JMA Service on Earthquake, Tsunami and Volcano

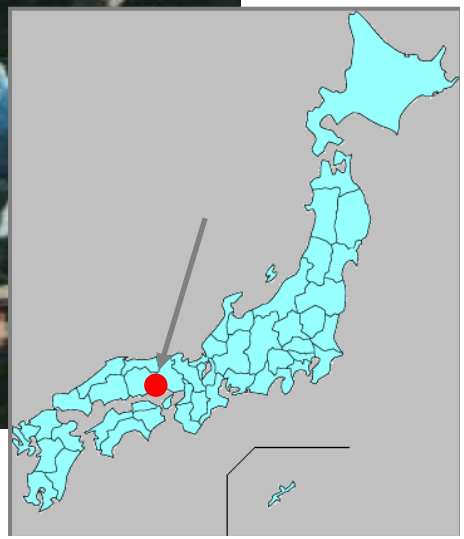
Keiji DOI

Seismological and Volcanological Department

Japan Meteorological Agency

Logo

The South Hyogo Prefecture Earthquake in 1995 (January 17, 1995, M7.3)



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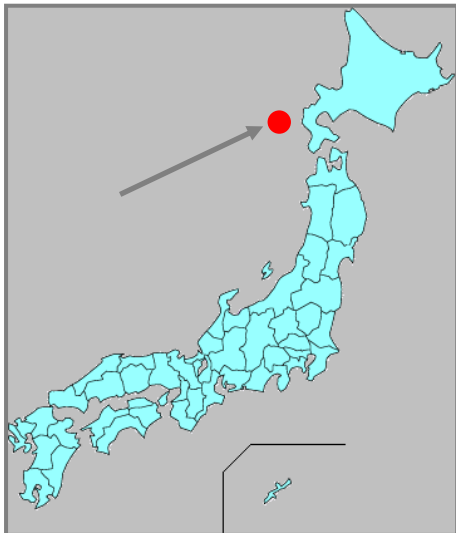
Southwest off Hokkaido Earthquake and Tsunami in 1993

- 12 July 1993, M7.8
- 230 people were dead or missing
- Tsunami ran up to 31.7m from the sea level



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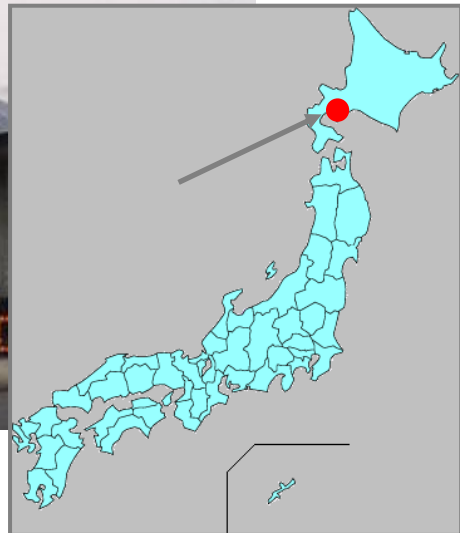
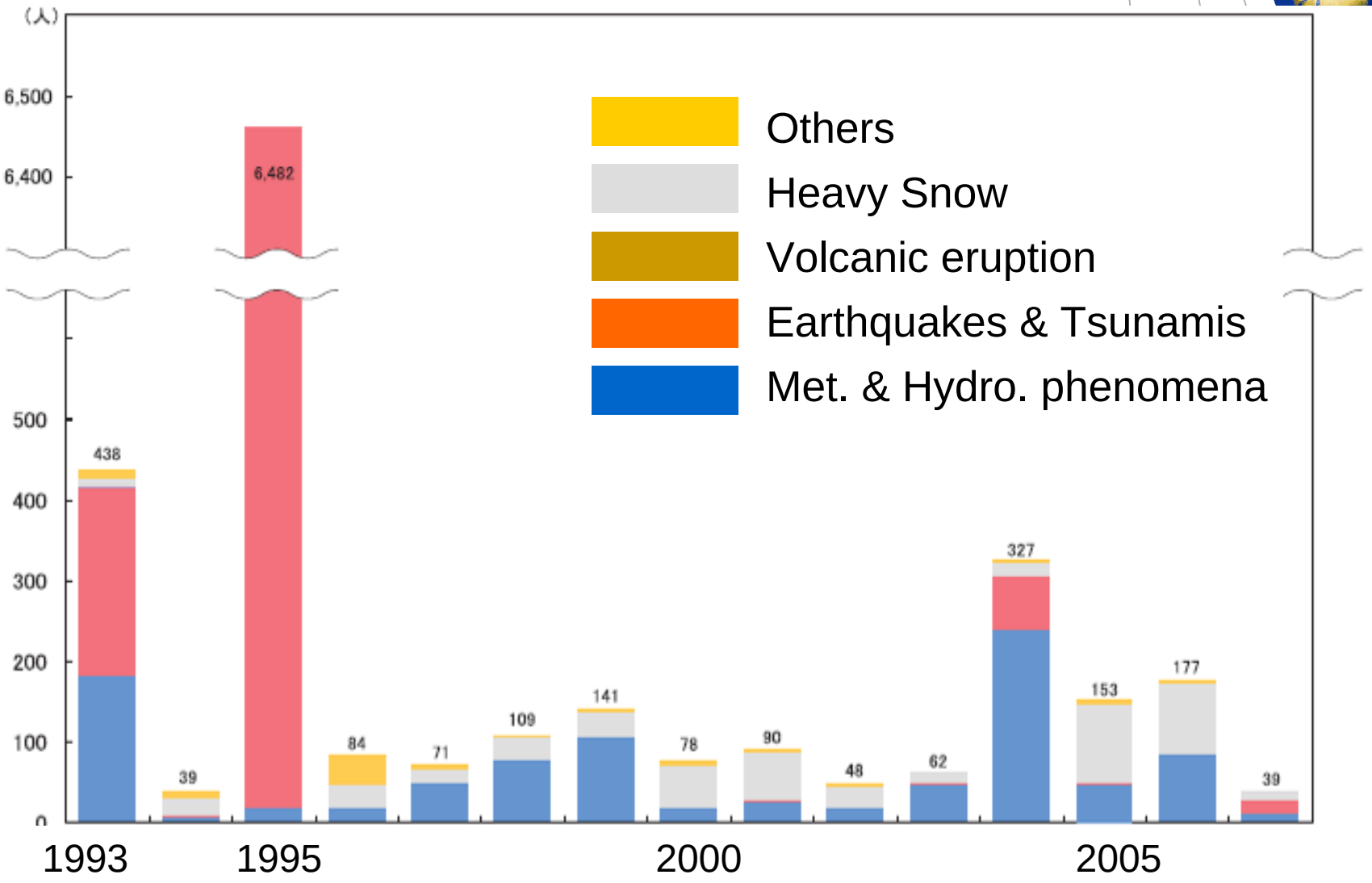
Eruption of Usu Volcano in 2000



