

Earthquake and Tsunami Services by JMA

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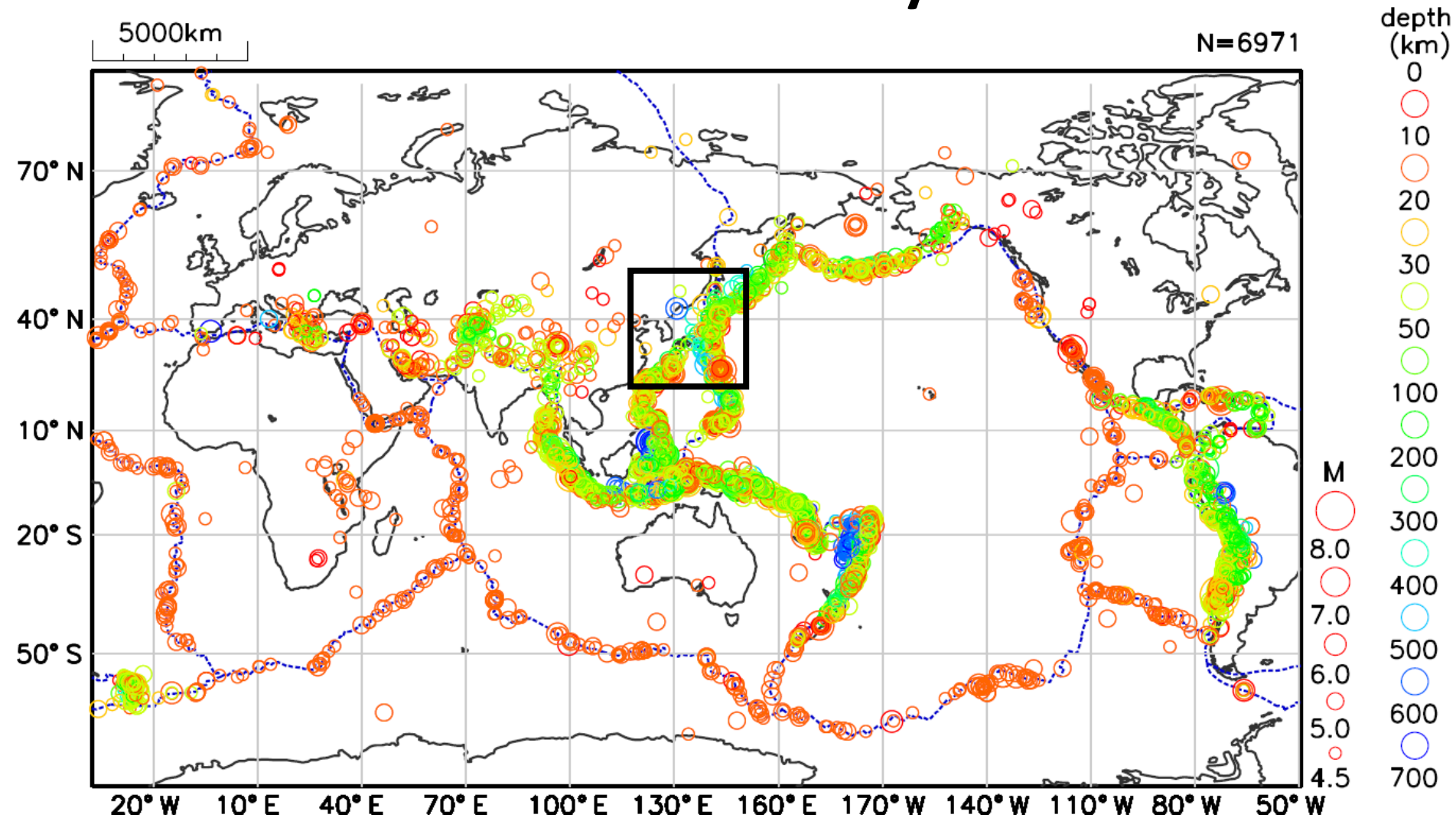
1. Seismic Activity
2. Monitoring Network
3. Earthquake and Tsunami Warning Services
4. Dissemination of Warnings

