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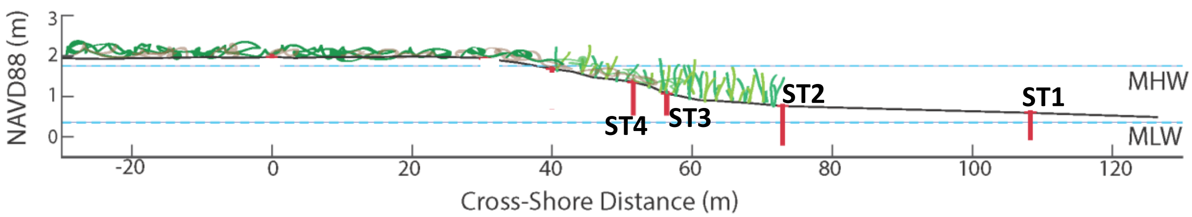
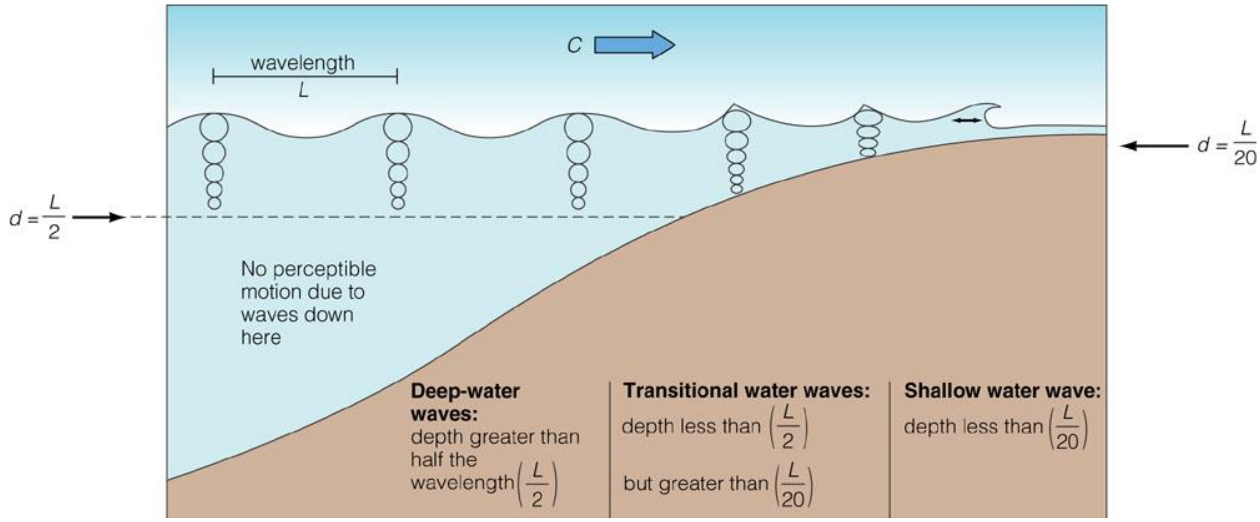
COESSING 2021: Nearshore Waves Lab

Intro: High-frequency pressure sensors are useful for measuring waves in water less than 20 m deep. The attached dataset contains measurements from four pressure sensors along a cross-shore transect. The first station, ST1, is on an intertidal mudflat, and the following stations are progressively inland, ending in a saltmarsh (see figure below, stations are shown by red bars). Each instrument took 2048 readings at 8 Hz every 30 minutes (called a "burst" of measurements). These readings were processed to produce wave statistics for each burst. For each burst, the dataset contains the depth, significant wave height, and peak wave period.



Code: Follow along with the code on the COESSNG jupyter hub to answer the questions.

- Step 1: What type is the variable "times" ? What type is the variable "data" ?
- Step 2: How would you classify the tides shown? (diurnal/semidiurnal/mixed)
    - This station is intertidal, meaning sometimes it is inundated and sometimes it is dry. When the signal is flat around 0.25 m, the pressure sensor is out of the water. The pressure sensor was attached to a frame that was 0.25 m above the surface. That means the lowest depth reading it can give is 0.25 m.
- Step 3: How many times is station ST3 inundated during the time period shown?
    - This plot shows the water depth for each of the four stations. You will see they have different depths because they are at different elevations. For example, ST4 is on higher land in the marsh, and it is only inundated on the higher high tides.
- Step 4: What is the datum in the water surface elevation plot?
    - The water surface elevation takes into account the elevation of each instrument station. Now the high tide peaks line up, indicating that there is a consistent water surface along the cross-shore instrument transect.
- Step 5: Estimate from the plot the largest wave in the dataset. At which station was it measured?
    - The significant wave height is the average of the largest 1/3 of waves over the measurement burst (described in the intro). Wave energy is a function of wave height.
- Step 6: Try to fill in the code to plot the deep water waves.
    - Waves are classified as shallow, intermediate (or transitional), and deep. Helpful approximations can be used when waves fall into the shallow or deep classifications. One distinction is that the orbital motions for shallow water waves reach the bottom interacting with the bed sediment, while the orbital motions of deep-water waves diminish before reaching the bottom (see figure on next page)



- Step 7: Do waves increase, decrease, or both increase and decrease from ST1 to ST2? From ST1 to ST3? From ST1 to ST4?
    - There is vegetation (marsh grass) from ST2 to ST4. The elevation also changes, increasing from ST2 to ST4. Vegetation causes wave attenuation (decrease in wave height), while increasing elevation causes wave shoaling (increase in wave height). Both processes are at work, but the decrease in wave height seen at ST4 indicates the vegetation effect of attenuation "wins" at the top of the transect.
- Step 8: What is the difference between the negative and the positive values shown?
    - To examine the changes in wave height fairly, we normalize the changes by the distance between the stations.
- Step 9: What trend is seen with increasing water depth? (particularly at ST4)
    - The vegetation has a great effect on the waves when it occupies a larger portion of the water column. When vegetation is deeply submerged, it has less effect on the wave energy.

The data in this lab are a processed subset of the data from: Lacy, J. R., Allen, R. M., Foster-Martinez, M. R., Ferreira, J. C., & O'Neill, A. C. (2017). Hydrodynamic and sediment transport data from San Pablo Bay and China Camp marsh (northern San Francisco Bay), 2013-2016. U.S. Geological Survey Data Release. https://doi.org/10.5066/F7HM56MX