

## Overview of the 2024 Noto Peninsula Earthquake

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Around the northern tip of the Noto Peninsula, central Japan, seismic activity had increased since December 2020, and about three years later, a Japan Meteorological Agency (JMA) magnitude ( $M_{\text{JMA}}$ ) 7.6 earthquake occurred there at 16:10 on 1st January 2024 (JST). The source region has shown high seismicity since then. The JMA has named the  $M_{\text{JMA}}7.6$  earthquake and a series of seismic activities since December 2020 “The 2024 Noto Peninsula Earthquake.” The JMA provides governmental agencies and residents in Japan with reliable and timely information on earthquakes and tsunamis for disaster prevention and mitigation. This presentation will review the early earthquake warning, tsunami warning/advisory, and prospects of seismic activity after the large earthquake provided by the JMA regarding the  $M_{\text{JMA}}7.6$  earthquake.

### 1. Earthquake Early Warning (EEW)

Due to the  $M_{\text{JMA}}7.6$  earthquake, a seismic intensity of 7 on the JMA seismic intensity scale (the maximum possible value by definition) was observed in two observation stations, and a seismic intensity of 6 Upper (6+) was observed in nine stations in Ishikawa Prefecture, where the epicenter was located.

The JMA identified that an  $M_{\text{JMA}}5.9$  earthquake occurred thirteen seconds before the  $M_{\text{JMA}}7.6$  earthquake in the same area. The JMA EEW system first detected a P-wave of the  $M_{\text{JMA}}5.9$  earthquake at 16:10:10.0 and issued the first warning at 16:10:16.0 (six seconds later). At that time, the magnitude was estimated to be 5.5, and the seismic intensity of up to 5 Upper (5+) was expected. The P-wave of the  $M_{\text{JMA}}7.6$  earthquake subsequently arrived, and the warning was updated as available waveform data accumulated with elapsed time. In the second warning at 16:10:43.1, the maximum seismic intensity was updated to 7, although the estimated magnitude was still 6.6. The magnitude was eventually updated to 7.4 in the third warning at 16:11:07.1, approximately one minute after the first detection, and the warning of the seismic intensity of 4 or higher was issued across central Japan. The JMA also predicted the long-period ground motion of class 3.

### 2. Tsunami Warning/Advisory

At 16:12, two minutes after the  $M_{\text{JMA}}7.6$  earthquake, the JMA issued a tsunami warning for three prefectures along the coast of the Japan Sea close to the hypocenter and a tsunami advisory for other coastal regions, based on the magnitude estimate of 7.4 at the time. The moment magnitude was subsequently

estimated to be 7.6 from the W-phase waveforms. At 16:22, based on the moment magnitude, the tsunami warning for a part of Ishikawa Prefecture was upgraded to a major tsunami warning, and the maximum tsunami height was expected to be 5 m.

Tide stations along the Japan Sea actually observed tsunamis of up to 0.8 m. The field survey conducted by the JMA found traces of tsunamis due to the earthquake, including tsunamis with a run-up height of over 5 m and ones with an inundation height of over 3 m.

### **3. Prospects of Seismic Activity after a Large Earthquake**

Even after the  $M_{JMA}7.6$  earthquake, the area near the source region was frequently hit by strong ground shaking due to active seismicity such as an  $M_{JMA}5.7$  event at 16:12 on 1st January with the maximum seismic intensity of 6 Lower (6-). The high seismicity area extends about 150 km in the direction of NE-SW, and more than 1,900 earthquakes with a seismic intensity of 1 or higher were observed from 16:00 on 1st January until August 2024. The JMA regularly issued the prospect of seismic activity in accordance with the guideline published by the Earthquake Research Committee (2016) immediately after the  $M_{JMA}7.6$  earthquake. Within one week after the  $M_{JMA}7.6$  earthquake, the JMA alerted to strong motions with a seismic intensity of 7 based on past examples. Between one week and two months after the earthquake, the JMA called for caution based on an aftershock probability calculated from the combination of the Omori-Utsu law and the Gutenberg-Richter law.