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Installation of seafloor cabled seismic and tsunami observation system developed by using ICT

Masanao Shinohara (1), Tomoaki Yamada (1), Shin'ichi Sakai (1), Hajime Shiobara (1), and Toshihiko Kanazawa (2)

(1) Earthquake Research Institute, the University of Tokyo, (2) National Research Institute for Earth Science and Disaster Prevention

A seafloor cabled system is useful for study of earth science and disaster mitigation, because real-time and long-term observation can be performed. Therefore seafloor cabled systems with seismometers and tsunami-meters have been used over the past 25 years around Japan. Because increase of a number of sensors is needed, a new system with low costs for production, deployment and operation is expected. In addition, the new system should have sufficient for flexibility of measurements after installation. To achieve these demands, we started development of a new system using Information and Communication Technologies (ICT) for data transmission and system control. The new system can be made compact since software processes various measurements. Reliability of the system is kept by using redundant system which is easily constructed using the ICT. The first system based on this concept was developed as Ocean Bottom Cabled Seismometer (OBCS) system and deployed in Japan Sea. Development of the second system started from 2012. The Ocean Bottom Cabled Seismometer and Tsunami-meter (OBCST) system has both seismometers and tsunami-meters. Each observation node has a CPU and FPGAs. The OBCST system uses standard TCP/IP protocol with a speed of 1 Gbps for data transmission, system control and monitoring. IEEE-1588 (PTP) is implemented to synchronize a real-time clock, and accuracy is less than 300 ns. We developed two types of observation node. One equips a pressure gauge as tsunami sensor, and another has an external port for additional observation sensor using PoE. Deployment of the OBCST system was carried out in September 2015 by using a commercial telecommunication cable ship. The noise levels at the OBCST system are comparable to those at the existing cabled system off Sanriku. It is found that the noise levels at the OBCST system are low at frequencies greater than 2 Hz and smaller than 0.1 Hz. This level of ambient seismic noise is close to a typical system noise. From the pressure data, pressure gauge has a resolution of less than 1 hPa, which corresponds to a change of water height of less than 1 cm, and data from all the pressure gauges are consistent. From the deployment, the system has been collecting data on seafloor until the present. Tsunami waves on November 22nd, 2016, which were generated by an earthquake with magnitude of 7.4 off Fukushima were clearly observed by all tsunami sensors in the system.