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The influence of gravel mixed with sand on the formation and development of ripples.

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Coarse and bimodal sediment mixtures like sand and gravel are common in palaeo-glaciated shelf seas and in coastal environments. Their presence leads to more complex sediment transport and morphodynamic processes, depending on the ratio of sand to gravel in the bed. With increased pressure on our near-and offshore sea beds, there is a growing need to more accurately model sediment transport and bedform dynamics with an increasing focus on bimodal sand-gravel sediment mixtures. Revisiting the quantification of the hiding-exposure (HE) effect highlighted how differently sized grains in a bimodal mixture modify each other's threshold of motion. The critical shear stress needed to mobilise the sand and gravel fractions increased by up to 75% and decreased by up to 64% respectively, compared to that needed to mobilise well-sorted sediment of similar size. Implementation of this newly quantified HE correction in current-and wave-driven models illustrated that its influence on bedload transport rates and bed morphodynamics was greatest for mixtures where gravel percentage ranges between 10 and 20 %. Laboratory experiments were therefore conducted to investigate ripple formation and bed dynamics in mixtures with gravel percentage between 0 and 25%. The development of initial bedforms was quicker in sand-gravel mixtures compared to those developed in pure sand, whilst final heights and migration rates of the developed ripples decreased with increasing fraction of gravel in the bed. During this presentation, a full comparison will be made of the morphology and "down-core" sedimentary properties of ripples formed at different flow speeds. If we want to use our seabeds cost-effectively and sustainably, we need a better understanding on the influence of a decreased mobilisation of the finer fractions and an increased mobilisation of the coarser fraction on the dynamics of beds with a bimodal sediment composition.