Geophysical Research Abstracts
Vol. 19, EGU2017-13813, 2017
EGU General Assembly 2017


# Modeling the 16 September 2015 Chile tsunami source with the inversion of deep-ocean tsunami records by means of the r - solution method

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The key point in the state-of-the-art in the tsunami forecasting is constructing a reliable tsunami source. In this study, we present an application of the original numerical inversion technique to modeling the tsunami sources of the 16 September 2015 Chile tsunami. The problem of recovering a tsunami source from remote measurements of the incoming wave in the deep-water tsunameters is considered as an inverse problem of mathematical physics in the class of ill-posed problems. This approach is based on the least squares and the truncated singular value decomposition techniques. The tsunami wave propagation is considered within the scope of the linear shallow-water theory. As in inverse seismic problem, the numerical solutions obtained by mathematical methods become unstable due to the presence of noise in real data. A method of r-solutions makes it possible to avoid instability in the solution to the ill-posed problem under study. This method seems to be attractive from the computational point of view since the main efforts are required only once for calculating the matrix whose columns consist of computed waveforms for each harmonic as a source (an unknown tsunami source is represented as a part of a spatial harmonics series in the source area). Furthermore, analyzing the singular spectra of the matrix obtained in the course of numerical calculations one can estimate the future inversion by a certain observational system that will allow offering a more effective disposition for the tsunameters with the help of precomputations. In other words, the results obtained allow finding a way to improve the inversion by selecting the most informative set of available recording stations. The case study of the 6 February 2013 Solomon Islands tsunami highlights a critical role of arranging deep-water tsunameters for obtaining the inversion results. Implementation of the proposed methodology to the 16 September 2015 Chile tsunami has successfully produced tsunami source model. The function recovered by the method proposed can find practical applications both as an initial condition for various optimization approaches and for computer calculation of the tsunami wave propagation.