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Introduction

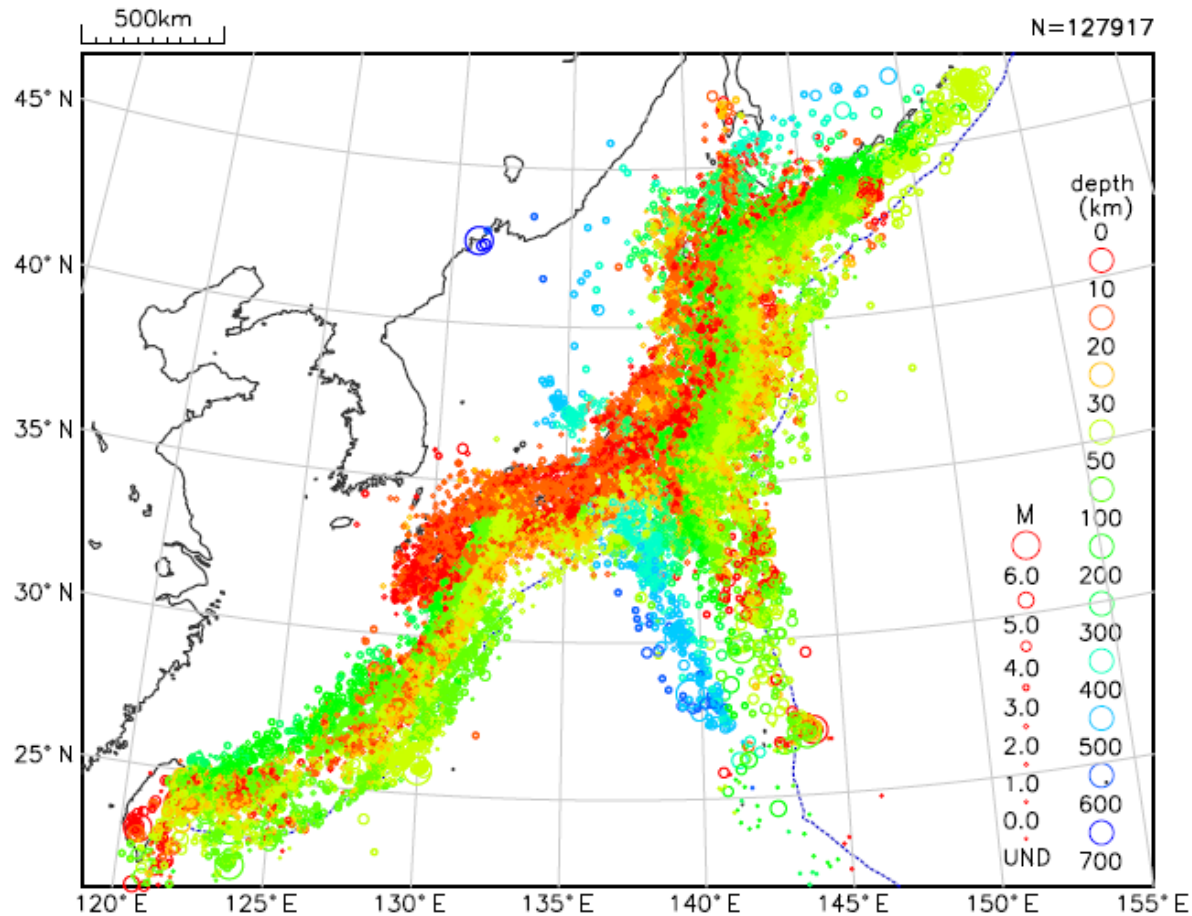
World Seismic Activity in 2010



(M ≥ 4.5, Determined by USGS)

Introduction

Seismic activity around Japan



(Determined by JMA)

about 128,000 earthquakes (2010)

