

# **Recent Technical Improvement of Earthquake Early Warning Operated by Japan Meteorological Agency and Utilization of Earthquake Early Warning Issued for the 2024 Noto Peninsula Earthquake**

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Japan Meteorological Agency (JMA) introduced Earthquake Early Warning (EEW) system in October 2007 and has issued 304 EEW warnings and 17,778 forecasts since October 2007. We have continued to improve EEW system and in recent years have developed Integrated Particle Filter (IPF) method which determines hypocenter accurately even if multiple earthquakes occur at the same time, and Propagation of Local Undamped Motion (PLUM) method which predicts the seismic intensity directly from observed intensity. In this presentation, first, we show one of our recent technical improvements of our EEW system, integration of multiple hypocenter determination methods into the IPF method. In addition, we show results of utilization survey about EEW for the 2024 Noto Peninsula Earthquake.

In the conventional EEW system, several hypocenter determination methods such as conventional IPF method (Tamaribuchi et al., 2014) which uses mainly the data of JMA's seismometers, and Not-yet-arrived-data (NYAD) algorithm method (Horiuchi et al., 2005) which uses only the data of Hi-net seismometers, etc., were processing, and then the most accurately determined result of hypocenter is adopted for EEW issuance. EEW score calculated from a percentage of area where an error of predicted seismic intensity is within one degree, which indicates prediction accuracy of EEW, remained at a high level of about 80% or more in recent years. That means we have issued EEWs with high accuracy.

On the other hand, at an earthquake occurred near Torishima Island on July 30, 2020, EEW system determined incorrect hypocenter, made a mistake in linking determined hypocenter and amplitude, and then overestimated magnitude resulting in over-predicted JMA seismic intensities. As a result, EEW system issued warning to mainly from Kanto to Chubu regions where JMA seismic intensity 1 or over was not observed, and the score lowered down to 68% in 2020. To overcome this problem, JMA integrated multiple hypocenter determination methods into the new IPF method which uses all seismometers used by conventional IPF and NYAD method available and enabled to prevent the overestimation.

At the 2024 Noto Peninsula Earthquake, earthquakes of M5.9 and M7.6 occurred continuously in 13 seconds. The first EEW warning was issued for the prior earthquake of M5.9, and following warnings were issued as the growth of amplitude from the earthquake of M7.6. Most of the determined hypocenters by IPF method were accurate, although some of the hypocenters were determined slightly offshore as the difficulty of hypocenter determination at a tip of peninsula. We conducted questionnaire survey about actions EEW users took when they received the EEW for this earthquake: many of them took actions such as preparing themselves on the site regardless of the time between the receipt of the EEW and arrival of

strong shaking. We consider that the EEWs was used effectively.

JMA will continue to raise public awareness on desired actions when they receive EEWs.