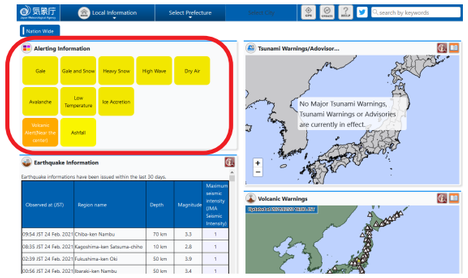
Earthquake/Tsunami Information

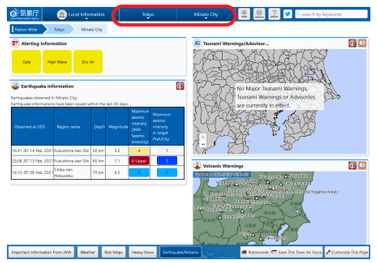
Current Warnings/Advisories is displayed with icons and color-coding for at-a-glance determination of risk levels.



Home > Earthquakes / Volcanoes

Users can switch between nationwide, prefectural and municipal display and specify areas for Warning/ Advisory information.

Select Prefecture / Municipality



JMA sends various information through SNS as well as the website.

Twitter YouTube

JMA Twitter	For press releases and event information.	JMA YouTube	For emergency press conferences.
JMA Disaster Mitigation Twitter	For disaster mitigation information. Current situations and prospects relating to extreme conditions such as typhoons, heavy rain, earthquakes and volcanic eruptions.	JMA YouTube Awareness	For on-site presentations to residents, leaflets, DVD content and other information supporting safety awareness and utilization of weather data.

気象庁
Japan Meteorological Agency

3-6-9 Toranomon, Minato-ku, Tokyo 105-8431, Japan
TEL:+81-3-6758-3900
FAX: +81-3-3584-8644

JMA website (Japanese)
https://www.jma.go.jp/

JMA website (English)
https://www.jma.go.jp/jma/indexe.html

Cover: Seismic Intensity map of the 2016 Kumamoto Earthquake (Apr. 16, M7.3)

March 2023

Earthquakes and Tsunamis

Observation and Disaster Mitigation

気象庁
Japan Meteorological Agency

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! : Notes when you use the information

M: Magnitude (overall earthquake scale)

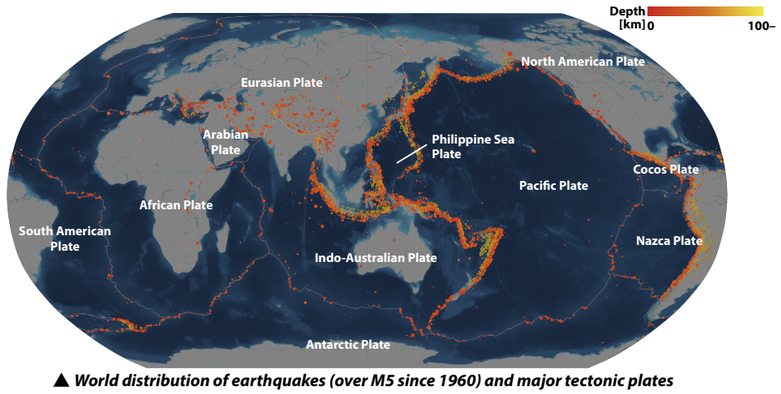
I_{JMA}: JMA Seismic Intensity Scale → p.16 (0, 1, 2, 3, 4, 5-Lower(5-), 5-Upper(5+), 6-Lower(6-), 6-Upper(6+), 7)

Introduction

Earthquake and Tsunami Disasters in Japan

Around a tenth part of all earthquakes occur in and around Japan, making it one of the world's most earthquake-prone countries.

Japan has suffered serious damage from earthquakes and tsunamis on a number of occasions. Earthquakes cause massive destruction nationwide, with the potential for massive strikes anywhere. Even distant earthquakes far from Japan also can cause damage in Japan due to the tsunami that came across the sea.



▲ ***World distribution of earthquakes (over M5 since 1960) and major tectonic plates***
Hypocenter data is based on the United States Geological Survey (USGS)

Mechanism of Earthquakes in and around Japan

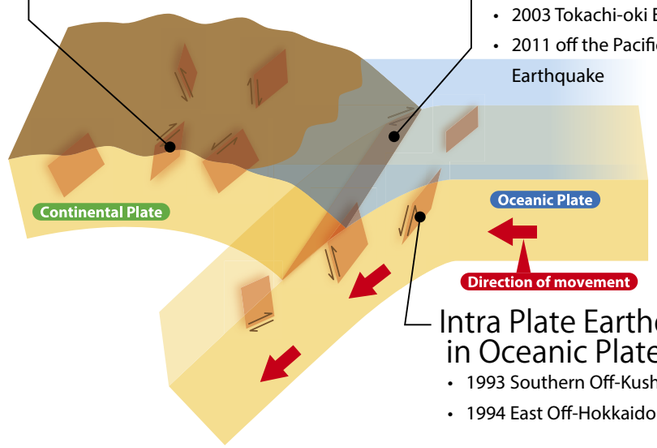
There are three mechanisms behind earthquakes occurring in and around Japan as in the lower figure. All earthquakes can bring down houses and cause landslides in and around residential areas. Large seabed earthquake can generate tsunami waves that cause massive damage to coastal areas.

Shallow Crustal Earthquake

- 1995 Southern Hyogo Prefecture Earthquake
- 2016 Kumamoto Earthquake
- 2018 Hokkaido Eastern Iburi Earthquake

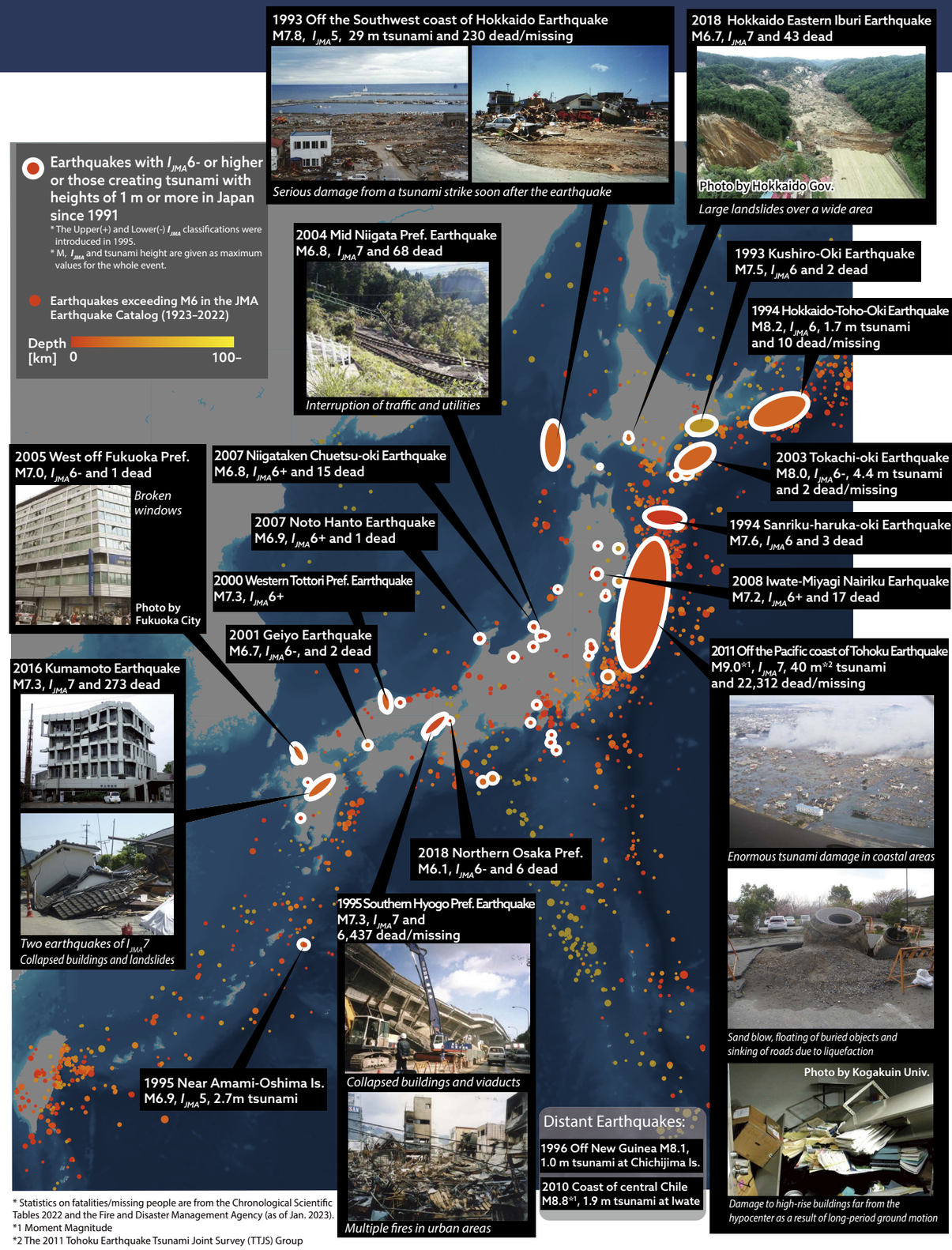
Inter Plate Earthquake

- 1944 Tonankai Earthquake
- 1946 Nankai Earthquake
- 2003 Tokachi-oki Earthquake
- 2011 off the Pacific coast of Tohoku Earthquake



Intra Plate Earthquake in Oceanic Plates

- 1993 Southern Off-Kushiro Earthquake
- 1994 East Off-Hokkaido Earthquake



* Statistics on fatalities/missing people are from the Chronological Scientific Tables 2022 and the Fire and Disaster Management Agency (as of Jan. 2023).
*1 Moment Magnitude
*2 The 2011 Tohoku Earthquake Tsunami Joint Survey (TTJS) Group

Major earthquakes and tsunamis(1991 – 2022) and resulting damage

Observation Network

JMA collects real-time data from its own seismometers, Seismic Intensity meters, sea-level gauges and other instruments and those of other organizations to support the monitoring of earthquakes and tsunamis.

*As of Jan 1, 2023

Seismic Intensity Meters

JMA	700+
others	3,700+

Seismic Intensity Meters measure the intensity of earthquake shakings as observed Seismic Intensity values based on acceleration records. JMA manages around 700 such meters nationwide, and also collects Seismic Intensity data from another 3,700 stations operated by local governments and NIED*1. These data are used for Earthquake Information issued by JMA.

Seismic Intensity Meters of JMA are equipped with satellite communications system that enables data transmission in the event of landline malfunction. If an earthquake causes serious damage, JMA assesses the integrity of its Seismic Intensity Meters and/or sets up temporary observation sites as necessary.

Seismometers

JMA	300+
others	1,500+

JMA operates a seismic network with about 300 seismometers to monitor seismic activity. Among these, accelerometers and velocity seismometers are used to identify/analyze seismic waveforms for Seismic Intensity Information and Earthquake Early Warnings, and transmit Seismic Intensity data and other analytical data as well as seismic waveform data to JMA. These seismic observation facilities are equipped with satellite mobile phone communication capability for backup, and have a power supply that can keep the whole system operational for about 72 hours in the event of power failure.