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Seismic Stations in Japan

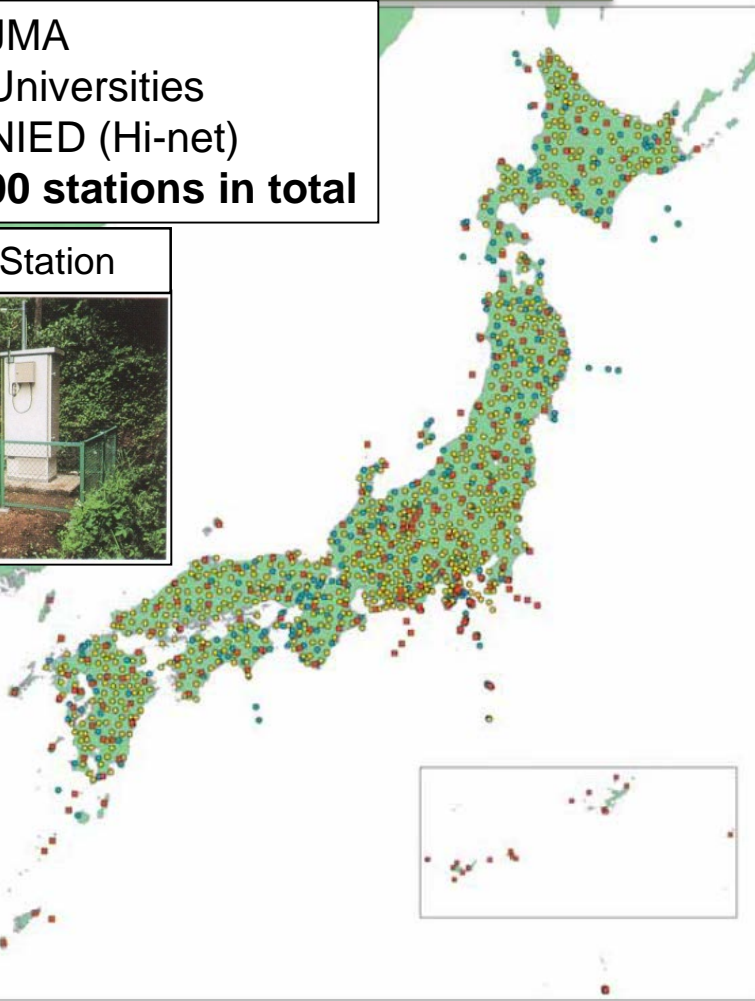
Seismometer Stations

- : JMA
 - : Universities
 - : NIED (Hi-net)
- ~1,300 stations in total**

Standard Station

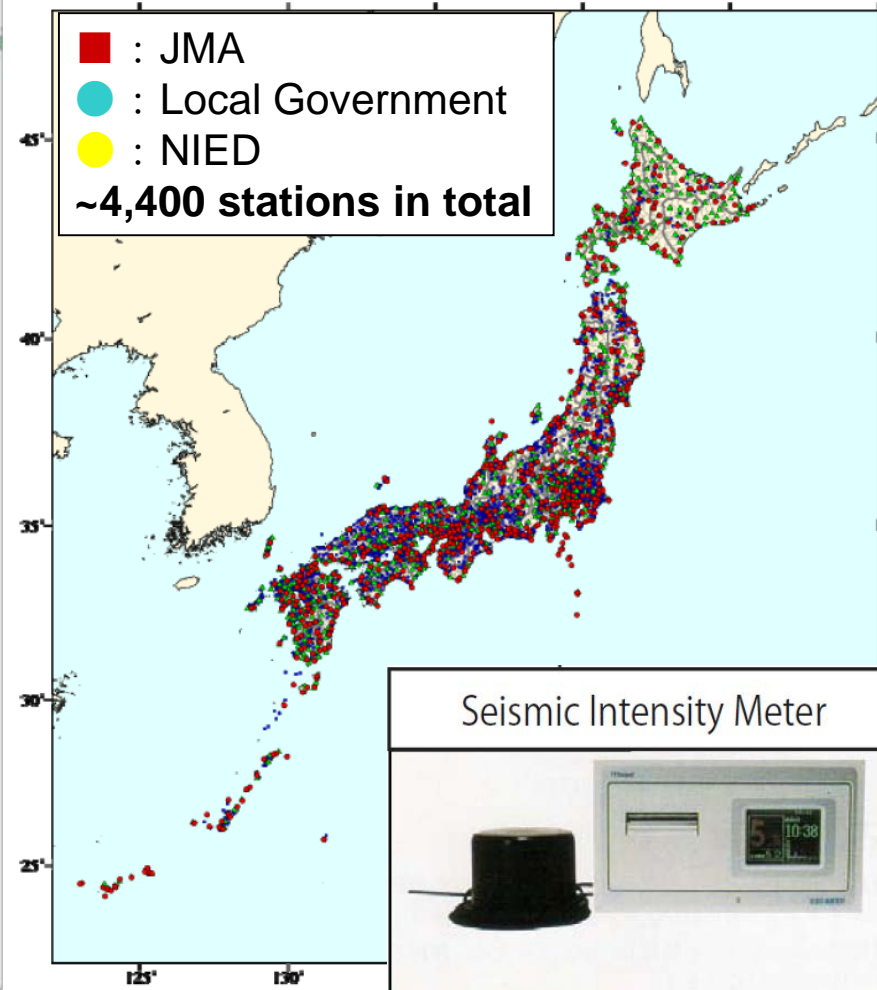


Sensors



Seismic Intensity Stations

- : JMA
 - : Local Government
 - : NIED
- ~4,400 stations in total**

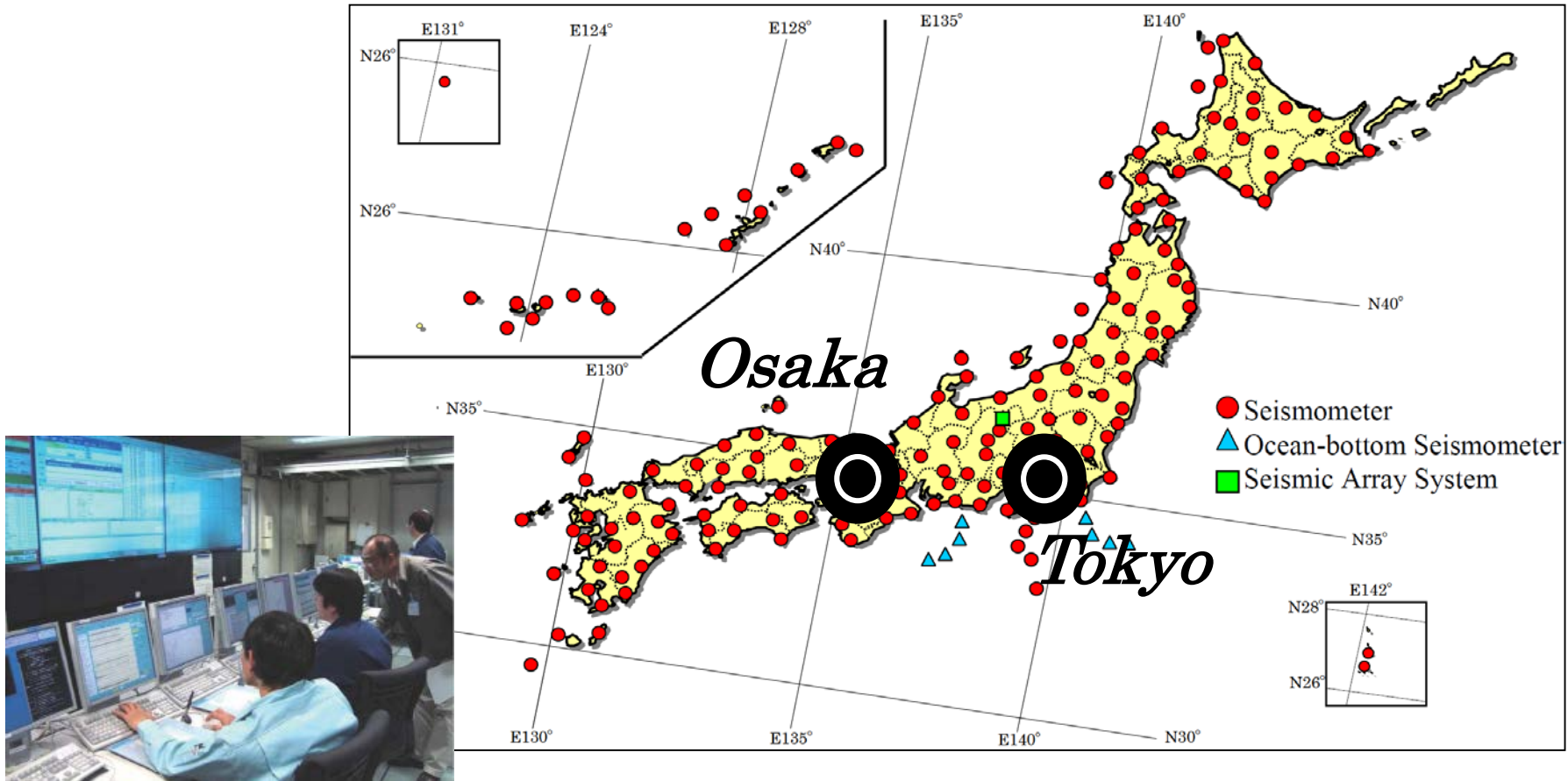


Seismic Intensity Meter



Maintaining reliable and real-time seismometers network is indispensable.

Earthquake Data Processing System



- To process seismological data and make and issue an earthquake and tsunami information, JMA developed Earthquake Phenomena Observations System (EPOS).
- EPOS is located in Tokyo and Osaka. Tokyo-EPOS and Osaka-EPOS work in parallel, and function as back-up system of each other.