Death by Natural Disasters



(after Cabinet Office of Japan)

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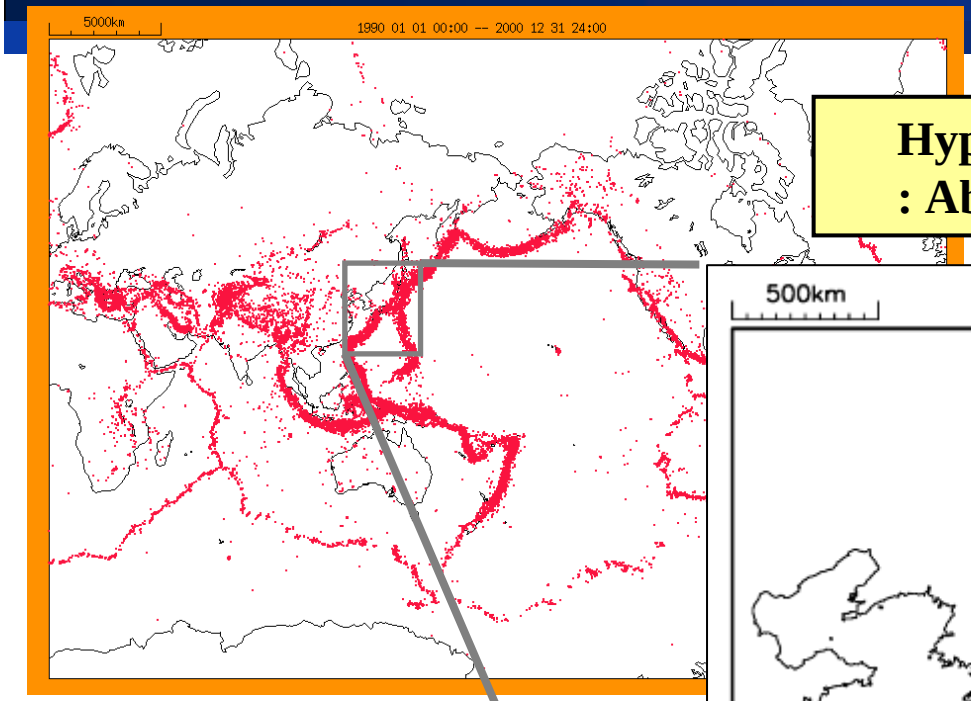
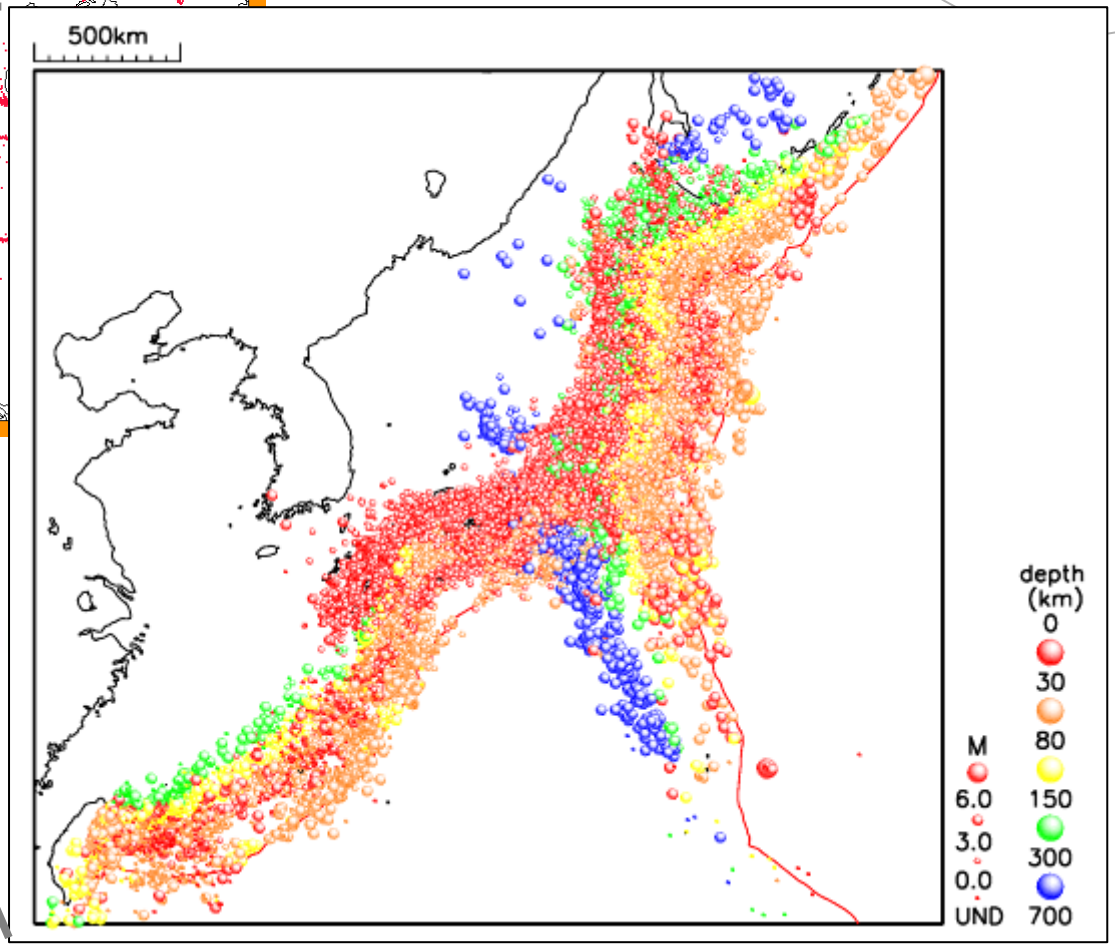
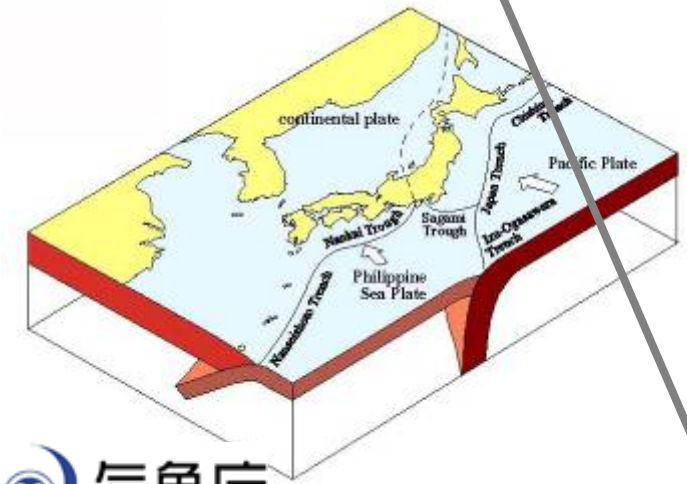
Seismic Activity around Japan



Hypocenter Determined by JMA in 2008
: About 123,400（felt events : aboout 1,900）





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Active volcanoes in Japan

注）この他、海底火山や無人の火山島がある。

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JMA's Responsibilities

- Earthquake Early Warning
- Earthquake Information
- Tsunami Warning
- Earthquake Prediction in the Tokai area
- Volcanic warning

