Automatic identification of airgun signals observed by ocean bottom seismic network

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In recent years, dense and high-sensitivity ocean bottom seismic (OBS) networks (S-net, DONET) have been deployed along the Japan Trench and the Nankai Trough. Effective use of these data is extremely important not only for research but also for disaster prevention, as it contributes to improving the accuracy and timeliness of Earthquake Early Warning in the offshore area, and understanding detailed seismicity. On the other hand, many signals different from those observed at inland stations are also detected by the OBS network, such as airgun signals used for seismic surveys. About 200 airgun shots were detected in an hour by using the PF method (Tamaribuchi et al., 2016; Tamaribuchi, 2018, EPS), which is an automatic hypocenter determination process for the JMA unified earthquake catalog. Therefore, it is important to properly exclude these airgun signals to improve the accuracy of the automatic process of the earthquake catalog.

Pulse-like signals of relatively high frequency are observed near the source. However, it is difficult to discriminate between natural earthquakes and airgun signals, since distinct features are not seen at a distance from the source. Airgun signals are generated at equal intervals of about 10–30 seconds, and those amplitudes and shapes are similar. In this study, we report an attempt to discriminate between natural earthquakes and airguns by using the autocorrelation by taking into account the similarity of the amplitudes and shapes of the airgun signals.

In the case of the M7.4 off Fukushima Prefecture earthquake, which occurred on November 22, 2016, an airgun survey was performed in the south of the aftershock area, off Ibaraki Prefecture on the same day. We applied the automatic classification method by autocorrelation to this seismic waveform. As a result, the number of aftershocks was reduced by only 2%, whereas the event detection by airgun was reduced by 91%. Furthermore, we applied this method to cases along the Nankai trough, and its effectiveness was also confirmed.

The waveform data are available from the Data Management Center of NIED (https://doi.org/10.17598/NIED.0009).

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