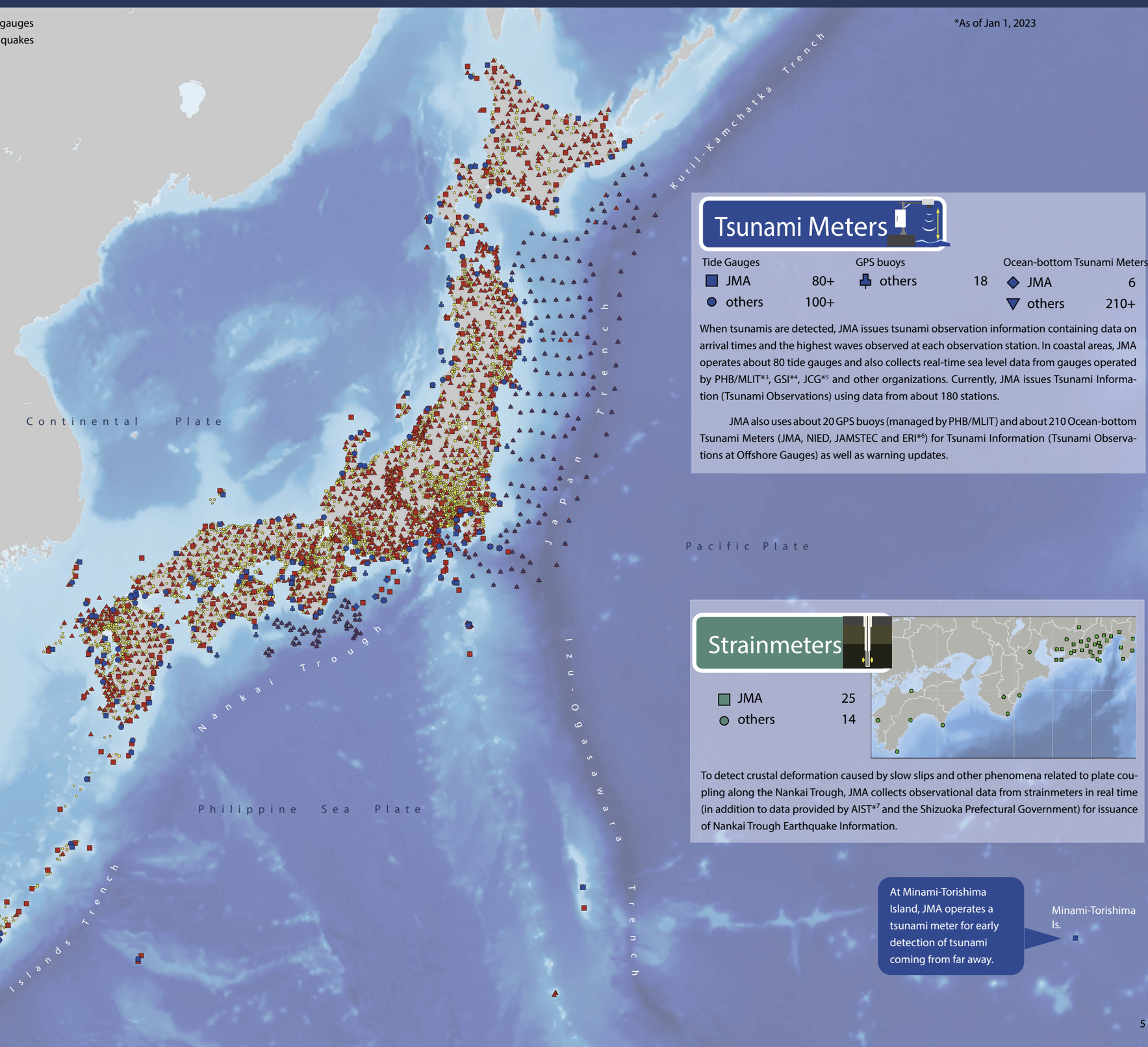
For the issuance of Earthquake Early Warnings, Tsunami Warnings/Advisories and Earthquake Information, JMA also uses seismic data observed using seismometers managed by other organizations (such as NIED, JAMSTEC*2 and universities).

Seafloor observation networks

Earthquakes can occur both at land and under the sea. In particular, the plate boundaries at which megathrust earthquakes occur are mostly located under the sea bed. Against this background, data from seafloor seismometers are highly useful in the monitoring and early detection of earthquakes in such areas. Tsunami meters on the seafloor are also helpful to detect tsunami waves before they reach coastal areas.

JMA, NIED and other organizations operate cable ocean-bottom seismometers and tsunami meters along the Japan Trench and the Nankai Trough. Data from both offshore and onshore stations are sent to JMA and used for the issuance and updating of Earthquake Early Warnings and Tsunami Warnings/Advisories.

*1 NIED: National Research Institute for Earth Seicence and Disaster Resilience
*2 JAMSTEC: Japan Agency for Marine-Earth Science and Technology
*3 PHB/MLIT: Ports and Harbours Bureau, Ministry of Land, Infrastructure, Transport and Tourism
*4 GSI: Geospatial Information Authority of Japan
*5 JCG: Japan Coast Guard
*6 ERI: Earthquake Research Institute, The University of Tokyo
*7 AIST:National Institute of Advanced Industrial Science and Technology



Tsunami Meters

Tide Gauges		GPS buoys		Ocean-bottom Tsunami Meters	
JMA	80+	others	18	JMA	6
others	100+			others	210+

When tsunamis are detected, JMA issues tsunami observation information containing data on arrival times and the highest waves observed at each observation station. In coastal areas, JMA operates about 80 tide gauges and also collects real-time sea level data from gauges operated by PHB/MLIT*3, GSI*4, JCG*5 and other organizations. Currently, JMA issues Tsunami Information (Tsunami Observations) using data from about 180 stations.

JMA also uses about 20 GPS buoys (managed by PHB/MLIT) and about 210 Ocean-bottom Tsunami Meters (JMA, NIED, JAMSTEC and ERI*6) for Tsunami Information (Tsunami Observations at Offshore Gauges) as well as warning updates.

Strainmeters

JMA	25
others	14

To detect crustal deformation caused by slow slips and other phenomena related to plate coupling along the Nankai Trough, JMA collects observational data from strainmeters in real time (in addition to data provided by AIST*7 and the Shizuoka Prefectural Government) for issuance of Nankai Trough Earthquake Information.

At Minami-Torishima Island, JMA operates a tsunami meter for early detection of tsunami coming from far away.

Minami-Torishima Is.

Flow of Warnings/Information

From Observation Data to Information

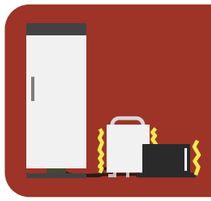
JMA collects data from its own observatories and those of other organizations in real time and monitors earthquakes and tsunamis on a 24/7 basis under the Earthquake Phenomena Observation System (EPOS).

When an earthquake is detected, JMA immediately determines its scale, the location of its epicenter, the risk of shaking and tsunami. Based on this information, JMA creates and issues Earthquake Early Warnings, Tsunami Warnings/Advisories and various other types of information.

Mirror-operation centers are run in Tokyo and Osaka so that warnings and information can still be issued if one is seriously damaged in a large-scale disaster.

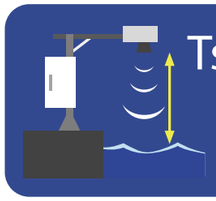
Seismic Intensity Meters

JMA	700+
others	3,700+



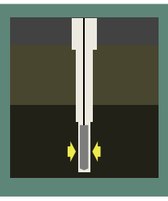
Seismometers

JMA	300+
others	1,500+



Tsunami Meters

JMA	80+
others	330+



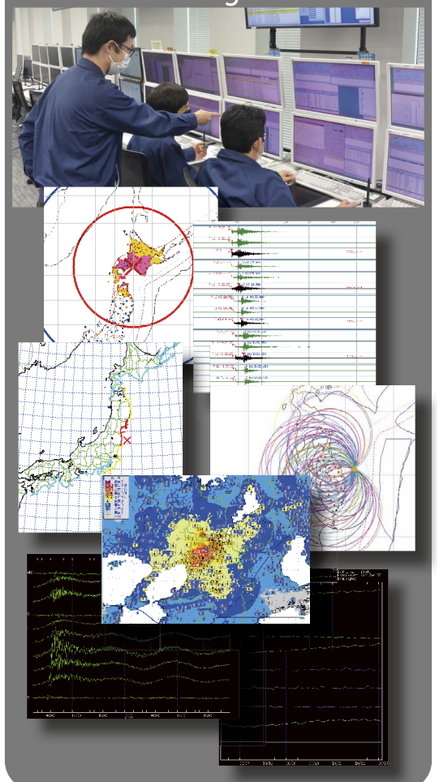
Strainmeters

JMA	25
others	14

* As of Jan. 1, 2023

JMA

Data analysis and assembling information



Various types of information

- **Earthquake Early Warning**
- **Tsunami Warning/Advisory**
- **Earthquake Information Tsunami Information**
- **Seismic Intensity Information**
- **Nankai Trough Earthquake Information**
- **Off the Coast of Hokkaido and Sanriku Subsequent Earthquake Advisory**
- **Other Information Prompt report**

JMA Website → Internet

- Mobile network operators → Emergency Alert E-mail
- Transmission company or Licensed company for forecasting → Dedicated device/Apps
- NHK and other Broadcasting media → TV, radio
- Fire and Disaster Management Agency / J-ALERT system → Emergency broadcast system
- Prefectural government
- Police
- Nippon Telegraph and Telephone Corporation

→ Local municipalities

- Ministry of Land, Infrastructure and Transport → Air traffic controls
- Japan Coast Guard → Ships
- Designated administrative organs
- Designated public institution

→ ***General public***

From Information to Disaster Mitigation

JMA's various types of Information on earthquakes and tsunami are provided in various ways suitable for purpose, and are utilized for disaster mitigation correspondence.

Information that prompts urgent evasive action and evacuation, such as **Earthquake Early Warnings** and **Tsunami Warnings/Advisories**, is provided immediately to local residents via TV and radio, mobile phone and Emergency broadcast system (J-ALERT).

Other types of information are provided to central and local government bodies, disaster prevention organizations, the media and other parties, and are also published on the JMA website for use in initial response, checking of damaged areas and resident evacuation/rescue.

At the stage of restoration work by municipalities, related organizations and local residents, careful attention is required to the risk of secondary disasters such as residential collapse and landslides associated with subsequent earthquakes, as well as to forming an accurate and comprehensive picture of the damage. To support planning and implementation in relation to associated tasks, JMA issues Prompt Reports with information including seismic intensity distribution, the current situation and prospects for earthquake activity/tsunami as well as notes on disaster mitigation. JMA staff also provide commentary at disaster management headquarters and press briefings.

Emergency broadcast system
Photo by Chiyoda City, Tokyo

Disaster management headquarters

Timing of Warnings/Information

JMA issues various types of information on earthquakes and tsunami with particular timing after the earthquake, and the accuracy of the content essentially increases with time.

Earthquake Early Warning

Detect seismic waves immediately after an earthquake and issue EEWs within seconds

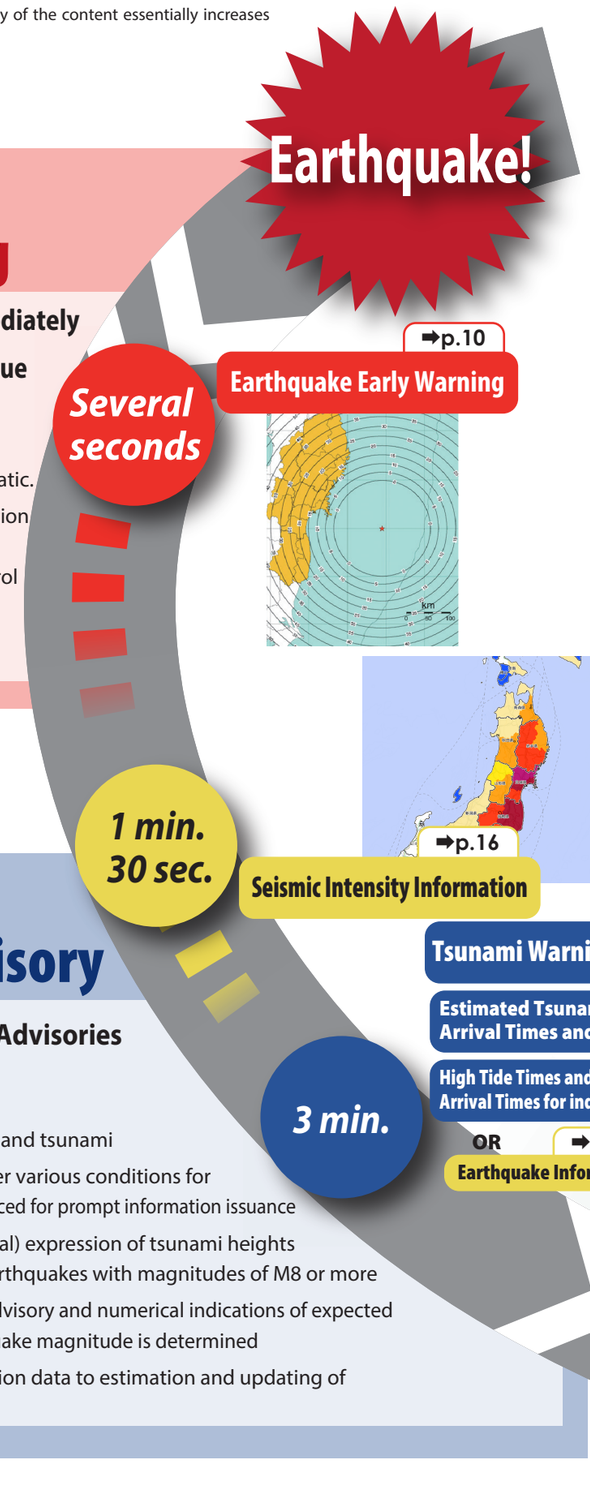
- ◆ The EEW process is fully automatic.
- ◆ "Warnings" (urging self-protection against strong shaking) and "Forecasts" (for automatic control of trains/plant equipment and the like) are issued.