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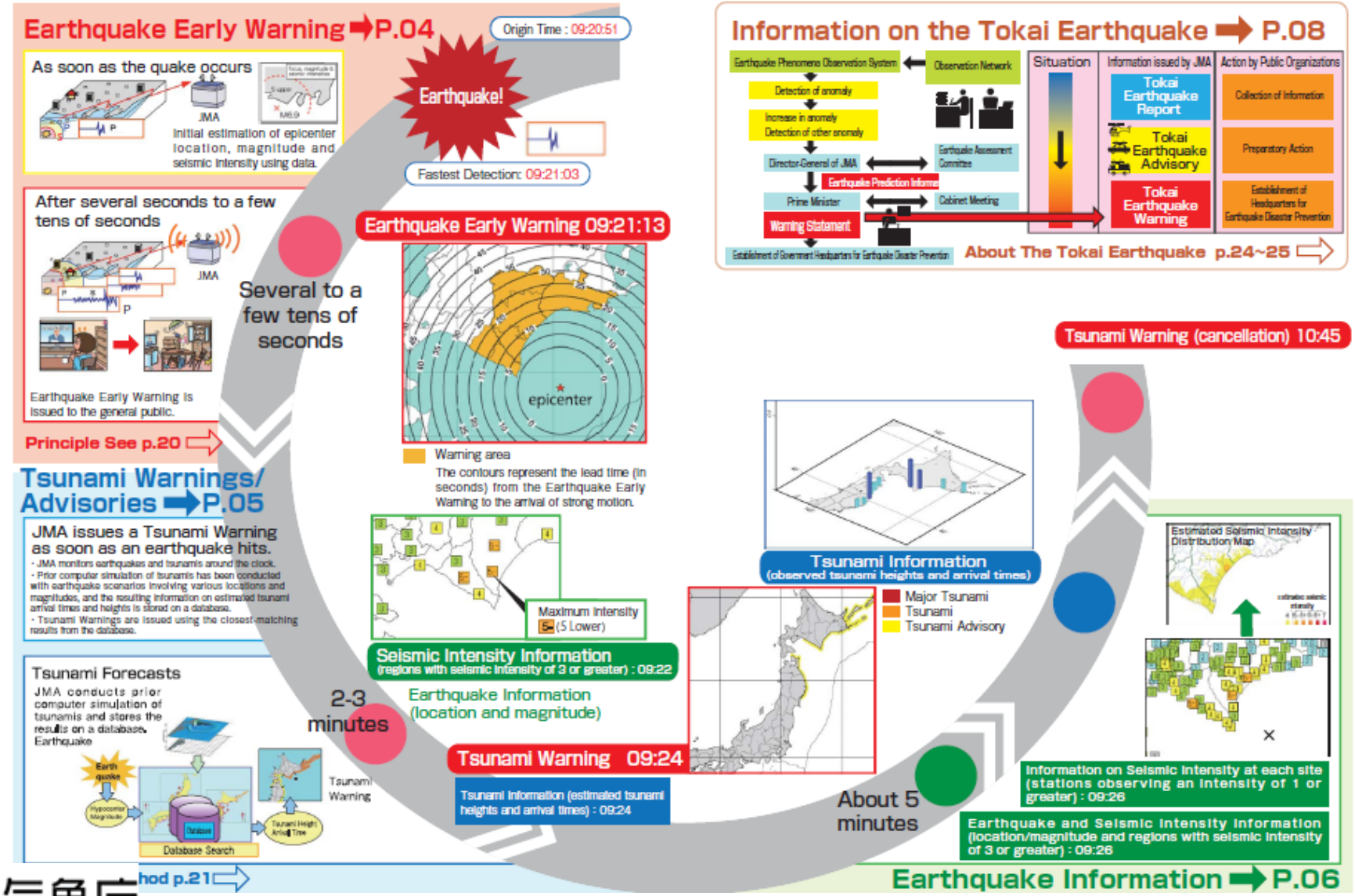
Earthquake & Tsunami Warnings/Information in JAPAN



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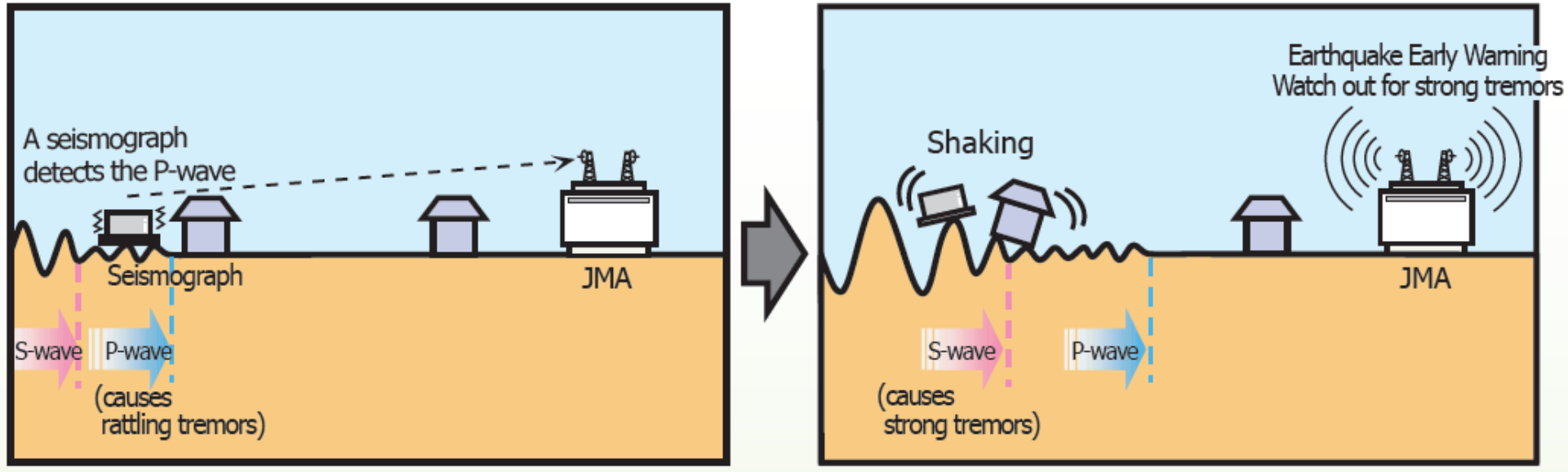
Earthquake Early Warning

