Application of R-sensors' seismic instruments on Sakhalin and Kunashir islands

Sakhalin island

Challenge

Most earthquakes on Sakhalin (the Far East) occur in the central part of the island's south – in the area of the Central Sakhalin fault. It is here that most population of the island lives in. In this regard, seismic monitoring observations become vitally essential. To ensure continuous observations as part of the study, a comprehensive observations site was deployed in southern Sakhalin.

To study a structure of the lithological section's top and to clarify compositions and properties of the soil at the equipment locations, seismic observation works were done at equipment locations.

Seismometer CME-6111

Solution

In June 2018, a molecular-electronic broadband **seismometer CME-6111** was installed. This is a precision seismometer having a frequency range of 0.016 Hz (60 csec) – 50 Hz, a low self-noise level, high linearity and wide bandwidth. The presence of force feedback ensures high time and temperature stability of the parameters.

Data logger NDAS-8226

A **data logger NDAS-8226** is used as a seismic data acquisition system. This is a 24-bit data recorder that is optimized for autonomous field seismic data recording. This data logger is reliable and easy-to-use and has high technical characteristics. It uses a USB and Wi-Fi connection for data transfer and system configuring and a 32 Gb internal memory storage. The data logger is equipped with a precision VCO quartz crystal with a real-time GPS/GLONASS clock adjustment.

R-sensors' hydrophone

In October 2018, a **hydrophone** was installed in the observation site. This hydrophone was specially manufactured as part of the research. A 3.5 m deep flooded borehole was built to install the hydrophone.

The installed hydrophone is an instrument that measures pressure changes in an acoustic wave in fluid and gaseous media. The hydrophone is made using an electrochemical transducer. It transforms motion of a working fluid into an output current which provides sensitivity to pressure variations in the bandwidth of 0.02 – 200 Hz with a high gain coefficient of not less than 1.5 mV/Pa.

Seismic monitoring equipment

A 4G modem-router is used to provide remote access and control of the equipment operation – it allows controlling the system over the Internet. The modem-router is connected to NDAS-RT via a WiFi-connection. The system is powered by a 12 V power source with an external battery – this guarantees the equipment operation in case of power failure.
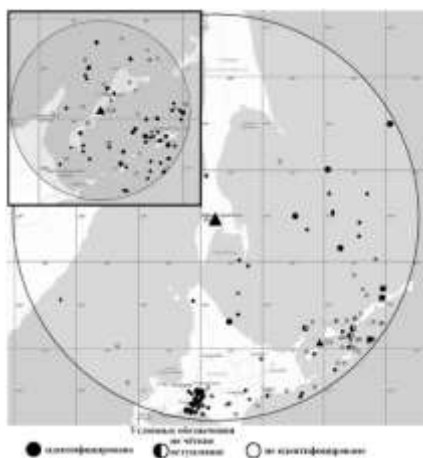
In April 2019, a similar set of equipment consisting of a data logger and a molecular-electronic hydrophone was installed in Kunashir (the Kuril Islands). The hydrophone was installed at the site of the Yuzhno-Kurilsk seismic station in an observation borehole at a depth of 25 meters. Remote access to the registered data as well as monitoring and control of the equipment is organized.

Observations at the sites in Kunashir and southern Sakhalin are conducted in a continuous mode.

Registration capabilities of R-sensors' seismic instruments

Results

The record analysis showed that **70%** of seismic events with M≥4 within a radius of 500 km from the site are reliably registered. That makes it possible to conclude the CME-6111 – NDAS-RT set of equipment is quite good.

According to records of the hydrophone installed in Kunashir, it was found that **72%** of events have a clear entry record within a radius of 100 km from the observation site.

*Seismometer installation
for seismic observations*

Conclusions

For the time being, seismic electromechanical receivers have been used for seismic monitoring in Sakhalin and the Kuril Islands. However, molecular-electronic sensors are **promising**.

As the observations showed, molecular-electronic instruments in terms of the main metrological parameters (frequency and dynamic ranges, self-noise levels) approach the best models of electromechanical instruments and can be used in processing ongoing seismological information.

A complex analysis of seismological, seismic & acoustic and other geophysical data can be aimed at the development of a method for generating short-term forecasts and the development of a seismic network in Sakhalin and the Kuril Islands.

The instruments used in the study

Broadband seismometer   CME-6111
Seismic data logger   NDAS-8226
Hydrophone made by R-sensors

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