Teacher Guide

Welcome to Teachable Moments! Our goal is to provide timely and accurate information to develop knowledge about a newsworthy earthquake for audiences from middle school through college. Please use the slides to get a concise, but thorough overview of the recent earthquake and then use them as is, or customize it for your students and curriculum.

New for the 2024-25 school year:

1. **Color-coding for grade levels.** ALL **middle school** + HS **high school** + C **college**

1. **Check out the new Slide Guide: Slides or pdf that will guide your students through the slide deck:** middle school pdf high school pdf college pdf
2. **New Geography slide(s): A quick hit about the city or area that gives you cross-curricular connections:** geography, physics, chemistry, biology, environmental science or even history.
3. **NGSS Connections linked to questions in the Slide Guide are located in the notes sections below each slide guide.**
4. **Fill in the blank sub-plans:** The first two pages can be completed and used all year (hint: sheet protector). The rest are for you to modify or fill-in to customize your sub-plans to fit what you're doing.

Magnitude 7.6 JAPAN

Monday, December 8, 2025 at 14:15:19 (UTC)

ALL

Latitude 41.043°N
Longitude 142.141°E
Depth 44.1 km

A strong earthquake struck northeastern Japan on Monday night, prompting a tsunami warning and coastal evacuations.

The magnitude 7.6 quake occurred at 23:15 local time (14:15 GMT) at a depth of about 50 km (31 miles), with its epicenter roughly 80 km off the Aomori coast. Waves of around 70 cm (27 inches) were observed before the warnings were lifted.

At least 30 people were injured, and thousands of residents temporarily evacuated from low-lying areas. The quake also caused infrastructure disruptions, including suspended train services and power outages affecting several thousand homes.

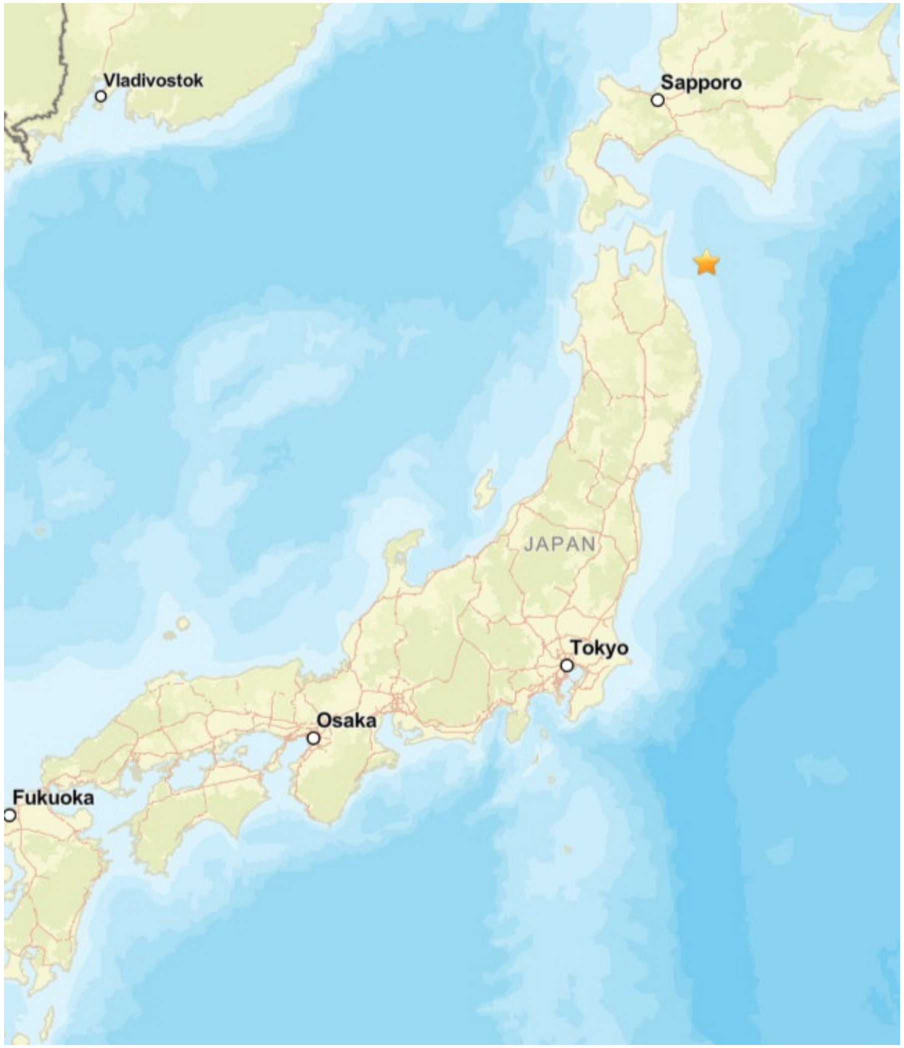

Image courtesy of the US Geological Survey

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Magnitude 7.6 JAPAN

Monday, December 08, 2025 at 14:15:11 UTC

The Aomori Prefecture is the northernmost prefecture on Honshu, the main island of Japan. It hosts an active stratovolcano, Mount Iwaki, the Hakkoda Mountains (volcanic group), the Ou Mountains, rivers, lakes, forests, and Mustu Bay. It is bordered by the Pacific Ocean to the east, Sea of Japan on the west, and the Tsugaru Strait to the north. Because of this diverse geography, it is highly biodiverse.

Papuan Frogmouth

Japanese Raccoon Dog

Tube Worm

Giant Rain Frog

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ALL

The Aomori Prefecture economy includes agriculture (especially apple orchards and black garlic), and mining (metals, nonmetals, and limestone). It serves as a transportation and logistics hub because of its location. Tourism is also a big part of its economy - Jomon Prehistoric Sites ad Shirakami-Sanchi World Heritage Sites are among the draws. Shinto and Buddhist religions are prominent.


