Numerical modeling of tsunami wave forces and overtopping on coastal structures

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Abstract. In this paper we will present a two-dimensional numerical model (nicknamed COBRAS, COrnell BRAaking-wave and Structure) for calculating the tsunami impact forces and the overtopping rate over a coastal structure. The COBRAS model solves the Reynolds Averaged Navier-Stokes Equations with a modified k-quation model. To improve the performance of the traditional eddy viscosity hypothesis, a nonlinear eddy viscosity model is implemented. To track the free surface movement with wave breaking, the volume of fluid (VOF) method is employed. The model is capable of generating various kinds of waves by specifying the time histories of free surface displacement and velocity at the lateral boundary. The partial cell treatment is implemented to simulate arbitrary shapes of bottom topography and coastal structures. By integrating the calculated fluid pressure around the structures, the wave forces on the coastal structure can be calculated. The model can be used to examine both surface piercing and submerged coastal structures and to calculate the overtopping rate for both cases. Comparisons between numerical results and experimental data for the interactions between breaking waves and a caisson breakwater protected by armors will be presented in the paper.

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