

Tsunami Warning System in Japan

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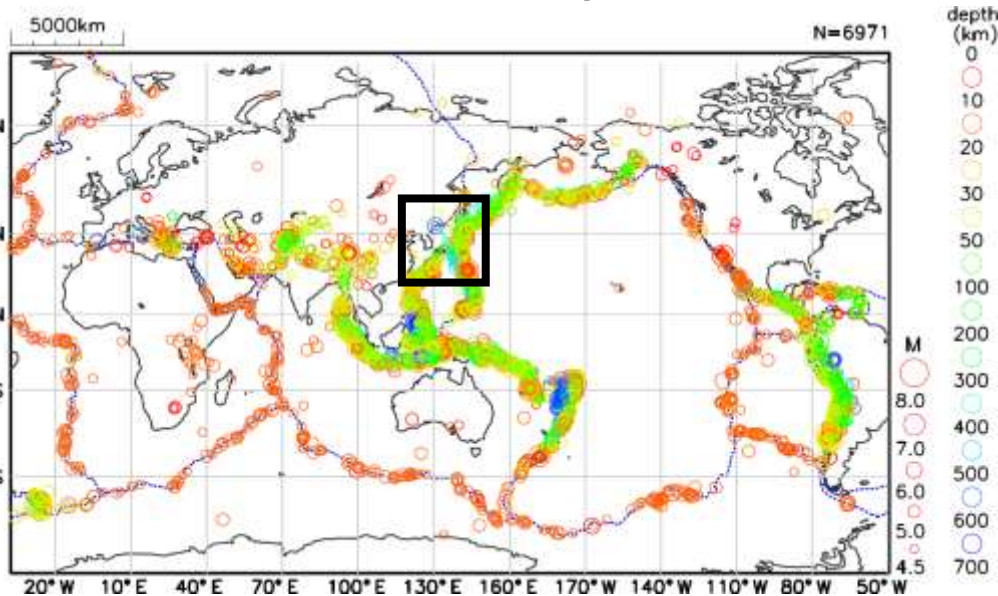
April 2018

TWCWG3

*This presentation is created by Japan Meteorological Agency (JMA)

Introduction

World Seismic Activity in 2010



($M \geq 4.5$, Determined by USGS)

