Dispersal Basin Geometry Influences Sediment Deposition, Shoreline Progradation Rates, and Grain Size Segregation: A Case Study of Poverty Bay, New Zealand

Bever, Aaron J.[1]; Harris, Courtney K.[1]; Swenson, John [2] (1) Virginia Institute of Marine Science, Gloucester Point, VA. (2) University of Minnesota, Duluth, MN.

Poverty Bay is a significant part of the Waipaoa River sedimentary dispersal system. It has acted as a sediment sink over the past 7,000 years, and processes within the bay significantly modify the fluvial sedimentary signal en route to the continental shelf. The geometry of such a receiving basin has large implications on how waves, currents, and high density gravity flows influence sediment transport to the continental shelf, sediment preservation within the receiving basin, and the segregation of coarse and fine sediments.

Through numerical modeling experiments, we investigated the role that basin geometry and river mouth configuration play in sediment retention and export within / from Poverty Bay. We used the Simulating Waves Nearshore (SWAN) model coupled to the Regional Ocean Modeling System (ROMS) to numerically estimate wave characteristics, current velocities, and sediment transport within Poverty Bay. Three different bay geometry and river mouth combinations were investigated: (1) the modern bay, (2) the modern bay circa 2 kya when the river mouth discharged at the bay's northern end, and (3) maximum marine transgression (~7 kya) when shoreline was 12 km landward of its present position. Simulations of realistic yearly floods were conducted to determine the wave energy, sediment transport dynamics, sediment preservation, and coarse and fine sediment segregation for these geometries.

Dispersal patterns were sensitive to both river mouth and shoreline location, but the sheltering effect generated by basin geometry was more dominant. Wave height on an along-bay transect of the 7 kya bay correlated very well with shoreline progradation rate along the same transect, indicating a link between wave energy, sediment preservation, and shoreline progradation within the bay. Higher wave energy and a shorter distance to the continental shelf, compared to the 7 kya bay, lead to an increased export of sediment from the modern bay with larger grain sizes preserved within the bay and the fines exported to the continental shelf. Relative to the modern bay, the 7 kya bay was less effective at segregating sediment by size and retained more sediment, potentially fueling the increased rate of shoreline progradation compared to that occurring today.