/2010 6:16	40.78606167	-73.98682	22.37	23.83		5.45		29.8
8/8/2010 6:17	40.78612833	-73.98684167	22.38	23.83		5.46		32.1
8/8/2010 7:02	40.78599333	-73.98680667	20.77	24.08		5.92		16.8
8/8/2010 10:17	40.78614	-73.98684667	17.94	24.43		6.45		4.9
8/8/2010 11:48	40.786005	-73.98677	20.35	24.12		5.61		6.4
8/8/2010 12:51	40.78621333	-73.98682	20.9	23.99		5.42		8.4
8/8/2010 12:53	40.78603667	-73.98680833	20.88	24		5.46		8
8/8/2010 12:57	40.78588	-73.986795	20.54	24.05		5.47		4.6
8/8/2010 12:58	40.78600833	-73.98680833	20.58	24.05		5.47		4.8
8/8/2010 13:00	40.78584	-73.98678333	20.63	24.04		5.47		5
8/8/2010 13:02	40.78610167	-73.9868	20.74	24.03		5.54		5.7
8/8/2010 13:36	40.786035	-73.98715333	20.89	24.02		5.61		9.5
8/8/2010 13:37	40.786085	-73.98742	20.83	24.06		5.88		5.3
8/8/2010 13:37	40.78617167	-73.98761167	20.72	24.09		6.2		3.6
8/8/2010 13:37	40.78625667	-73.98775833	20.7	24.11		6.32		3.5
8/8/2010 13:38	40.786355	-73.987945	20.78	24.11		6.32		3.1
8/8/2010 13:39	40.78647167	-73.98806667	21.48	24.08		6.17		3.1

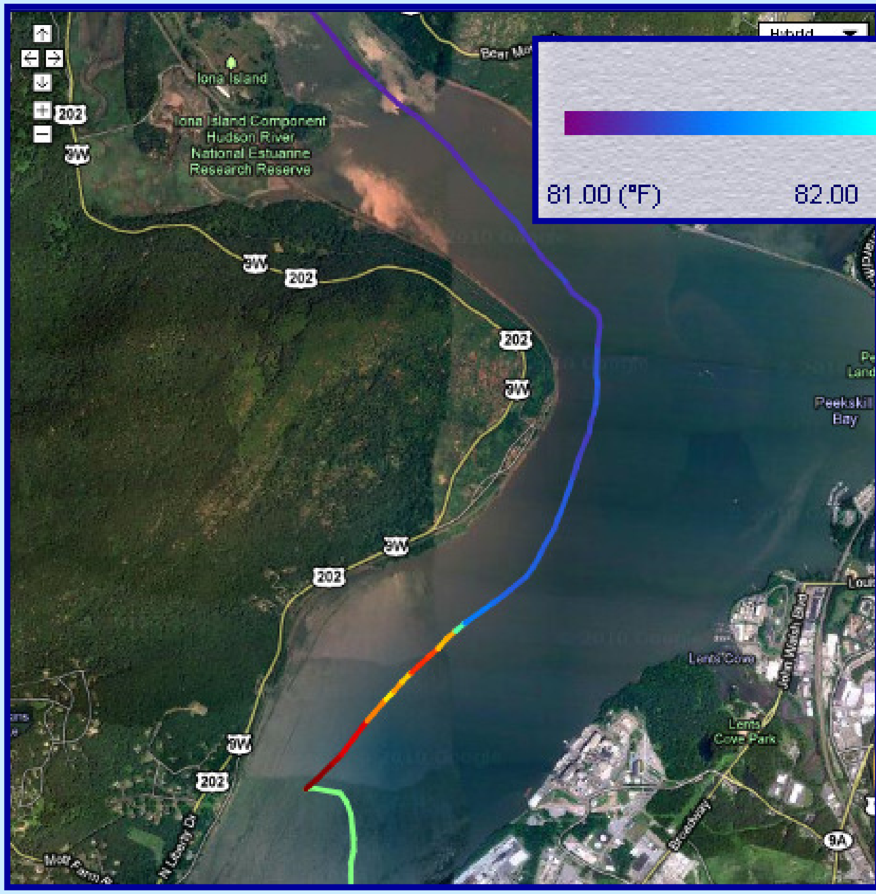
Comparing Time Periods:

