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Simulation on the Three-Dimensional Landslide Generated Tsunamis

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Tsunamis generated by mass movements such as landslides, underwater slumps, and rock avalanches can lead to serious inundation of nearby populated areas. At 21:39 on June 17, 2017, local time, a large landslide (2000 m long and 1100 m wide, occurred in Greenland, with the landslide mass descending into the sea at Karrat Fjord. Different from the seismic tsunami, the landslide tsunami features the intensive wave height and concentrated energy distribution. On the other hand, 3D complicated flow filed with splash water waves implead the use of shallow water or Boussinesq wave equations. Not to say the tsunami is generated by a moving obstacle. In this study, a new moving-solid method, named rigid-water method, was developed to describing the solid material moving in the fluid and the response from the fluid to the moving solid. The rigid-water method controls the fluid velocity to satisfy the velocity in the solid regime by iterating and converging the velocity and pressure at the same time. The solution on the fluid part is obtained by solving the full Navier-Stokes equations with the volume of fluid (VOF) method. The piecewise linear interface calculation (PLIC) scheme is adopted for the free-surface reconstruction. As for the solid part, the discrete element method (DEM) is used. This method was validated by four benchmark cases. 1. The vortex shading by a fully immersed square cylinder. 2. A floating obstacle on the waves. 3. Landslide tsunami generated by a box-Shaped. Good results can be seen. At the end, we perform a series of simulations for inspecting the accuracy of the equations commonly for describing the initial wave profile of the landslide tsunami. A good agreement can be seen.