Computed seaquake and tsunami precursors and recommendations for monitoring

O. Novik (1), Yu. Ruzhin (1), S. Ershov (2)

(1) Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of Russian Acad. of Sciences (IZMIRAN), Troizk, Moscow Region, Russia, (2) Keldysh Inst. of Applied Math. of Russian Acad. of Sciences, Moscow, Russia (onovik@online.ru / Eax: 7-495-3340124 / Phone: 7-495-3322808)

According to our computations on the basis of the combined magneto-thermo-elasticity and magneto-hydrodynamic principles along with geophysical data, oscillations of the magnetic field components may be recorded at the sea floor, i.e. at the top of a sedimentary layer, $3 \div 4$ sec after the beginning of weak (the amplitude is of the order of a few cm) vertical displacements in the upper mantle, namely 40 km under the sea level in the case described here. We suppose that similar weak disturbances of the stationary configuration of the oceanic lithosphere elastic field are arising in the course of accumulation of deformations of lithosphere geological structures during a seaquake and tsunami preparation period. The delay of the computed seismic P wave in regard to the EM one depends on the elastic and EM parameters of rocks along the trace in the oceanic lithosphere and is of the order of 0.1 sec per 1 km, on the average. The computed magnetic signal amplitude at the sea bottom is approximately proportional to one of elastic displacements (see above) and is of the order of a few hundreds of pT. It is the first measurable signal of a seismic excitation beneath a sea floor. The amplitude of the electric and temperature seismic oscillations is of the order of a few μV/m and mK respectively (quartz thermo-resistors are needed) at the sea floor.

At the sea surface and in the atmosphere up to the ionosphere, the computed EM oscillations, similar to ones at the seafloor, are arising together with the hydro-acoustic wave caused by the delayed seismic P wave's shock into the sea bottom. Before this shock, penetration of the computed EM signal from the lithosphere into sea depths is negligible because of high electric conductivity of seawater (3.5 S/m). Let us note, the frequency spectrum of the computed EM oscillations at the sea floor, surface, and up to the lower boundary of the ionosphere domain D resembles the spectrum of the seismic excitation ($0.1 \div 10$ Hz) in the upper mantle under the sea. The computed elastic, temperature, EM and hydrodynamic seismic signal characteristics (velocities, amplitudes, spectra) correspond to known observations. For example, the computed long (150 km) tsunami wave's amplitude far from a shore is about 12 cm only and EM signals propagating in the atmosphere with the light velocity should be recoded at the sea surface and above. Basing on numerical results about ULF precursory signals and observations of VHF ones in the atmosphere above a sea (Ruzhin et al., 2000), the authors develop the project of the Lithosphere-Ocean-Atmosphere Monitoring System (LOAMS) including: bottom stations (with seismometers, magnetometers, thermometers, pressure gauges, magneto-telluric sounding of changes of electric conductivity beneath the sea floor, measurements of the magnetic field horizontal gradients for prognosis of the epicenter of a seaquake), a moored ocean surface buoys (oceanography, measurements of a hard sea EM effect, satellite link) and an observation balloon (multidisciplinary measurements, including vertical gradients of geophysical fields, optics, a long receiving antenna, radio-tomography using satellite instrumentations). In particular, we hope that the LOAMS, computations of the seismo-hydro-EM interaction and the signal time series analysis will provide prognostic interpretation of the recorded signals, including a stable detection of ionosphere Pc pulsations and EM signals of lithosphere origination, as well as estimation of the prognostic value of different particularities of the satellite instrumentation recordings.