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Development of High Precision Tsunami Runup Calculation Method Coupled with Structure Analysis

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The 2011 Great East Japan Earthquake (GEJE) has shown that tsunami disasters are not limited to inundation damage in a specified region, but may destroy a wide area, causing a major disaster. Evaluating standing land structures and damage to them requires highly precise evaluation of three-dimensional fluid motion – an expensive process. Our research goals were thus to develop a coupling STOC-CADMAS (Arikawa and Tomita, 2016) coupling with the structure analysis (Arikawa et. al., 2009) to efficiently calculate all stages from tsunami source to runup including the deformation of structures and to verify their applicability. We also investigated the stability of breakwaters at Kamaishi Bay.
Fig. 1 shows the whole of this calculation system. The STOC-ML simulator approximates pressure by hydrostatic pressure and calculates the wave profiles based on an equation of continuity, thereby lowering calculation cost, primarily calculating from a e epi center to the shallow region. As a simulator, STOC-IC solves pressure based on a Poisson equation to account for a shallower, more complex topography, but reduces computation cost slightly to calculate the area near a port by setting the water surface based on an equation of continuity. CS3D also solves a Navier-Stokes equation and sets the water surface by VOF to deal with the runup area, with its complex surfaces of overflows and bores. STR solves the structure analysis including the geo analysis based on the Biot's formula. By coupling these, it efficiently calculates the tsunami profile from the propagation to the inundation.
The numerical results compared with the physical experiments done by Arikawa et. al.,2012. It was good agreement with the experimental ones. Finally, the system applied to the local situation at Kamaishi bay. The almost breakwaters were washed away, whose situation was similar to the damage at Kamaishi bay.

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