Effects of sediment-settling potential on ripple morphodynamics: wave-flume experiments simulating shoaling zone

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The wave-flume experiment was conducted to examine the effects of the grain size and wave period of shoaling waves on ripple morphodynamics. The findings include the following: (a) The ripple roundness index correlates systematically with the nondimensional settling parameter which was newly introduced in this study. Specifically, the ripples take rounded profiles as the effect of sediment settling becomes pronounced. The observations in terms of the high-speed camera show that the characteristic rounded crests result from the preferential deposition of sediment on the crest and onshore-side slope of each ripple, when the flow direction turns from onshore to offshore. (b) As the value of the nondimensional settling parameter becomes smaller, the nondimensional ripple migration rate tends to be higher. By contrast, under larger values of the nondimensional settling parameter, the nondimensional ripple migration rate tends to correlate well with the mobility number, regardless of median grain size. (c) As the value of the nondimensional settling parameter decreases, the sediment transport rate derived from the ripple migration rate tends to be larger than that predicted from Ribberink's (1998) bedload transport formula. This strongly suggests that the existing bedload transport formulae including Ribberink's (1998) have inherent limitations to capture the essential aspect of migration of vortex ripples. The key physical process observed in the experiment on the vortex ripples, is the preferential sediment deposition upon flow reversal; namely, it occurs on the crest and onshore-side slope of each ripple when the flow direction turns from onshore to offshore.