farmland


apple blossom and Mt. Iwaki


Jomon dogu 1000-400 BC


Hirosaki castle


Mount Osore entrance


Takayama Inari Shrine

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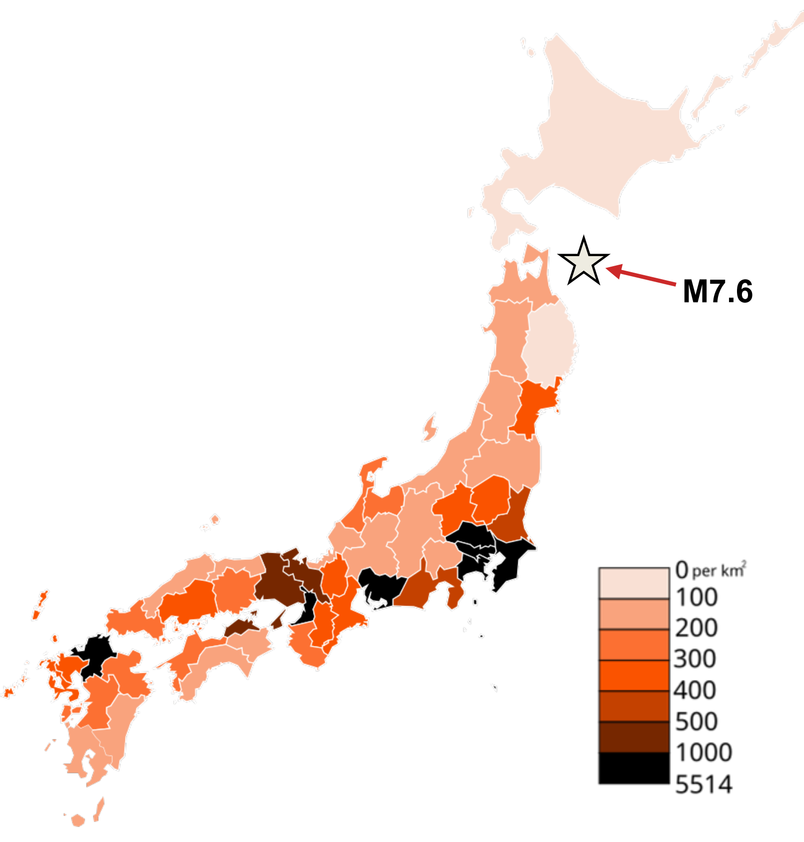
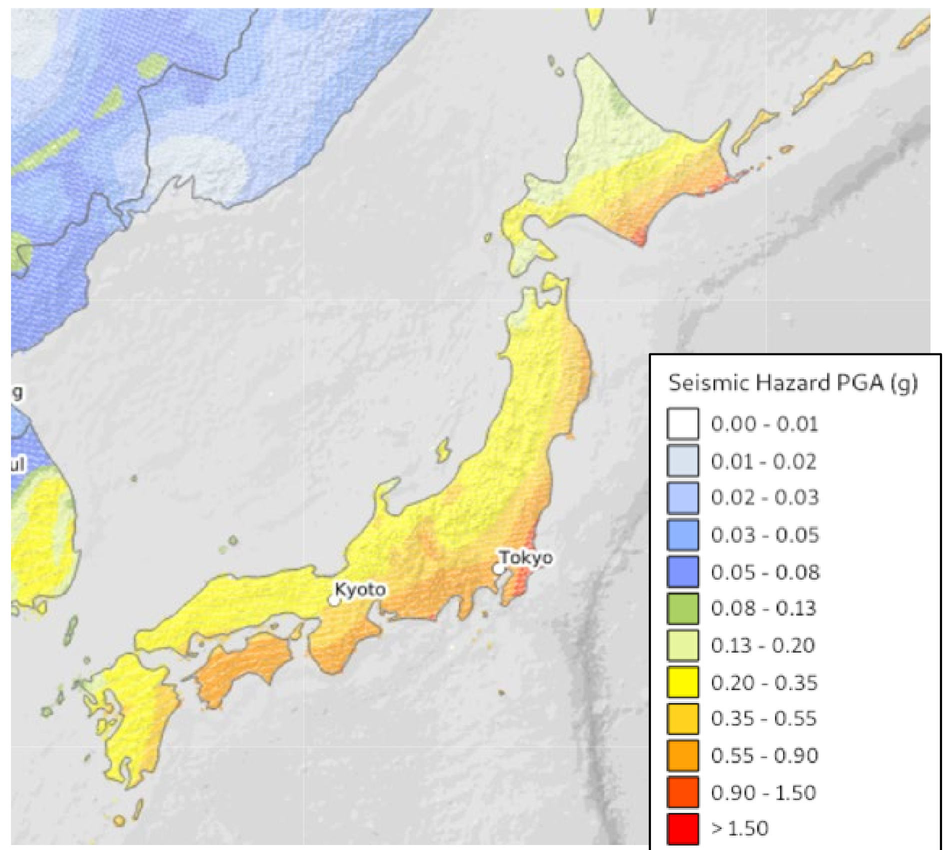
Due its location at the convergence of four tectonic plates, around 80% of Japan's population live in areas of relatively high seismic hazard. The December 8 earthquake occurred offshore the lesser populated Aomori Prefecture on northern Honshu, located adjacent to the even less-populated Iwate and Hokkaido prefectures.

