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Development of tsunami waveform database based on linear dispersive-wave theory for real-time tsunami forecasting

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Real-time tsunami forecasting based on source inversion of offshore tsunami data is effective for update of tsunami early warnings. To accomplish the real-time analysis in a short time, in advance of an earthquake we prepare a database of the tsunami Green's functions that are responses to the unitary displacement of a sea-surface element (unit source) at observing points. For the construction of our present database, linear long-wave (LLW) approximation was used in the numerical simulation. However, recent offshore tsunami observations have demonstrated that the LLW approximation is sometimes invalid and the linear dispersive effect should be taken into account in tsunami modeling. If the effect is neglected in our source inversion, the accuracy of the resultant tsunami predictions should be degraded. In this study, we develop a database of Green's functions based on the linear dispersive-wave (DSP) simulations to improve the forecasting accuracy. A difficulty to make the DSP database is very long computation time. The DSP simulation takes much longer time than LLW one. In addition, we have to perform the simulation more than 1000 times, corresponding to the number of the unit sources. To reduce the computation time, we used tsunami-simulation code JAGURS [Baba et al., 2015, PAGEOPH], which is optimized for the parallel computation in K computer (the Japanese supercomputer) by using OpenMP and MPI techniques. For more effective computation of many cases, we implemented a function that the tsunami simulations for more than 1000 source are performed in parallel once a user submits only one job. As the result of its application to the Nankai-trough region where there is 1059 sources, the whole calculation was finished in ˜20 hours by using 4236 nodes of the K computer.

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Keywords: real-time tsunami forecasting, database, linear dispersive-wave theory, K computer