



Improvement of short cut numerical method for determination of periods of free oscillations for basins with irregular geometry and bathymetry

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A short cut numerical method for evaluation of the modes of free oscillations of the basins which have irregular geometry and bathymetry was presented in the paper (Yalciner A.C., Pelinovsky E., 2007). In the method, a single wave is inputted to the basin as an initial impulse. The respective agitation in the basin is computed by using the numerical method solving the nonlinear form of long wave equations. The time histories of water surface fluctuations at different locations due to propagation of the waves in relation to the initial impulse are stored and analyzed by the fast Fourier transform technique (FFT) and energy spectrum curves for each location are obtained. The frequencies of each mode of free oscillations are determined from the peaks of the spectrum curves.

Some main features were added for this method and will be discussed here:

1. Instead of small number of gauges which were manually installed in the studied area the information from numerical simulation now is recorded on the regular net of the «simulation» gauges which was place everywhere on the sea surface in the depth deeper than "coast" level with the fixed presetted distance between gauges. The spectral analysis of wave records was produced by Welch periodogram method instead of simple FFT so it's possible to get spectral power estimation for wave process and determine confidence interval for spectra peaks.
2. After the power spectral estimation procedure the common peak of studied seiche can be found and mean spectral amplitudes for this peak were calculated numerically by a Simpson integration method for all gauges in the basin and the mean spectral amplitudes spatial distribution map can be plotted. The spatial distribution helps to study structure of seiche and determine effected dangerous areas.
3. Nested grid module in the NAMI-DANCE - nonlinear shallow water equations calculation software package was developed. This is very important feature for complicated different scale (ocean – sea – bay – harbor) phenomenons studying.

The new developed software was tested for Mediterranean, Sea of Okhotsk and South China sea regions. This software can be usefull in local tsunami mapping and tsunami propagation in the coastal zone.

References:

Yalciner A.C., Pelinovsky E. A short cut numerical method for determination of periods of free oscillations for basins with irregular geometry and bathymetry // Ocean engineering. V. 34. 2007. . 747 – 757