Population Density of Japan



Seismic Hazard of Japan



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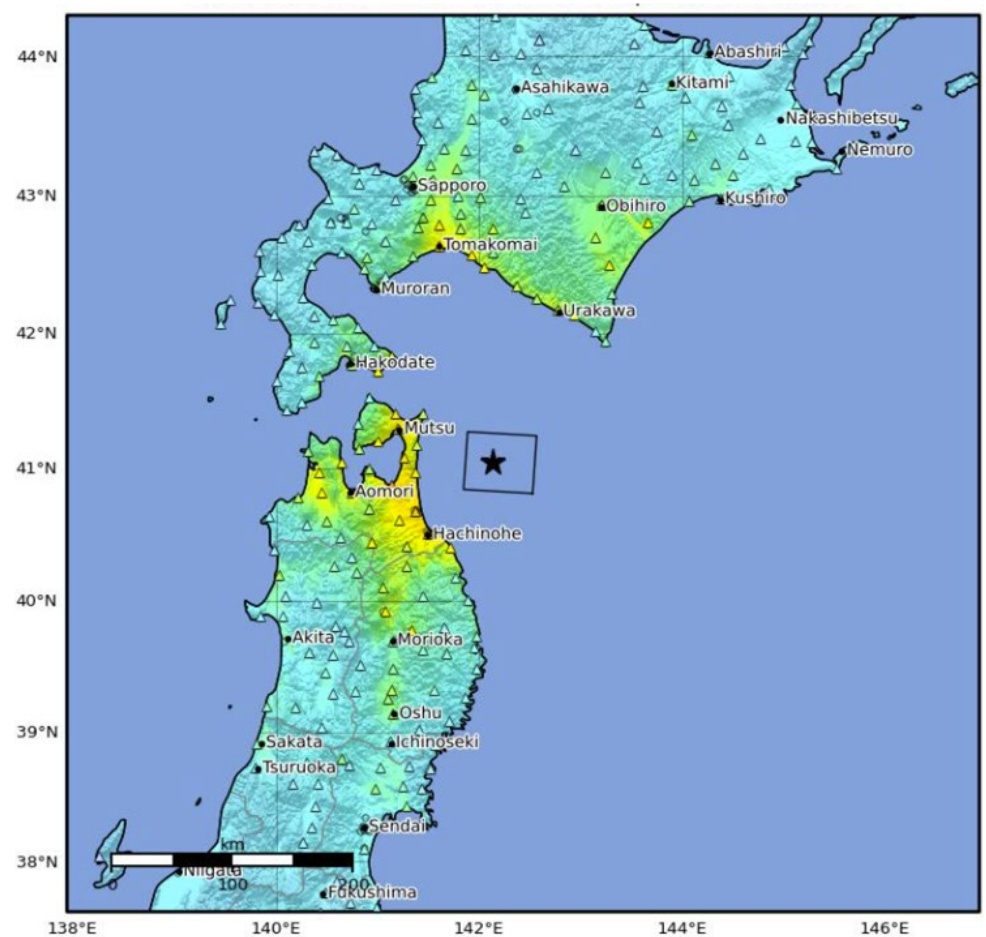
The Modified-Mercalli Intensity (MMI) scale is a ten-stage scale, from I to X, that indicates the severity of ground shaking.

Intensity is based on observed effects and is variable over the area affected by the earthquake and is dependent on earthquake size, depth, distance, and local conditions.

MMI	Perceived Shaking
X	**Extreme**
IX	**Violent**
VIII	**Severe**
VII	**Very Strong**
VI	**Strong**
V	Moderate
IV	Light
II-III	Weak
I	Not Felt



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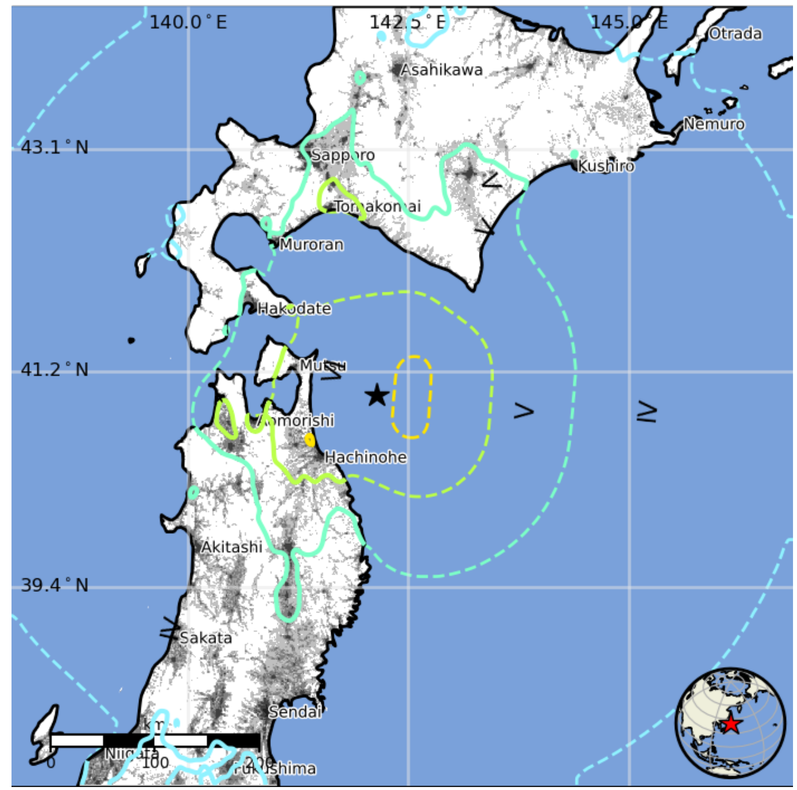
The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels. The USGS estimates that approximately 222,000 people felt very strong shaking from this earthquake.

MMI	Shaking	Population
I	Not Felt	0 k*
II-III	Weak	181 k*
IV	Light	7,917 k
V	Moderate	4,166 k
VI	Strong	994 k
VII	Very Strong	222 k
VIII	Severe	0 k
IX	Violent	0 k
X	Extreme	0 k



The color-coded contour lines outline regions of MMI intensity. The total population exposure to a given MMI value is obtained by summing the population between contour lines. The estimated population exposure to each MMI Intensity is shown in the table.

