Development of a numerical 2-dimensional beach evolution model

This paper presents the description of a 2-dimensional numerical model constructed for the simulation of beach evolution under the action of wind waves only over the arbitrary land and sea topographies around existing coastal structures and formations. The developed beach evolution numerical model is composed of 4 submodels: a nearshore spectral wave transformation model based on an energy balance equation including random wave breaking and diffraction terms to compute the nearshore wave characteristics, a nearshore wave-induced circulation model based on the nonlinear shallow water equations to compute the nearshore depth-averaged wave-induced current velocities and mean water level changes, a sediment transport model to compute the local total sediment transport rates occurring under the action of wind waves, and a bottom evolution model to compute the bed level changes in time based on the gradients of sediment transport rates in cross-shore and longshore directions. The developed models are applied successfully to the SANDYDUCK field experiments and to some conceptual benchmark cases including simulation of rip currents around beach cusps, beach evolution around a single shore perpendicular groin, and a series of offshore breakwaters. The numerical model gave results in agreement with the measurements both qualitatively and quantitatively and reflected the physical concepts well for the selected conceptual cases.

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