Contribution of the hydroacoustic hydrophone stations of the International Monitoring System to natural disaster mitigation

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In-situ data recorded by the water-column hydrophones of the hydroacoustic (HA) stations of the International Monitoring System (IMS) of the Comprehensive Nuclear-Test-Ban Treaty (CTBT) are examined. The main objective of this study is to share the knowledges and understand how the IMS HA facilities contribute to natural disaster mitigation through the examination of in-situ data of the IMS hydrophones. The first part of the presentation is focusing on the detectability of tsunami by the IMS hydrophones. Data of the IMS hydrophones station HA11, Wake Island (U.S. Territory) at the Tohoku, Japan earthquake in 2011 are examined. The HA11 station which is about 3100 km southeast from the source area could detect tsunami signals in addition to T-phase associated with the main shock. It is evidenced that the theoretical dispersion curve of surface gravity wave follows the dispersive feature recorded at the frequency range less than 10^{-2} Hz. The similar result could be obtained at HA03, Juan Fernandez Islands during the Chile earthquake in 2015. These instances suggest that the tsunami signals can be identified by the water-column hydrophones at the time when tsunami propagates over the IMS hydrophone stations. The second part of the study is focusing on the hydroacoustic signals originated from the submarine eruptions of Ioto, a volcanic island of Japan. Cross-correlation analysis is applied to the hydrophone triplet data of HA11, about 2700 km away from the volcano to estimate the direction-of-arrival (DOA) of hydroacoustic signals of the entire period of September in 2018. Volcanic seismicity based on the on-site observation had become higher than usual, and discolored waters and a splash were observed nearshore by a local flyover during this period. Although hydroacoustic signals associated with seismic activities in the Pacific region are usually apparent, it is possible to discriminate between Ioto volcanic activity and other seismic activities based on the DOA. Our analysis suggests that about three-fourth of detectable hydroacoustic signals were associated with the submarine eruptions of Ioto. The analysis of hydroacoustic data recorded at the IMS hydrophone station HA11 shows that the remote hydrophones appear to be capable of detecting and identifying signals from submarine volcanic eruptions at distances of 1000’s of kilometers.