Tsunami Warning/Advisory

Issue Tsunami Warnings/Advisories within around 3 minutes

- ◆ 24/7 monitoring of earthquakes and tsunami
- ◆ Prior simulation of tsunami under various conditions for creation of a database to be referenced for prompt information issuance
- ◆ Qualitative (rather than numerical) expression of tsunami heights (e.g., "Huge" and "High") after earthquakes with magnitudes of M8 or more

  Updating of Tsunami Warning/Advisory and numerical indications of expected tsunami heights once the earthquake magnitude is determined
- ◆ Application of tsunami observation data to estimation and updating of Tsunami Warnings/Advisories



Reports and Commentaries

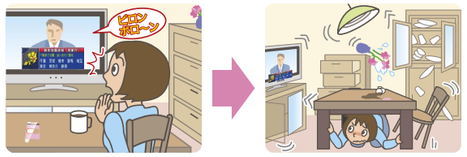
Publish reports containing information and commentary on earthquake and tsunami details

Earthquake Information

Issue information timely on hypocenter, M, seismic intensity, etc.

EEW: Earthquake Early Warning

Earthquake Early Warnings (EEWs) provide advance notice of estimated Seismic Intensities and expected arrival times of principal motion just after an earthquake occurs. Although strong motion hits within just a few tens of seconds, EEWs can be utilized in various situations to mitigate earthquake-related damage by providing precious seconds before shaking starts.



"Warnings" and "Forecasts"

Categories	Criteria	Details	Features
Warnings	• For estimated I_{JMA}5- or greater. (Provided for areas where I_{JMA} is expected to be 4 or greater) • For estimated Long-Period Ground Motion (LPGM) class 3 or greater	• Estimated origin time and hypocenter • Areas with estimated I_{JMA} 4 or LPGM class 3 or greater	• Generally issued only once, except for large earthquakes • Information is provided on TV and via phones to urge protection from strong shaking
Forecasts	• For estimated I_{JMA}3 or greater • For estimated LPGM class 1 or greater • For estimated magnitude is 3.5 or greater	• Estimated origin time, hypocenter and magnitude • Areas with estimated I_{JMA} 4 or greater/Estimated I_{JMA} /Estimated arrival time • Areas with LPGM class 1 or greater/Estimated LPGM class/Estimated arrival time	• Detailed information such as I_{JMA} values and estimated arrival times are updated on an ongoing basis for equipment control and other earthquake countermeasures

JMA added LPGM class values to its I_{JMA} predictions in Earthquake Early Warnings as shown in the table. However, the action to be taken remains the same; shelter in a safe place until shaking subsides. See page 18 for LPGM details.

* Earthquake Early Warnings incorporating prediction of shaking with I_{JMA} 6- or greater and LPGM class 4 are issued in the classification of Emergency Warnings.

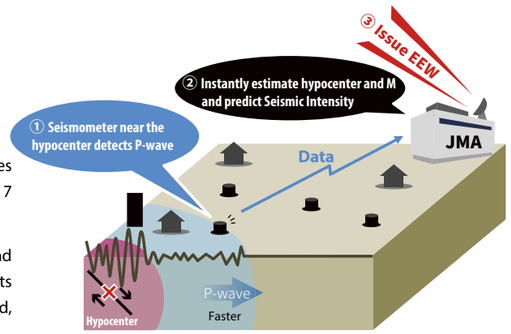
How it Works

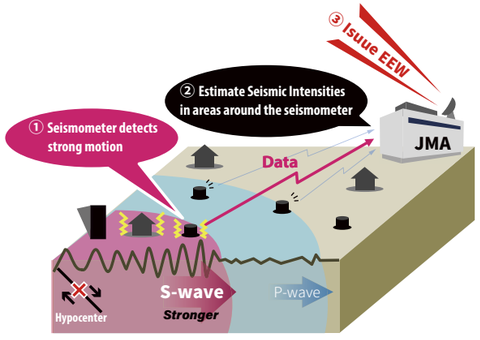
When an earthquake occurs, seismic waves propagate. The main types are primary waves (P-waves) and secondary waves (S-waves), the latter of which propagate more slowly (4 vs. 7 km/s) but are much stronger and can cause far more serious damage.

JMA analyzes data from seismometers that detect P-waves near the hypocenter and estimates the hypocenter location, magnitude and expected seismic intensity. If the results meet set criteria, EEW Warnings and Forecasts are issued. The process is automatic and rapid, enabling EEW output before the arrival of S-waves.

If strong motion is detected by a seismometer, JMA predicts continued local strong shaking and issues EEWs via the automatic processing system to warn people of imminent seismic motion.

The EEW system is generally based on science and technology for analysis and estimation, observation systems capable of quickly detecting the occurrence of an earthquake, and information and communications technology for prompt delivery of EEWs.





Appropriate Preparation and Response

It is important to understand the different issuance criteria/characteristics and respond appropriately.

Warnings

Warnings are issued widely through various media such as not only TV and radio, but also cellphones, smartphones and emergency broadcast systems to help people protect themselves from strong shaking.

It is advisable to prepare in advance by creating a safe space and implementing drills for immediate self-protection in the event of a Warning.

To support the rapid implementation of self-preservation measures, TV/radio and cellphones/smartphones emit individually unique alarms. Get to know the sounds they make so that you will recognize an alert as soon as it is issued.

▲ ***EEW broadcast(NHK)***

NHK alarm can be previewed on the NHK website.
https://www.nhk.or.jp/sonae/bousai/

EEW via Emergency Alert Email
("Area Mail": NTT DOCOMO)

Forecasts

Forecasts are issued quickly even when the accuracy of available information remains limited, and are updated iteratively with increasing precision over time. As a result, Forecasts can provide alerts of shaking before **Warnings** in some cases.

Some corporate operators licensed for forecasting predict seismic intensities and times at which strong shaking will start in specific locations based on forecast data from JMA. This information can be used to enable advance preparations such as mechanical control of machinery/equipment and issuance of automatic announcements in indoor environments.

Users can subscribe to these forecasts by contracting with the relevant licensed company or installing dedicated applications.

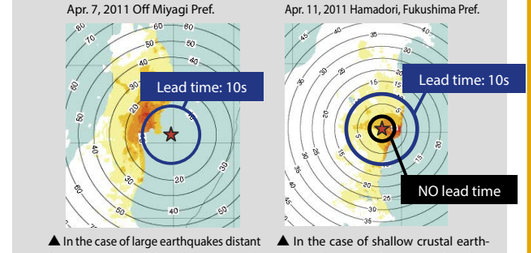
!

- In areas close to the hypocenter, Warnings **may not arrive in time** before strong shaking hits.
- EEW Seismic Intensity estimations have **an error margin of ±1 or so**.
- Warning accuracy may vary due to calculation with the limited data available immediately after an earthquake.

Check other points to note for response to EEWs on the JMA website (in Japanese only).

https://www.data.jma.go.jp/eew/data/nc/shikumi/tokusei.html

○ Lead time from EEW until strong shaking



▲ In the case of large earthquakes distant from land areas, a lead time of several seconds is expected before strong shaking begins.

▲ In the case of shallow crustal earthquakes, strong shaking may begin before an EEW can be issued.

Estimated Seismic Intensity
4 5- 5+ 6- 6+

★ hypocenter

The numbers in the figures indicate the times (in seconds) at which strong shaking (S-wave) is expected to start after EEW issuance.

Tsunami Warnings/Advisories

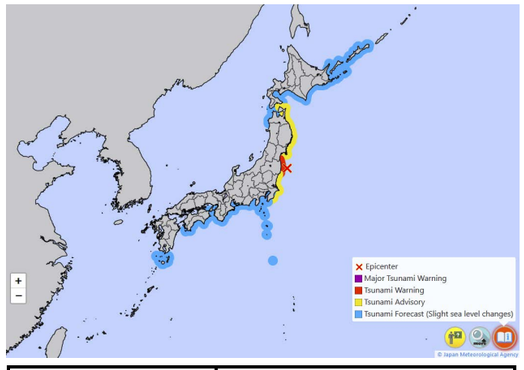
Tsunami strikes can cause serious damage and loss of life. When an earthquake occurs, JMA estimates whether a tsunami has been generated based on the earthquake's location and magnitude. If disastrous waves are expected in coastal regions, JMA issues Tsunami Warnings/Advisories.

Tsunami Warnings/Advisories

Immediately after an earthquake, JMA estimates the earthquake's location/magnitude and potential maximum tsunami heights in coastal regions of Japan with reference to a tsunami database. If damage is expected, **Tsunami Warnings/Advisories** are issued for the relevant forecast regions within around three minutes of the earthquake. JMA generally expresses maximum tsunami heights in five quantitative levels.

However, it takes time to determine the exact scale of earthquakes with a magnitude of 8 or more. In such cases, JMA issues an initial warning based on the predefined maximum magnitude to avoid underestimation. When such values are used, estimated maximum tsunami heights are expressed in qualitative terms such as "**Huge**" and "**High**" rather than quantitatively.

Once the exact magnitude is determined, JMA updates the Warning with quantitatively estimated maximum tsunami heights, which are included in subsequent tsunami information.



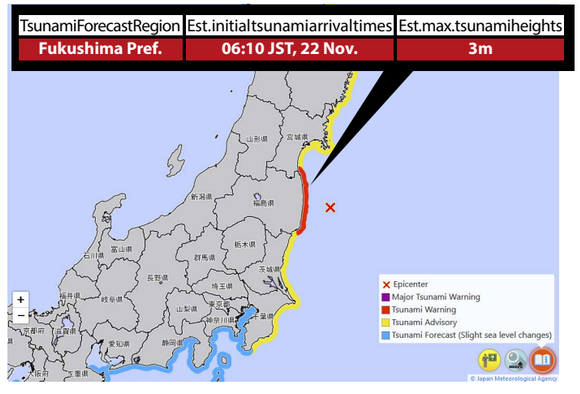
Tsunami Forecast Region	Category of Tsunami Warning/Advisory
Fukushima Pref.	**TSUNAMI WARNING**

Categories	Estimated maximum tsunami heights in Tsunami Information		Criteria	Expected damage and action to be taken (★)
	Qualitative expression	Quantitative expression		
Major Tsunami Warning	Huge	over 10 m (10 m -)	Maximum tsunami height is estimated to be over 3 m.	Wooden buildings will be completely destroyed and/or washed away, and people will be caught in tsunami currents. ★ **A huge tsunami is expected to cause serious damage. Evacuate immediately to a safer place such as high ground or an evacuation building. Tsunami waves are expected to hit repeatedly. Do not leave safe ground until the warning is lifted.**
		10 m (5 - 10 m)		
		5 m (3 - 5 m)		
Tsunami Warning	***High***	3 m (1 - 3 m)	Maximum tsunami height is estimated to be up to 3 m.	A tsunami of this scale is expected to cause damage in low-lying areas. Wooden buildings will be flooded and people will be caught in tsunami currents. ★ **A tsunami is expected to cause damage. Evacuate immediately to a safer place such as high ground or an evacuation building. Tsunami waves are expected to hit repeatedly. Do not leave safe ground until the warning is lifted.**
Tsunami Advisory	(no expression)	1 m (0.2 - 1 m)	Maximum tsunami height is estimated to be up to 1 m.	A tsunami of this scale is expected to result in people being caught in strong currents in the sea. Fish farming facilities will be washed away and small vessels will capsize. ★ **It is dangerous in the sea or near the coast. Get out of the water and leave coastal regions immediately. Due to the risk of ongoing strong currents, do not enter the sea or approach coastal regions until the advisory is lifted.**

* Major Tsunami Warnings are issued in the classification of Emergency Warnings.

When issuing Tsunami Warnings/Advisories, JMA also provides information on estimated tsunami arrival times of the first wave and maximum tsunami heights for relevant forecast regions and data on high-tide times and estimated arrival times of the first wave at selected points.

