

Taking the pulse of our coastal Skidaway River

*In this activity, you are to take several observations to learn about the technology scientists use to learn about the coastal ocean. The measurements will not be the same as water in the coastal ocean would be; less saline, different temperatures, higher current velocity, and lower wave height than the coastal ocean are all likely. See the informational sheets for each station that follow.

Station 1. Salinity.

Measurement tool:

How it worked:

Units:

Measurements: 1 () 2 () 3 ()

If the average salinity of surface ocean water is 35 ppt, what do your measurements tell you about the Skidaway River in comparison with the ocean?

Station 2. Current velocity.

Measurement tool:

How it worked:

Units:

Measurements: 1 () 2 () 3 ()

Station 3. Wind speed and direction.

Measurement tool:

How it worked:

Units:

Measurements: 1 () 2 () 3 ()

Station 4. Wave height and length.

Measurement tool:

How it worked:

Units:

Measurements: 1 () 2 () 3 ()

Station 5. Temperature and Turbidity.

Measurement tool:

How it worked:

Units:

Measurements: 1 () 2 () 3 ()

OBSERVATION STATION 1: SALINITY

Objective: To determine the salinity of the Skidaway River using hands-on technology. To understand the technology and instruments used for a better overall understanding of the salinity.

About Salinity: *(from University Corporation for Atmospheric Research (UCAR) at www.windows.ucar.edu)*

Everyone who has taken in a mouthful of ocean water while swimming knows that the ocean is really salty! Dissolved salts in ocean water make it taste this way. Fresh water has dissolved salts in it too, but not nearly as many as ocean water. These dissolved salts can come from the land, precipitation, or the atmosphere, and are particles that have completely dissolved in with the water. Ocean water is about 3.5% salt. That means that if the oceans dried up completely, enough salt would be left behind to build a 180-mile-tall, one-mile-thick wall around the equator! More than 90 percent of that salt would be sodium chloride, or ordinary table salt. The average salinity of the ocean is between 35-37 psu (practical salinity units), or ppt (parts of salt per thousand parts of ocean.) Salinity is a CONSERVATIVE property of seawater, meaning it is only affected by precipitation and evaporation at the sea surface. Once water sinks, the salinity does not change.

Life in the oceans has adapted to this salty environment. But, most creatures that live in the ocean could not live in fresh water. When the salty waters of the ocean meet fresh water, an estuary is formed. This is a special environment where some creatures have learned to adapt to a mixture of fresh and salt water. For biologists, salinity controls some of the distribution of marine species. For physical oceanographers, salinity is part of the team of variables that control seawater density, driving ocean currents and other ocean motion.

Tools, instruments, and technology:

When we measure the salinity of water, we look at how much dissolved salt is in the water, or the concentration of salt in the water. Concentration is the amount (by weight) of salt in water and can be expressed in parts per thousand (ppt).

Water classes:

Fresh water - < 1 ppt
Slightly saline water - 1-3 ppt
Moderately saline water - 3-10 ppt
Highly saline water - 10-35 ppt

Dissolved salts in sea water (atoms):

55.3 % Chlorine
30.8 % Sodium
3.7 % Magnesium
2.6 % Sulfur
1.2 % Calcium
1.1 % Potassium

There are multiple ways that salinity can be measured. Salinity is often measured with a conductivity meter by measuring how well electricity travels through the water (conductivity). Water that has dissolved salt in it will conduct electricity better than water with no dissolved salt. The more salt that is dissolved in the water, the better the water conducts electricity. The salt content of the water can be measured very precisely using the conductivity method. Another way that salinity can be measured is by measuring light attenuation (or, how light moves and is bent) through water. This can be done with a hand held refractometer that is used by trapping a drop of the water to be tested on its lens and looking through the instrument in sunlight. A refractometer measures the change of direction or bending of the light as it passes from air to water. Light moves slower in water than air. Light moves slower as salt content increases.

