Project Summary

We propose to study the turbulent water flows that shape mangrove swamps in the Mekong Delta, Vietnam. Mangroves in this region are in decline, as is common in estuarine wetlands worldwide. It is well known that mangrove trunks and surrounding roots (pneumatophores) slow currents, likely encouraging deposition of sediments. However, direct measurements of turbulent flows within vegetated regions are limited, as is our ability to predict the complex interplay between flows, plant growth, and patterns of sediment erosion and deposition. By deploying a large array of turbulence-resolving instruments within, and adjacent to, mangrove swamps, we will measure in detail the influence of mangroves on water flows and turbulence. Two very high resolution profiling current meters will measure flows within, above, and adjacent to pneumatophore canopies (1 mm and 100 Hz vertical and temporal resolution). The near-bed turbulent stresses that erode sediments will be measured directly. A large array of Acoustic Doppler Current Profilers will be deployed in a grid to map the spatial variability of flows within and near the mangrove canopy. These instruments will resolve horizontal scales of tens of meters, with slightly lower, but still high, vertical and temporal resolution (2.5 cm and 8 Hz). A large array of high-accuracy temperature gauges will map surface and bottom water temperatures at eleven horizontal locations. Vegetation, sediments, and seabed elevation will be mapped across the large array. Three high-accuracy pressure gauges will measure the pressure gradients that drive water flows. In combination, these measurements will be used to determine drag coefficients, and improve models for the drag exerted by the vegetation canopy. The decay of flows with distance from the canopy edge, and the associated transition to an environment favouring sediment deposition will be measured. We will investigate whether the dissipation of currents by vegetation near the swamp-edge enhances swamp-edge turbulence (as opposed to vegetation simply damping motions everywhere). We will examine possible correlations between spatial patterns in water flows, sediments, vegetation, water temperature, and bathymetry. Correlations with water surface temperature may have application to interpreting remote sensing data. These results will be used to refine an existing numerical model for the interacting dynamics of vegetation, water flows, and bathymetry. Subsequent modelling experiments will examine the effects of mangrove removal on subsequent marsh evolution.