Image courtesy of the US Geological Survey

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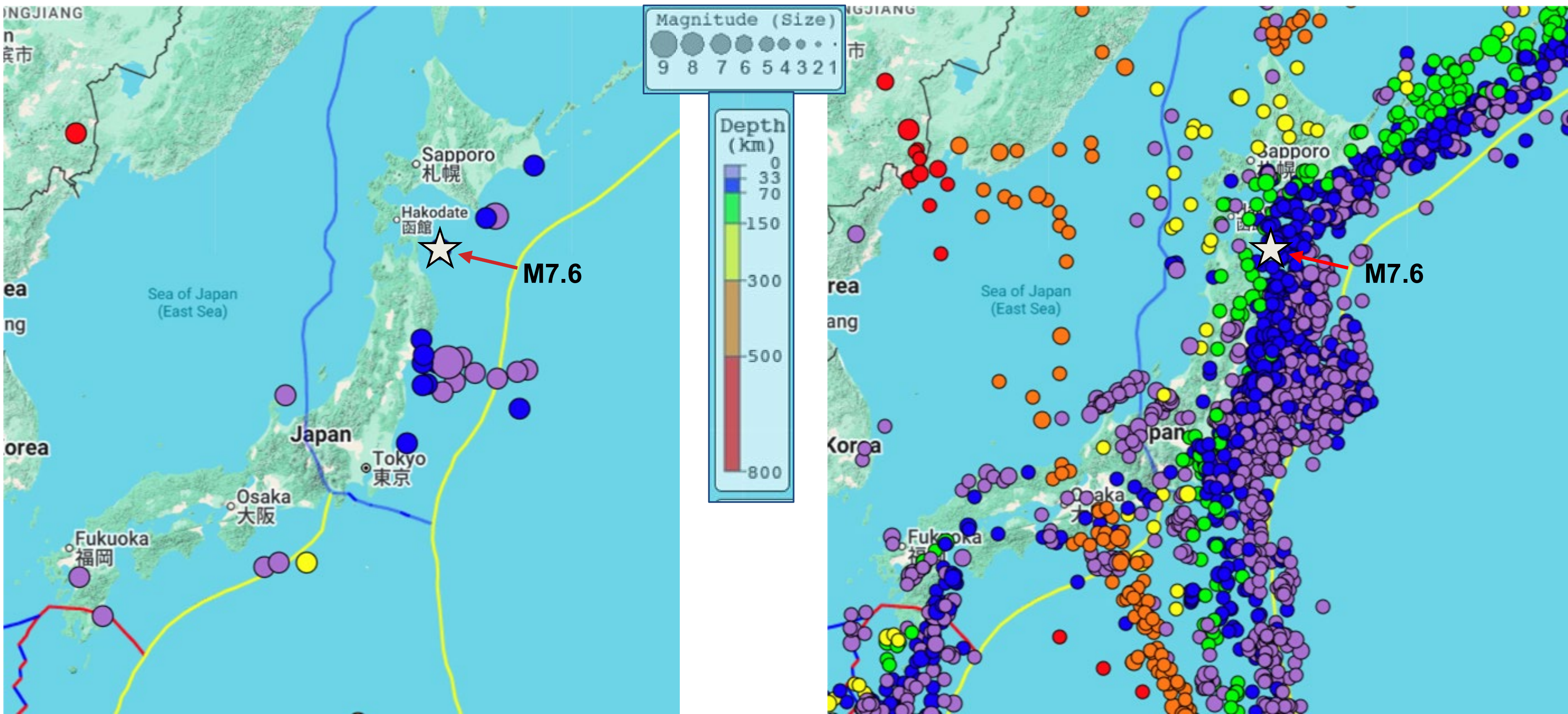
Historical seismicity 2000–2025 in the region of the December 8, 2025 earthquake, with location marked by white star. Image on the left shows earthquakes >M7; Image on the right shows earthquakes >M5 for the same period.

Earthquakes are color coded by depth as shown by the legend between the maps. Depths of earthquakes increase from east to west across the subduction zone boundary between the Pacific and Okhotsk plates.



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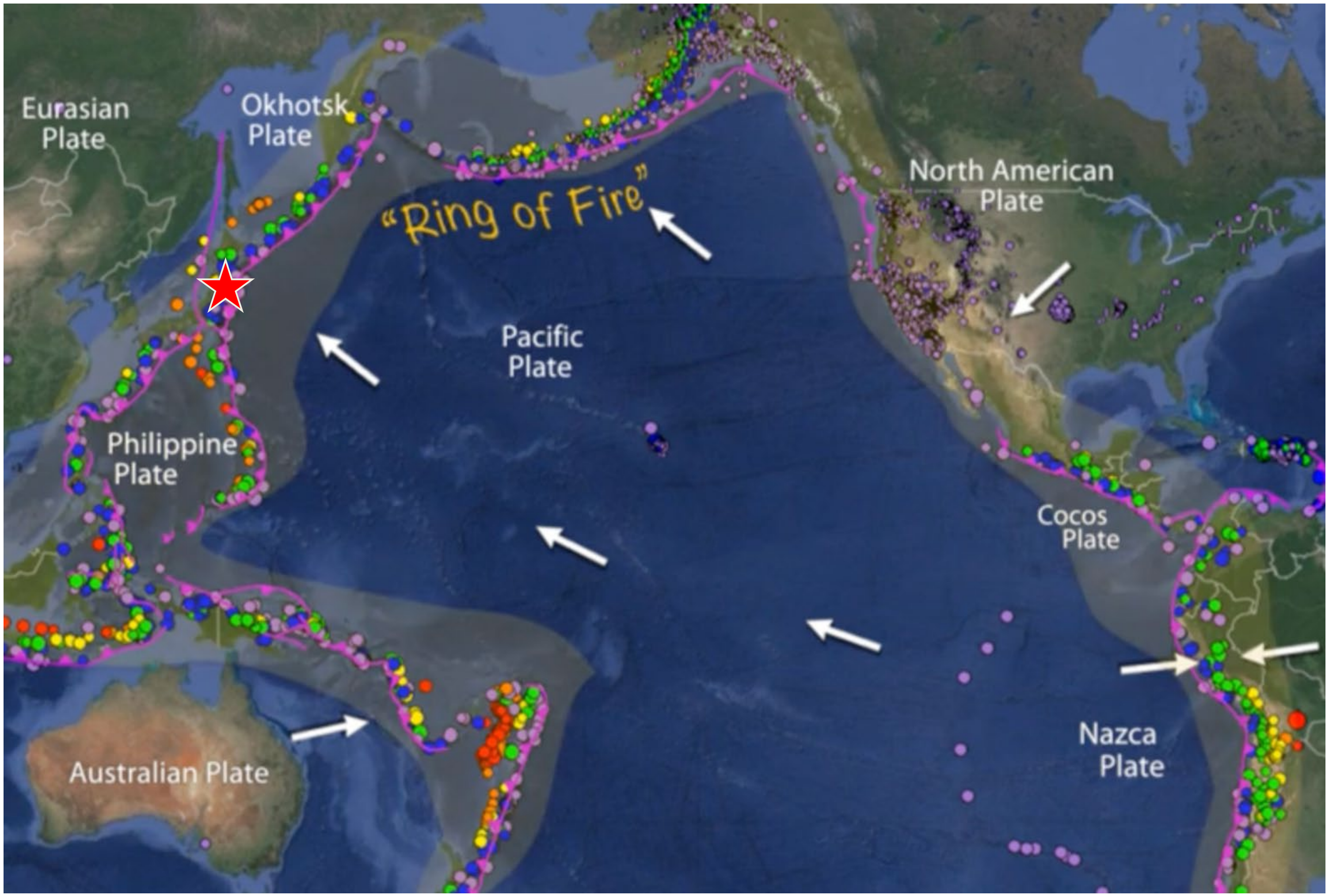
The Japan is located along the northwestern side of the Pacific Plate's "Ring of Fire" – in a region of complex subduction zones and other faulting.