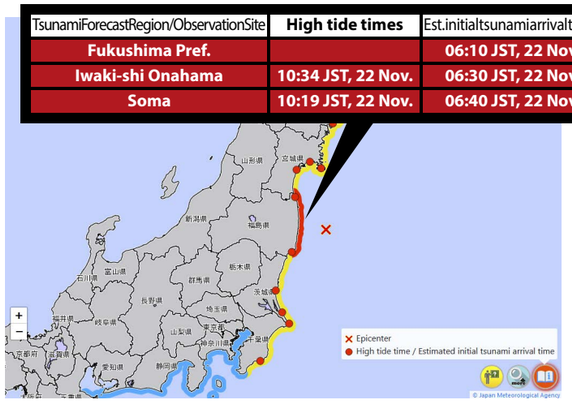
■ Tsunami Information (Estimates Tsunami Arrival Times and Heights)



Estimated arrival times (the time at which a tsunami is expected to hit first in any part of an area) and maximum heights for relevant tsunami forecast regions are indicated.

*In JMA XML telegrams and on the JMA website, Tsunami Information (Estimated Tsunami Arrival Time and Height) is combined with Tsunami Warning/Advisory.

■ Tsunami Information (High Tide Times and Estimated Tsunami Arrival Times for individual location)



High-tide times and estimated initial tsunami arrival times at selected points are also indicated. Tsunami arrival at high tide boosts wave height and increases the scope of potential damage.

Tsunami Forecast

JMA issues Tsunami Forecast or Earthquake Information to indicate no tsunami threat in association with an earthquake (➡ p.16) .

- ▶ Maximum tsunami heights may ***exceed estimates*** in some regions.
- ▶ Estimated initial tsunami arrival times are the earliest predictions for each tsunami forecast region. As the arrival time in each region depends on the location, tsunamis may hit some coastal areas ***tens of minutes or more*** after the estimated time.
- ▶ Tsunami waves may hit ***before Tsunami Warnings/Advisories*** are issued if the source region is near the coast.
- ▶ When the exact magnitude is determined or tsunami waves are observed, JMA may ***update*** Tsunami Warnings/Advisories.

● Approximate relationship between tsunami height and damage (Modified Shuto[1993])

Height ▶	1m	2m	4m	8m	16m	32m
Aquaculture raft	*Damaged*					
Fishing boat		*Damage begins*	*Damage ratio 50%*	*Damage ratio 100%*		
Tsunami control forest — DAMAGE ▶	*Slight*		*Moderate*		*Extreme*	
Tsunami control forest — EFFECT ▶	*Tsunami buffering / Debris capture*		*Debris capture*		*Ineffective*	
Wooden house	*Partial damage*	*Destruction*				
Stone house		*Intact*			*Destruction*	
Reinforced concrete building			*Intact*			*Destruction*

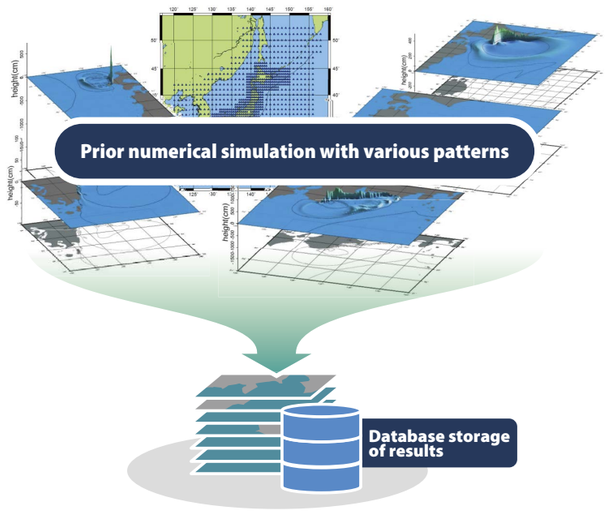
Heights indicated for Tsunami control forest, Wooden house, Stone house and Reinforced concrete building are from the ground (inundation depth). Actual values may differ significantly.

Estimation of Tsunami Heights and Arrival Times

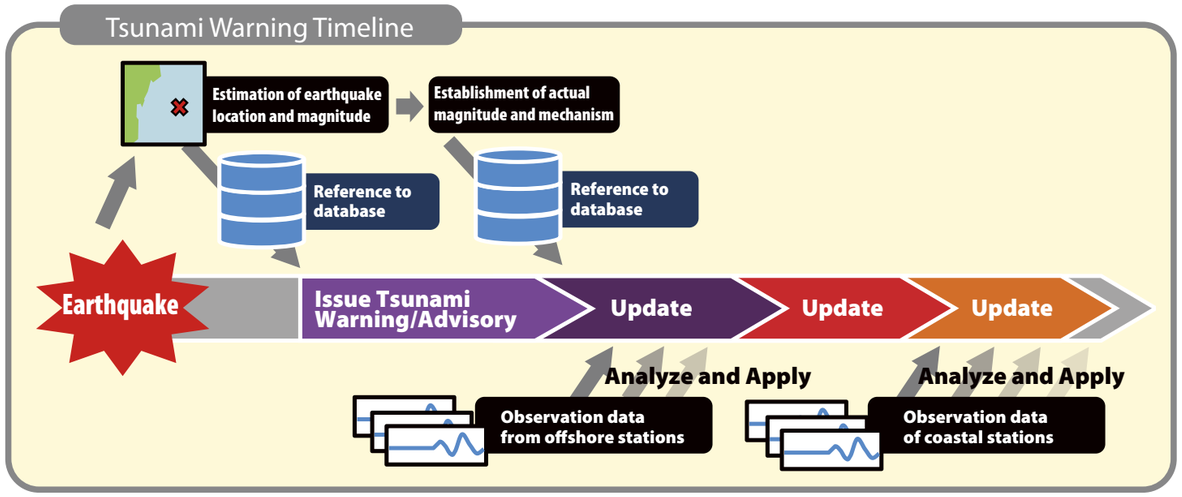
Tsunami waves strike near-field coastal areas soon after the occurrence of a tsunamigenic earthquake. However, due to the time-consuming nature of tsunami simulation, timely processing is impossible if calculation is begun only after an earthquake occurs.

To address this situation, JMA simulates tsunami propagation in advance with a variety of earthquake scenarios, locations and magnitudes to determine arrival times and wave heights for particular coastal areas. The results are stored in a database to be referenced in the event of an actual earthquake for issuance of appropriate Warnings and Advisories.

JMA also uses data recorded by tsunami meters to update and/or lift Advisories and Warnings as necessary. Coastal tsunami heights are estimated 1. via simple conversion from observed offshore heights, and 2. more accurately based on reproduction of the tsunami source and propagation process from offshore tsunami waveforms.



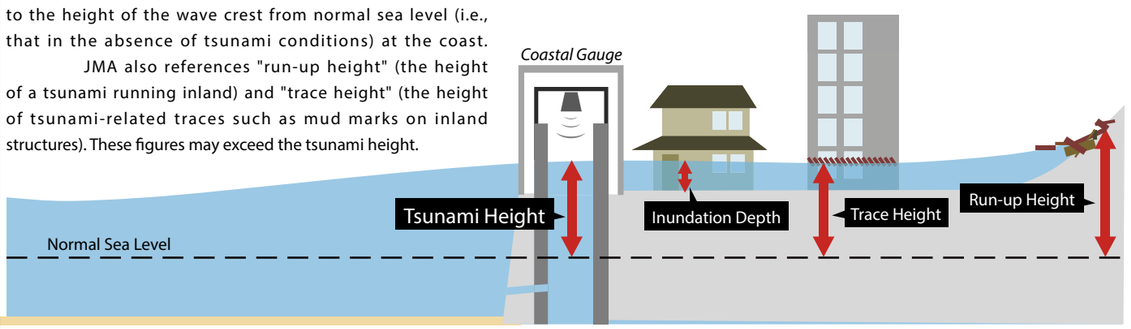
Tsunami Warning Timeline



What is "tsunami height"?

Tsunami height figures in JMA Warnings/Advisories refer to the height of the wave crest from normal sea level (i.e., that in the absence of tsunami conditions) at the coast.

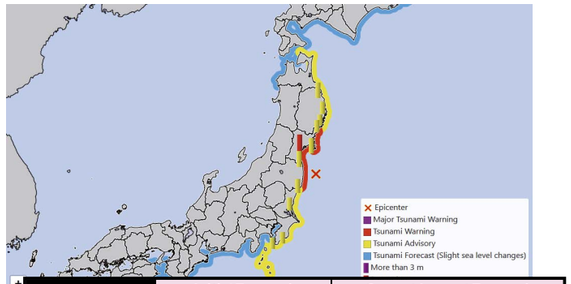
JMA also references "run-up height" (the height of a tsunami running inland) and "trace height" (the height of tsunami-related traces such as mud marks on inland structures). These figures may exceed the tsunami height.



Information on Tsunami Observations

JMA and other public agencies have placed coastal and offshore tsunami meters, and JMA collects data from these stations in real time. When tsunamis are observed at these stations, JMA announces in tsunami information bulletins and updates or lifts Tsunami Warnings /Advisories.

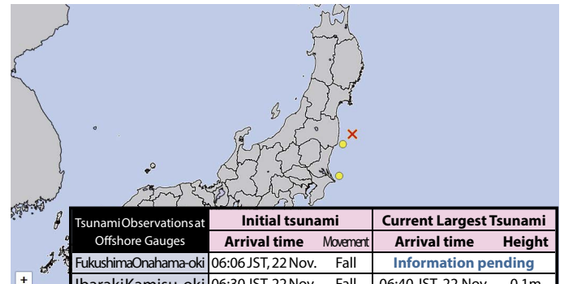
■ Tsunami Information (Tsunami Observations)



Tsunami Observations at coastal areas	Initial Tsunami		Current Largest Tsunami	
	Arrival time	Movement	Arrival time	Height
Kuji-ko	07:25 JST, 22 Nov.	Fall	07:54 JST, 22 Nov.	0.8m (increased)
Miyako	07:07 JST, 22 Nov.	Fall	08:09 JST, 22 Nov.	0.4m (increased)
Kamaishi	(unconfirmed)		07:15 JST, 22 Nov.	0.2m

When tsunamis are observed at coastal meters, JMA announces arrival times and initial movement (rise/fall) of the observed first waves in coastal areas as well as the arrival times and scale of the maximum waves observed as of the times of issuance for each tsunami observation site.

■ Tsunami Information (Tsunami Observations at Offshore Gauges)

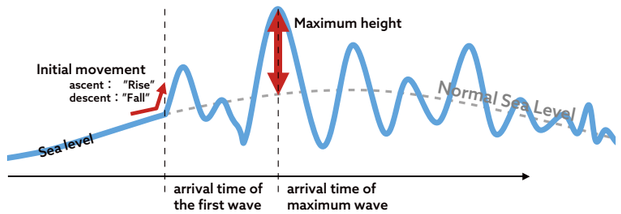


Tsunami Observations at Offshore Gauges	Initial tsunami		Current Largest Tsunami	
	Arrival time	Movement	Arrival time	Height
FukushimaOnahama-oki	06:06 JST, 22 Nov.	Fall	Information pending	
IbarakiKamisu-oki	06:30 JST, 22 Nov.	Fall	06:40 JST, 22 Nov.	0.1m

Est. Tsunami Heights and ArrivalTimesatcoastalareas	Initial tsunami	Current Largest Tsunami	
	Est. arrival time	Est. arrival time	Est. height
Fukushima Pref.	06:22 JST, 22 Nov.	Information pending	
Ibaraki Pref.	06:50 JST, 22 Nov.	07:00 JST, 22 Nov.	1m

When tsunamis are observed at offshore meters, JMA announces arrival times and initial movement (rise/fall) of the observed first waves as well as the arrival times and scale of the highest waves observed as of the times of issuance. In addition, JMA issue estimated values such as arrival time of initial wave and arrival time and height of current largest wave for each tsunami forecast region from these offshore data.

