Geophysical Research Abstracts
Vol. 15, EGU2013-5562, 2013
EGU General Assembly 2013
© Author(s) 2013. CC Attribution 3.0 License.

Toward the Real-Time Tsunami Parameters Prediction

Mikhail Lavrentyev (1), Alexey Romanenko (1), and Andrey Marchuk (2)

(1) Novosibirsk State University, Russian Federation (mmlavrentiev@gmail.com), (2) Institute of Computational Mathematics and Mathematical Geophysics

Today, a wide well-developed system of deep ocean tsunami detectors operates over the Pacific. Direct measurements of tsunami-wave time series are available. However, tsunami-warning systems fail to predict basic parameters of tsunami waves on time. Dozens examples could be provided. In our view, the lack of computational power is the main reason of these failures. At the same time, modern computer technologies such as, GPU (graphic processing unit) and FPGA (field programmable gates array), can dramatically improve data processing performance, which may enhance timely tsunami-warning prediction. Thus, it is possible to address the challenge of real-time tsunami forecasting for selected geo regions.

We propose to use three new techniques in the existing tsunami warning systems to achieve real-time calculation of tsunami wave parameters. First of all, measurement system (DART buoys location, e.g.) should be optimized (both in terms of wave arriving time and amplitude parameter). The corresponding software application exists today and is ready for use [1]. We consider the example of the coastal line of Japan. Numerical tests show that optimal installation of only 4 DART buoys (accounting the existing sea bed cable) will reduce the tsunami wave detection time to only 10 min after an underwater earthquake.

Secondly, as was shown by this paper authors, the use of GPU/FPGA technologies accelerates the execution of the MOST (method of splitting tsunami) code by 100 times [2]. Therefore, tsunami wave propagation over the ocean area 2000*2000 km (wave propagation simulation: time step 10 sec, recording each 4th spatial point and 4th time step) could be calculated at:

- 3 sec with 4’ mesh
- 50 sec with 1’ mesh
- 5 min with 0.5’ mesh

The algorithm to switch from coarse mesh to the fine grain one is also available.

Finally, we propose the new algorithm for tsunami source parameters determination by real-time processing the time series, obtained at DART. It is possible to approximate the measured time series by a linear combination of synthetic marigrams. Coefficients of such linear combination are calculated with the help of orthogonal decomposition. The algorithm is very fast and demonstrates good accuracy.

Summing up, using the example of the coastal line of Japan, wave height evaluation will be available in 12-14 minutes after the earthquake even before the wave approaches the nearest shore point (usually, it takes places in about 20 minutes).

1. The determination of the optimal sensors’ location using genetic algorithm / A.S.Astrakova, D.V.Bannikov, S.G.Cherny, M.M.Lavrentiev // 3rd Nordic EMW Summer School, Turku, Finland, June, 2009: proceedings - Finland: TUSC General Publications, 2009. - N 53. - P.5-22.
2. M.Lavrentiev Jr., A.Romanenko, "Modern Hardware Solutions to Speed Up Tsunami Simulation Codes", Geophysical research abstracts, Vol. 12, EGU2010-3835, 2010