Real-Time Tsunami Monitoring Network in Japan

408 stations

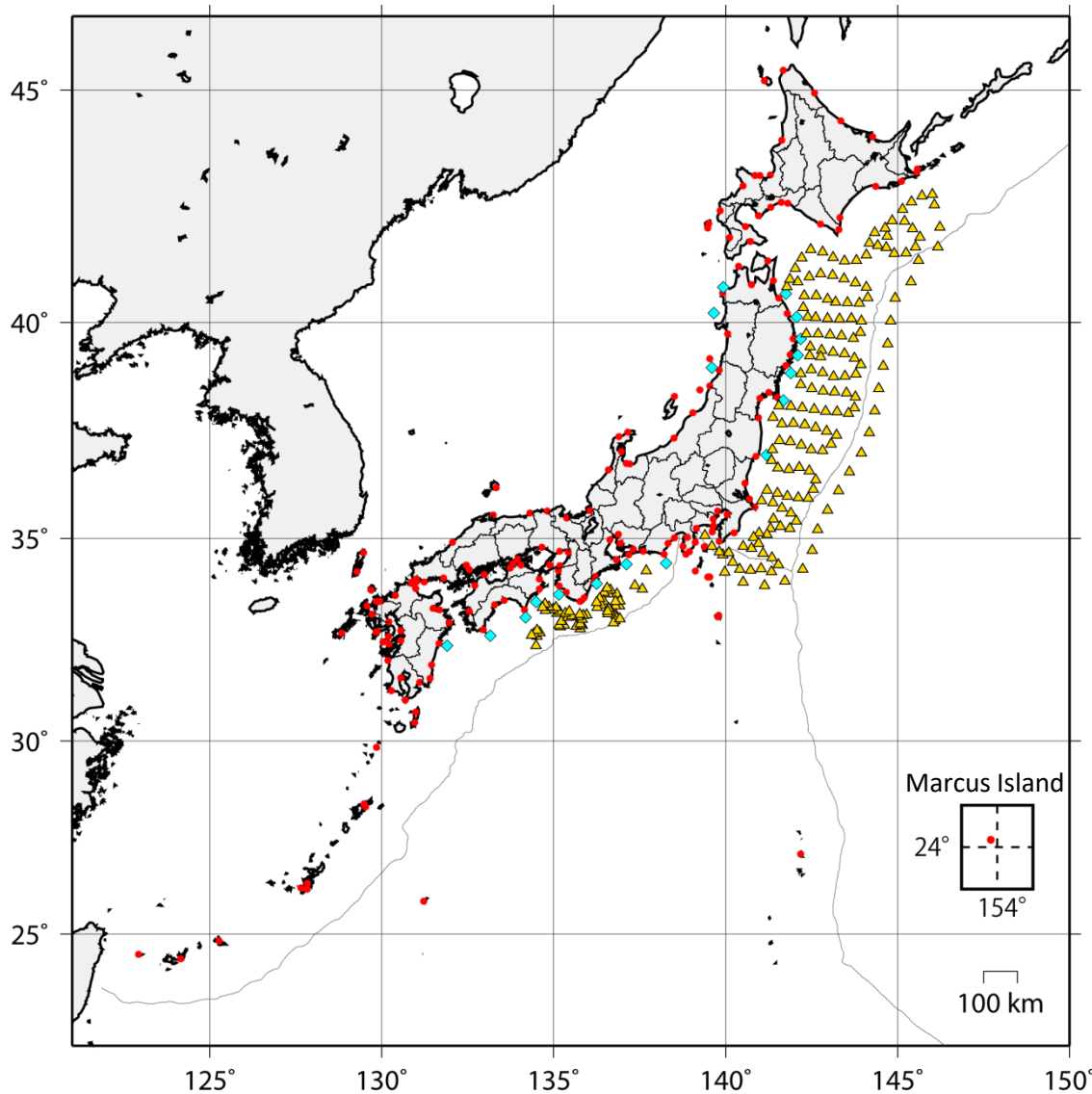
- Tide Gauge (174)
- ◆ GPS Buoy (18)
- ▲ Pressure Sensor on Sea Floor (216)