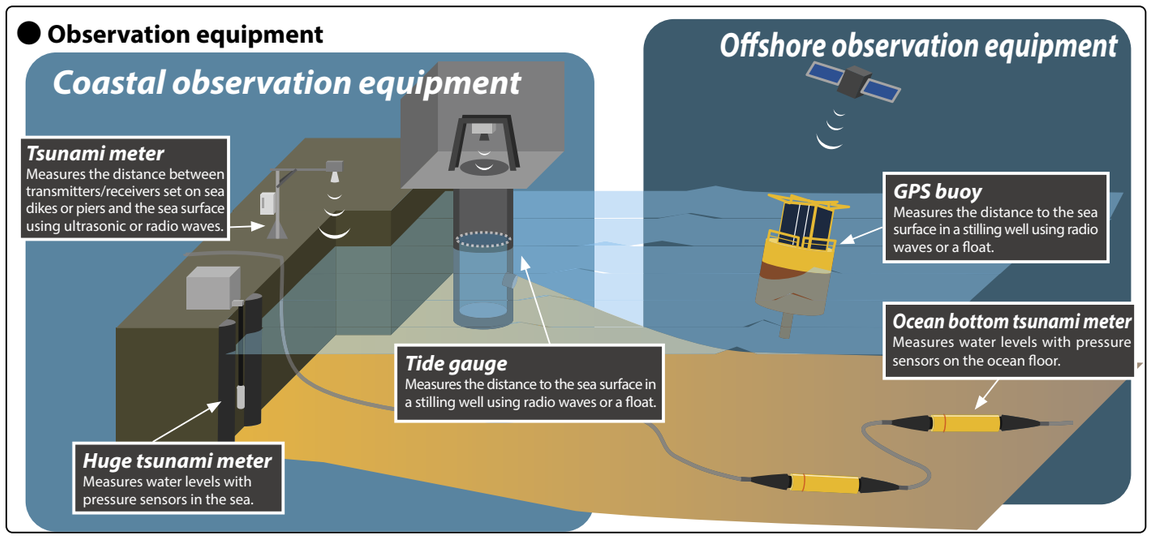
● "First wave" and "maximum wave"



"Information pending"

To prevent delays in evacuation, JMA does not issue observation/estimation values if the maximum wave height is below the evacuation trigger threshold. When observed tsunamis are smaller than estimated, JMA uses the phrase "Information pending" rather than providing actual values to avoid creating a false sense of security in regions where Major Tsunami Warnings and/or Tsunami Warnings are in effect.

● Observation equipment



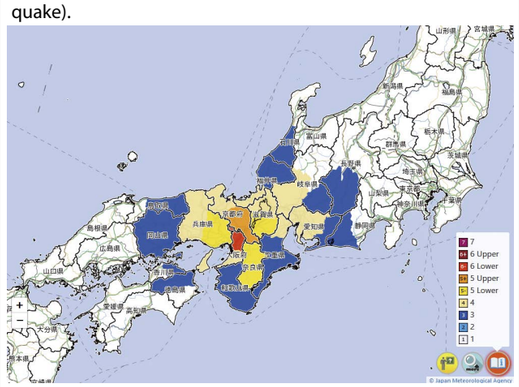
Earthquake Information: Flow and Content

When an earthquake occurs, JMA promptly issues related information based on seismic intensity (I_{JMA}) observations and determines its time of occurrence, hypocenter and magnitude.

■ Seismic Intensity Information

Announcement of Shaking

This information specifies the time of earthquake occurrence and identifies sub-prefectural regions where I_{JMA}3 or greater has been observed (issued within 90 seconds of the earthquake).



■ Earthquake Information

Announcement of No Tsunami Risk

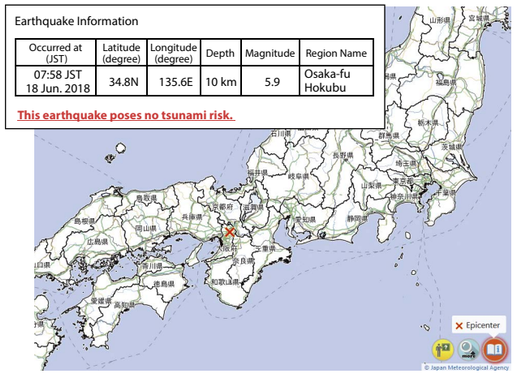
This information specifies the hypocenter and magnitude with the information "No threat of tsunami" or "Sea levels may fluctuate slightly, but no danger is expected" for earthquakes with I_{JMA}3 or greater.

*Relevant information is issued for Tsunami Warnings/Advisories.
See page 12 for details.

Earthquake Information

Occurred at (JST)	Latitude (degree)	Longitude (degree)	Depth	Magnitude	Region Name
07:58 JST 18 Jun. 2018	34.8N	135.6E	10 km	5.9	Osaka-fu Hokubu

This earthquake poses no tsunami risk.



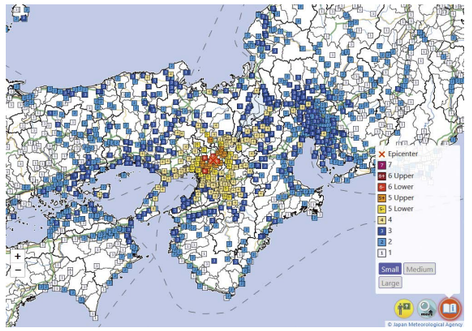
■ Earthquake and Seismic Intensity Information

Announcement of Local Seismic Intensity and Locations

If I_{JMA}1 or greater are observed, the following information is provided:

- Hypocenter and magnitude
- Points where I_{JMA}1 or greater have been observed, and related seismic intensity
- Localities where I_{JMA}3 or greater have been observed

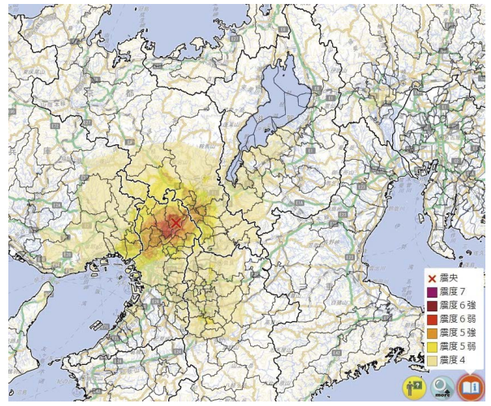
The information also identifies localities with estimated I_{JMA}5- or greater where related observation data are incomplete.



■ Estimated Seismic Intensity Distribution Maps

Indication of Seismic Intensity Distribution in Map Form

When the observed maximum I_{JMA} is 5- or greater, JMA issues **Estimated Seismic Intensity Distribution Maps** showing expected Seismic Intensity based on observation data in consideration of site amplification to areas where I_{JMA}4 or greater has been estimated.



From Earthquake → 1 min → **Earthquake/Magnitude Calculation** → 3 min → **Collection of Seismic Intensity Data** → 5 min → **Long-Period Ground Motion Class Calculation** → 10 min → **Estimated Seismic Intensity Calculation** → 15 min

● Summary of the JMA Seismic Intensity Scale

0
- Imperceptible to people.

1
- Felt slightly by some people keeping quiet in buildings.

2
- Felt by many people keeping quiet in buildings.

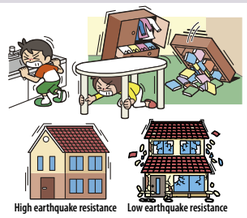
3
- Felt by most people in buildings.

4
- Most people are startled.
- Hanging objects such as lamps swing significantly.
- Unstable ornaments may fall.

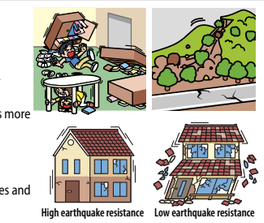
5 Lower
- Many people are frightened and feel the need to hold onto something stable.
- Dishes in cupboards and items on bookshelves may fall.
- Unsecured furniture may move, and unstable furniture may topple over.

5 Upper
- Many people find it difficult to walk without holding onto something stable.
- Dishes in cupboards and items on bookshelves are more likely to fall.
- Unsecured furniture may topple over.
- Unreinforced concrete-block walls may collapse.

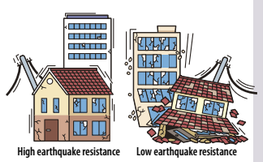
6 Lower
- It is difficult to remain standing.
- Many unsecured furniture moves and may topple over. Doors may be stuck.
- Wall tiles and windows may sustain damage and fall.
- In wooden houses with low earthquake resistance, tiles may fall and buildings may lean or collapse.



6 Upper
- It is impossible to move without crawling. People may be thrown through the air.
- Most of unsecured furniture moves, and is more likely to topple over.
- Wooden houses with high earthquake resistance may lean in some cases.
- Large cracks may form, and large landslides and massif collapses may be seen.



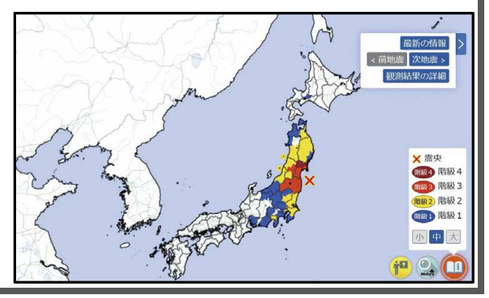
7
- Wooden houses with low earthquake resistance are even more likely to lean or collapse.
- Wooden houses with high earthquake resistance may lean in some cases.
- Reinforced-concrete buildings with low earthquake resistance are more likely to collapse.



■ Information on Long-Period Ground Motion

Indication of Long-Period Ground Motion not represented by Seismic Intensity Values Alone

For long-period ground motion with LPGM class 1 or greater, the class at the observation site and areas are indicated. If I_{JMA}4 or less and LPGM class 3 or greater have been observed, these areas are also indicated.



!

- Seismic Intensity measured at observation sites even in the same city or block may ***differ with a margin of ±1*** because ground motion is affected by ground conditions and topography.
- Earthquakes in very shallow parts of the crust may be felt even if their magnitude is small. Tremors are often felt over a limited area, and those with a Seismic Intensity of 1 or less may not be observed if there is no Seismic Intensity meter nearby. In such cases, ***no earthquake information*** is issued.
- As estimated intensity values have a margin of error, these maps should be used to determine ***the approximate extent and distribution*** of strong ground motion rather than for focus on the estimated values in each grid.

Information on Long-Period Ground Motion

When a major earthquake occurs, Long-Period Ground Motion may cause greater damage to upper floors of buildings than at ground level. Information is provided to clarify the characteristics of long-period shaking in such structures and support mitigation of related damage.

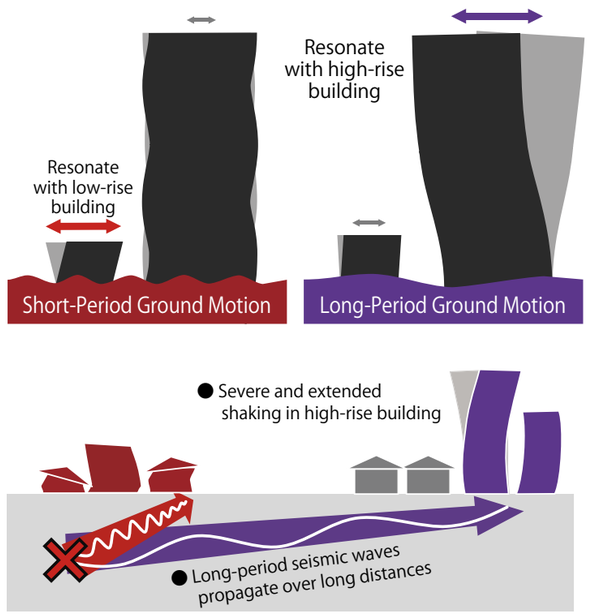
Long-Period Ground Motion

Earthquakes generate ground motion with various *periods* – the term given to the time between one wave and the next. Major earthquakes such as the 2011 off the Pacific coast of Tohoku Earthquake bring notable **Long-Period Ground Motion** (LPGM), which does not attenuate as readily as its short-period counterpart and propagates over great distances. Such shaking is especially amplified and tends to last longer in soft strata such as those found on sedimentary plains.

