11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Generation and propagation of solitary waves over varying topography

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Keywords: *Solitary wave, Varying topography, Hybrid Cartesian immersed boundary, Improved volume of fluid method*

ABSTRACT

Generation of solitary waves by submarine processes and their propagation are investigated through a new continuum-based volume-of-fluid numerical model. The processes represent the relations between the varying topography and free-surface elevations are described in a two-dimensional mathematical model. The proposed numerical model is particularly suited for wave propagations over complex bottom geometries, such as river and estuarine mobile beds. A combined hybrid Cartesian immersed boundary (HCIB) and improved volume of fluid (IVOF) methodology is developed to simulate the interaction problem. The methodology facilitates numerical studies of the fluid wave motion above finite sources, with irregular topography and with arbitrary distributions of the bottom uplift, for various properties of the fluid flows. A number of examples are illustrated and validated with the laboratory data through the proposed model. The model is also applied to simulate a simplified tsunami scenario as a forecasting application in a near-field source region. The results show that the methodology presented in this paper serves an applicable tool for predicting the possible amplification mechanisms of the generating waves resulting from the uplifted sea floor before the catastrophic damages happen.

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