Coastal tide gauge

- Float type
- Acoustic type
- Radio wave type
- Huge tsunami type

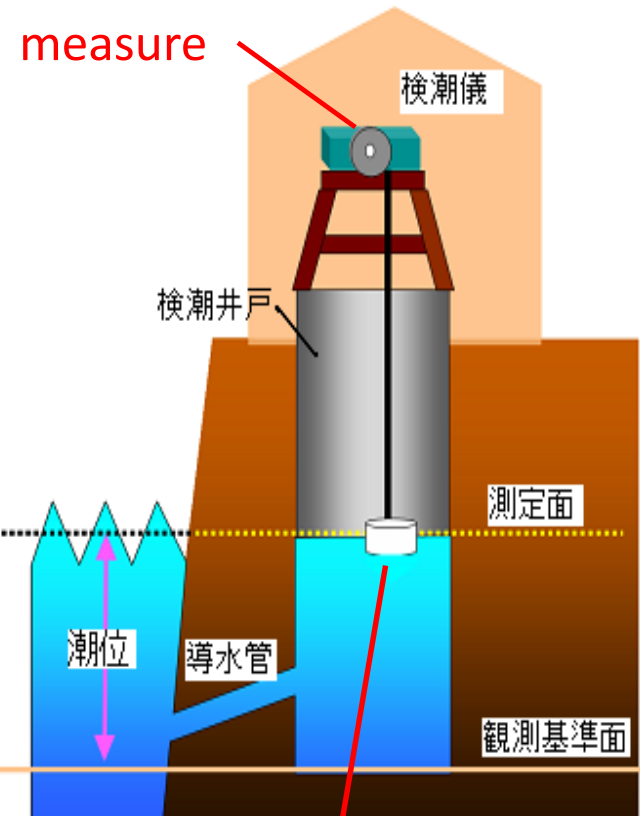
Offshore stations

- GPS buoy
- Pressure Sensor on Sea Floor



Coastal tide gauge

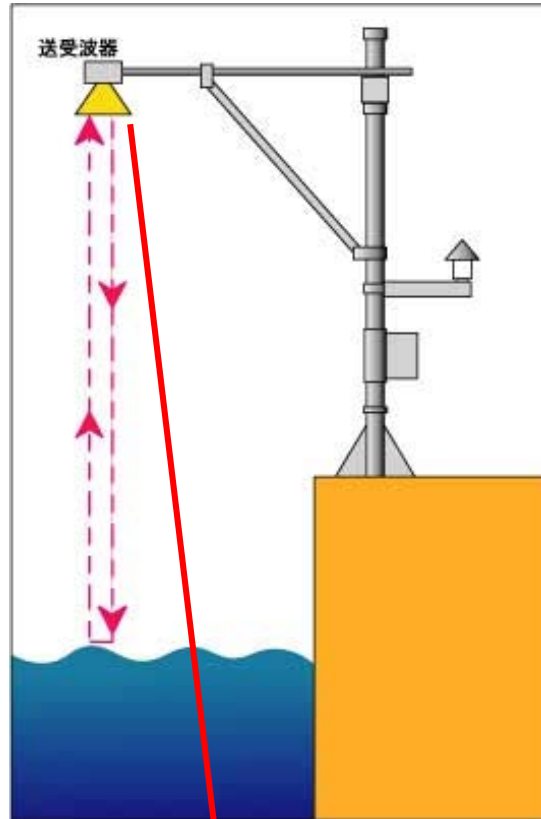
Float type



measure

float

Acoustic and Radio wave type



launcher & sensor

Huge tsunami type



pressure sensor



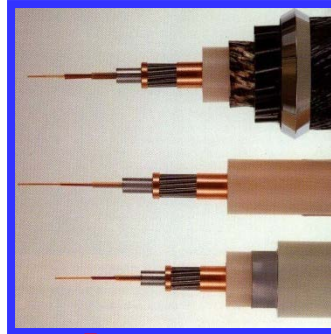
Pressure Sensor

Terminal Equipment



Data receiving
OBS control
Data processing
Power feeding

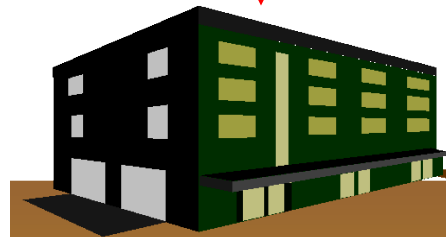
Cables & Fibres



Ocean Bottom Units



Ocean Bottom Seismometer
Pressure Gauge



OBS: Ocean Bottom Seismometer
PG: Pressure Gauge

OBS (1)

PG (1)

OBS (n)

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Time Sequence to Issue Information



Several to a few tens seconds

Earthquake Early Warning

Automatic processing

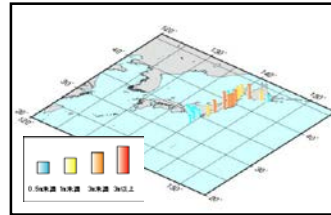


About 1.5 minutes

Seismic Intensity Information
(regions with seismic intensity of 3 or greater)

Automatic processing

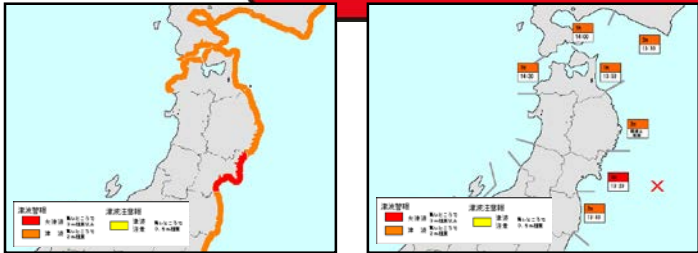
Tsunami Warning/Advisory(cancel)



Tsunami Information
(tsunami observation)

