Geophysical Research Abstracts
Vol. 16, EGU2014-9887, 2014
EGU General Assembly 2014

SPH Simulation of Impact of a Surge on a Wall

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Structures located on the downstream of a dam are prone to impact of the surge due to dam break flow. Ramsden (1996) experimentally studied the run-up height on a vertical wall due to propagation of bore and surge on dry bed and measured their impact on the wall. Mohapatra *et al*. (2000) applied Navier Stokes equations to numerically study the impact of bore on vertical and inclined walls. They also obtained the evolution of surge on dry bed. In the present work, the impact of a surge wave due to dam break flow against the wall is modeled with a two-dimensional smoothed particle hydrodynamics (SPH) model. SPH is a mesh-free method that relies on the particle view of the field problem and approximates the continuity and momentum equations on a set of particles. The method solves the strong form of Navier-Stokes equations. The governing equations are solved numerically in the vertical plane. The propagation of the surge wave, its impact and the maximum run-up on the wall located at the boundary are analyzed. Surface profile, velocity field and pressure distributions are simulated. Non-dimensional run-up height obtained from the present numerical model is 0.86 and is in good agreement with the available experimental data of Ramsden (1996) which is in the range of 0.75-0.9. Also, the simulated profile of the surge tip was comparable to the empirical equations refereed in Ramsden (1996). The model is applied to the study the maximum force and the run-up height on inclined walls with different inclinations. The results indicate that the maximum force and the run-up height on the wall increase with the increment of wall inclination. Comparison of numerical results with analytical solutions derived from shallow water equations clearly shows the breakdown of shallow water assumption during the impact. In addition to these results, the numerical simulation yields the complete velocity and pressure ?elds which may be used to design structures located in the path of a dam-break wave. The study shows that the smoothed particle hydrodynamics can effectively simulate fluid flow dynamics.

References:

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