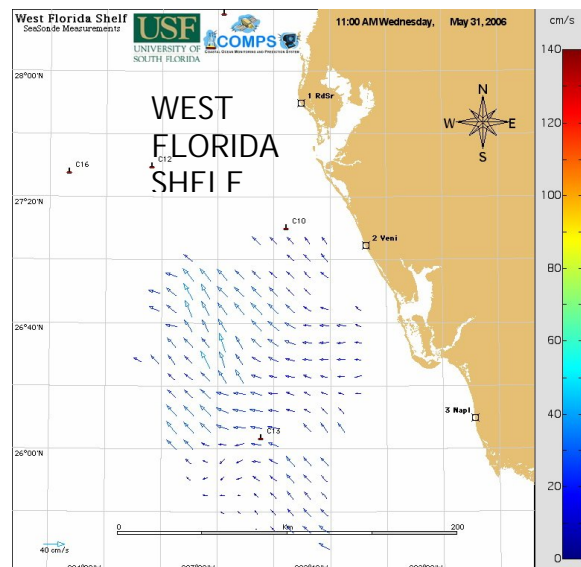
OBSERVATION STATION 2: CURRENT VELOCITY

Objective: To measure the current velocity of the Skidaway River and gain experience using a Current Velocity Meter.

About Current Velocity: Current velocity is a very important COOS variable for real-world applications like Search and Rescue, swimming and recreational boat safety, and marine operations.

Tools, instruments, and technology: This variable is measured with a Current Velocity Meter. The current velocity meter allows you to measure stream flow velocity in feet or meters per second and measure water depth in hundredths of a foot up to three feet. The average stream flow velocity times the cross-sectional area of the stream determines the stream flow measurement in cubic feet or meters per second. A current velocity meter is essentially a water velocity probe on a stick. The probe portion consists of a protected water turbo prop positive displacement sensor. This means that the water flow turns the prop and registers how quickly the prop turns. Current velocity meters can make these measurements at discrete locations and can be used to take measurements at multiple depths to create a vertical profile of current velocity.

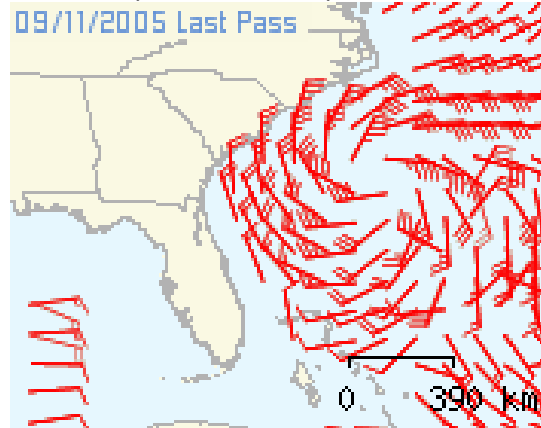
The newest technology available for measuring current speed and direction is High-Frequency (WERA) Radar. Now an integral part of SEACOOS, HF Radar scans the top 200 meters of the ocean surface and returns information on current speed and direction using the Doppler Shift. Heard an ambulance go by recently? Remember how the siren's pitch changed as the vehicle raced towards, then away from you? First the pitch became higher, then lower. Originally discovered by the Austrian mathematician and physicist, Christian Doppler (1803-53), this change in pitch results from a shift in the frequency of the sound waves. As the ambulance approaches, the sound waves from its siren are compressed towards the observer. The intervals between waves diminish, which translates into an increase in frequency or pitch. As the ambulance recedes, the sound waves are stretched relative to the observer, causing the siren's pitch to decrease. By the change in pitch of the siren, you can determine if the ambulance is coming nearer or speeding away. If you could measure the rate of change of pitch, you could also estimate the ambulance's speed. This is essentially how HF Radar measures the speed and direction (towards or away) of ocean currents!



OBSERVATION STATION 3: WIND SPEED AND DIRECTION

Objective: To measure wind speed and direction and understand the technology that allows COOS to measure the same.

