Geophysical Research Abstracts
Vol. 20, EGU2018-11836, 2018
EGU General Assembly 2018

Localization using P-phases recorded on the CTBT IMS hydro-acoustic stations

Peter Nielsen, Ronan Le Bras, Mario Zampolli, Paulina Bittner, and Georgios Haralabus
CTBTO, P.O. Box 1200, 1400 Vienna, Austria

The Comprehensive Nuclear-Test-Ban Treaty's (CTBT) International Monitoring System (IMS) consists of a network of different sensor technologies deployed and designed to detect nuclear explosions worldwide. Eleven of these stations are hydro-acoustic stations, five of which are equipped with seismometers to detect underwater signals converted to seismic waves and may also contribute as auxiliary seismic stations. The other six stations are based on hydrophones deployed underwater to monitor the oceans for signs of nuclear explosions. Each hydrophone station is typically composed of two triplets of hydrophones suspended in the Sound Fixing and Ranging (SOFAR) channel. Placing hydrophones at this depth ensures optimum performance of the hydro-acoustic stations in detecting signals from very long distances as a result of the low attenuation that a signal undergoes when propagating in the SOFAR channel. On the other hand, seismic waves such as P-phases propagating in the earth and coupled into the ocean undergo much higher loss and may be more difficult to detect at the hydro-acoustic stations. However, the declared nuclear test DPRK6 conducted underground on 3rd September, 2017 had an estimated body wave magnitude 6.07, and signals compatible with P-phases were detected at the hydro-acoustic stations on Wake Island (HA11) in the Pacific Ocean and Cape Leeuwin (HA01) west of Australia by the International Data Center's (IDC) automatic processing system. Further inspection of the recorded acoustic data revealed that the stations at Diego Garcia (HA08) in the Indian Ocean and Juan Fernández Islands in the South Pacific (HA03) also received similar signals from the nuclear explosion. Evidence of a weak T-phase arrival from the nuclear explosion is also present on HA11, which most likely originates from coupling of the seismic signal to a hydro-acoustic signal in the ocean at the south-eastern Japanese slope. An event was manually formed from these detections, and it is demonstrated that localization of the nuclear test using only the hydro-acoustic data can be obtained with reasonable uncertainty compared to the localization that is possible using all available sensors in the IMS network. Although in general, P-phases detected on hydro-acoustic stations are not considered further in the processing of the IMS data, in a second part of this work estimates of hydrophone depths were obtained by assuming that the P-phase couples into the ocean just below the triplet, propagates vertically through the water and reflects off the sea surface. The estimated time lag by auto-correlation between the main arrival and the sea surface reflected arrival provides indications of hydrophone depths and is demonstrated for a series of automatic P-phase detections on a selection of hydro-acoustic stations. The hydrophone depth estimates from auto-correlation are compared to the reported deployment depths.