- No. 16 is out of this map
- red font: with Tsunami

※1 As of Mar.1, 2018, Report from Fire and Disaster Management Agency

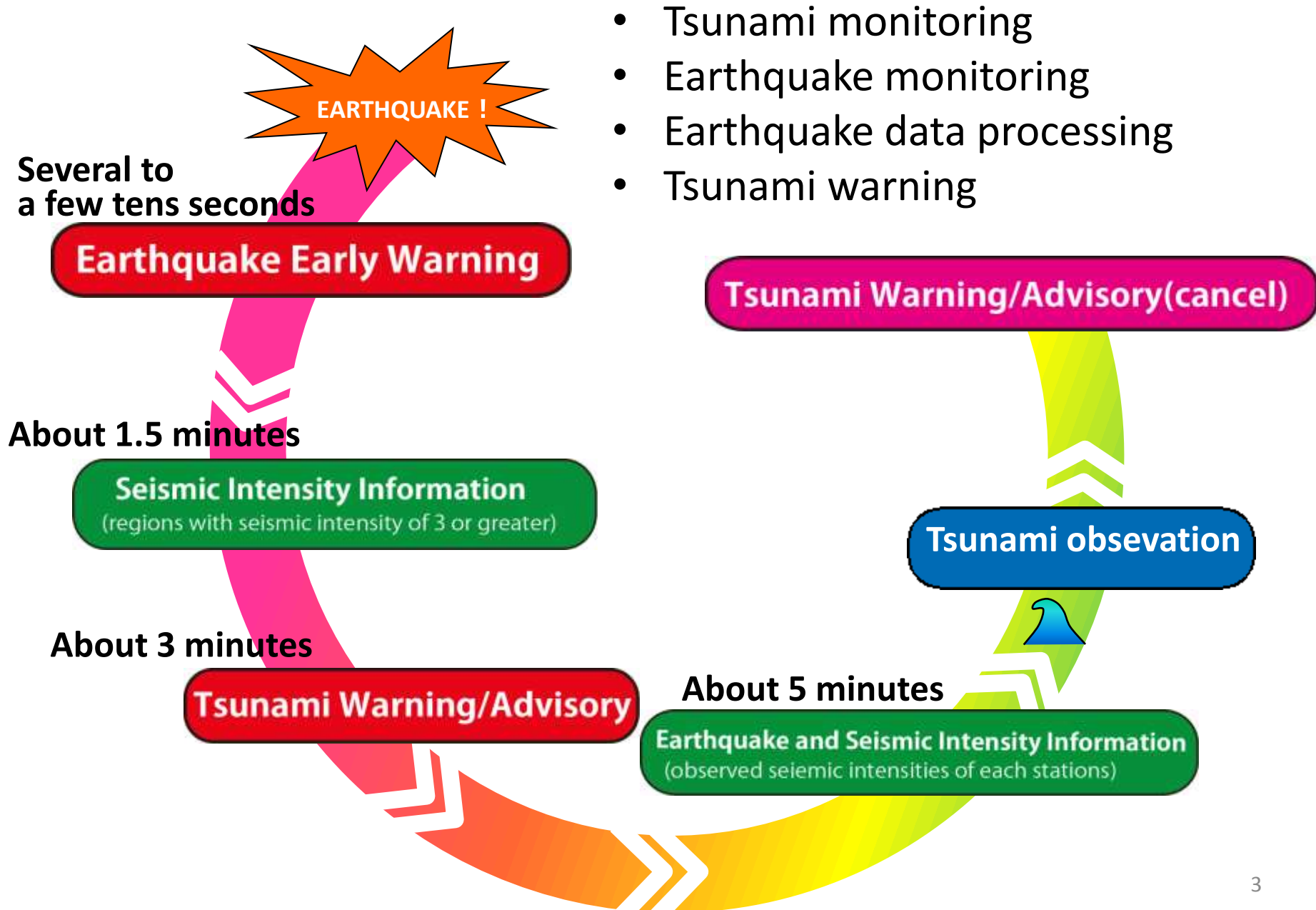
※2 As of Feb.14, 2018, Report from Fire and Disaster Management Agency

