Modeling morphological changes by tsunami-induced currents

Sangyoung Son¹, Taehwa Jung², Dae-Hong Kim³, and Hyun-Doug Yoon⁴

¹Korea University, School of Civil, Environmental and Architectural Engineering, Republic of Korea (sson@korea.ac.kr)
²Hanbat National University, Department of Civil and Environmental Engineering, Republic of Korea
³University of Seoul, Department of Civil Engineering, Republic of Korea
⁴Myongji University, Department of Civil and Environmental Engineering, Republic of Korea

At the nearshore area, strong and energetic flow fields can be easily formed during the tsunami event and it is hence expected coastal morphology is significantly affected by complex tsunami-induced currents. In this study, the morphological changes by tsunami impacts on the US west coasts were investigated by numerical modeling. Firstly, we introduced a developed numerical model for calculating morphological changes by the tsunami wave, which incorporates a set of sub-models; hydrodynamics, sediment transport and morphological evolution models. The fully nonlinear Boussinesq-type model was adopted in the hydrodynamics calculations aiming at the better recreation of nearshore current fields which easily develop into turbulent flows due to various types of sources (e.g., wave-breaking). Then, the benchmark tests of one-dimensional or two-dimensional sedimentation problems were performed for validation; dam-break flow over the movable bed, breaking solitary waves over a sloping beach, partially breached dam-break flow over the movable bed, and dam-break flows over a movable bed with a sudden enlargement. Calculated results revealed good agreement with the experimental records when a reasonable parameter has been chosen for closure models. As a real-scale application of the model, the 2011 Tohoku-Oki tsunami event was attempted, which subsequently presented a good prediction of tsunami-generated scouring and deposition in harbors. It was also confirmed that strong currents were successfully generated through the model, causing severe depth changes through the sedimentation process. To provide a rough guide for prospective users, we also performed several types of sensitivity tests on many parameters involved in the model.