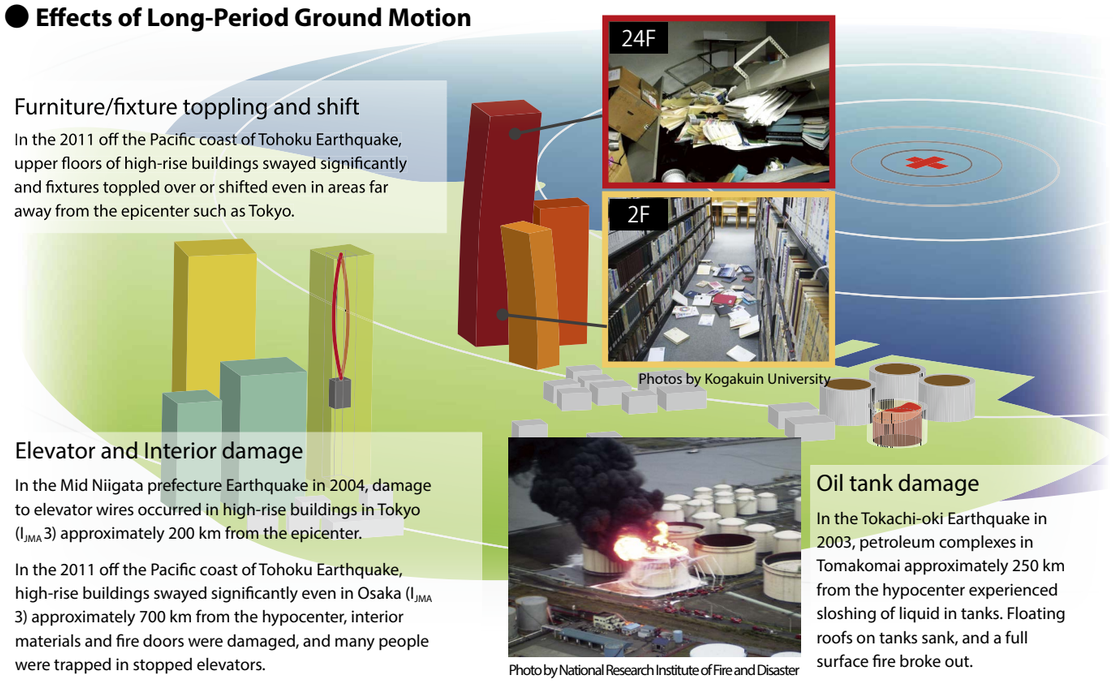
Artificial structures also have their own **natural periods**. If the predominant period of ground motion is close to the natural period of a building, the structure resonates and the amplitude increases. As the natural periods of high-rise buildings are longer than those of low-rise types, the former tend to resonate more with LPGM and undergo longer-lasting extreme shaking.

Furniture and fixtures in high-rise buildings subjected to extreme shaking may topple over or shift, and elevators may cease to operate. The amplitude tends to increase on higher floors, causing greater damage.

As the high-rise buildings found extensively on sedimentary plains in metropolitan areas of Japan such as Tokyo, Nagoya and Osaka are vulnerable to extreme shaking in association with LPGM, there are concerns that the anticipated Nankai Trough Earthquake could cause large-scale damage in these areas.



● Effects of Long-Period Ground Motion



Furniture/fixture toppling and shift

In the 2011 off the Pacific coast of Tohoku Earthquake, upper floors of high-rise buildings swayed significantly and fixtures toppled over or shifted even in areas far away from the epicenter such as Tokyo.

Elevator and Interior damage

In the Mid Niigata prefecture Earthquake in 2004, damage to elevator wires occurred in high-rise buildings in Tokyo (I_{JMA} 3) approximately 200 km from the epicenter.

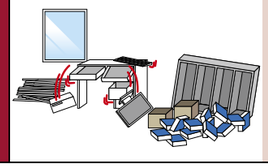
In the 2011 off the Pacific coast of Tohoku Earthquake, high-rise buildings swayed significantly even in Osaka (I_{JMA} 3) approximately 700 km from the hypocenter, interior materials and fire doors were damaged, and many people were trapped in stopped elevators.

Photo by National Research Institute of Fire and Disaster

Oil tank damage

In the Tokachi-oki Earthquake in 2003, petroleum complexes in Tomakomai approximately 250 km from the hypocenter experienced sloshing of liquid in tanks. Floating roofs on tanks sank, and a full surface fire broke out.

JMA Intensity Scale for Long-Period Ground Motion

Long-Period Ground Motion (LPGM) class		Human perception	Indoor situation
class1		• Felt by most people in buildings. Some people are startled.	• Hanging items such as lamps and blinds swing significantly.
class2		• Many people find it difficult to walk without holding onto something stable.	• Furniture on casters moves slightly. • Items in cupboards and bookshelves may fall. • Some of unsecured moves and may topple over.
class3		• It's difficult to remain standing.	• Furniture on casters moves significantly. • Some of unsecured moves and may topple over. • Partition walls may crack.
class4		• It's impossible to remain standing or move without crawling. People are at the mercy of shaking.	• Furniture on casters moves significantly and may topple over. • Unsecured furniture moves and may topple over. • Partition walls are likely to crack.

As Seismic Intensity data only partially express the strength of long-period shaking on higher floors, JMA is using a four-category intensity scale for LPGM to indicate the strength of shaking in high-rise buildings and the possibility of related damage.

The scale quantifies the effects of shaking in a high-rise building with a natural period of around 1.5 to 8 seconds (approx. 14 stories or more). There are four classes based on degrees of human perception and damage, such as toppling or shifting of furniture and fixtures. The conditions indicated are a rough guide, and actual damage may differ. Effects also vary with factors such as building/structural conditions and the duration of earthquake motion.

Earthquakes producing LPGM class 3 or higher (since Mar. 2013)

Date(JST)	Hypocenter	M	I_{JMA}	LPGM class
2014/11/22 22:08	Northern Nagano Pref.	6.7	6-	3
2015/05/13 06:12	Off Miyagi Pref.	6.8	5+	3
2016/04/14 21:26	Kumamoto Pref.	6.5	7	3
2016/04/15 00:03	Kumamoto Pref.	6.4	6+	4
2016/04/16 01:25	Kumamoto Pref.	7.3	7	4
2016/10/21 14:07	Middle Tottori Pref.	6.6	6-	3
2018/09/06 03:07	Middle Eastern Iburi, Hokkaido	6.7	7	4
2019/06/18 22:22	Off Yamagata Pref.	6.7	6+	3
2021/02/13 23:07	Off Fukushima Pref.	7.3	6+	4
2021/03/20 18:09	Off Miyagi Pref.	6.9	5+	3
2022/03/16 23:36	Off Fukushima Pref.	7.4	6+	4

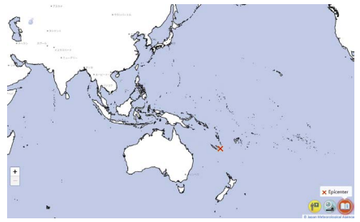
!

- ▶ How the high-rise building shakes varies depending on its height, shape and structure. LPGM class may not be accurate due to individual building.
- ▶ The characteristics of shaking in high-rise buildings differ between higher and lower floors. The top of a building may be more severely shaken than scale values suggest.
- ▶ As buildings with a seismic isolation structure have a long natural period, the damping effect is strong with short-period seismic motion but may be larger seismic motion with long-period motion.
- ▶ Structural measures are taken against major earthquakes, and work is undertaken to raise awareness of action to be taken with the assumption of no major architectural failure.

Other Information and Commentary on Earthquakes and Tsunamis

Distant Earthquake Information

JMA monitors seismic activity not only around Japan but also worldwide. When an earthquake with a magnitude of 7.0 or larger or with a remarkable magnitude that may cause significant damage to nearby cities occurs outside Japan, JMA issues **Distant Earthquake Information** to the public within about 30 minutes after the earthquake occurs. Its content includes the date, time, epicenter and magnitude of the earthquake as well as the estimated impact and observation of tsunami generated by the quake.



Occurred at (JST)	Latitude (degree)	Longitde (degree)	Depth	Magnitude	Region Name
13:18 JST 05 Dec 2018	22.1S	169.2E	-	7.6	Southern Pacific Ocean

Earthquake parameters by PTWC.

There is a possibility of a destructive regional tsunami in the Pacific Ocean.

The possibility of tsunami generation toward Japan is currently under evaluation.

The Pacific Tsunami Warning Center has issued a Tsunami Bulletin.

"-" in the above information represents an indeterminable value.

!
- ▶ When a head time of hours is expected before tsunami could reach the country, JMA evaluates the possibility of strikes and issues Tsunami Warnings/Advisories if necessary hours before the estimated arrival time. If Distant Earthquake Information indicates the risk of a tsunami or indicates that the possibility of such is under evaluation, look out for further information from JMA.

Information on Tsunamis Caused by Volcanic Eruptions and Similar

Tsunamis are often caused by earthquakes, but also result from other factors such as volcanic eruptions and landslides. In January 2022, atmospheric pressure waves generated by a volcanic eruption in Tonga in the South Pacific caused sea level changes of 1 m or more as far away as Japan.

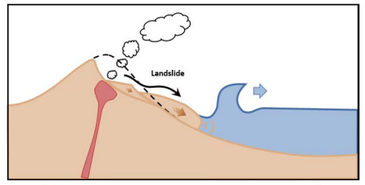
In the event of a tsunami caused by a volcanic eruption or similar, JMA calls for caution and vigilance via its Tsunami Warning/Advisory system.

- Information is also provided on any potential for tsunami occurring due to volcanic eruptions overseas.
- Tsunami Warnings/Advisories are generally based on domestic tide level observations.

For tsunami caused by volcanic eruptions, the action to be taken is the same as that for tsunami caused by earthquakes (table, P.12).

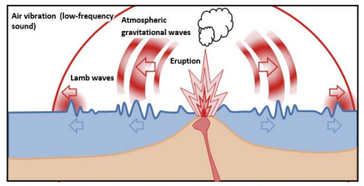
!
- ▶ Anticipation of tsunami caused by volcanic eruptions and issuance of Tsunami Warnings/Advisories before coastal impact may be imprecise due to the difficulty of prediction. Volcanic phenomena causing tsunami may also not be recognized.
- ▶ The information here will be updated as necessary. Be sure to check back regularly.

■Tsunami caused by volcanic collapse

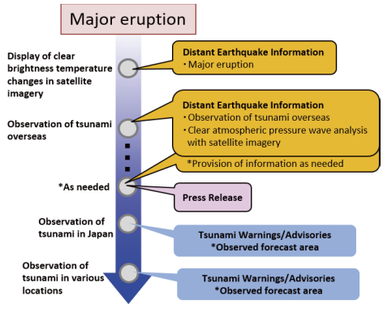


Volcanic eruption → Landslide → Tidal changes

■Tsunami caused by atmospheric pressure waves



Volcanic eruption → Generation of atmospheric pressure waves → Tidal changes



▲*Information release for tide-level changes caused by atmospheric pressure waves associated with volcanic eruptions*

Information on Numbers of Earthquakes and Other Variables

JMA provides a frequency of earthquakes with maximum seismic intensity 1 or greater, omitting issuance of intensity information of each of earthquakes with maximum seismic intensity 1 or 2, if many earthquakes occur within a short period of time.

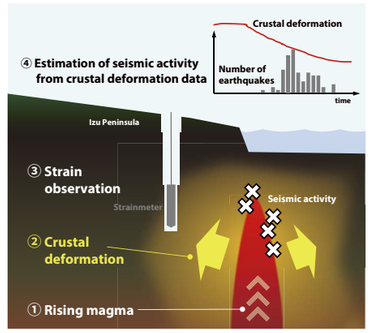
When hypocenter and magnitude of significant earthquakes are scrutinized, JMA issues information on update of hypocenter and magnitude.

Information on Seismic Activity in the Eastern Izu District

In the eastern Izu district, seismic swarms related to magma activity have frequently occurred in the past. Based on the data obtained from past activities, JMA evaluates the transition and prospect of further earthquakes in eastern Izu.

If anomalous crustal deformation caused by magma rising is detected and active seismicity is expected, JMA issues information on the maximum possible magnitude and Seismic Intensity of the largest earthquake, the expected number of earthquakes with a Seismic Intensity of 1 or greater, and the expected duration of the activity.

The region of the seismic swarms



!
- ▶ If the relationship cannot be applied (e.g., when the source region of the seismic activity differs from past instances), provision of this information may be omitted.
- ▶ In cases where magma rises to shallow areas, this information will be included in reports on volcanoes, and ***Volcanic Warnings*** and other related information will be issued.

Prompt Reports and Press Briefings

When a large earthquake with around I_{JMA}4 or greater shaking occurs, or when Tsunami Warnings/Advisories are in effect, JMA issues **Prompt Reports** on Large Earthquakes and Tsunamis to provide information on the hypocenter, magnitude, tsunami (if observed), distribution of Seismic Intensity, historical earthquake activity around the hypocenter and other data. If there is a risk of serious damage, JMA issues information on the earthquake and provides important notifications to the public through the media (via news releases) and to disaster management authorities.

When further damage is expected (as is often the case after earthquakes with I_{JMA}5- or greater shaking), JMA details the prospect of further earthquakes in press releases and provides information on the period during which caution is required, expected seismic intensity, and related points to note (such as the presence of nearby active faults and possible major subduction-zone earthquakes). Reporting also includes seismic activity observation data, information on weather conditions and calls for attention to the developing situation.

Immediately after the Earthquake

- There is about 10–20% of cases where similar earthquakes occurred in the past in the vicinity.
- Caution should be exercised for a week or so after earthquakes with I_{JMA}7 shakings.
- Further major earthquakes often occur within a few days in the vicinity of large earthquakes.

