SEISMOELECTROMAGNETIC SIGNALS ABOVE THE OCEAN (ELEMENTS OF THE TSUNAMI PRECURSOR PHYSICS)

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A mathematical model of seismo-hydro-electromagnetic geophysical field interaction is formulated basing upon the theory of elasticity, electrodynamics of slowly moving media, hydrodynamics, irreversible thermodynamics and geophysical data. The authors show that the initial boundary value problem for the system of partial differential equations (PDF) of the model is well-posed though the differential operators included in the system of the PDFs are of different mathematical types, according to different physical nature of interacting fields (above).
Then the authors traced numerically and visualized generation and propagation of ultra-low frequency (ULF) electromagnetic (EM) signals in a seismically disturbed moving model medium with a lithosphere zone, a marginal sea and an atmosphere zone up to the lower boundary of the ionosphere. Demonstrated are sequential stages of the physical process of transformation of a seismic excitation in geological structures beneath the sea bottom into EM signals in the atmosphere: generation of an ULF EM wave in a seismically deformed conductive domain of the ocean lithosphere (similar domains are known to be typical for tectonically active lithosphere zones, both continental and oceanic ones); a spatial modulation of the generated long EM wave by the seismic wave , “freezing” of the EM wave (arrived at the top of the sedimentary layer) before going over from the lithosphere into the sea depth with its high electric conductivity (4 S/m); the delayed seismic P wave’s shock into the deep part of the sea bottom, arising of a vertical hydrodynamic flow and a surface long (about 150 km) tsunami wave of a small (up to 15 cm) amplitude far from the shore), EM emission from the sea surface.
As a result, it is shown that measurable ULF EM signals (hundreds of pT at the sea bottom and the sea-atmosphere interface by the frequency spectrum similar to one of the initial seismic excitation) do arise in atmosphere during development of a seismo-hydro-EM process initialized by a rather moderate (precursory) seismic excitation in the form of elastic displacements with main frequencies 0.1 to 10 Hz and the amplitude and duration of the order of a few cm and sec respectively in the upper mantle under the sea bottom. The quantitative characteristics of the computed seismo-hydro-EM process (e.g. the amplitudes of the EM, temperature and tsunami waves, the delay of the EM signal in regard to the beginning of a seaquake etc) are of the orders observed. The recommendations for the EM tsunami observations are given including the description of a lithosphere-ocean-atmosphere monitoring system.

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