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Experimental study of surf beats near southeastern coast of Sakhalin Island

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The Institute of marine geology & geophysics (Russian Academy of Sciences) performs a sea level and wind waves measurements during 2000 - 2005 on the southeastern Sakhalin coast. One of the basic purposes of these experiments is the study of transformation of wind waves and swell in the narrow coastal zone and infragravity waves generation - surf beats and rip currents.

Very interesting results were obtained during the observations 28 June - 30 July 2005. Three cable stations with bottom pressure gauges were installed in the nearshore zone. We obtained a lot of two-hour and diurnal time-series with discreteness 2 seconds for different stages of the waves and weather. Besides, simultaneously the recording of atmospheric pressure oscillations, speed and direction of a wind was performed with 1 minute discreteness with the using of digital weather station WS 2300 .

The preliminary spectrum analysis of these records has shown that two types of waves dominate in spectra - wind waves and swell. The periods of these waves depend on weather conditions and were changed from 5 to 7 sec for wind waves, from 7.5 to 10 sec for relatively short swell and from 12.5 to 14 sec for long swell. The energy of wind waves considerably predominated over the energy of swell in the majority of records

The groups of oscillations with a period about 11 minutes are stood out clearly on the records of sea level oscillations that obtained 18 July. And they are traced well on all three bottom sensors. It is necessary to note, that such groups of oscillations are not discovered not earlier and not later.

The significant peak with the period of 11.38 minutes was stood out in spectra of the sea level fluctuations. Besides, peaks on the multiple periods - 5.69 minutes, 3.83 minutes, 2.84 minutes are stood out. The energy of oscillations is attenuated more quickly on the nearshore gauge. The spectra of the sea level fluctuations that registered 17 July a peaks of this kind are absent and the spectral energy below on 1-1.5 orders.

The period of repetition for wind peaks and groups of level oscillations is identical - about 3 hours that follow from spectral - time diagrams of wind speed and sea level fluctuations. At the same time the energy of wind peaks is decreased with time. Besides, peaks on spectral-time diagram of wind speed advance peaks on spectral-time diagram of sea level approximately on 1 hour.

Structure of the level oscillations spectrum with presence of peaks on the multiple periods is typical most for the shelf resonance that connected with reflections of long waves from coast and an edge of a shelf (sometimes this phenomenon is named shelf seiche because of analogy to eigentones in bays). Presence of a sharp bend of a coastal line in area of cape promotes more effective generation of long waves as affected of wind. At affinity of frequencies in spectra of external influence to frequencies of a shelf resonance (that generally speaking is not characteristic for atmospheric processes in ordinary conditions) it is possible to expect effective generation of waves in a coastal zone.

Estimations of wave process envelopes have allowed to select fluctuations with the period 50 sec, that denote on generation of edge free waves by group structure of waves. It is shown also, that peak of a power spectrum for the packages waves envelopes on the period nearby 200 sec, corresponds to forced infragravity waves that formed as a result of nonlinear transformation of wind waves and swell and has the same phase speed and direction of propagating to the coast. It is agreed with the theory Longuet-Higgins – Stewart.