▲ Comments on expected maximum Seismic Intensity and the period during which caution against strong shaking is required based on past seismic activity and regional characteristics

- There is an active fault zone near the hypocenter of the earthquake.
- According to the Headquarters for Earthquake Research Promotion, a I_{JMA} value of 6+ or greater is expected for a major earthquake on this active fault.

▲ Notification of nearby active faults

After one week or more

- The probability of earthquakes with I_{JMA}5+ or greater shakings is 1/7 of that immediately after the main earthquake. However, this is still considerably higher (more than 100 times) than normal.
- Caution should be exercised for a week or so after earthquakes with around I_{JMA}5- shakings.

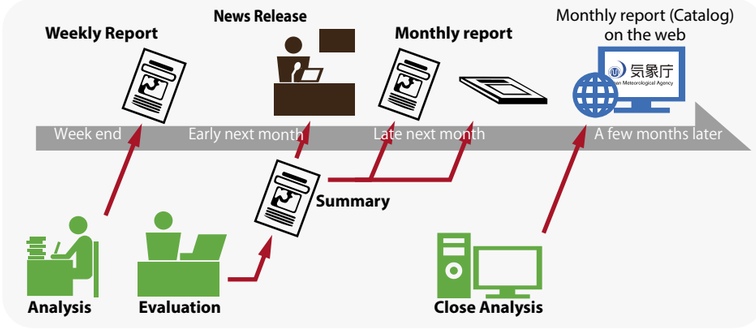
Press Briefing

◀ As a numerical prospect based on the subsequent seismic activity, we describe the occurrence probability of earthquakes with I_{JMA}5- or greater shaking with the expression as a ratio to the corresponding probability before or just after the largest earthquake.

◀ We also detail regularly about the period during which earthquakes exceeding a certain scale are expected.

Regular Reports on Earthquake Activity

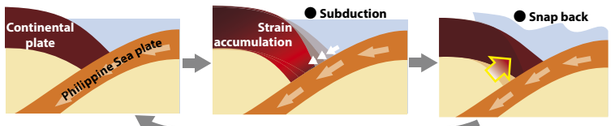
JMA announces summary of earthquake activities. Reports are published on JMA website. In addition, JMA issues the monthly summary as news releases in early next month.



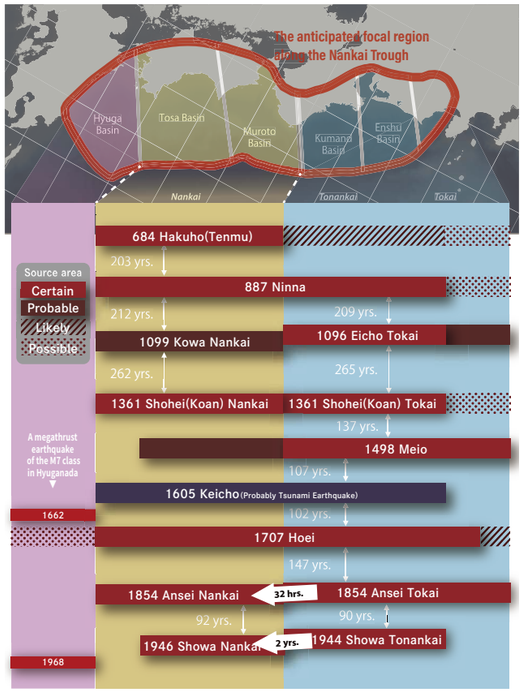
Nankai Trough Earthquake Information

What is the Nankai Trough Earthquake?

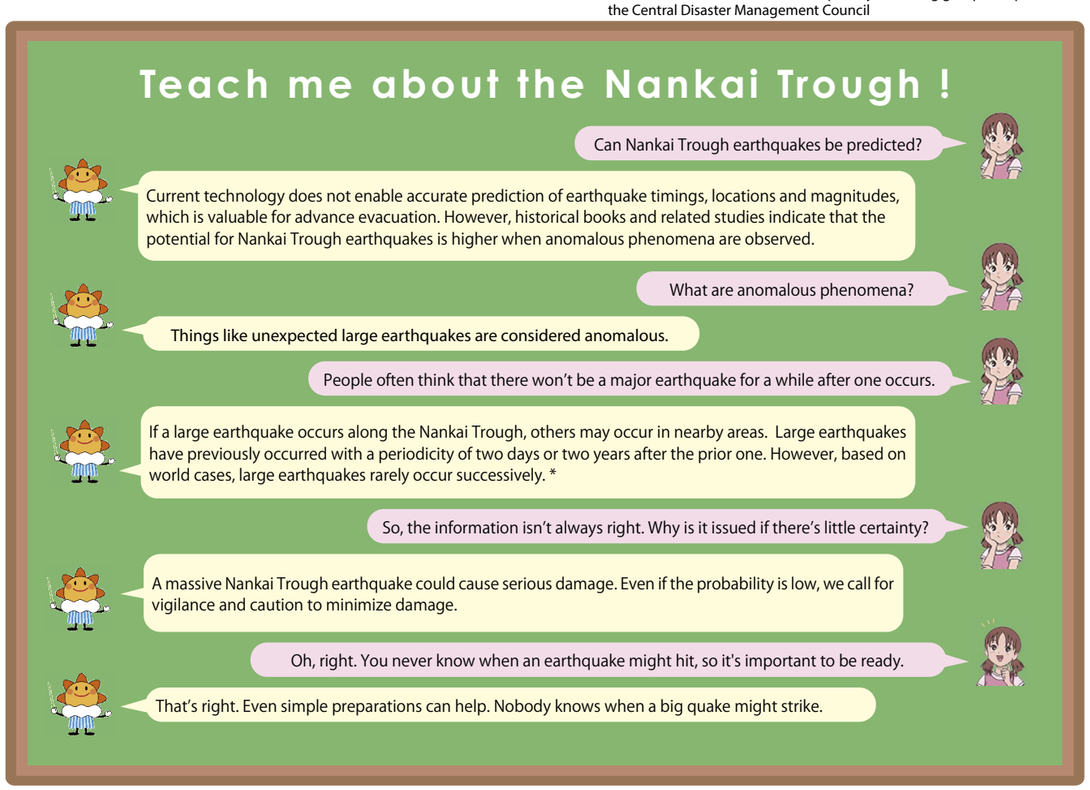
The Nankai Trough, which runs from Japan's Suruga Bay to the Hyuganada sea region, is an oceanic trench where the Philippine Sea Plate subducts underneath the Eurasian plate (continental plate) at a rate of several centimeters a year. In some places the two plates stick together, causing the lower plate to pull the upper one downward and creating an accumulation of strain. When this build-up exceeds the bearable limit, the upper plate snaps back and a Nankai Trough Earthquake occurs. The Philippine Sea Plate continues to subside along the trough, and the cycle of pulling down and snapping back repeats.



Nankai Trough Earthquakes occur with a cycle of roughly 100-150 years with various repetition intervals and source areas. In some cases multiple earthquakes occur within a certain period, and in others most of the trough can rupture at once. About 80 years have passed since the massive 1944 Showa Tonankai and 1946 Showa Nankai earthquakes, suggesting that another may be imminent.



▲ ***Time sequence and source areas of historical Nankai Trough Earthquakes***
Modified from a December 2018 report by a working group set up under the Central Disaster Management Council



*Global records indicate that an earthquake with a magnitude of 7.8 or higher will follow one with a magnitude of 8.0 or higher in 1 in 12 cases within a week, or follow one with a magnitude of 7.0 or higher in 1 in every few 100 cases within a week.

Nankai Trough Earthquake Information

JMA monitors seismicity and crustal deformation along the Nankai Trough around the clock. If anomalous phenomena are detected or the possibility of an earthquake along the Nankai Trough is considered relatively high, Nankai Trough Earthquake Information is issued as outlined below.

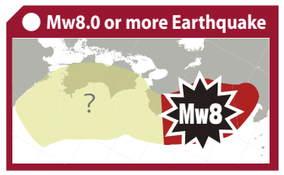
Information	Conditions
Nankai Trough Earthquake Extra Information	• When analysis is performed to determine whether anomalies may be Nankai Trough Earthquake precursors • When analysis results are issued
Nankai Trough Earthquake-Related Commentary	• When analysis results are updated • When analysis results are reported at regular meetings of the Nankai Trough Earthquake Assessment Committee (except for Nankai Trough Earthquake Extra Information) * Once necessary disaster prevention measures have been taken, information on analysis status and results may be issued in Nankai Trough Earthquake-Related Commentary

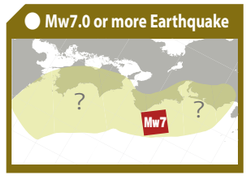
Keywords of Nankai Trough Earthquake Extra Information

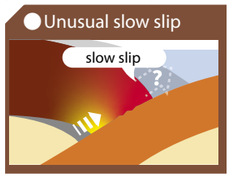
Nanaki Trough Earthquake Extra Information is issued with the title Nankai Trough Earthquake Extra Information (Megathrust Earthquake Alert) with appended keywords. Examples of keywords and disaster prevention measures are shown below.

Keywords	Conditions
Under Analysis	When analysis is underway to determine whether anomalies relate to the Nankai Trough Earthquake
Megathrust Earthquake Alert	For an earthquake of Mw*8.0 or more considered to have occurred at a plate boundary with an anticipated focal region along the Nankai Trough
Megathrust Earthquake Attention	For an earthquake of Mw7.0 or more considered to have occurred with an anticipated focal region and surroundings along the Nankai Trough (except in Megathrust Earthquake Alerts) For an unusual slow slip considered to have occurred at a plate boundary with an anticipated focal region along the Nankai Trough
Analysis Complete	When the results of analysis indicate that the anomalies are not classified into either Megathrust Earthquake Alert or Megathrust Earthquake Attention output

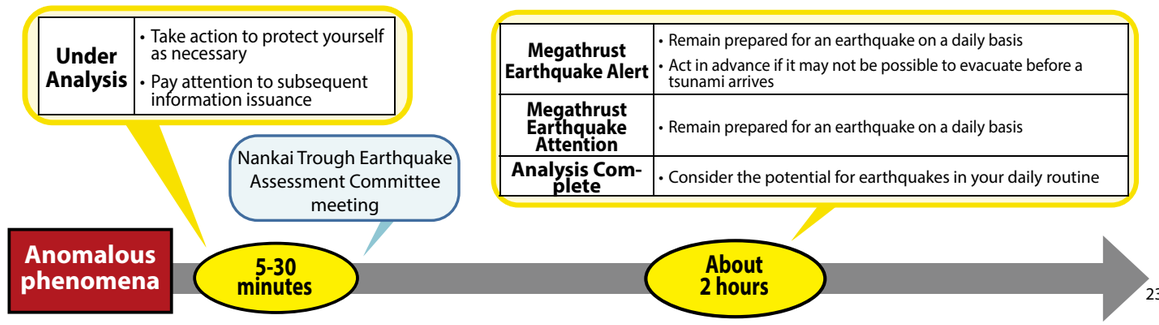
*Mw: Moment magnitude. It is a type of magnitude calculated based on the scale of rupture area along source fault, average slip, and rigidity of rocks.







Issuance of Nankai Trough Earthquake Extra Information and Disaster Prevention Measures



Off the Coast of Hokkaido and Sanriku Subsequent Earthquake Advisory

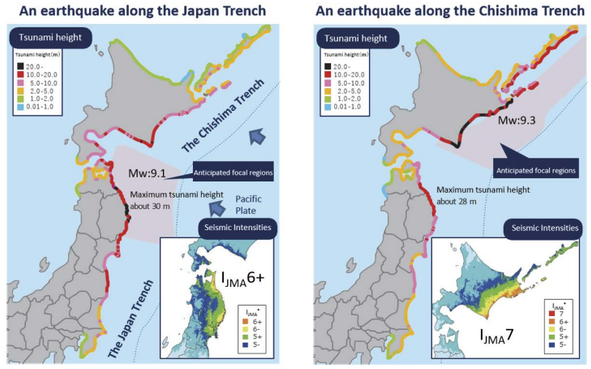
Megathrust Earthquake Along the Japan Trench and the Chishima Trench

The Pacific Plate subducting beneath Japan forms the Japan Trench (off the coast of the Boso Peninsula to the east of Aomori Prefecture) and the Chishima Trench (off the coast of Tokachi toward off the coast of Etorofu and eastward), where many large earthquakes have occurred in the past. A large earthquake which causes a massive tsunami and strong ground motions could well happen in the area in the future.

