Geophysical Research Abstracts
Vol. 13, EGU2011-4456, 2011
EGU General Assembly 2011

Identification of tsunami wave parameters at source

Mikhail Lavrentiev (1), Andrey Marchuk (2), and Konstantin Simonov (3)

(1) Novosibirsk State University, Novosibirsk, Russian Federation (mmlavr@nsu.ru), (2) Institute of Computational Math and Math Geophysics, Novosibirsk, Russian Federation (mag@omzg.sscc.ru), (3) Institute of Computational Modeling, Krasnoyarsk, Russian Federation (simonovkv@icm.krasn.ru)

Accurate prediction of tsunami wave parameters at certain coast locations is still among unsolved problems of tsunami hazard mitigation: for example, a country-wide tsunami alert in Japan after Chilean event of February 27, 2010. The expected wave height was largely overestimated: more than 3 meters expected versus 1,2 meters in reality. Thus, hundreds of thousands people were suggested to move out of coast line, hundreds of trains were delayed of canceled, which led to significant unjustified costs.

One of the reasons of inaccurate predictions of tsunami parameters is that very little information about initial disturbance of the sea bed at tsunami source is available. In this paper, we suggest a way to improve the quality of tsunami source parameters prediction.

So-called preliminary calculation approach is one of the most popular ways to determine tsunami parameters at source. This technique consists of several steps. First, the subduction zone is covered by the set of "unit sources". Then, this zone typical shape of initial disturbance of unit amplitude is suggested at each unit source. Wave propagation from all these sources is calculated over the entire bathymetry, including the tsunameters locations (DART buoys). After real event time series obtained at DART are approximated as linear combinations of preliminary calculated time series from unit sources. V. Titov (University of Washington, Seattle) proposed and implemented this technique. This works rather well provided that a few unit sources cover the entire source area. However, there are a few constraints. Firstly, in case of an extended source area, too many CPU resources are needed. Secondly, real disturbance at source is approximated as a linear combination of only one selected shape, located at several unit sources.

We suggest the following improvements to the methodology by V. Titov. Smaller system of unit sources should be considered to approximate all typical shapes of initial disturbance by several suitable basis functions. To support this, performance of data analysis should be dramatically improved. This could be done by using signal orthogonalization procedure and calculation of Fourier coefficients of the measured time series with respect to orthogonal basis. We will show preliminary numerical tests.

To have more stable results, we suggest a direct solution of inverse problem of source parameters identification in 1D (in space) hyperbolic equation (shallow water approximation) along the wave ray from source to DART buoy. As was recently discovered, uniqueness theorems are available to such inverse problems.