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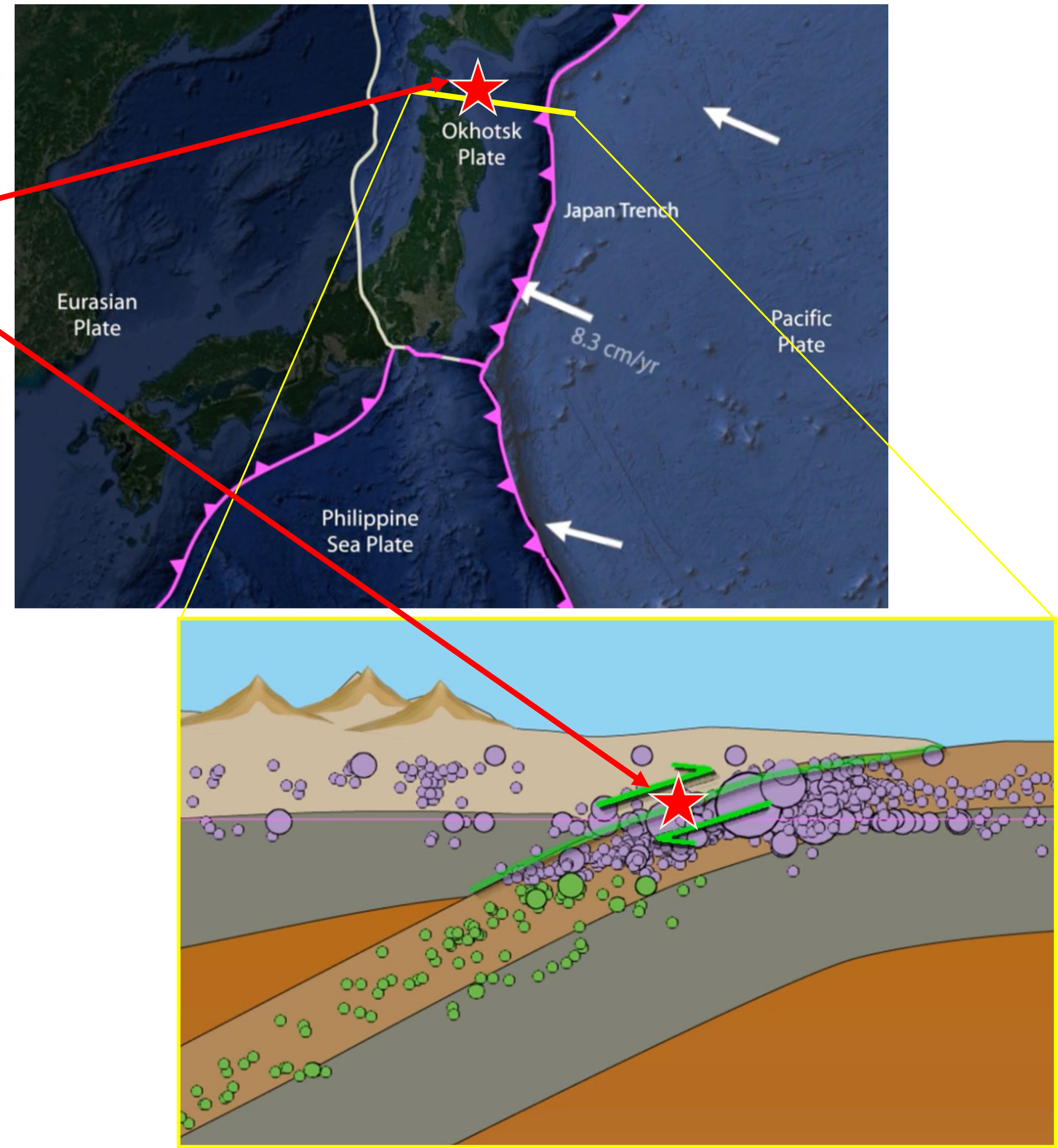
The December 8, 2025 Magnitude 7.6 earthquake occurred west of the Japan Trench – on the megathrust boundary where the Pacific Plate dives below the Okhotsk Plate.

