

The Great 2011 Tohoku, Japan Earthquake (Mw9.0): An Unexpected Event for Japan

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Based on about 400 years of historical records that included 18 M7 to 8 earthquakes, there was thought to be good knowledge of the expected sizes and locations of expected large events in the Tohoku region of Japan. So the Tohoku earthquake on March 11, 2011 (Mw9.0) was a shocking surprise to the seismological community. The unprecedented size of the earthquake caused very large tsunamis that inundated coastal regions, which were probably among the best tsunami-prepared regions in the world. Tsunami heights of 15 to 30 meters topped sea walls that were typically about 10 meters high. The effects of the tsunami were amplified by large subsidence of much of the coastal areas by up to 2 meters. Most of the extensive damage (US\$200 to 300 billion) and loss of lives (over 27,000) that occurred on the east coast of Honshu were due to the tsunami and not the strong shaking.

The sequence started with a M7.2 foreshock on March 9 and followed by the mainshock two days later. The mainshock was located about 40 km southwest of the foreshock. There have been three M7 aftershocks in the immediate aftershock region.

The mainshock has triggered other earthquake activity across Japan with increases in seismicity in many regions, including 13 volcanoes. There have been at least 8 crustal earthquakes in the M5.0 to M6.7 range outside of the immediate aftershock zone, which are apparently related to the Tohoku earthquake. These events are likely due to both static and dynamic stress changes caused by the mainshock.

The society and infrastructure of Japan is still struggling to recover from the widespread effects of this earthquake. Power shortages, nuclear power plant issues, and the large number of displaced people have caused severe problems for the country.