公益財団法人 セコム科学技術振興財団
研究成果報告書

研究課題名

複合型インフラサウンドセンサーの面的展開による津波防災情報伝達ネットワークの構築

Construction of information relay network for tsunami disaster prevention with wide-spreading comprehensive infrasound sensors

研究期間

平成２８年　４月　～　令和　２年　３月

報告年月

令和　２年　６月

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Abstract

Infrasound, which is the core of this research, is low-frequency sound waves with a frequency of less than 20 Hz, that are inaudible to the human ear, also known as micro-pressure waves. Due to their large wavelengths, infrasound cannot be produced by objects as large as normal sounding instruments. It is possible to be excited by the movement of a large geophysical object, such as a sediment disaster. The system we have developed can be used to measure infrasound, thus, the infrasound waves excited by various events can be precisely measured by using a planar array of sensors. Various geophysical events can be detected remotely by checking time differences of sound arrival. An alert system with infrasound remote-sensing can be done in the near future, just as the emergency earthquake alert system are realized from the earthquake observation network. If an observation network can be established, there is a possibility of transmitting important information related to disaster prevention.

In this research project, comprehensive infrasound sensors that have already been developed by the principal investigator and colleagues are used, and then they use it to measure the infrasound in Kochi Prefecture as a model area. We have developed a dense wide-spreading observation network with the comprehensive infrasound sensors. At the preparatory research stage in FY 2016, they were installed in five locations in Kuroshio Town, Kochi. In FY 2017, the project was spread to a total of 15 locations in Kochi Prefecture. With tsunami disaster prevention as the main target, we are collaborating with research institutes and related local governments to develop new disaster prevention information network. We have explored the possibility of transmission, and analyzed the data obtained from the observation network to find out the possibility of various geophysical events. Feasibility and optimal configuration for the detection of large-scale geophysical events as well as human-caused events, or explosions, were studied. The results of this study are presented in the form of an analysis of the environmental noise in the infrasound caused by artificial sources, vibration sources and weather phenomena. In addition, we will also be able to respond to various local conditions, including the effects of sensor installation and the surrounding terrain, at the installation point. We examined the dependence on environmental factors by using datasets obtained in a few years.

As for the main target of this research project, tsunami-excited infrasound, studies were reported after the Great East Japan Earthquake in 2011, but no major tsunami occurred during the period of this research, so it could not be verified. However, with respect to the infrasound during the passage of a typhoon that excites the same degree of infrasound are verified for a few cases. Specifically, in Typhoon No. 21, which caused severe damage to the Japanese archipelago on September 4, 2018, the same kind of large infrasound wave with a period of more than 30 minutes and over-pressure of more than 100 Pa was clearly observed at Muroto City observation site, where the typhoon hit directly. Frequency and amplitude of the wave were about the same or greater than that of the tsunami, but they were detected only at Muroto City observation site; no detection at more distant observation

sites from Aki City, at about 25 km far away from Muroto. The difference between the tsunami and the typhoon could clearly be seen.

The mechanism for communicating tsunami information is based on a system that the information obtained at each observation site is stored on multiple data servers with uploading and aggregating the waveforms, with their quasi-real-time waveform display on web browsers. The system was developed and opened to the public for some of the observed datasets in Kochi Prefecture. In addition, a briefing conference was held in Kuroshio Town, Kochi Prefecture, for representatives of the local community in cooperation with local government officials. We exhibited at various disaster prevention exhibitions to discuss the possibility of linking with existing disaster prevention information transmission systems with the people concerned. Discussions and specific outcomes include real-time earthquake alerts that operate a membership-based emergency earthquake early warning provision service. Infrasound for the preliminary stages of constructing a new system in collaboration with the Real-time Earthquake & Disaster Information Consortium (REIC), experiments are underway at some points in the infrasound observation network. Information just before the earthquake is obtained in conjunction with the earthquake early warning system, and in the event of an earthquake, triaxial acceleration (vibration) sensors on the comprehensive infrasound sensors detect seismic motions at each site, resulting in a double-triggering system, which turns on the tsunami infrasound standby mode. If the infrasound arrives at the speed of sound and can be verified on site, we can estimate the magnitude of tsunami, *i.e.*, it can make a positive contribution to tsunami prevention.