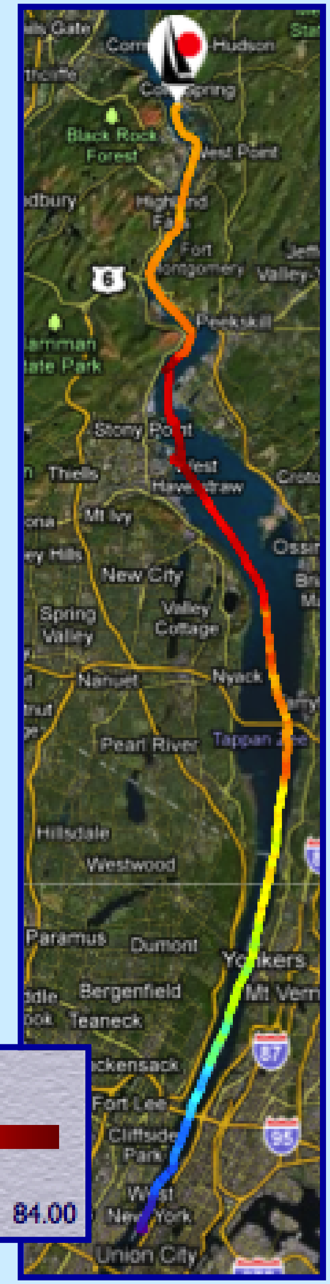
So far, we have mostly looked at large-scale changes in the data. Let's try looking at a much smaller time period.

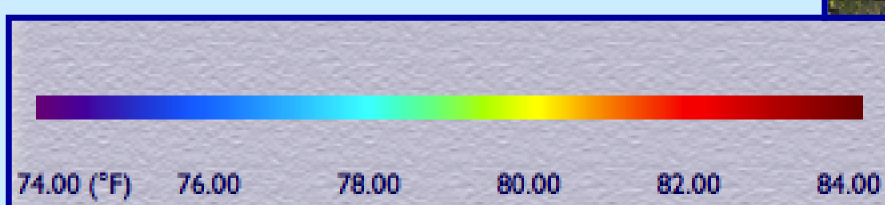
Task #4:

1. Plot and Examine the Water Temperature as the Sloop passes Peekskill on August 8th, 2010 from 00:00 – 23:59
2. Now plot the same parameter between 17:55 - 18:25
3. Compare your findings with the next slide

You can see the difference when visualizing results on different time scales—why are we seeing different trends?





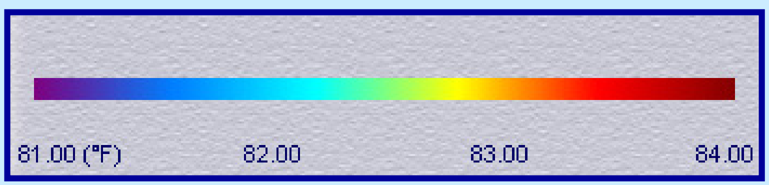


What do you think is causing this increase in water temperature?

When collecting data over a long period of time, we observe general trends. Haverstraw Bay is a wide but very shallow part of the river where the sun increases the water temperature.

When collecting data over a short period of time, we begin to observe *local* effects on these parameters.

In this case, the hot water discharge from the Indian Point Power Plant caused an immediate increase in the water temperature.