* tsunami earthquake

Earthquakes with Death/Missing over 100 people since 1868 in Japan

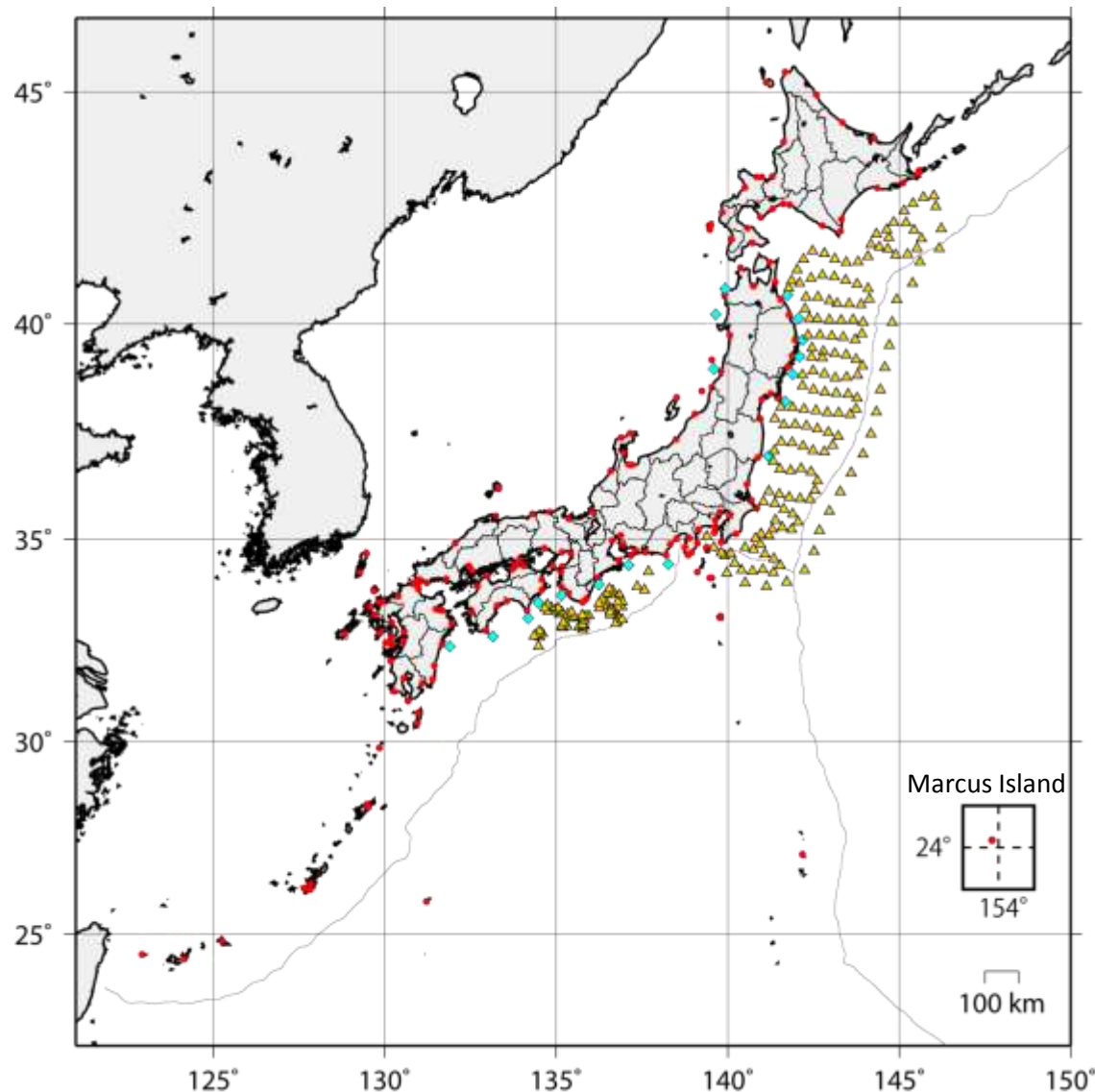
	Date	M	Death /Missing
1	1872/03/14	7.1	~550
2	1891/10/28	8.0	7,273
3	1894/10/22	7.0	726
4*	1896/06/15	8.2	21,959
5	1896/08/31	7.2	209
6	1923/09/01	7.9	~105,000
7	1925/05/23	6.8	428
8	1927/03/07	7.3	2,925
9	1930/11/26	7.3	272
10	1933/03/03	8.1	3,064
11	1943/09/10	7.2	1,083
12	1944/12/07	7.9	1,223
13	1945/01/13	6.8	2,306
14	1946/12/21	8.0	1,330
15	1948/06/28	7.1	3,769
16	1960/05/23	9.5	142
17	1983/05/26	7.7	104
18	1993/07/12	7.8	230
19	1995/01/17	7.3	6,437
20	2011/03/11	9.0	22,199※1
21	2016/04/14・16	6.5,7.3	258※2

