EARTHQUAKE AND HURRICANE REMOTE MONITORING WITH GROUND-BASED INTERFEROMETRY

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ABSTRACT:

The threatening natural disasters such as the most powerful earthquakes and tropical cyclones bringing the colossal human and environmental losses seem to have be coupled geophysical phenomena in their origin. The wide spread anomalies in deformations (tilts and strains) of the solid Earth which are usually preceding to the strongest earthquakes, and which are observed by many authors everywhere in experiments, have a great analogy with barometric forerunners of such extreme atmospheric events as storms, typhoons, hurricanes etc. The similarity will increase considerably if we take into account the conventional dilatance-diffusion earthquake model and the frequently detected cove-shape precursor varieties before the most powerful earthquakes. In particular the deformation (tilt and strain) precursors are often accompanied by the peculiar tremor precursors, which are known as a lowering of micro-seismic and acoustic noise background before earthquakes - quite similar as calm before the storm.

The quantitative analysis of geophysical occurrences in lithosphere and in adjacent geospheres has become possible after the high quality long-path laser interferometers - the most precise tools for the earth surface observations have been manufactured. A number of experimental data in laser geophysical studies of the deformation and acoustic phenomena foregoing to earthquakes have been collected and summarized since our first tangible results in the last decades. By using the precise laser interferometers we have revealed that the dynamic disturbances of the Earth's surface and perturbations in atmosphere have a wave microstructure and are often accompanied by the ascending of seismic activity. By means of spatially distributed laser instruments we could observe the traveling strain-baric anomalies (wave-shape disturbances of the atmospheric pressure and synchronous earth strain variations) with spreading velocities of 30-60 km/h deep into the continental zone and up to 250 km/h nearby the coastal region. It was shown that anomalous lithosphere activity (to which the earthquake precursors should be attributed) looks like as interference with atmosphere, hydrosphere (including an underground water level), and another geospheres activities.

As a result of analysis of geophysical fields variations and lithosphere-atmosphere interactive disturbances, we have found the correlation between the seismic activity of the Earth and the tropical cyclogenesis in the World Ocean.

This correlation is demonstrated by few examples of parallel recordings obtained by long-path laser interferometers during the powerful earthquakes in 1998-2003. The comparison with global and regional cyclogenesis has become possible owing to issuing the Catalog of Tropical Cyclones and Tropical Disturbances of the World Ocean for 1983-2005 (I.V. Pokrovskaya and E.A. Sharkov). As obvious illustration we present the detection of anomalous lithosphere-atmosphere activity which was observed on 21-25.03.1998 with maximum intensity of strain-baric perturbations being recorded on 22-23.03.1998. The detected processes have been compared with two rows of natural phenomena: (1) - the tropical typhoon origins in SW region of Pacific Ocean - 16.03.1998 (Yaly), 18.03.1998 (Nathan), and 26.03.1998 (Zuman) with maximum wind velocities Vm=65-90 mile/h; and (2) - the most powerful earthquakes on those periods - 25.03.1998 (Balleny Islands, M=7.5), 28.03.1998 (Tonga Islands, M=6.9), 01.04.1998 (Southern Sumatra, M=7.0), and 01.04.1998 (Coast of Southern Chile, M=7.0). The last of three mentioned typhoons (Zuman) was destroyed on 06.04.1998 after transition into midlatitudes, and tropical waves background (Vm=10-20 mile/h) was observed on 02-15.03.1998 and 01-07.04.1998 periods.

The found correlation can be interpreted as earthquake triggering by powerful atmosphere disturbances. Investigation of the observed phenomena in more detail seems to be very useful for the development of a methodology for early warning of seismic hazard and other natural disasters.