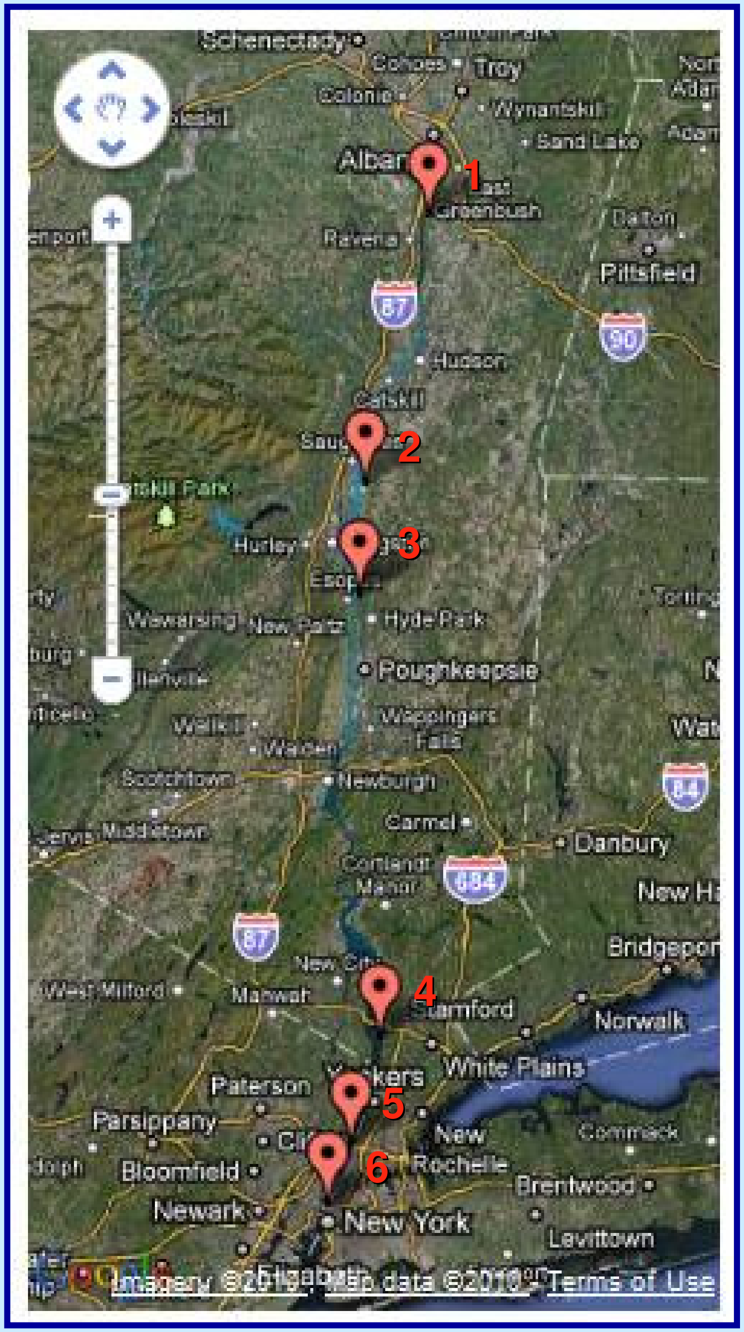
This particular phenomenon was featured as a HRECOS Story: "Observations from the Sloop Clearwater"

Fixed Stations:

Clearwater is only a small part of the HRECOS network. There are six stationary sites which collect hydrological and meteorological data.

Available stations:

1. Schodack Island
2. Tivoli Bay
3. Norrie Point
4. Piermont
5. GW Bridge
6. Castle Point



Fixed stations provide even more information about the Hudson River Estuary:

Hydrological Parameters

- Acidity
- Water Level
- Dissolved Oxygen
- Salinity
- Specific Conductance
- Chlorophyll
- Turbidity
- Water Temperature