Timeline of Tsunami Warning System



Real-Time Tsunami Monitoring Network in Japan

407 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

Seismic Stations in Japan

Seismometer Stations

Standard Station



Sensors



- JMA
 - Universities
 - ▲ NIED
 - ◆ Others
- ~1,600 stations in total**

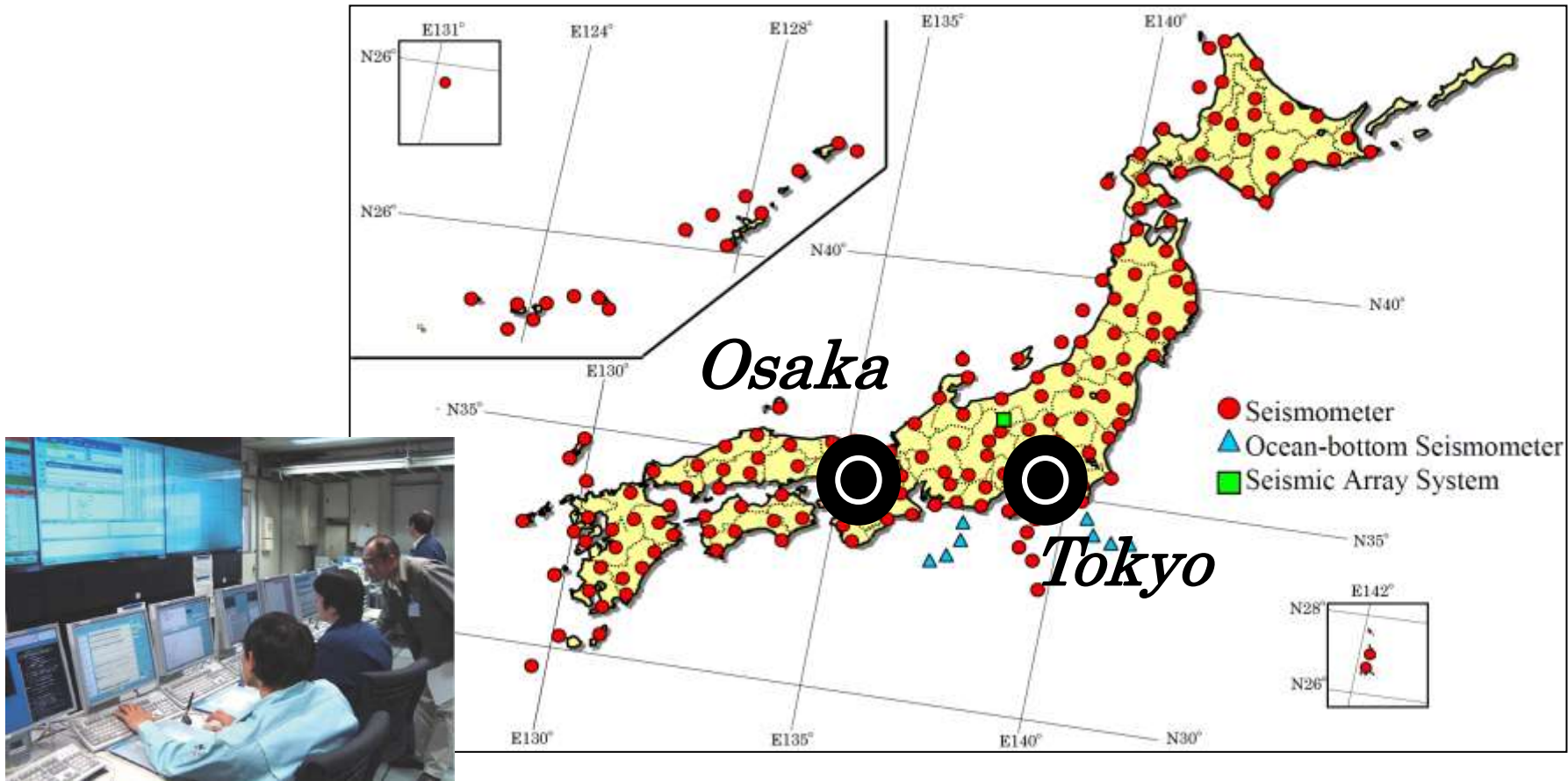
Seismic Intensity Stations