About 3 minutes

Tsunami Warning/Advisory

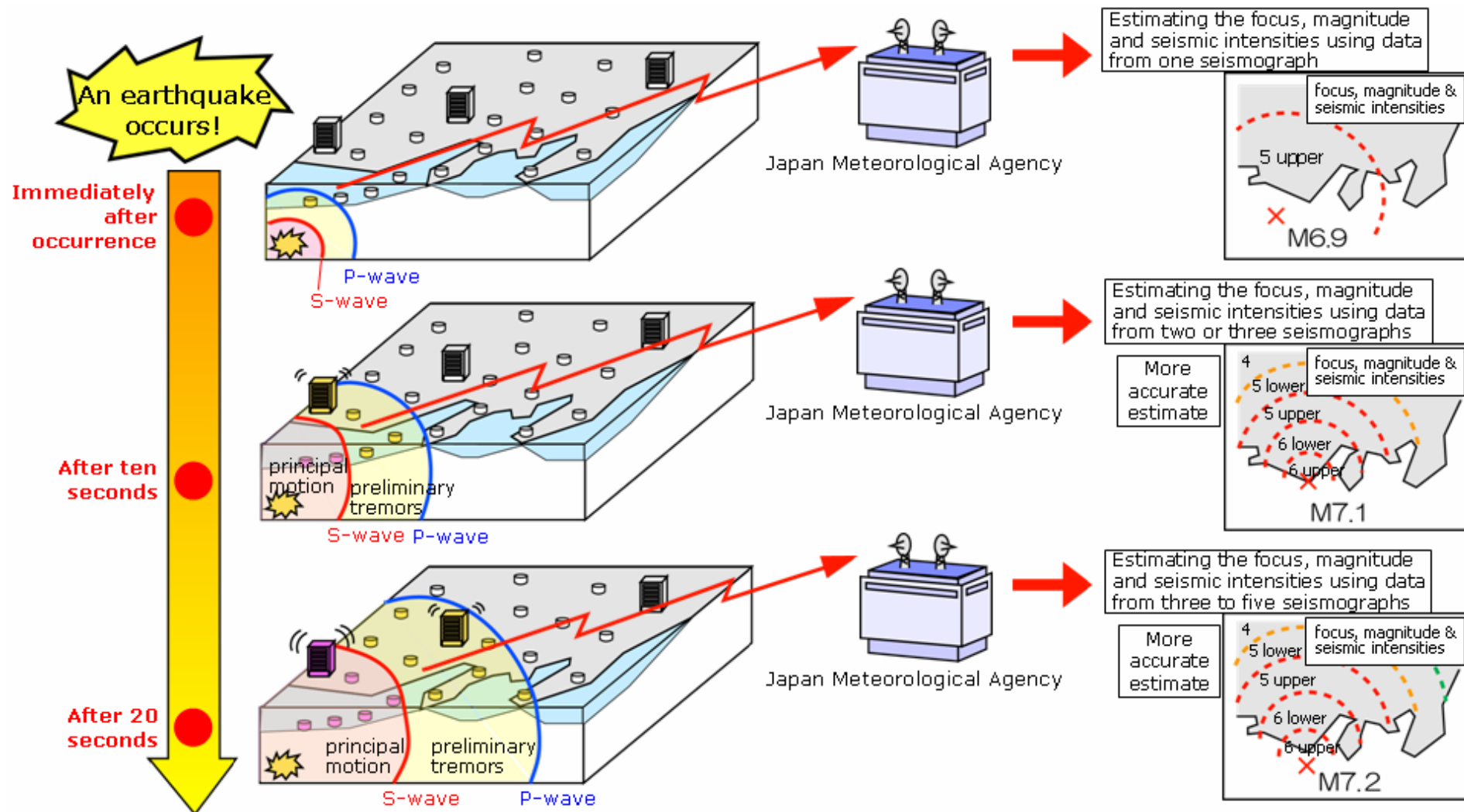


About 5 minutes

Earthquake and Seismic Intensity Information
(observed seismic intensities of each stations)



The Concept of Earthquake Early Warning (EEW)

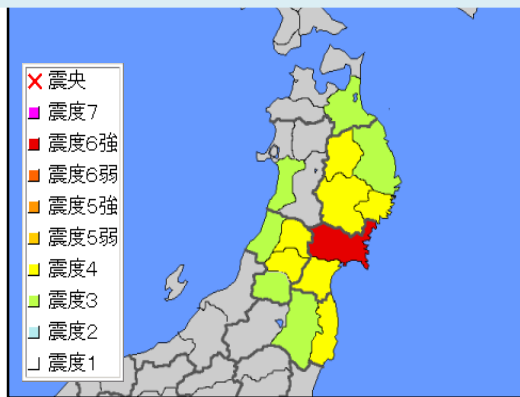


Seismic Intensity Information

EARTHQUAKE !

1.5min.

Seismic Intensity Information



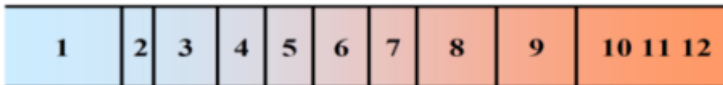
Emergency operations triggered by JMA's SI information

3	NHK, Commercial broadcasting 	Broadcast of seismic intensity information
4	Cabinet Office	Estimation of damages
	Metropolitan Police Department, Fire and Disaster Management Agency 	Investigation of damages
5 lower	Ministry of Defense	Investigation of damages
	Japan Coast Guard	
6 lower	Cabinet Secretariat	Call for an emergency meeting