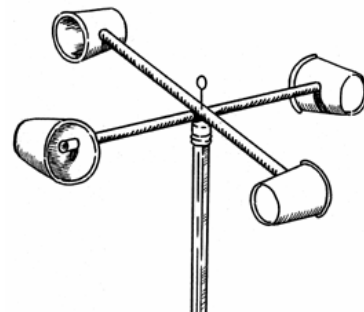
About Wind Speed and Direction: Changes in wind speed and direction can signal several important things about the ocean and atmosphere. Wind speed increases with the approach of a low pressure system (such as a hurricane, nor'easter, or other storm). Wind direction changes with the passage of a center of low pressure (such as a hurricane) since wind flows counter-clockwise around a center of low pressure (in the Northern Hemisphere.) These changes in wind speed and direction can alert marine weather forecasters, the National Hurricane Center, or local weather forecasters to the approach of a storm to improve preparedness or to recommend an evacuation. Wind speed, fetch (distance over which the wind blows), and direction can determine wave height and frequency and contribute to the severity of storm surge.



Tools, instruments, and technology: The easiest and most commonly used instrument to measure wind speed and direction is an anemometer. COOS stations mount these instruments on the tops of towers and buoys, and at different levels for a vertical wind profile if possible. Professional-grade Anemometers work by the wind initiating the movement of the rotating cups, and recording the revolutions per minute of the cups. Revolutions per minute are then converted into miles per hour or meters per second. Fortunately for us, anemometers are easily made by hand (although much less accurate of course



Professional-grade anemometer



Hand-made anemometer

than professional-grade anemometers) and can be used just outside your classroom. Using anemometers helps students visualize something usually invisible to the naked eye...wind!

OBSERVATION STATION 4: WAVE LENGTH AND HEIGHT ESTIMATION

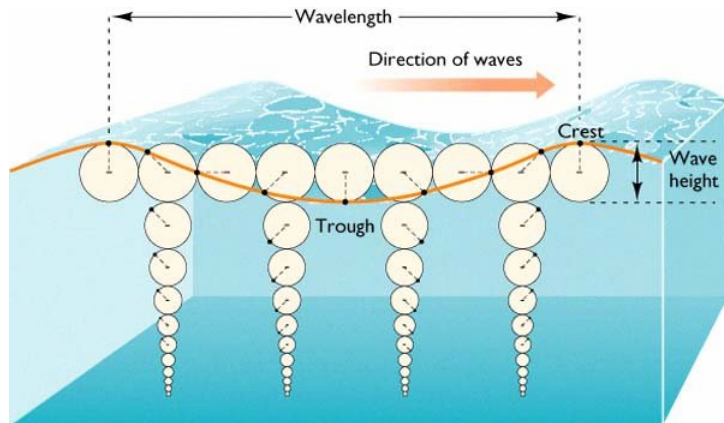
Objective: To estimate wave length, height, and velocity of propagation visually and learn the relationship between the three.

About Wave length and height:

Wavelength is simply the distance between two adjacent wave crests or troughs. When estimating visually, it may be easiest to estimate between crests. You should also note the speed at which the waves seem to be moving by. This speed is called 'velocity of propagation.' Wave frequency can be calculated using the following wave relationship:

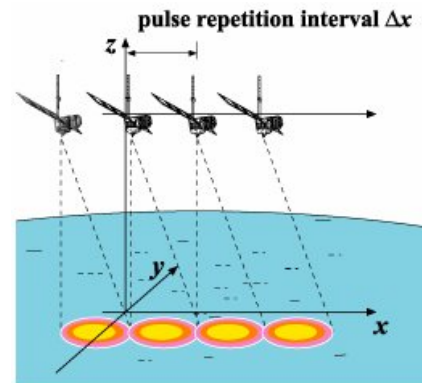
Wave frequency = Wavelength ÷ Velocity of propagation

For each observation of wavelength and velocity of propagation, you should calculate wave frequency and see what effect your observations have on your calculation.