Seismic Intensity Meter



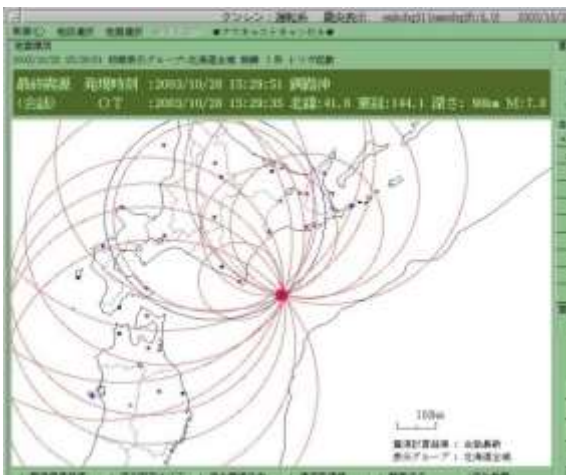
- JMA
 - Local Governments
 - ▲ NIED
- ~4,400 stations in total**

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.

Tsunami Warnings/Advisories



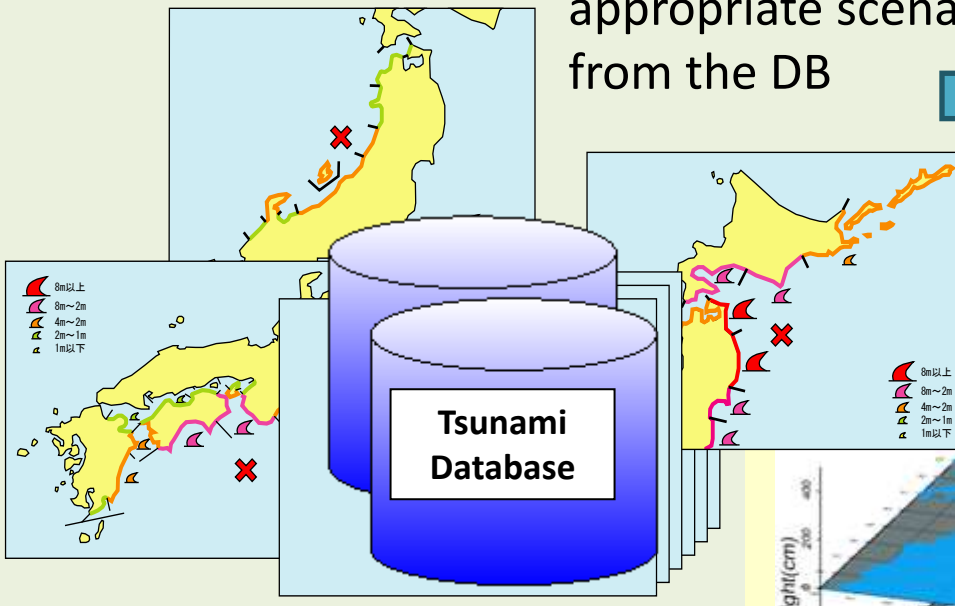
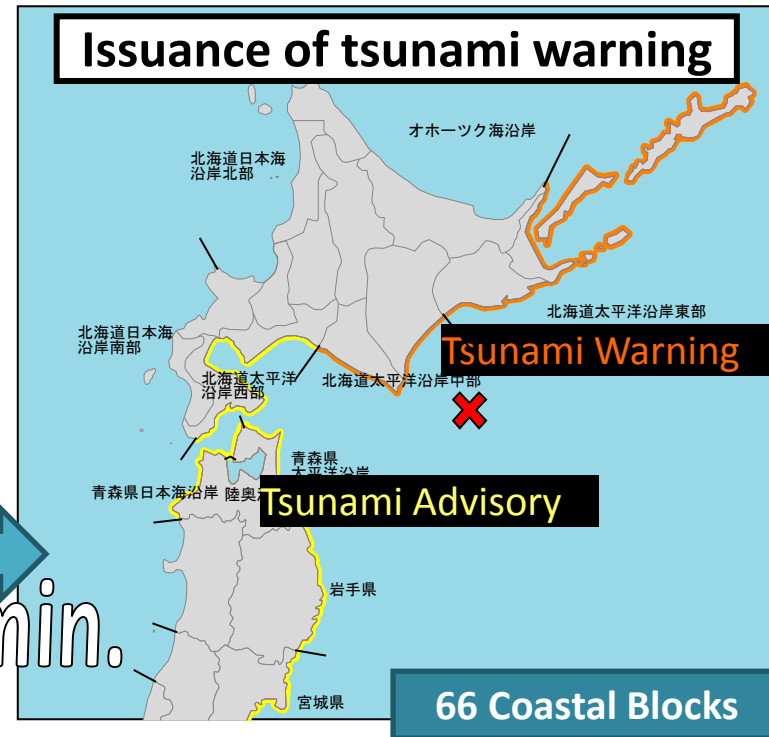
Determined
Magnitude
and Hypocenter