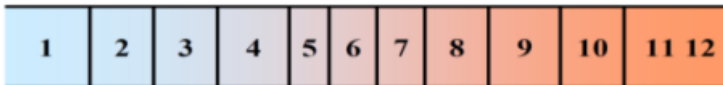
JMA Scale



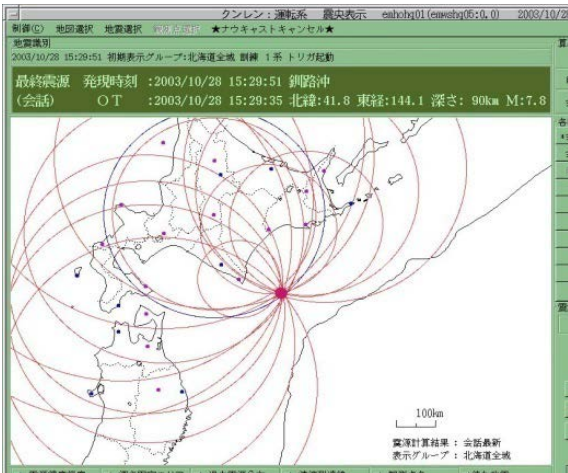
MM Scale



MSK Scale



Tsunami Warnings/Advisories

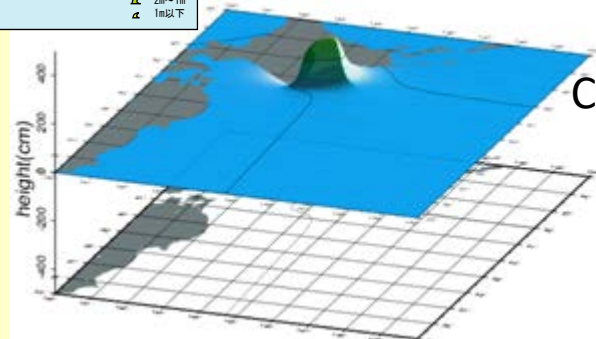
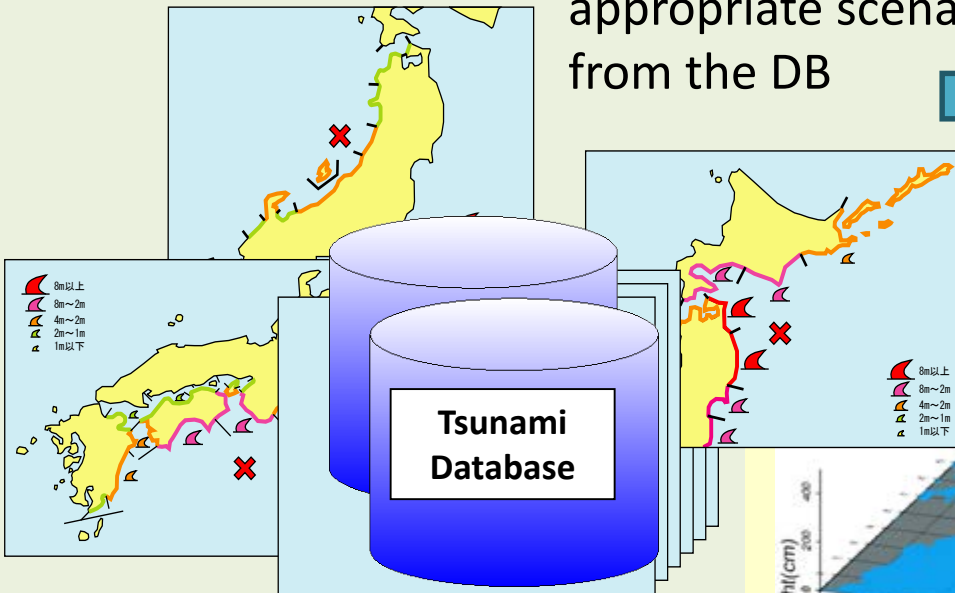
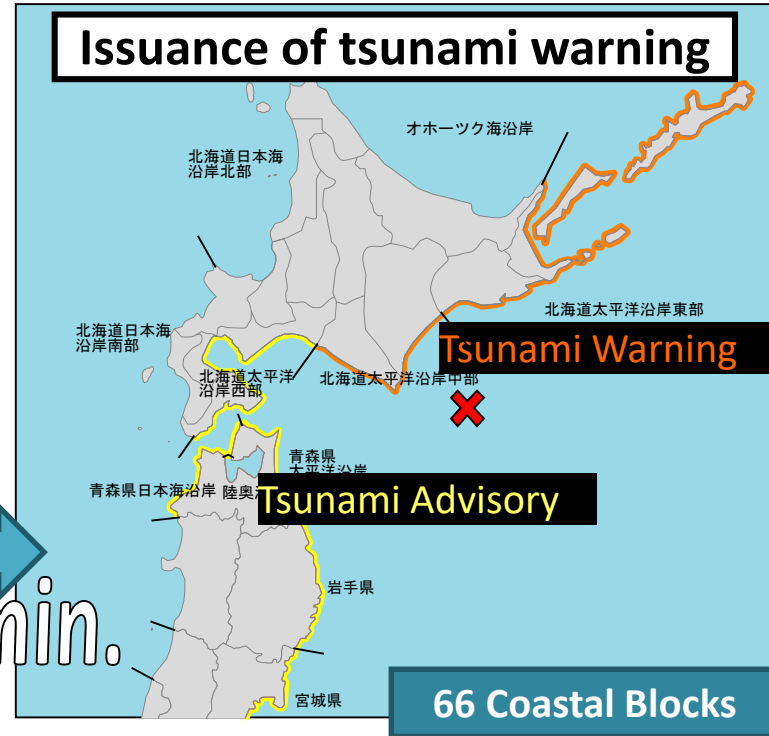


Determined
Magnitude
and Hypocenter



Search tsunami DB
and pick up the most
appropriate scenario
from the DB

3min.