Conceptual Image of Earthquake Early Warning (EEW)



① **The EEW system automatically calculates the focus and magnitude of the earthquake and estimates the seismic intensity for each location by detecting the quake (i.e. the P-wave, or the preliminary tremor) near its focus.**

② **An EEW is then given a matter of seconds (i.e. a few seconds to a few tens of seconds) before the arrival of strong tremors (i.e. the S-wave, or principal motion).**

※Strong tremors may arrive at the same time as the Earthquake Early Warning in areas that are close to the focus of the earthquake.

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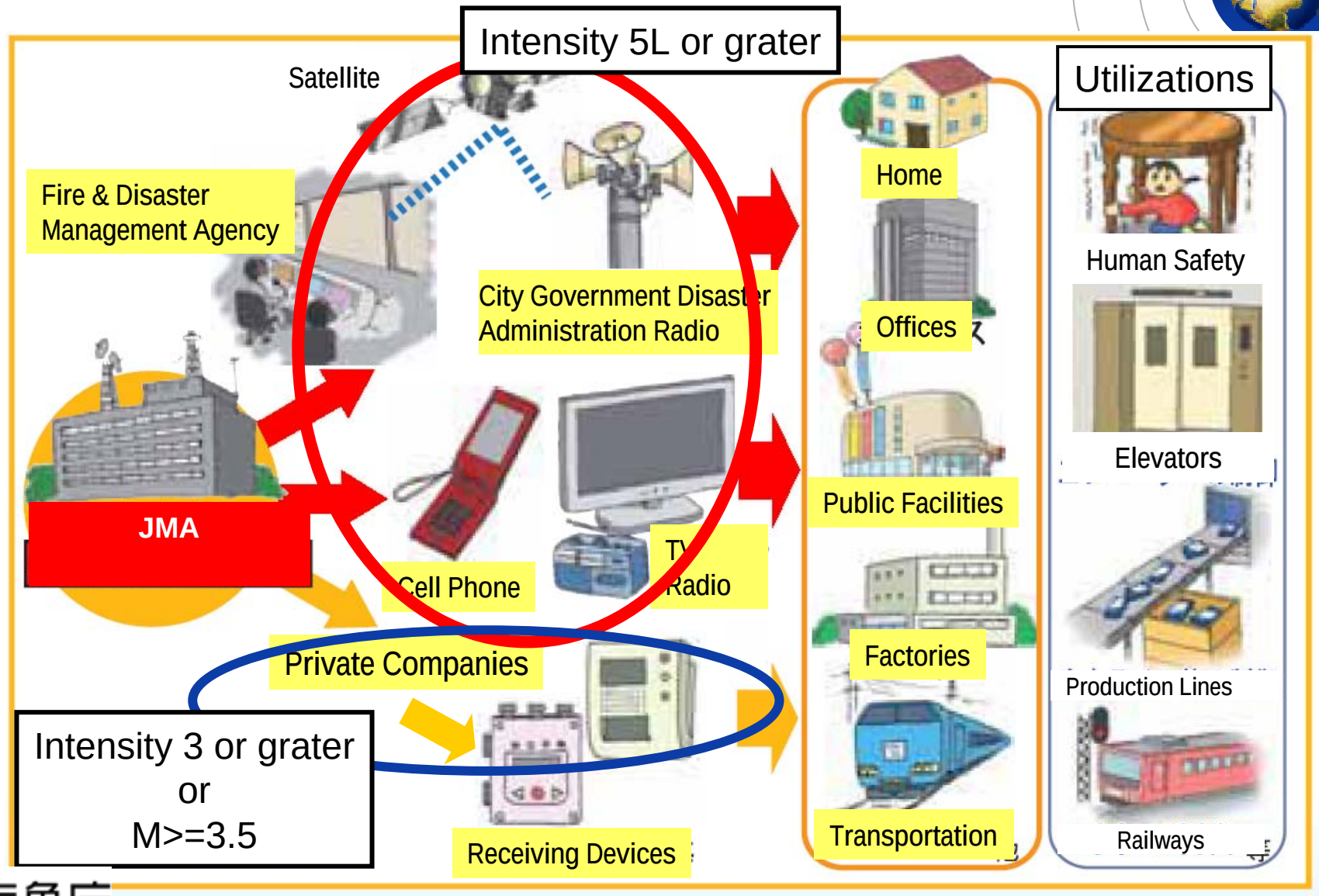
Dissemination of EEW



Drill

A drill at an elementary school

A scene of 2nd Grade pupils at Hirata Elementary School in Kamaishi, Iwate, participating in a drill on 4th July 2008 huddling under their desk after receiving EEW through City Government Disaster Administration Radio. Courtesy of Kamaishi City

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Seismic Intensity

Seismic Intensity Scale in Japan

0

Imperceptible to people.

