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Remote assessment and short-term forecasting for the nearshore

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Accurate characterization of the nearshore is essential for maintaining navigation, understanding flood risk, controlling beach erosion, and public safety. Unfortunately, the nearshore is extremely dynamic with variations in wave conditions, currents, and morphology that occur over many spatial and temporal scales. Direct observation of these processes is well understood, but remains difficult and expensive to maintain across the many areas where the US Army Corps of Engineers (among others) has operational responsibility. As a result, there is significant interest in techniques for assessing nearshore conditions remotely from air or sea-borne platforms.

Recent improvements in radar and photogrammetry have made it possible to obtain large amounts of high-resolution data from small, mobile platforms. On the other hand, these data are indirect observations of surface properties like energy dissipation or wave speed from which the quantities of prime interest (bathymetry, sub-surface currents, wave breaking height and/or type) must be inferred. Moreover, each observation type has its own limitations. Optical imagery, for example, is limited to daylight collections, while radar-based approaches perform well only in certain sea states.

In this project, students will consider the development of a short-term forecast of the sea-state 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 potentially large data sets of optical, radar, and lidar observations available from standoff measurements to provide a composite assessment of conditions, while dealing with the variability and uncertainty inherent in such measurements in natural systems. Based on their interest, they will be asked to explore ways to simulate the dominant nearshore processes efficiently, use innovative techniques to obtain parameters of interest from indirect observations, and have the opportunity to explore methods for assimilating observations and model predictions to provide short-term forecasts of sea-state.