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The role of the depth-averaged concentration in coastal morphodynamics

D. Calvete (1), A. Falques (1), H.E. de Swart (2), N. Dodd (3), F. Ribas (1), R. Garnier (3)

(1) Fisica Aplicada, Universitat Politecnica de Catalunya, ES (2) Institute for Marine and Atmospheric Research, Utrecht University, NL, (3) School of Civil Engineering , University of Nottingham, UK (calvete@fa.upc.edu)

In this contribution a general discussion is presented on the development of self-organised coastal morphodynamic patterns which are due to the joint action of gradients in the depth-integrated concentration (also called potential stirring) and the flow perturbations produced by the bedforms. This is done in the context of a depth-averaged shallow water model. In spite of its remarkable simplicity, this analysis has proven to be a powerful tool to get insight into the underlaying feedback mechanisms between the morphology and the hydrodynamics. The effect of the morphology on the hydrodynamics includes effects like wave refraction, diffraction or shoaling and currents deflection. As an illustration, the formation of shoreface-connected ridges, nearshore bedforms and beach cusps will be discussed. Summarising, two physical mechanisms produce deposition-erosion patterns: deposition either occurs where the current flows from high to low depth-averaged concentrations (1) or where the flow diverges (2). On quasi-steady flow conditions (i.e., the time scale on which bedforms evolve is much larger than the hydrodynamic time scales) only the former mechanism contributes to the formation of patterns.