Development of a specified-low-power radio telemeter

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Introduction:

In the seismic observation around volcanoes, it is difficult to use commercial power supply and telephone lines for data transmission, because seismometers are often installed in the severe condition such as a summit crater. Therefore, wire cables, which sometimes exceed several kilometers, are commonly used for analog data transmission from the satellite stations. When the animals gnawed the wire cables away or the system broke down by the falling of a thunderbolt, we coped with the trouble by burying a cable and by using an overhead cable. However, such repairing works do not basically solve the disconnection problem but also need many people and costs. Supposing severe field experiments around volcanoes in which the apparatus are preferred to be small, we developed a new low-power radio telemeter that will relieve us from cable maintenance.

Design of the radio telemeter:

We here used the specified-low-power radio unit (frequency band: 400MHz, output power: 10mW), which is free from a licensing system specified in the radio law, to transmit a single channel data of analog signal from the short period seismometer. In the transmitter side, the instrumentation amplifier amplifies the analog signal from the seismometer, and then the signal is converted to 16bit digital data by the delta-sigma type A/D converter after processing by the low-pass filter having the pass band frequency from DC to 30Hz. After the effort to reduce electricity consumption, we succeeded in realizing the low electricity consumption in the transmitter about 65mA (12V DC). In the receiver side, after decoding the received signal, the digital data are converted to analog ones by the 16bit D/A converter. Then the analog data are processed by the low-pass filter having the pass band frequency from DC to 30Hz.

The antenna of the transmitter must be a small whip type following to the radio law, but we used the directive short-wave antenna for the receiver to increase the antenna gains. As a result, this system can send the data over 3 - 5km in spite of small output from the transmitter.

Installation and Observation:

We made a woody box covered with a shed-roof. A solar battery was attached to the roof, and we put a storage battery for motorbike, an overcharging preventer and a transmitter in the box. Supposing the snow coverage in winter, the woody box was settled at 1-meter height from the ground surface. We have been operating the telemeter system at Usu volcano since November 1999. The transmitter and the receiver are installed at the southern rim of the crater basin and OHD station at the southern flank of Usu volcano, respectively. The distance between them is approximately 2 kilometers. Output power of the solar battery is 13W and the capacity of the storage battery is 10Ah (12V DC).

At OHD station, analog output from the receiver is connected to the data converter LT8500 (Hakusan corp.). Signal is converted to UDP packet having win format and then the packet is transmitted to Usu Volcano Observatory, Hokkaido University. The station installed at the southern rim has properly operated during the eruptive activity of Usu volcano in 2000. The system passed winter season twice without any maintenance and is still now working.

Conclusions and Future study:

We succeeded to develop a new radio telemeter system that can be installed easily by a few people. In the future studies, we hope to develop a system that can transmit the plural channels of data without increasing electricity consumption.