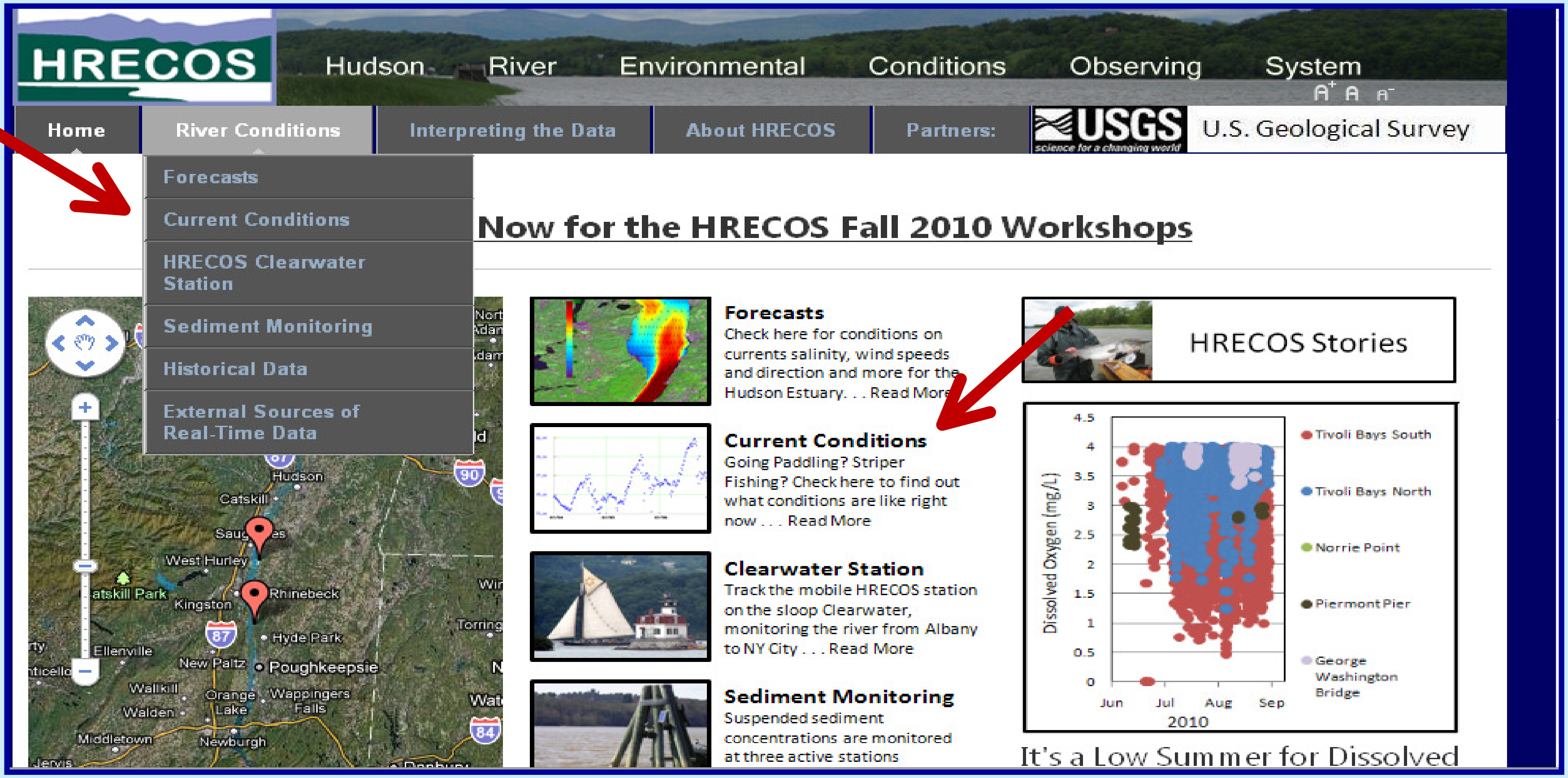
Meteorological Parameters

- Air Temperature
- Barometric Pressure
- Dew Point
- Radiation
- Daily Rainfall Accumulation
- Relative Humidity
- Wind Direction
- Wind Speed

Finding The River Conditions:

You can gain access to the data collected along the river in two ways

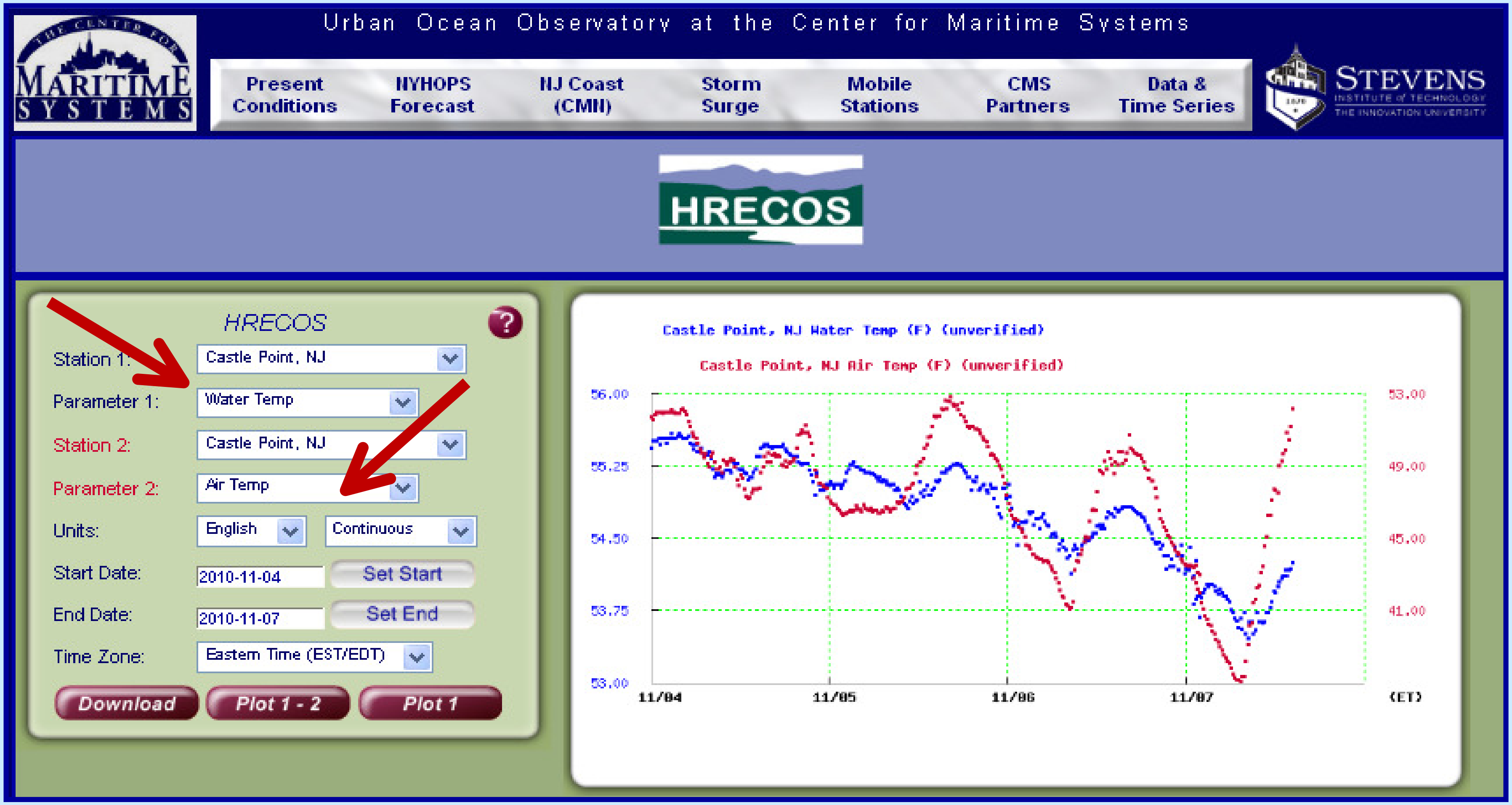
1. Click on "**Current Conditions**" within the drop-down menu of the "River Conditions" tab:
2. Or by directly clicking on the "**Current Conditions**" link:



HRECOS: Fixed Stations

The network of fixed stations allows for exciting analysis:

1. Graphically comparing two different parameters (shown below)
2. Graphically comparing data from two different fixed stations



Now let's look at how the data collected on *Clearwater* compares with the fixed stations she sails past!

