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Nonlinear dynamics of storm-driven currents, waves and sand ridges on the shelf: a spectral model

H.E. de Swart (1), N.C. Vis-Star (1), D. Calvete (2)

(1) Institute for Marine and Atmospheric Research, Utrecht University, The Netherlands (h.e.deswart@phys.uu.nl), (2) Department of Applied Physics, UPC Barcelona, Spain

Results will be presented of an idealized model that simulates the evolution of wind-driven currents, waves and the sandy bottom during storms on an inner shelf. The extension with respect to earlier work is that wave properties are now calculated using a physical model, rather than by adopting a severe parametrization. Currents are described by the shallow water equations and changes in bed level are governed by mass conservation of sand, coupled to a Bailard type formulation for sand transport. Upon expanding the variables in known linear eigenmodes of the system and subsequently performing a Galerkin projection equations are obtained that govern the temporal evolution of the modal amplitudes. Model experiments reveal that, starting from a topography without bedforms, the inherent interactions between currents, waves and the bottom result in the formation of sand ridges (typical distance between successive crests of several km). On the long term these ridges reach a finite height of several meters. The sensitivity of the model results (temporal behaviour and spatial patterns of currents, waves and bottom) with respect to characteristics of incoming waves will be discussed. Also, the model results will be compared with data of sand ridges on Long Island inner shelf (US).