about 100,000 scenarios

Calculate Crustal Movement
for each Assumed Fault

Computer Simulation of
Tsunami Propagation

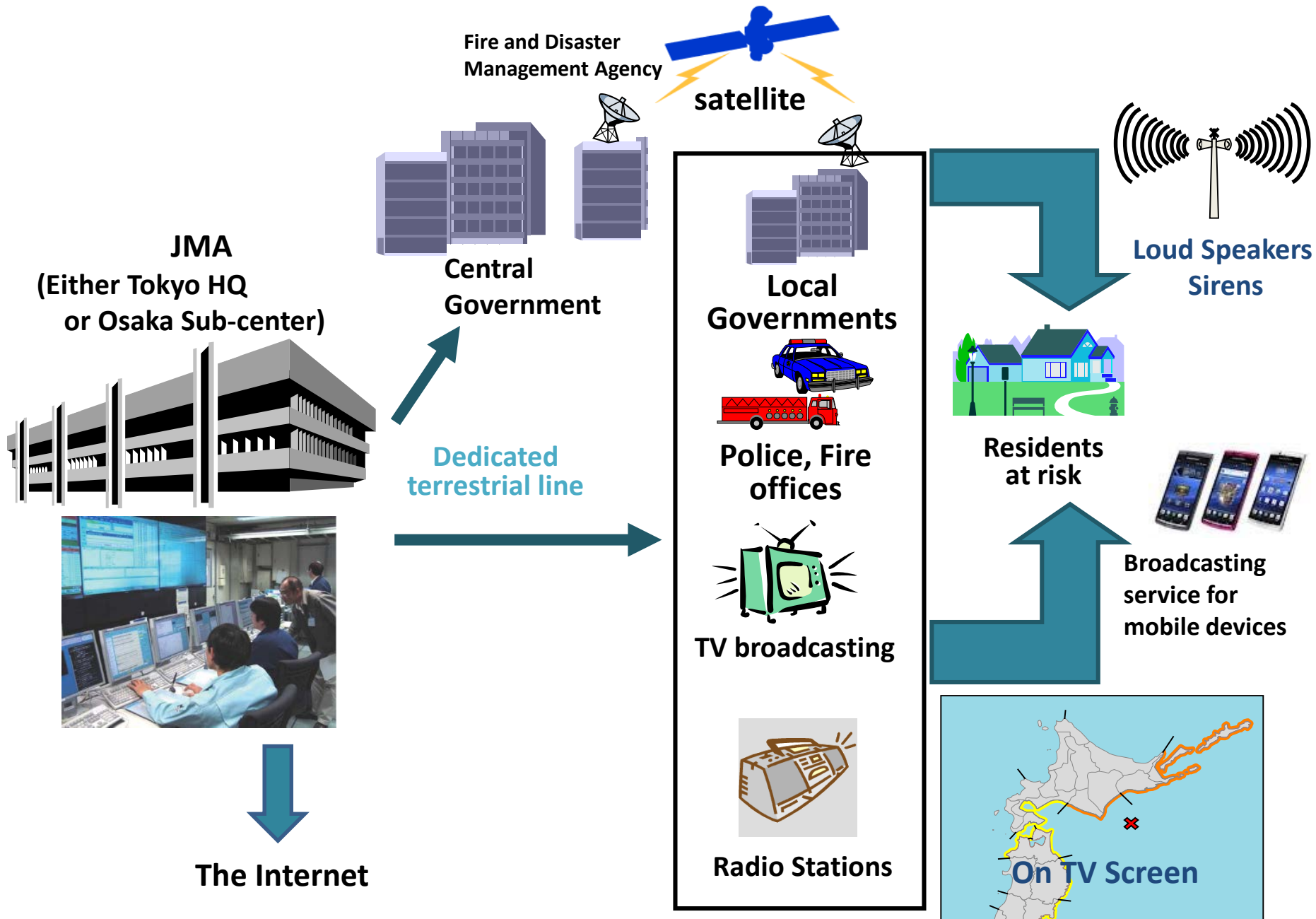
Earthquake and tsunami services

	Estimated maximum tsunami height		Action to be taken	Expected damage
	Quantitative expression	For huge earthquakes		
Major Tsunami Warning	over 10 m (10m < height)	Huge	<p>Evacuate from coastal or river areas immediately to safer places such as high ground or a tsunami evacuation building.</p> <p>Tsunami waves are expected to hit repeatedly. Do not leave the evacuation location until Tsunami Warnings are cleared.</p> <p>Keep evacuating to higher and higher ground wherever possible!</p>  <p>Educational video "Escape the Tsunami" (JMA)</p>	<p>Wooden structures are expected to be completely destroyed and/or washed away; anybody exposed will be caught in tsunami currents.</p>  <p>(Most wooden structures washed away due to the tsunami in 2011)</p>
	10m (5m < height ≤ 10m)			
	5m (3m < height ≤ 5m)			
Tsunami Warning	3m (1m < height ≤ 3m)	High	 <p>Educational video "Escape the Tsunami" (JMA)</p>	<p>Tsunami waves will hit, causing damage to low-lying areas. Buildings will be flooded and anybody exposed will be caught in tsunami currents.</p>  <p>Toyokoro-cho (2003)</p>
Tsunami Advisory	1m (20cm ≤ height ≤ 1m)	(N/A)	<p>Get out of the water and leave coastal areas immediately. Do not engage in fishing or swimming activities until Advisories are cleared.</p> 	<p>Anybody exposed will be caught in a strong tsunami currents in the sea. Fish farming facilities will be washed away and small vessels may capsize.</p> 

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Dissemination of Warning/Information



Dissemination of Warning/Information

Major Tsunami Warning for Fukushima Pref.

大津波警報 福島県
津波到達を確認

Estimated Height: 6m

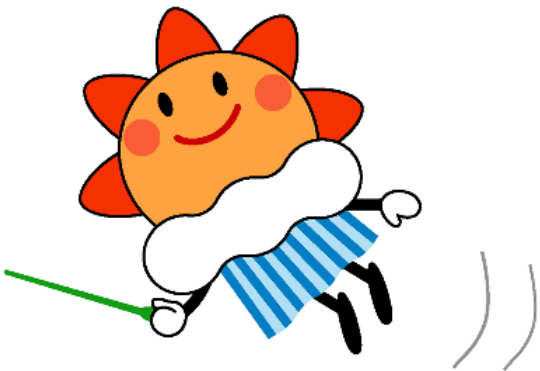
予想6m



Provided by Japan Broadcasting Corporation (NHK)

- Yellow box: Tsunami Advisory
- Red box: Tsunami Warning
- White box: Major Tsunami Warning

**Thank you for
your attention!**



<http://www.jma.go.jp/jma/indexe.html>

Supplements

- Concept for the JMA Tsunami Service
- Change of JMA's system and operation

Concept for the JMA Tsunami Services

1. To be announced quickly

Real-time Seismic Monitoring
Tsunami Simulation Database
System for Rapid Tsunami Warning

2. To be as simple as possible

Contents to be easily understood and consistent
Fixed format and encoded messages

3. To be usable for disaster management

Assuming the worst case scenario
Dissemination of tsunami warnings to users such as
local governments and media

Change of JMA's System and Operation

1983.5.26
The 1983 Central Sea of Japan Eq.

1987.3 EPOS* began operation

1991.4 Seismic intensity meters introduced

* Earthquake Phenomena Observation System

1993.7.12
The 1993 Southwest off Hokkaido Eq.

1994.4 Tsunami earthquake early detection network developed

1995.1.17
The 1995 Southern Hyogo Prefecture Eq.

1996.10 Seismic Intensity Scale revised (8 → 10 classes)
Real-time issuance of Seismic Intensity 7 (max.) started

1997.11 Information issuance based on seismic intensity data of both JMA and local government started

1999.4 Quantitative tsunami forecast introduced
Tsunami Forecast Block subdivided (18 → 66)

2000.3 Eruption of Mt. Usu
2000.9 Eruption of Miyakejima

2001.10 VOIC* established

2007.12 Volcanic Alert Levels introduced

* Volcanic Observation and Information Center

2007.10 EEW* began operation to the public
* Earthquake Early Warning

2011.3.11
The 2011 Great East Japan Eq.

2013.3 New tsunami warning system operation started

2014.9.27
Eruption of Mt. Ontake

2015.8 Eruption Notice introduced

2016.4 VOWS* established

* Volcanic Observation and Warning Center