Task #5:

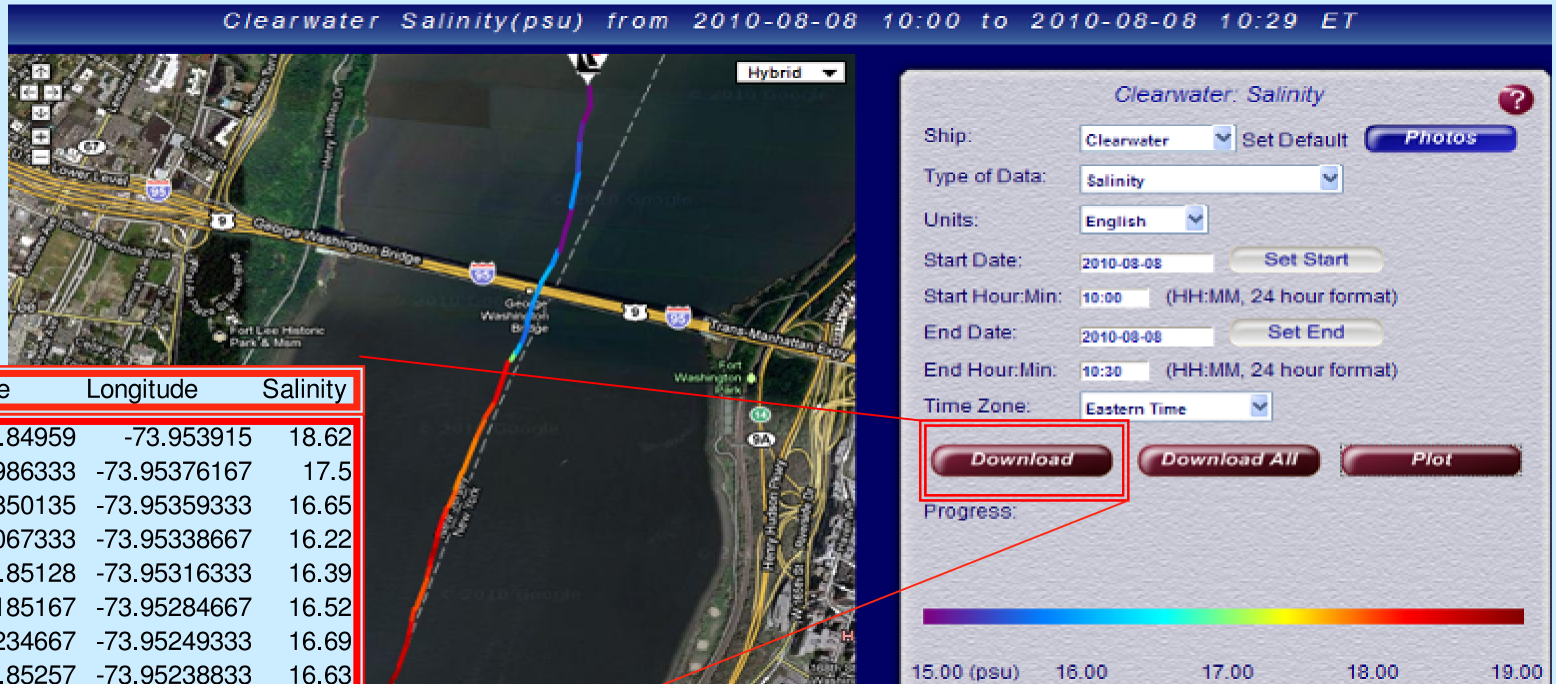
1. Examine *Clearwater's* data on Salinity as she sails under the George Washington Bridge on August 8th, 2010.

