

Numerical simulation of runup height of 1771 Yaeyama tsunami by CIP method

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Non-linear shallow-water equation has been conducted by using the finite-difference method for the numerical simulation of tsunami. In this case, the advective term can be generally discretized using the upwind-difference. However, the upwind-difference scheme contains the diffusion component. The diffusion attenuates the short-wavelength components intensely. The computed tsunami runup height would be smaller than the observed because of the diffusion and attenuation of short-wavelength components. This would occur remarkably when the tsunami source is small.

CIP (cubic interpolated propagation) method was employed to compute the advective term accurately. The equation was based on two-dimensional shallow-water theory. The equation was divided into two schemes; advective term and non-advective term. For the advective term, the CIP method by Yabe and Aoki (1991) was employed.

In the CIP method, the physical value at next time-step is computed using the physical value and its first order differentiation. Non-advective term is solved explicitly to compute height of water and velocity of water. Staggered-grid was used for the simulation.

For the test case, numerical simulation of the 1771 Yaeyama tsunami was computed using the CIP method. The computed area is range of 124.037-127.773E and 24.154-24.828N, and it was divided to 150 m mesh. The simulation was conducted for one-hour. Time step was 0.25 s. The normal fault model by Nakamura (2006) was used. The normal fault, striking N135E was located between Ishigaki Island and Tarama Island. Length, width, slip of the fault is 50 km, 25km, and 8 m, respectively. Linear equation was used for the depth deeper than the 50m. Non-linear equation (CIP method) with bottom friction and runup was used for the depth shallower than 50m.

The computed runup heights by CIP are about 1.5 times greater than those by upwind difference method. In the southeast of Ishigaki Island, maximum runup height is 13 m by upwind method; it is 20 m by the CIP method. The runup height was greatly improved.