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



3min.



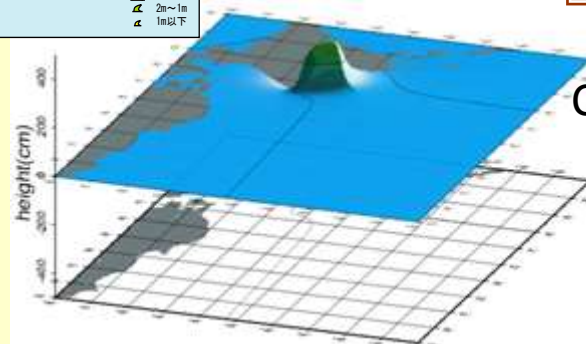
about 100,000 scenarios









Calculate Crustal Movement
for each Assumed Fault



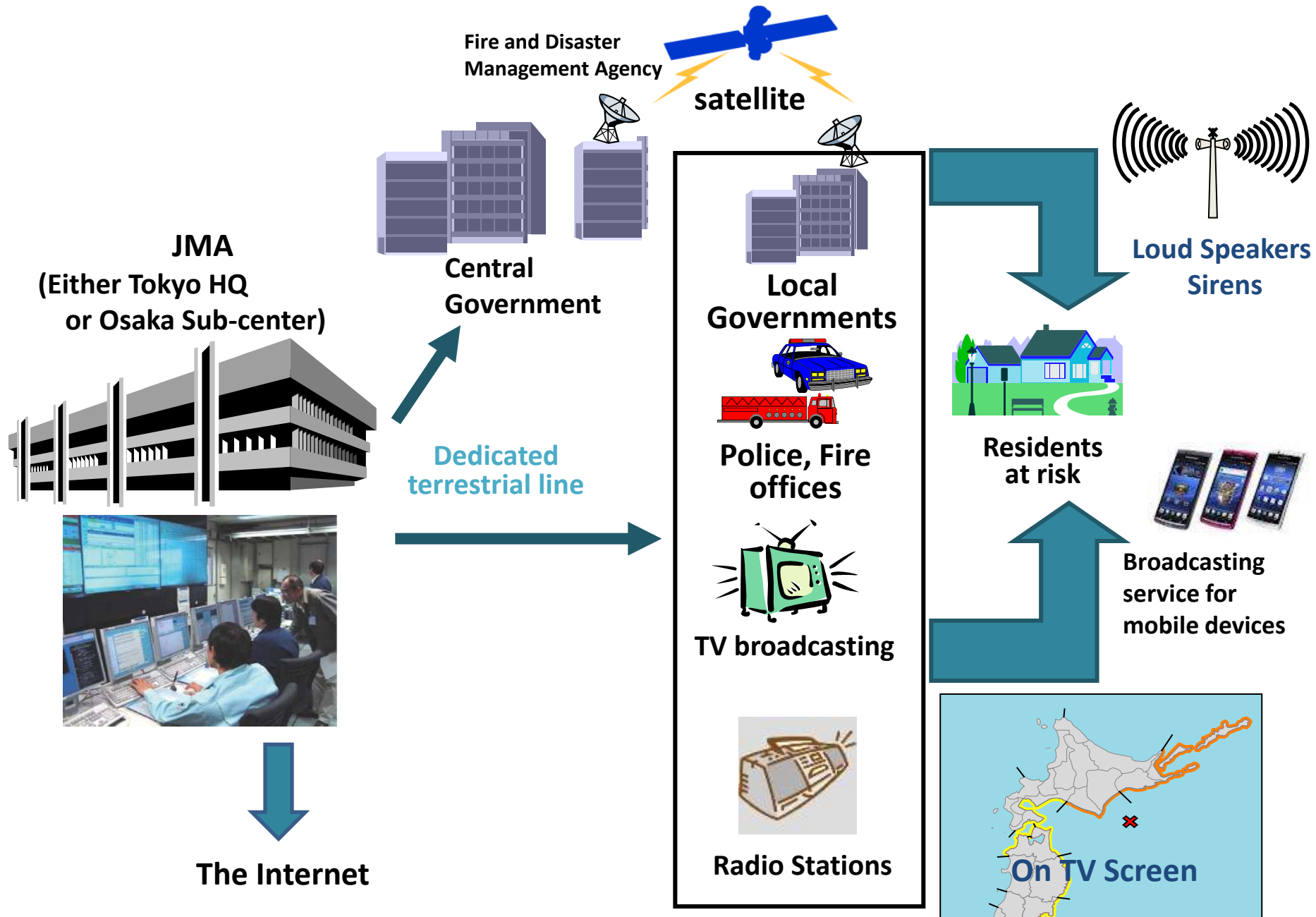
Computer Simulation of
Tsunami Propagation