1

Felt slightly by some people keeping quiet in buildings.

2

Felt by many people keeping quiet in buildings.

3

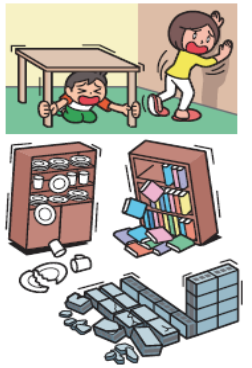
Felt by most people in buildings.

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.

JMA Scale	0	1	2	3	4	5L	5U	6L	6U	7
MM Scale	1	2	3	4	5	6	7	8	9	10 11 12
MSK Scale	1	2	3	4	5	6	7	8	9	10	11 12

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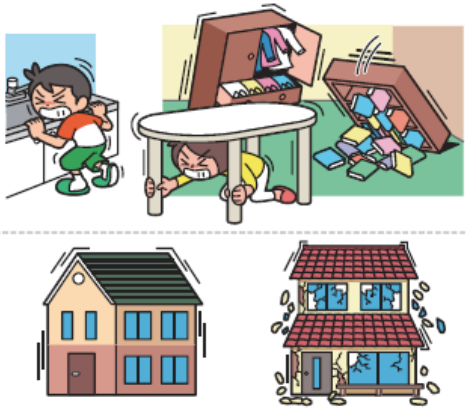
Seismic Intensity Scale in Japan

6 Lower



- It is difficult to remain standing.
- Many unsecured furniture moves and may topple over. Doors may become wedged shut.
- 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 unsecured furniture moves, and is more likely to topple over.
- Wooden houses with low earthquake resistance are more likely to lean or collapse.
- 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.

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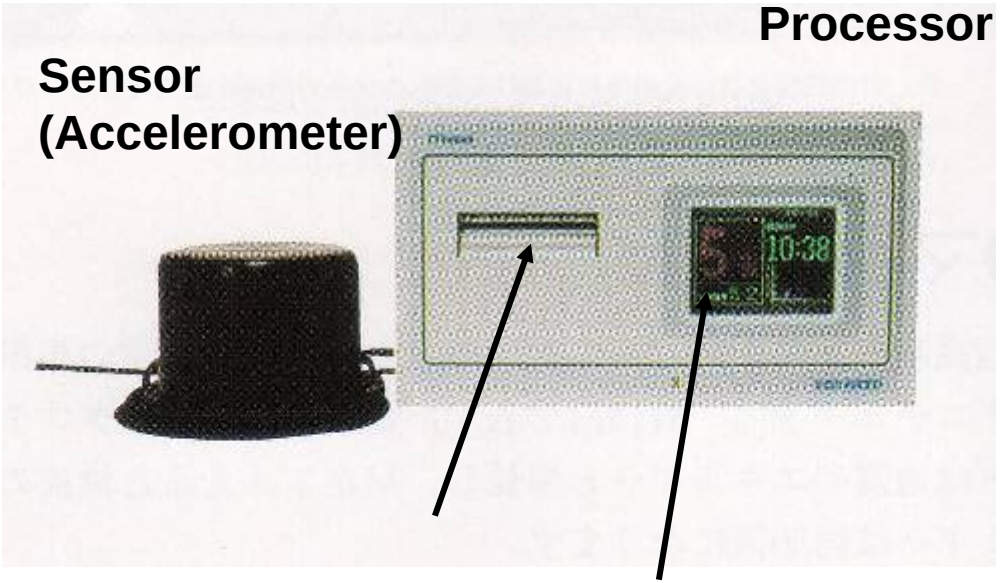
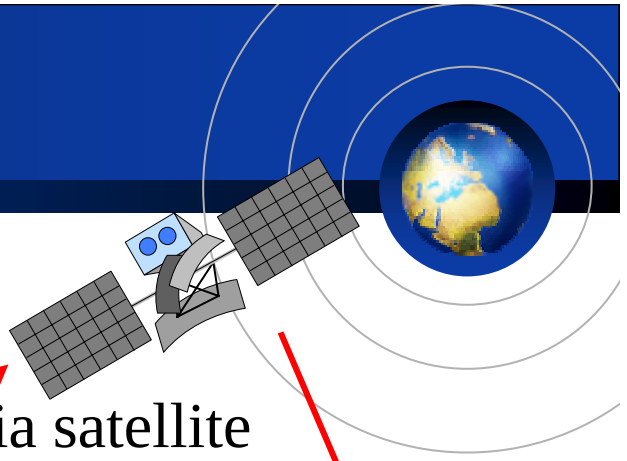
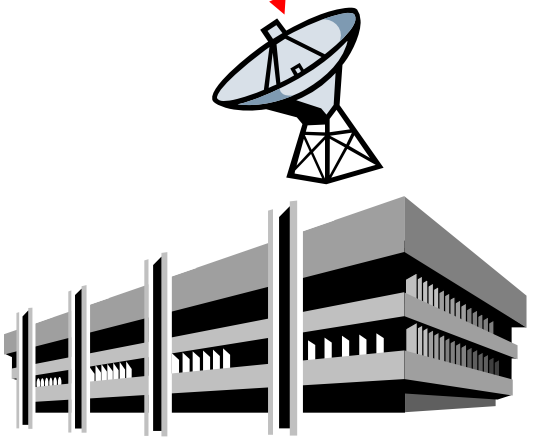
Seismic Intensity Meter