As multiple large earthquakes have occurred locally within clusters of a few days, there is a need for precaution both against initial large earthquakes and against following large ones.

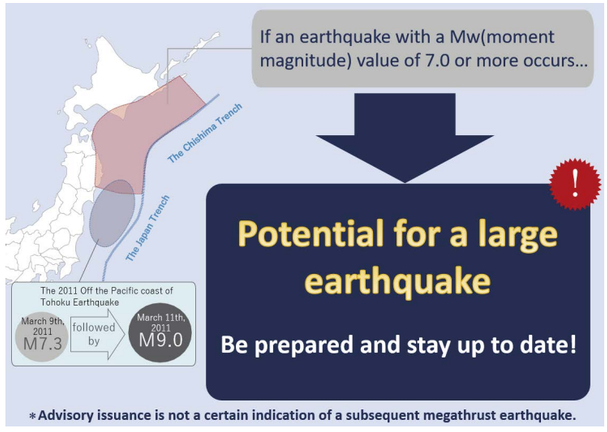
Estimated seismic intensities and tsunami heights is based on data from the Central Disaster Mitigation Council, 2022.

Estimated Seismic Intensities and Tsunami Heights Associated with Megathrust Earthquakes Along the Japan Trench and the Chishima Trench



*I_{JMA}: JMA Seismic Intensity Scale

Off the Coast of Hokkaido and Sanriku Subsequent Earthquake Advisory



∗Advisory issuance is not a certain indication of a subsequent megathrust earthquake.

If an earthquake with a Mw (moment magnitude) value of 7.0 or more occurs in or around the anticipated focal regions of megathrust earthquakes along the Japan Trench and the Chishima Trench, the potential for a large subsequent earthquake is considered to be relatively high.

JMA issues **Off the Coast of Hokkaido and Sanriku Subsequent Earthquake Advisory** in such cases, even though probability based on actual worldwide records is only about 1/100.

Issuance of Off the Coast of Hokkaido and Sanriku Subsequent Earthquake Advisory and Disaster Mitigation Measures

Advisory issuance does not necessarily indicate a need to evacuate. During the following week, people can go about their daily activities, but should be aware of the potential need to evacuate in the event of strong ground motion or tsunami warnings, in addition to making sure that earthquake preparations are in place.

- Advisory issuance is not a certain indication of a subsequent megathrust earthquake.
- Such advisory advises preparation for earthquakes during the following week, but does not call for advance evacuation.
- It is important to be prepared for earthquakes on a daily basis, as large earthquakes may occur without warning regardless of the timing of advisory issuance.

International Cooperation

International Tsunami Information

Since 2005, JMA has served as the Northwest Pacific Tsunami Advisory Center (NWPTAC) and monitored earthquakes and tsunamis within its Area of Service (AoS), which covers the Northwest Pacific region. When a major earthquake with a magnitude of 6.5 or greater occurs inside the AoS, the NWPTAC provides Northwest Pacific Tsunami Advisories (NWPTA) to the countries concerned. Advisories report the origin time, hypocenter and magnitude of the earthquake, as well as estimated arrival times and heights of tsunami at coastal Forecast Points (FPs). Subsequent analysis of seismic observation data revealing the mechanism of the earthquake will be used to perform real-time numerical simulation and issue related NWPTA updates. Information on the height of any tsunami waves observed is also included. JMA has also issued tsunami information for the Sea of Japan to surrounding countries since 2001.

JMA's international tsunami information helps recipient countries to issue their own domestic tsunami warnings and/or evacuation recommendations.

The NWPTAC is operated under the auspices of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) under the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO/IOC), and contributes to tsunami disaster mitigation systems of Pacific countries in collaboration with the US Pacific Tsunami Warning Center (PTWC), which monitors earthquakes and tsunamis throughout the Pacific region and provides tsunami information accordingly.

▲ ***Area of Service (AoS) of the Northwest Pacific Tsunami Advisory Center (NWPTAC) and its Forecast Points (FPs)*** as of March 2023

Technical Assistance

JMA contributes in various ways to the improvement of disaster mitigation systems in other countries and to the establishment of international tsunami warning systems.

Bilateral Assistance

In conjunction with the Japan International Cooperation Agency (JICA) and other bodies, JMA hosts trainees from other countries at its offices and dispatches experts to overseas organizations based on its experience of earthquake/tsunami early detection and information provision.

For countries and regions seeking to strengthen their tsunami warning capabilities, JMA provides technical support on various matters ranging from observation and analysis of earthquakes and tsunamis to information provision and disaster mitigation measures. Since the Indian Ocean Tsunami of 2004, JMA has received numerous support requests and provided technical assistance to related parties in Indonesia, Malaysia, Myanmar, Turkey, Chile, the Philippines, El Salvador, Ecuador, Nicaragua and Vanuatu.

Multilateral Assistance

JMA contributes to the establishment of tsunami warning systems in various regions of the world through international conferences, workshops and the like within UNESCO/IOC framework. For instance, NWPTAC contributes to annual/biennial Exercise Pacific Wave (PacWave) efforts by assisting with the production of exercise scenarios, manuals and products so that the countries concerned can conduct their own tsunami warning exercises.

▲ ***Presentation course in Nicaragua***

▲ ***IOC Executive Council at UNESCO headquarters in Paris***

Protect yourself from **Earthquake**

Earthquake Readiness

Earthquakes strike out of the blue. Get to know your surroundings and evacuation routes, both indoors and outdoors, to prepare for tremors so that you can protect yourself.

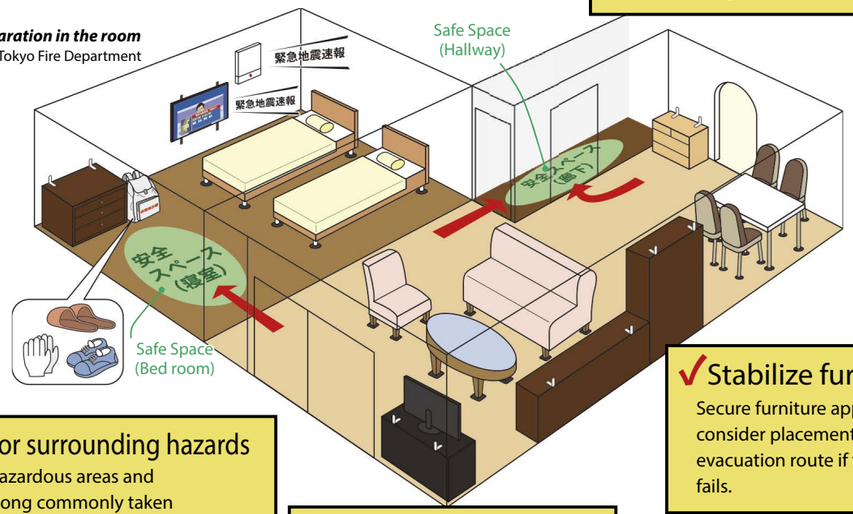
✓Stock provisions and other necessary items

Have a store of water and food, and keep an emergency kit.

✓Secure a Safe Space

Create a "Safe Space" in your home where nothing can fall, topple over or move.

Image of preparation in the room
Base document: Tokyo Fire Department



✓Stabilize furniture

Secure furniture appropriately and consider placement to ensure an evacuation route if the securement fails.

✓Check for surrounding hazards

Check for hazardous areas and materials along commonly taken routes.

Rainfall may trigger landslides on and around soft ground or terrain loosened by earthquakes.

Be sure to check your surroundings.

✓Drill!

Can you really protect yourself in emergency?

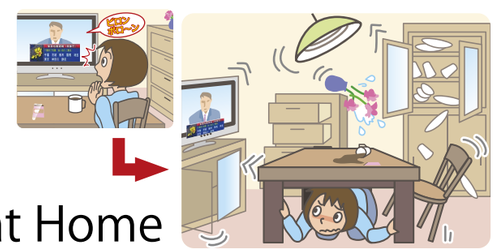
Take part in drills to learn calm self-protect techniques.

✓Establish methods of contact

Plan post-earthquake meet-up points and communications with family members.

If you feel shaking...
If you see/hear an EEW...

Stay calm and Secure your safety!



at Home

- Evacuate to "Safe Space"
- Protect your head and shelter under a table
- Do NOT rush outside
- Prioritize self-protection over firefighting

Outdoors

- Look out for collapsing concrete-block walls
- Be careful of falling signs and broken glass

in Elevator

- Stop the elevator at the nearest floor and get off immediately

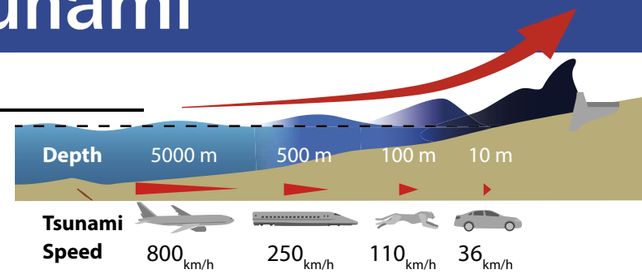
on Bus or Train

- Hold on tight to a strap or a handrail

Protect yourself from **Tsunami**

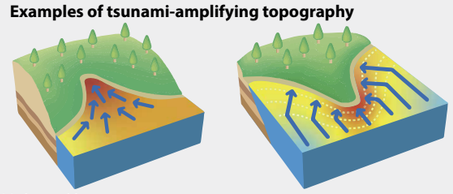
Learn About Tsunami

Tsunami form as a result of sea wave propagation caused by uplift or sedimentation of the seafloor due to an earthquake.



- Escalation: As a tsunami approaches the coast and the sea becomes shallower, it grows much higher. Heights may exceed estimates in some regions due to coastal topography characteristics and other factors.
- Speed: If you see a tsunami, it's already too late to evacuate.
- Power: Even knee-high tsunamis can wash people away.
- Recurrence: Tsunami can hit repeatedly due to reflection and refraction. Later waves may be higher.
- Duration: It may be several hours before the largest waves are recorded as tsunami-related sea level changes are observed.
- Precursor variety: Tsunami may be preceded by an ebb tide or a rising tide, the assumption of a preceding ebb tide only may be a fatal error.

Examples of tsunami-amplifying topography



V-shaped bay
Tsunami energy is concentrated at the back of the bay.

Cape tip
As a tsunami travels perpendicular to the coast-line, energy concentrates at the tip of the cape.

Tsunami Readiness

✓Check tsunami hazard areas

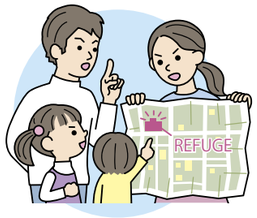
Familiarize yourself with the locations of tsunami hazard areas around your home and school or workplace with local government tsunami hazard map and topographical characteristics.

✓Check tsunami safety areas

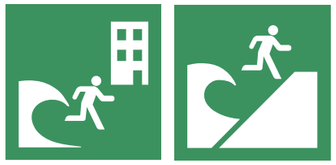
Check where tsunami evacuation areas and tsunami evacuation buildings are. Consider evacuation routes with local residents. Have multiple evacuation spots and areas of higher ground in mind.

✓Drill!

Take part in disaster mitigation drills such as walking along evacuation route.



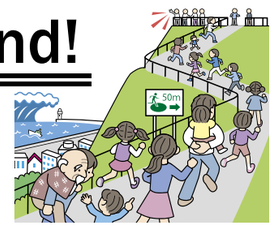
Tsunami hazard zone
This indicates a DANGER of tsunami.



Tsunami refuge building/area
This indicates a SAFE refuge from tsunami.

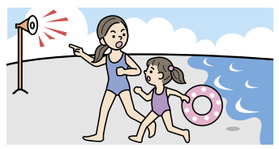
If you feel a strong shaking at seaside...
If you feel long-lasting slow shaking...
If you see or hear a Tsunami Warning...

Leave coastal areas and Go to higher ground!



Be careful even during Advisory status

- Bathing or fishing in coastal areas even during a Tsunami Advisory is hazardous. Move away from the water and leave coastal areas immediately.



Remain on alert until Warnings are lifted

- Since tsunamis may strike repeatedly, remain on alert and keep evacuating until a Tsunami Warning/Advisory is lifted.
  Never return to a coastal area while a Tsunami Warning is in effect.

Get accurate information

- Accurate information can come from TV, radio, announcement vehicles, radio broadcast systems and the Internet.

Tsunami evacuation flag

- This red and white checkered flag indicates that Tsunami Warning/Advisory information has been issued. Evacuate as soon as possible.