Application of an Adaptive Mesh Refinement Method to Simulations of Nankai Trough Earthquake Tsunami

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Numerical simulations of tsunamis with nested grids are widely used to estimate tsunami heights in a coastal area. In a general method of the nested grids, the resolution and time increment of each grid are fixed and needed in advance. It requires high computational cost as the number of the nested regions with the finer grid increases. A solution to this problem is to use an adaptive mesh refinement (AMR) method, which allows the grid resolution to vary dynamically depending on its necessity.

This study conducts a model validation of the numerical modeling of a tsunami using the AMR method and the fixed grid method. The simulation results with the AMR method are compared to those with fixed resolutions of the nested grids. Both are based on nonlinear shallow water equations (NSWE). The study area is the western Japanese Pacific coast, which is located along Nankai Trough. Eleven earthquake sources with the moment magnitude of 9.0 proposed by the Cabinet Office of the Japanese Government are used as benchmark tsunami scenarios for comparison. The tsunami waveforms and velocities at the coastal areas simulated with AMR methods are very similar to those with the other method. This comparison highlights that uncertainty associated with the numerical methods is small and the AMR method is useful to simulate tsunami propagation efficiently in regions with complex bathymetry.

Keywords: adaptive mesh refinement method, finite volume method

