Coastal Engineering 757/857
Homework 5: Sediment Properties and Transport

Problem 1: Find d_{50} by the CDF method for all 5 sediment samples from Hampton Beach in your notes. Plot both a CDF and PDF of the samples. Then comment on which part of the beach profile each sample could be from (i.e. offshore of the sandbar, at the sandbar, onshore of the sandbar, in the swash zone).

Problem 2: What is the bulk density, sediment density, porosity, packing, and specific gravity of the sample at Location 2 from Problem 1? The volume of the sample is 270.9 cm^3. When the container is filled with a sediment sea-water mixture that exactly fills the container it is sitting in, it weighs 544.9 g. The density of the sea water is 1030 kg/m^3.

Problem 3: Bed shear stress, Shields Parameter, and Rouse Number

a) What is the physical meaning of the Shields parameter and critical Shields parameter? Draw a free body diagram of the forces acting on a grain sitting on the bed exposed to a flow field, label all forces. Find the critical Shields parameter for each d_{50} in Problem 1.

b) Calculate the full record average bed shear stress imposed by the combined wave-current flows given to you in the Duck dataset (duck_puv_station_5_4096) provided on Canvas. Hint: First you will need to decompose your velocity signal to estimate your current velocity and your wave orbital velocity.

c) Using your estimates of the record averaged bed shear stress, calculate the corresponding Shields parameter and Rouse Number for each of the 5 locations in Problem 1. Hint: You will use your wave-current bed stress estimate to find u_*, and you will need to calculate the settling velocity.

d) At which, if any, of the 5 locations is the sediment moving? Which type of bedload transport regime does the Shields parameter suggest is occurring? What type of sediment transport is occurring at each site according to your Rouse Number estimates?

Problem 4: Estimate the bedload and suspended load contributions to transport at the location with the largest Shields Parameter estimated from Problem 3c. For bedload use both the Meyer Peter-Muller approach and the Energetics approach. For the suspended load use both the CEM approach and the Energetics approach.

a) Comment on the differences between the two approaches for each of the bedload and suspended load estimates, why do you think they are different?

b) Does the bedload or suspended load contribute more to the net transport in the system?

Problem 5: Finding data for your project - There are PDFs posted in Canvas under the Project folder that will help you get started with where to find data for both the Duck and NH groups.

a) Find and plot the bathymetry profiles your group will be using for your project from pre- and post- hurricane.

b) Find tidal, wind, wave, and current data for your assigned hurricane. Plot a time series of each to show that you found data for your hurricane.