via satellite

(284 : about the half number of all)



JMA

Telephone line(land line)

Seismic Intensity is calculated on the basis of amplitude and frequency of acceleration

Seismic Intensity = “Shindo”: 1 to 4, 5L, 5U, 6L, 6U, 7

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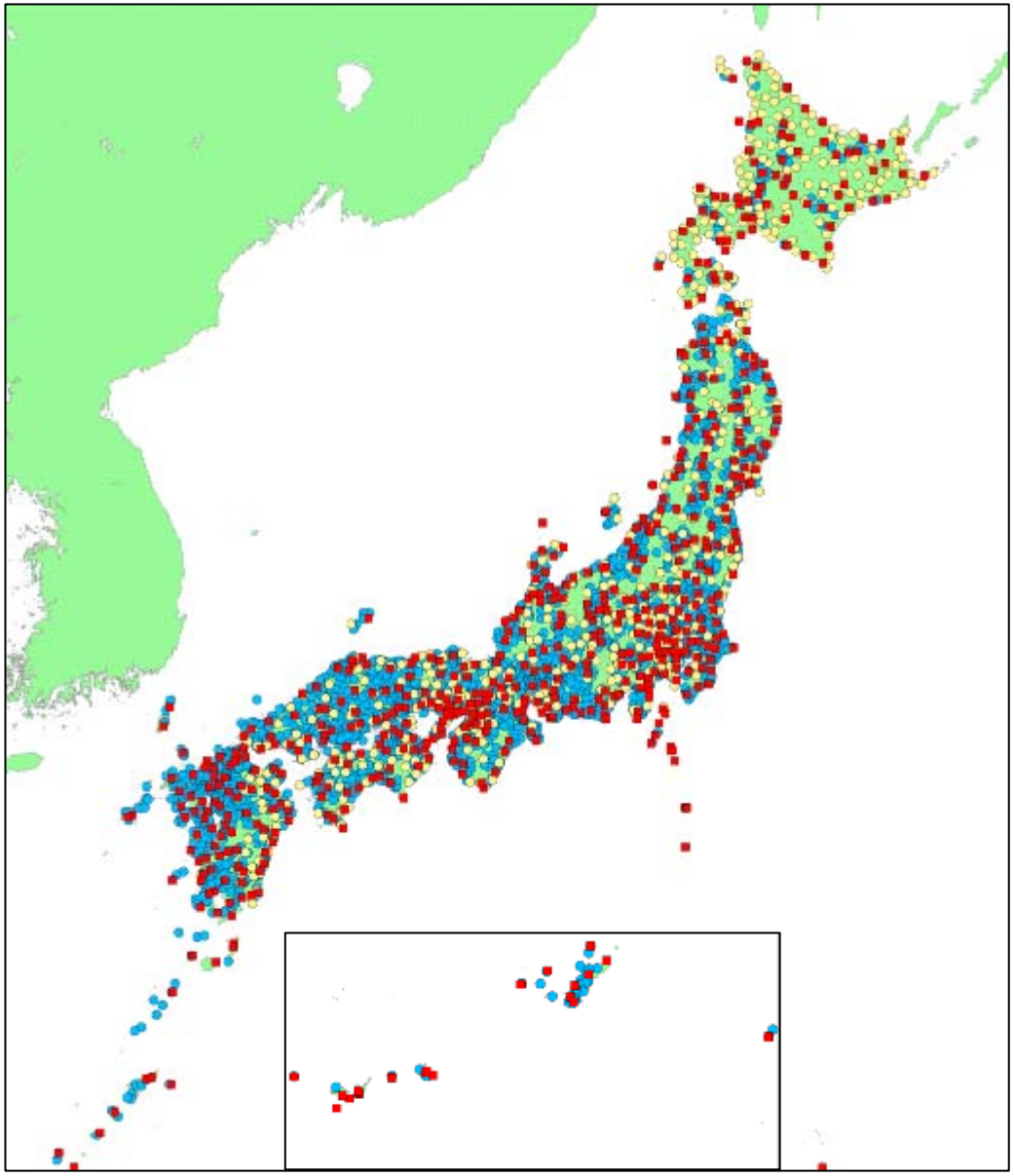
Seismic Intensity Measurement Stations



○ : **JMA** （624）

● : **Local governments** （2,843）

● : **NIED** （781）

Total : 4,248

As of April 2009

NIED: National Research Institute for Earth Science and Disaster Prevention

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Emergency Operation by Seismic Intensity information

EQ.

