Improvement and speed optimization of numerical tsunami modelling program using OpenMP technology

A. Chernov (1,4), A Zaytsev (2,3,4), A Yalciner (5), and A Kurkin (4)

(1) Institute of Marine Geology and Geophysics, FEB RAS, Yuzhno- Sakhalinsk, Russia, (2) Special Research Bureau for Automation of Marine Researches, Uzhno-Sakhalinsk, Russia (aizaytsev@mail.ru), (3) Department of Nonlinear Geophysical Processes, Applied Physics Institute, Nizhny Novgorod, Russia (Pelinovsky@hydro.appl.sci-nnov.ru, 007 8312 365976), (4) Nizhny Novgorod State Technical University, Applied Mathematics, Nizhny Novgorod, Russian Federation (tme-nn@yandex.ru), (5) Department of Civil Engineering, Ocean Engineering Research Center, Middle East Technical University, Ankara, Turkey (yalciner@metu.edu)

Currently, the basic problem of tsunami modeling is low speed of calculations which is unacceptable for services of the operative notification. Existing algorithms of numerical modeling of hydrodynamic processes of tsunami waves are developed without taking the opportunities of modern computer facilities. There is an opportunity to have considerable acceleration of process of calculations by using parallel algorithms.

We discuss here new approach to parallelization tsunami modeling code using OpenMP Technology (for multiprocessing systems with the general memory). Nowadays, multiprocessing systems are easily accessible for everyone. The cost of the use of such systems becomes much lower comparing to the costs of clusters. This opportunity also benefits all programmers to apply multithreading algorithms on desktop computers of researchers. Other important advantage of the given approach is the mechanism of the general memory - there is no necessity to send data on slow networks (for example Ethernet). All memory is the common for all computing processes; it causes almost linear scalability of the program and processes.

In the new version of NAMI DANCE using OpenMP technology and multi-threading algorithm provide 80% gain in speed in comparison with the one-thread version for dual-processor unit. The speed increased and 320% gain was attained for four core processor unit of PCs. Thus, it was possible to reduce considerably time of performance of calculations on the scientific workstations (desktops) without complete change of the program and user interfaces. The further modernization of algorithms of preparation of initial data and processing of results using OpenMP looks reasonable.

The final version of NAMI DANCE with the increased computational speed can be used not only for research purposes but also in real time Tsunami Warning Systems.