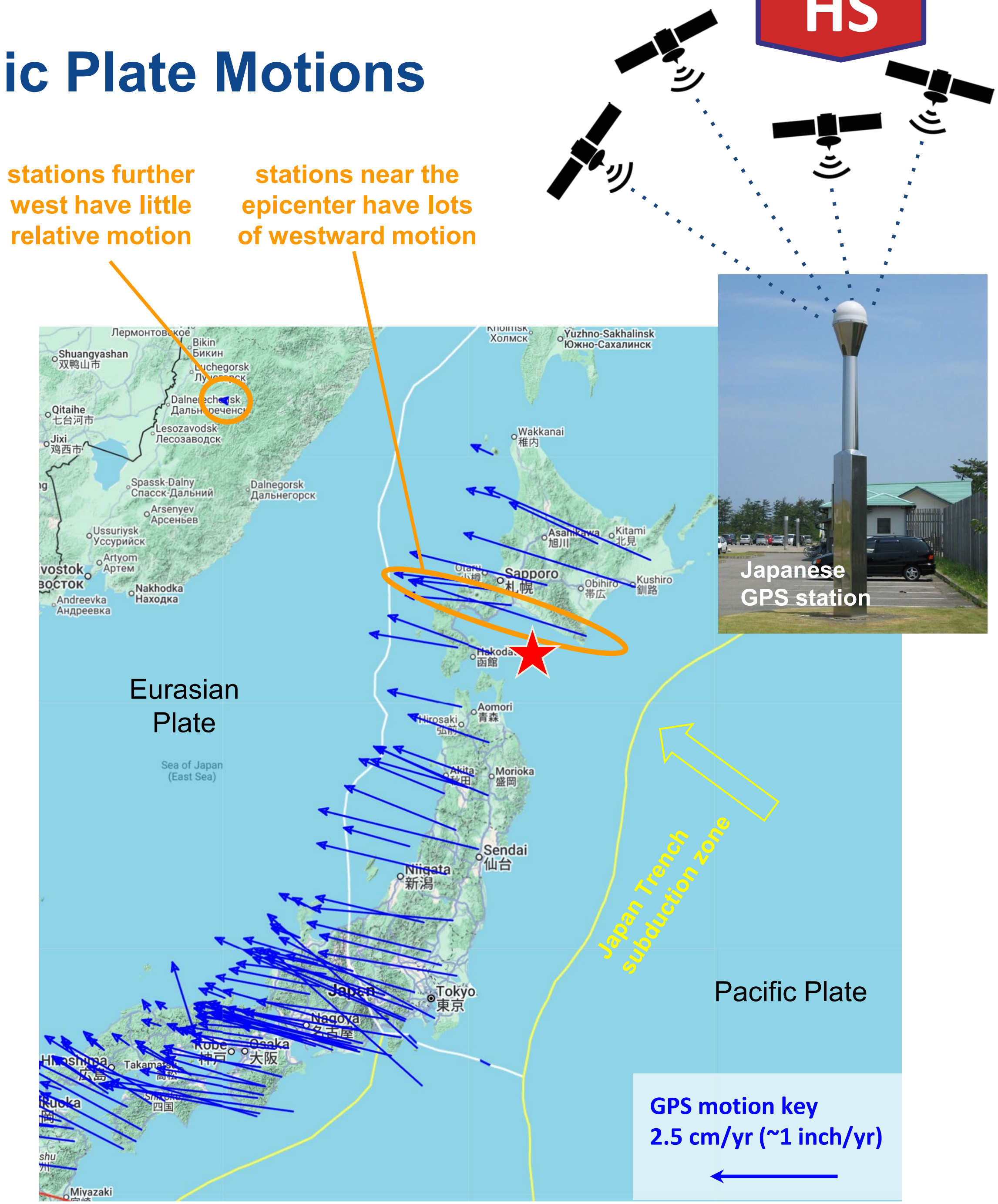


Regional Tectonic Plate Motions

Japan has GPS stations that record the long term motion from plate tectonics. GPS stations receive signals from satellites and use the time offset between when the signal leaves the satellite and when it arrives at the station to determine distance. With signals from 4 or more stations, location and velocity can be determined.

Compared to stable parts of the Eurasian Plate, stations near the epicenter are moving west at ~3 cm/yr (>1 inch/yr) as the Pacific Plate pushes northwestward. Stations on the Eurasian mainland move much slower.

Over decades and centuries this compression accumulates and is occasionally released in earthquakes such as the Mag 7.6 earthquake on December 8, 2025.



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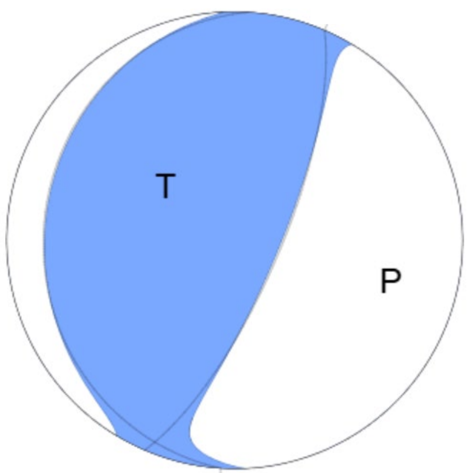
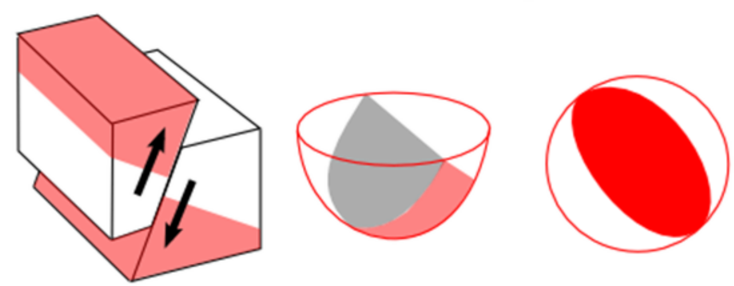
The focal mechanism is how seismologists plot the 3-D stress orientations of an earthquake. Because an earthquake occurs as slip on a fault, it generates primary (P) waves in quadrants where the first pulse is compressional (shaded) and quadrants where the first pulse is extensional (white). The orientation of these quadrants determined from recorded seismic waves determines the type of fault that produced the earthquake.



USGS W-phase Moment Tensor Solution

The tension axis (T) reflects the minimum compressive stres direction. The Pressure axis (P) reflects the maximum compressive stress direction.

Reverse/Thrust/Compression



Block model | **Focal Sphere** | **2D Projection of Focal Sphere**

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ALL

What is a tsunami? It is a series of swift, powerful floods of water, not a single, enormous wave. More waves can follow anywhere from 5–90 minutes (or for hours) after the initial wave, sometimes lasting 24–48 hours after the initial wave.

During this event, waves of around 70 cm (27 inches) were observed before the warnings were lifted.

