Granular sorting by bedforms in oscillatory flows

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Bedform dynamics dominate the coastal bottom boundary layer and exert physical control over processes such as wave attenuation, wave-induced currents, and the acoustic scattering properties of the seafloor. While models for sand ripple formation and evolution have skill predicting geometric properties such as wavelength and height, they do not explicitly include sediment heterogeneity and account for the resulting granular sorting that is part of the bedform dynamics. (Figure 1) Laboratory investigations of bedform dynamics with bimodal size distributions of sediments reveal granular sorting that occurs from both bedload transport and suspended load transport during ripple migration (Calantoni et al. 2013). Optical techniques such as particle image velocimetry (PIV) and particle tracking velocimetry (PTV) that can follow both fluid tracer particles and sediment particles reveal evidence of vortex trapping and transport in both laboratory and field studies of ripple dynamics. During bedform migration granular sorting occurs by bedload transport forming alternating layers of coarser and finer sediments within the migrating ripple. Additionally, vortex entrainment drives sorting of surficial sediments along the streamwise direction of the bedforms. Discussion will focus on observations of granular sorting in both the laboratory and field under oscillatory flow conditions.

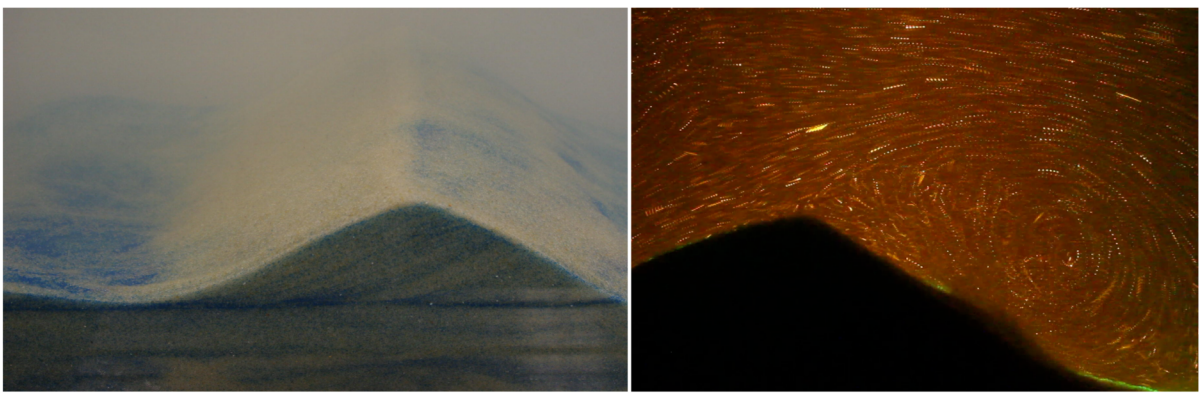

Figure 1: (left) Bimodal mixture of sediment is sorted by both bedload and suspended load transport during ripple migration observed in the laboratory. (right) Fluorescent particle tracking shows a vortex entraining sediment from the slope of a bedform in the laboratory.

References

J. Calantoni, Landry, B.J., and A.M. Penko. Laboratory observations of sand ripple evolution using bimodal grain size distributions under asymmetric oscillatory flows. Journal of Coastal Research. Special Issue No. 65. 1497-1502. 2013.