Estimation of coastal bathymetry using near shore imagery

Accurate resolution of shallow free-surface flows is essential to understanding the behavior of riverine, estuarine, and coastal systems. The relative importance of waves, currents, vegetation, and surface roughness will vary depending on the system. However, it is almost always essential that we characterize the system's bathymetry (i.e., submarine topography) accurately in order to resolve its hydrodynamics. While direct measurement of bathymetry is clearly possible, it is often expensive and impractical to maintain detailed bathymetric surveys in many natural systems. As a result, our ability to address problems from flooding, to navigation, or erosion in these systems is limited. Recently, there has been significant interest in developing techniques to measure bathymetry using remote sensing. Unfortunately, direct measurement from airborne (or satellite) platforms is usually limited by the depth and clarity of the water body. Alternatively, one can hope to infer bathymetry from measurements of other variables like surface velocities, wave dynamics, or the trajectory of objects advected with the current. This inference often requires solution of an inverse problem that relies on the hydrodynamics to relate the observable properties to the bathymetry.

In this project, students will consider the estimation of bathymetry in near-shore systems where we have access to few or no direct measurements. They will be asked instead to search for effective ways to leverage data available from indirect and remote sources, while dealing with the variability and uncertainty inherent in such measurements in natural systems. Based on their interest, they will also be asked to explore methods for retrieving data from standoff measurements, solving the inverse problem and simulating the dominant physical processes