source: jma.go.jp

Video: *Why do some earthquakes produce tsunamis while others don't?*

ALL

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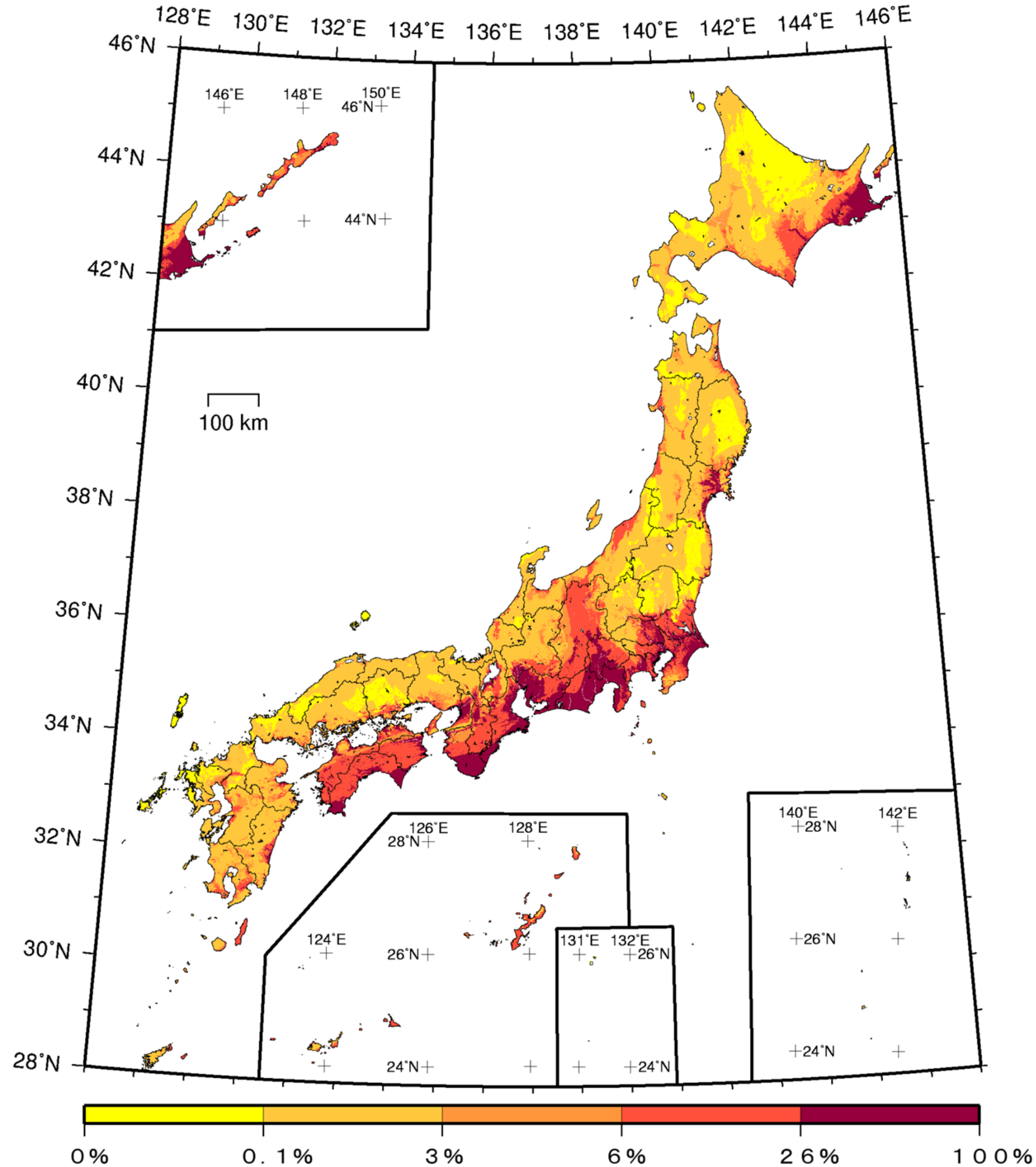
Seismic Hazard

Seismic hazard is the likelihood and severity of potentially damaging earthquakes at a location.



source: [*jma.go.jp*](https://www.jma.go.jp)

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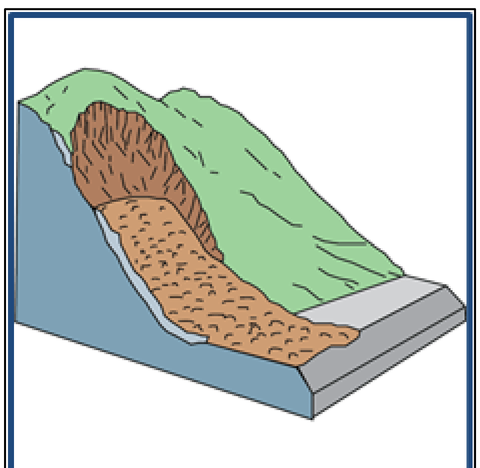
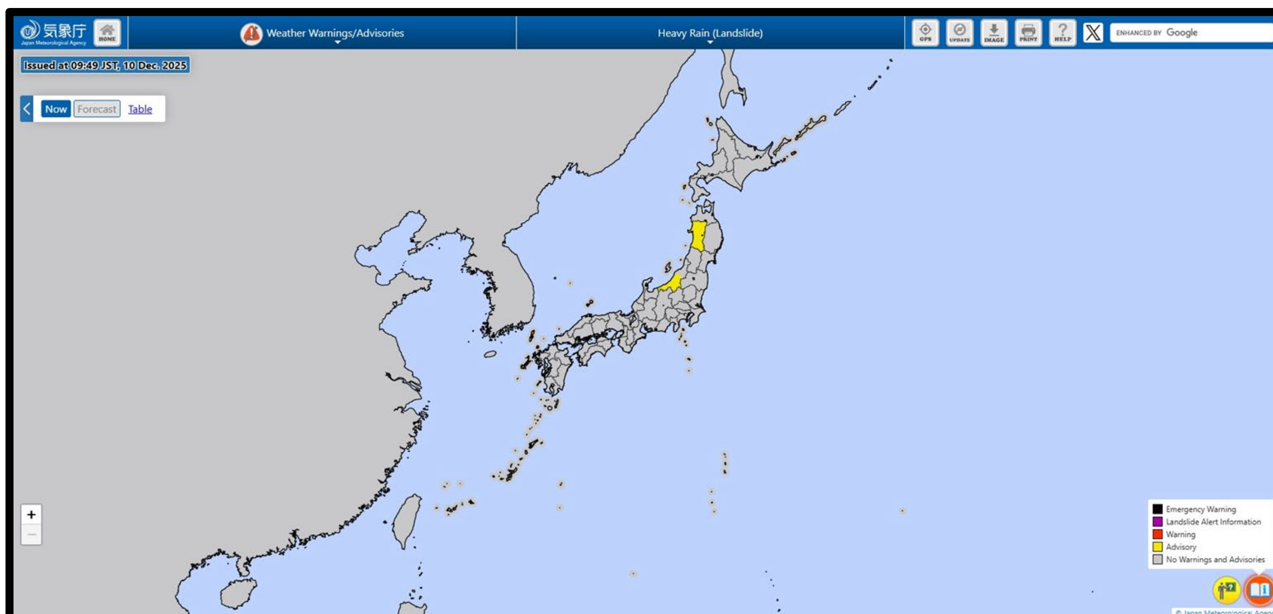
Landslide Hazard Map

Earthquakes can trigger landslides over wide areas causing societal disruptions by blocking roads, destroying infrastructure, and damming waterways causing flooding hazards. Landslides can happen during aftershocks and heavy precipitation events.

