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PROCEEDINGS

Three-Dimensional Numerical Simulation of Large-Scale Landslide-Generated Surging Waves with a GPU–Accelerated Soil–Water Coupled SPH Model

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ABSTRACT

Soil–water coupling is an important process in landslide-generated impulse waves (LGIW) problems, accompanied by large deformation of soil, strong interface coupling and three-dimensional effect. A meshless particle method, smooth particle hydrodynamics (SPH) has great advantages in dealing with complex interface and multiphase coupling problems. This study presents an improved soil–water coupled model to simulate LGIW problems based on an open source code DualSPHysics (v4.0). Aiming to solve the low efficiency problem in modeling real large-scale LGIW problems, graphics processing unit (GPU) acceleration technology is implemented into this code. An experimental example, subaerial landslide-generated water waves, is simulated to validate this model. Then, the Huangtian LGIW, a real large-scale LGIW problem in China is simulated to reproduce the entire disaster chain, including landslide dynamics, fluid–solid interaction, and surge wave generation. The convergence analysis shows that a particle distance of 5.0 m can provide a converged landslide deposit and surge wave for this example. Numerical simulation results are in good agreement with the limited field survey data. The application example of the Huangtian LGIW provides a typical reference for large-scale LGIW assessments, which can provide reliable information on landslide dynamics, interface coupling behavior, and surge wave characteristics.

KEYWORDS

Landslide-generated impulse waves; smoothed particle hydrodynamics; graphics processing unit; Huangtian landslide; convergence analysis

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