Toward tsunami damage prediction based on high performance computing

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Tsunami damage prediction is important in making the tsunami disaster prevention plan in the coastal area. In general, tsunami damage prediction is based on three processes: 1. Setting a fault rupture model based on past earthquake, 2. Computation of crustal deformation due to the fault rupture model in an elastic body of homogeneous half-space, 3. Calculation of tsunami using two-dimensional shallow water approximation with the computed crustal deformation as input. In this study, we aim to upgrade each of these components that are necessary for the predictions by simulation methods based on techniques of high performance computing. In 1, we extract fault rupture scenario from a physical simulation of earthquake generation in the target region. Thanks to the improvement of the calculation method (e.g, Hyodo et al. 2016), such a physical simulation is applicable to a large-scale earthquake that causes a large tsunami. 2, we introduce the crustal deformation calculation based on the more realistic three-dimensional inhomogeneous elastic structure by using the finite element method. With the fast calculation method for finite element modeling of elastic deformation developed by Ichimura et al. (2016), it is possible to calculate crustal deformation in a necessary high resolution for calculation of tsunami sources. 3, in collaboration with tsunami researchers, we are considering introducing calculations based on the three-dimensional particle method where detailed calculations such as upstream calculations in urban areas are necessary.

We have succeeded in calculating the crustal deformation by replacing the process 1 and 2 as above in the case assuming a Nankai Trough large earthquake. In the presentation, we will discuss the progress of 3 as well as present examples of applications in other regions.

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