The landslide probability is estimated by considering ground shaking intensity, topographic slopes, and soil or geological conditions.





source: [jma.go.jp](jma.go.jp)

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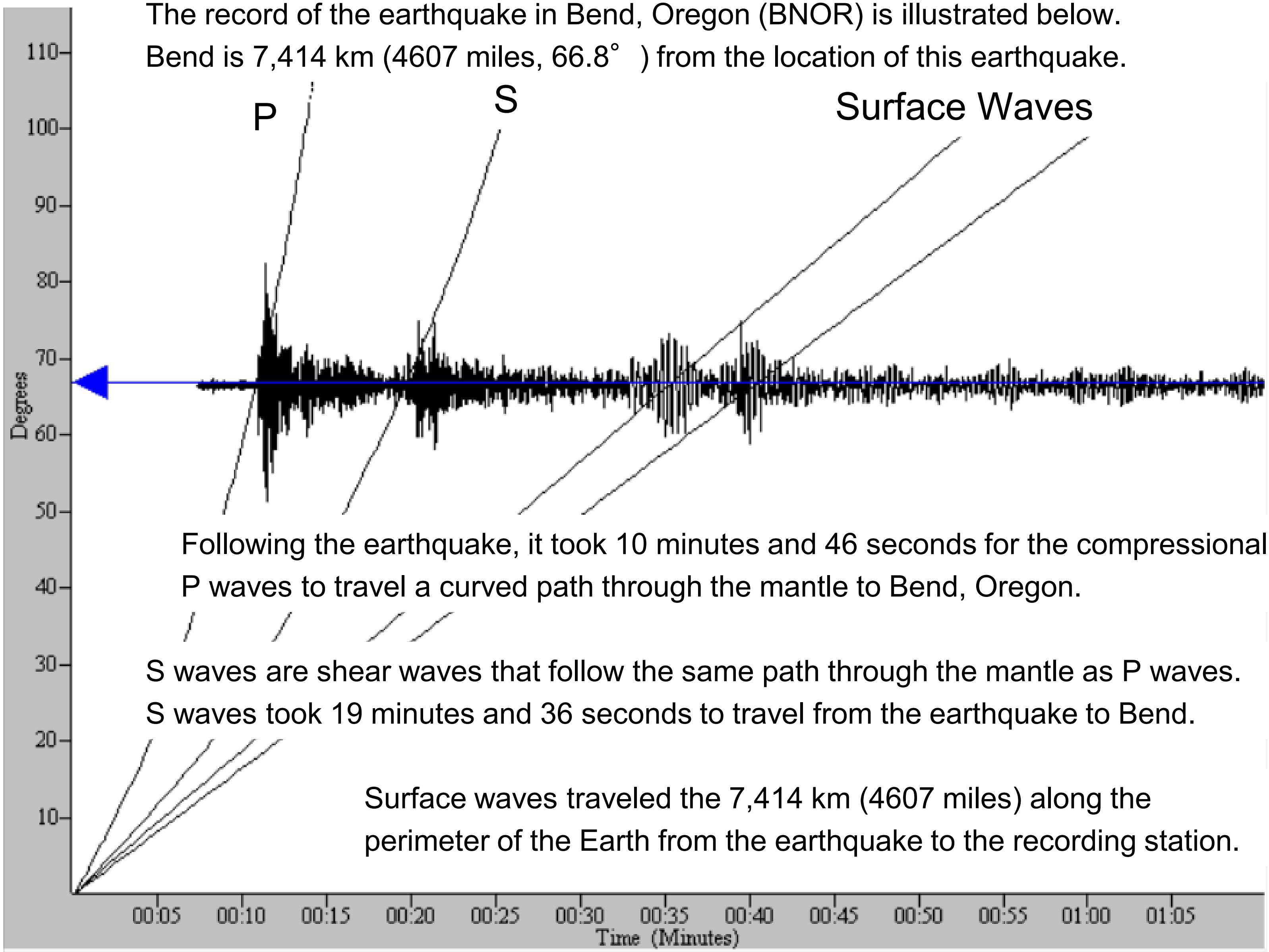
The record of the earthquake in Bend, Oregon (BNOR) is illustrated below.
Bend is 7,414 km (4607 miles, 66.8°) from the location of this earthquake.



Following the earthquake, it took 10 minutes and 46 seconds for the compressional P waves to travel a curved path through the mantle to Bend, Oregon.

S waves are shear waves that follow the same path through the mantle as P waves. S waves took 19 minutes and 36 seconds to travel from the earthquake to Bend.

Surface waves traveled the 7,414 km (4607 miles) along the perimeter of the Earth from the earthquake to the recording station.

ALL

Slide Guide

1. Where was the epicenter of this earthquake? (What city/region was it closest to?) When did the earthquake happen? What was its magnitude?
2. How many people are estimated to have felt the earthquake?
3. Which type of boundary is this earthquake related to?
4. What impact did the earthquake have on the location in which it was felt the strongest? (buildings, streets, animals, people…)
5. What additional hazards occurred in addition to the ground shaking? (tsunamis, floods, sinkholes, landslides, fires, volcanoes…)
6. How long did it take the first P-wave to travel to the seismic station in this slide stack?
7. What are 2 more questions you have about earthquakes that can NOT be answered with this slide stack?

Extension Questions

1. Seismic waves travel through the earth. Why did you or did you not feel the earthquake?
2. If you were going to write a news story on this earthquake, what would the headline be? *HINT: Think about where this earthquake occurred, the impact it had on the people living in the area, any effects the earthquake had on the area itself.*

Slide Guide

1. Where was the epicenter of this earthquake? (What city/region was it closest to?) When did the earthquake happen? What was its magnitude?
2. How many people are estimated to have felt the earthquake?
3. What relationship is shown between the seismic hazard map and population density?
4. Which plates are involved and what type of boundary are they creating?
5. What impact did the earthquake have on the location in which it was felt the strongest? (buildings, streets, animals, people…)
6. What additional hazards occurred in addition to the ground shaking? (tsunamis, floods, sinkholes, landslides, fires, volcanoes…)
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Extension Questions

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C

Slide Guide

1. Where was the epicenter and hypocenter of this earthquake? (What city/region was it closest to? Longitude/latitude/depth?) When did the earthquake happen? What was its magnitude?
2. What impact did the earthquake have on the location in which it was felt the strongest? *(buildings, streets, animals, people…)*
3. Draw the block model of the fault for this earthquake. Overlay a drawing of the focal mechanism to show how the 2D projection was created. Label it with the type of fault.
4. How are the related tectonic plates involved in creating the nearby boundary? *(Include the type of boundary, and the velocity and name of the plates.)*
5. What additional hazards occurred in addition to the ground shaking? *(tsunamis, floods, sinkholes, landslides, fires, volcanoes…)*
6. Relate the area's population density to its seismic hazard level and earthquake history

Extension Question

1. What efforts have there been to mitigate impacts from earthquakes? What additional mitigation efforts should be implemented?

Teachable Moments are a service of

EarthScope Consortium

Please send feedback to gillian.haberli@earthscope.org

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