Tsunami Warnings/Advisories

	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> 

Dissemination of Warning/Information



Dissemination of Warning/Information

Major Tsunami Warning for Fukushima Pref.

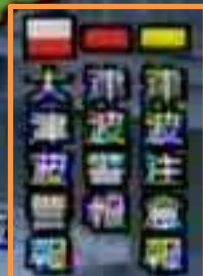
大津波警報 福島県
津波到達を確認

Estimated Height: 6m

予想6m

岩手・宮城・福島
大津波警報

岩手 釜石
中継



Provided by Japan Broadcasting Corporation (NHK)

- Tsunami Advisory
- Tsunami Warning
- Major Tsunami Warning

Thank you for your attention

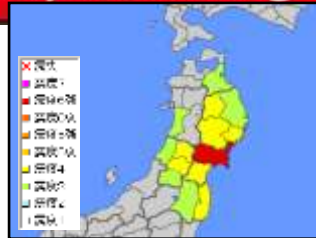
- Earthquake monitoring
- Earthquake data processing
- Tsunami warning
- Tsunami monitoring

EARTHQUAKE !

**Several to
a few tens seconds**

Earthquake Early Warning

Automatic processing



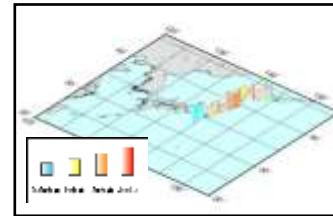
About 1.5 minutes

Seismic Intensity Information

(regions with seismic intensity of 3 or greater)

Automatic processing

Tsunami Warning/Advisory(cancel)

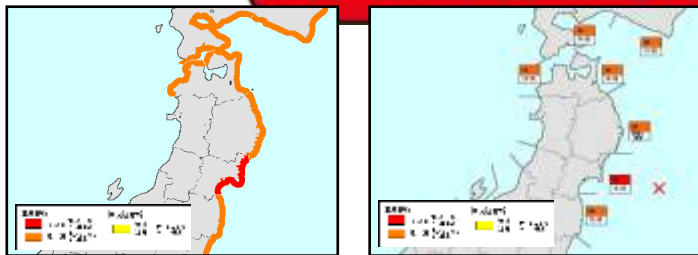


Tsunami Information

(tsunami observation)

About 3 minutes

Tsunami Warning/Advisory



About 5 minutes

Earthquake and Seismic Intensity Information

(observed seismic intensities of each stations)