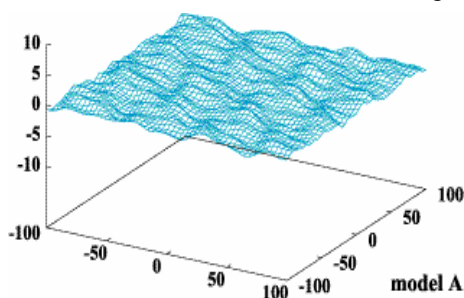


Tools, instruments, and technology:

While wave data based on visual observation are valued by the scientific community for their wide-reaching coverage, visual estimates bring up questions of the quality & consistency of the observations (Challenor 1997). Today, satellite altimetry allows us to look at seasonal and inter-annual variations in the 'wave climate' - or, how waves seem to be changing over seasons, years, and decades (Challenor 1990, Carter 1991.) A satellite altimeter works by scanning the sea surface and picking up differences in the height of the ocean surface, much like reading Braille. The



Satellite Altimeter



statistical ocean wave model

information on the ocean surface that is gathered by the satellite is then used to derive a description of the sea state (ocean surface wave data.) Radar altimeter (signals emitted by satellites) is the only instrument providing almost global coverage with sufficient accuracy. In addition, mathematical models allow forecasters to predict how wave trains (groups of waves) are going to evolve at sea. Many weather services use wave models every day to predict sea state all over the globe.

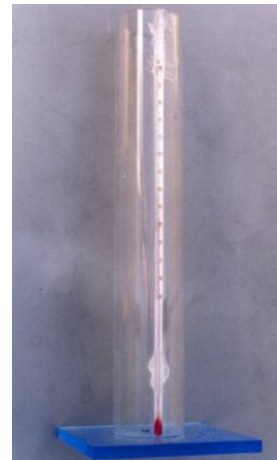
OBSERVATION STATION 5: TEMPERATURE AND TURBIDITY

Objective: To measure temperature and turbidity and use this information to make inferences about the Skidaway River. To learn to use a Secchi Disk and thermometer at multiple depths.

About Temperature and Turbidity: Ocean temperature at the surface and at multiple depths is a very important variable for oceanographers. At the surface, ocean temperature can provide information for hurricane track and intensity forecasts. Recorded at multiple depths, ocean temperature provides a vertical profile of the ocean that can paint a reliable picture of living conditions for pelagic fishes and other ocean organisms. Turbidity, in the coastal ocean in particular, provides oceanographers with valuable information about water quality. These factors can provide insight into nutrient levels, coastal erosion, river output, and other important ingredients that contribute to the overall ecological well-being of the coastal ocean.

Tools, instruments, and technology:

To measure temperature: The good ole' thermometer is used to determine ocean temperature. This can be used at multiple depths to develop a vertical ocean profile of ocean temperature.



To measure turbidity: (from <http://dipin.kent.edu/secchi.htm>)

The Secchi Disk (pictured), named for Father Pietro Angelo Secchi, is used to measure turbidity. It is lowered into the water until it can be no longer seen by the observer. This depth of disappearance, called the Secchi depth, is a measure of the transparency of the water. Transparency can be affected by the color of the water, algae, and suspended sediments. Transparency decreases as color, suspended sediments, or algal abundance increases. Therefore, the Secchi depth can provide insight into several elements of the body of water being studied.



The best attributes of the Secchi Disk are that it is cheap and easy to use. Turbidity and transparency can be affected by plant nutrients coming from sewage treatment, lawn/agricultural fertilizer. Suspended sediments in the coastal ocean may have come from re-suspension, coastal erosion, agricultural runoff of sediments and chemicals, and urban storm runoff. All of these elements, among others, affect the turbidity and transparency of the water. Based on Secchi readings in combination with studying water samples, oceanographers can get a general indication of problems with algae, zooplankton, and silt.