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Samoa (30.09.2009) and Chilean (28.02.2010) tsunami recording in the bays of Shikotan Island (South Kuril Islands)

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The Institute of Marine Geology & Geophysics (the Russian Academy of Sciences) is providing direct tsunami measurements in the area of South Kuril Islands which is area of high seismic activity. The bottom pressure gauges (which represent sea level oscillations) were installed in Malokurilskaya Bay and Krabovaya Inlet on the inner Yuzhno Kurilsky Strait coast and in the Tserkovnaya and Mayachnaya Bays on the oceanic coast of Shikotan Island. Two tsunamis were recorded in the Shikotan Bays recent times. A relatively weak remote Samoa tsunami) was recorded on September 29, 2009 in the Malokurilskaya, Tserkovnaya and Mayachnaya Bays. A stronger Chilean tsunami was recorded on February 28, 2010 in the Malokurilskaya and Tserkovnaya Bays, and Krabovaya Inlet.

The maximal heights of Samoa tsunami were about 30-40 cm, they were recorded about 3 hour later after tsunami arrival. The Chilean tsunami trough-to-crest wave heights were about 180 cm in the Tserkovnaya Bay, 90 cm in Malokurilskaya Bay and 80 cm in Krabovaya Inlet. The time shift between first and maximal waves reached 4 hours for Chilean tsunami. The intense sea level oscillations were continuing for a long time, about 15-17 hours at both the tsunami.

To examine spectral properties of long wave oscillations in each Bay, we calculated power spectra using two different data segments (both of 1 day length): The period preceding the tsunami event, was identified as “normal” and selected for analysis of the background signal; the “tsunami period” included tsunami caused oscillations. The length of the window was chosen as 6 hours, yielding a degree of freedom equal to 14.

Samoa caused the high-frequency oscillations, the considerable increase in spectral energy in the tsunami spectrum in comparison with the background spectrum is observed at periods of 4 to 20 min. In contrast to Samoa tsunami, Chilean tsunami caused the low-frequency oscillations, the most considerable increase in spectral energy is observed at periods of 30 to 80 min. A probable reason for these differences is the different orientation of radiation energy in the tsunami sources.

The main spectral maxima at each station were different, however, they are mainly the same in each bay for the two states (“normal” and “tsunami”). Well-expressed peaks with a period of 19 were distinguished in power spectra in the Malokurilskaya and Tserkkovnaya Bays and 29 min in the Krabovaya Inlet. These peaks being associated with zero resonant mode oscillations. Eigen periods and spatial structure of resonant oscillations in particular bays were examined based on results of numerical modeling.

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