



## **Experimental study of tsunamis in the Kolmsk Harbor, southwestern Sakhalin**

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The existent warning system of a sea level dangerous rises in the Sakhalin region has a series of limitations. They are connecting with the absence of on-line information about wave process in the Tsunami Warning Center. Besides, the operational experience of warning system with using only seismological information discovers a series of problems, in particular, at definition time of alarm.

Therefore one of the major problems is connecting with development of the warning system about the dangerous sea phenomena is the expansion of monitoring system and installation of the tsunami recorders in area of settlements with the purpose of wave detection and operative estimation of its height on coast.

Besides, the large-scale heterogeneities of coastline, such as gulfs, harbors and other, leads to formation of own systems of standing oscillations which parameters are determined by geometry of corresponding water area. Investigation of such resonant oscillations (seiches) in harbors with the open external boundary is of interest in connection with threat of a tsunami - it is necessary to calculate the resonant features of various water areas. For example, according to A.B. Rabinovich (1993), during a tsunami of 2.23.1980 the wave heights inside Malokurilskay harbor were amplified almost five times in comparison with an external shelf and had the period about 17 minutes, i.e. practically the same as the period of the basic spectral maximum of level oscillations for this harbor.

The specified circumstances have lead to necessity of experiments with installation of measuring system and meteorological station WS 2300 in the Kholmsk port in

July 2006 with the purpose to receive new long-term records of sea level fluctuations, including dangerous, such as a tsunami, seiches, storm surges and harbor oscillations. These researches will allow obtain more detailed estimations of the dangerous sea phenomena in Kholmsk port.

The analysis of observations had shown that in area of the gauge installation (removed part of the harborage) the oscillations with a period about 8 minutes are connected with one-nodal longitudinal seiche of the harbor. In some situations the oscillations with multiple frequencies of this mode are stood out. This seiche determines character of oscillations in this part of the harbor in the time of a tsunami and it is generated more effectively by close sources (Moneron 1971, Akita 1983) and much more feebly removed (Kamchatka 1952, Chile 1960). Also results of experimental measuring the eigentones with periods 90, 57 and 33 seconds are shown. These oscillations are connected with characteristics of wind waves and, probably, are responsible for forming of the phenomenon harbor oscillations in the port.

Also the Simushir tsunami was recorded in the Kholmsk harbor (15 November 2006). It was a first tsunami that recorded here with using high precision digital system. Seiche with period 8 min dominated in sea level oscillations during several hours after tsunami coming. Seiche with period 3 min was found in tsunami records too.

The investigations in the Kholmsk harbor have shown the important role of a seiches in a tsunami forming, especially when the tsunami source was located in the Japanese Sea. The realization of numerical experiments allows to determine their spatial structure and segments of harbour area which are susceptible to exposure of tsunami.