2. What time does the boat go under?
3. What happens to the Salinity?

Check your findings:

You will find that the sloop crosses beneath the GW Bridge between 10:00 and 10:30 AM

The salinity appears to decrease from almost 19 psu to 15 psu as she sails under the bridge.



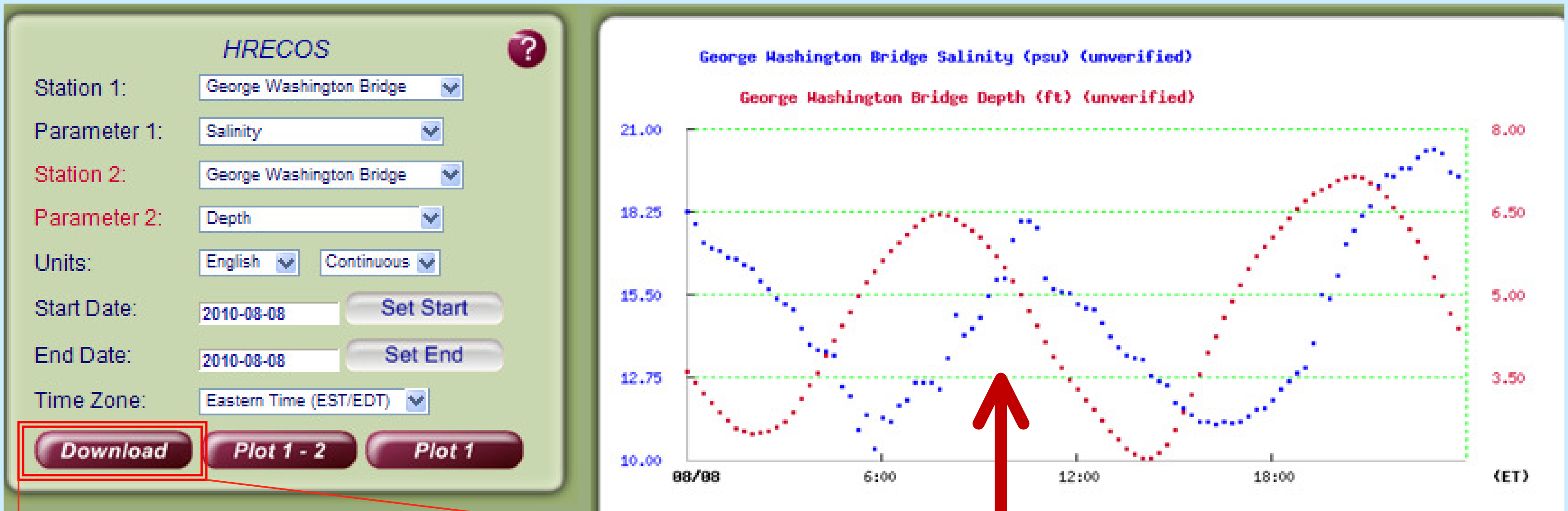
Date Time	Latitude	Longitude	Salinity
8/8/2010 10:19	40.84959	-73.953915	18.62
8/8/2010 10:19	40.84986333	-73.95376167	17.5
8/8/2010 10:19	40.850135	-73.95359333	16.65
8/8/2010 10:20	40.85067333	-73.95338667	16.22
8/8/2010 10:21	40.85128	-73.95316333	16.39
8/8/2010 10:21	40.85185167	-73.95284667	16.52
8/8/2010 10:22	40.85234667	-73.95249333	16.69
8/8/2010 10:22	40.85257	-73.95238833	16.63
8/8/2010 10:23	40.85279	-73.95229	16.44
8/8/2010 10:23	40.853035	-73.95220333	16.06
8/8/2010 10:24	40.85353	-73.95205667	15.67

How do the Salinity levels detected in the middle of the river compare with the fixed station readings along the shore?

3. Now chart the Salinity collected from the George Washington Bridge fixed station and the Water Depth. Use the following inputs:

- Current Conditions
- Station 1: George Washington Bridge (hydro)
- Parameter 1: Water Temp
- Station 2 George Washington Bridge (hydro)
- Parameter 2: Depth
- Units: English / Continuous
- Start Date: 2010-08-08
- End Date: 2010-08-08
- Time Zone: Eastern Time (EST/EDT)

The following graph should appear:



George Washington Bridge, NJ Start: 2010-08-08 00:00:00 Through: 2010-08-08 23:59:59		
Date Time (ET)	**Salinity(psu)**	**Depth(ft)**
8/8/2010 9:01	14.74	6.0333912
8/8/2010 9:16	15.48	5.8660704
8/8/2010 9:31	16.021	5.692188
8/8/2010 9:46	16.05	5.4986208
8/8/2010 10:01	17.32	5.2624032
8/8/2010 10:16	17.951	5.0097816
8/8/2010 10:31	17.931	4.7177904
8/8/2010 10:46	17.73	4.4487648
8/8/2010 11:01	16.041	4.150212
8/8/2010 11:16	15.72	3.8943096
8/8/2010 11:31	15.62	3.6810576
8/8/2010 11:46	15.55	3.4842096
8/8/2010 12:01	15.23	3.297204

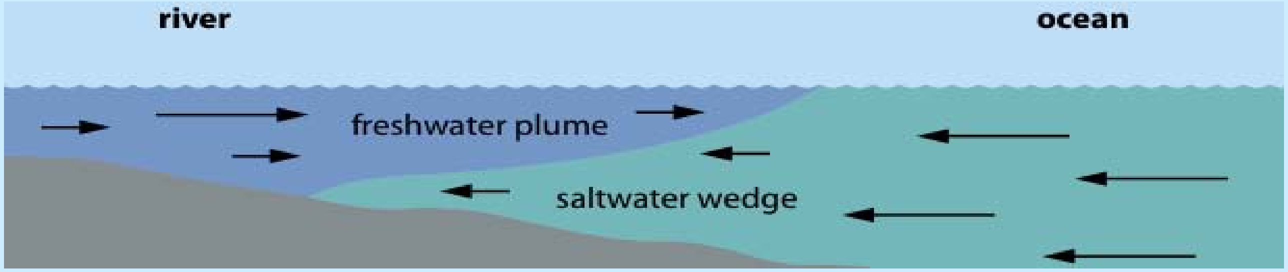
The data is accessible either graphically or in an excel table

Conclusions:

Time	Salinity (psu) *Clearwater*	Salinity (psu) GW Bridge
10:01	18.62	17.32
10:16	18.21	17.75
10:31	15.23	17.93
10:46	15.04	17.73

The salinity levels are slightly higher in the middle of the channel until *Clearwater* passes the bridge and heads up into fresher waters.

Notice how the rising and falling tides precede the same trend in the salinity at the bridge by a couple of hours. When ocean water rushes up into the Hudson River, the denser salt water flows along the river bottom.



There is stratification of water before vertical mixing occurs which causes this echo effect seen in the graph between the depth and salinity levels.

HRECOS uses:

- Educational Tool
- Research Resource
- Forecast site for mariners
- Flood warning system

Resources:

- Clearwater Classroom Curriculum
- More HRECOS Lessons
- Book a Sail on *Clearwater*
- Contact *Clearwater* Education Staff: 845-265-8080
  educator@clearwater.org

HRECOS Partners:

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Hudson River Foundation for Science & Environmental Reasearch

National Estuarine Research Reserve System

NOAA
National Oceanic and Atmospheric Administration
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The Earth Institute at Columbia University

Clearwater™