2min **Seismic intensity information**

3min **Tsunami Warning**

5min **Earthquake information**

Cabinet Research Office

6Lower Call of an urgent gathering team

Cabinet Office → Estimation of damages

4

Ministry of Defense → Investigation of damages

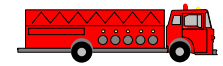
5 Lower

Japan Coast Guard → Investigation of damages

5 Lower

Metropolitan Police Department

Fire and Disaster Management Agency



4 Investigation of damages

NHK, a broadcast organization

Announcement with TV & Radio

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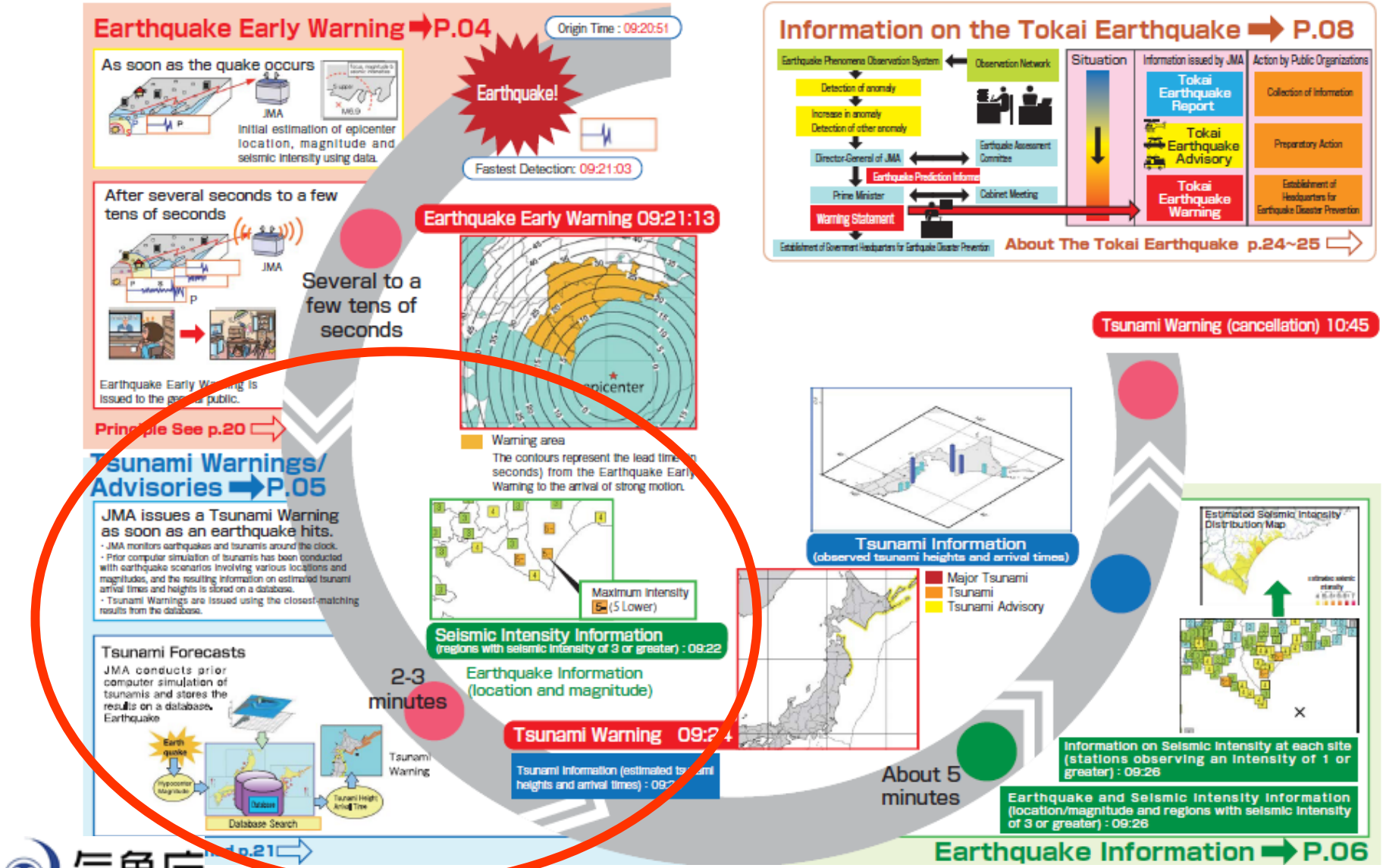
Tsunami Warning

Earthquake & Tsunami Warnings/Information in JAPAN



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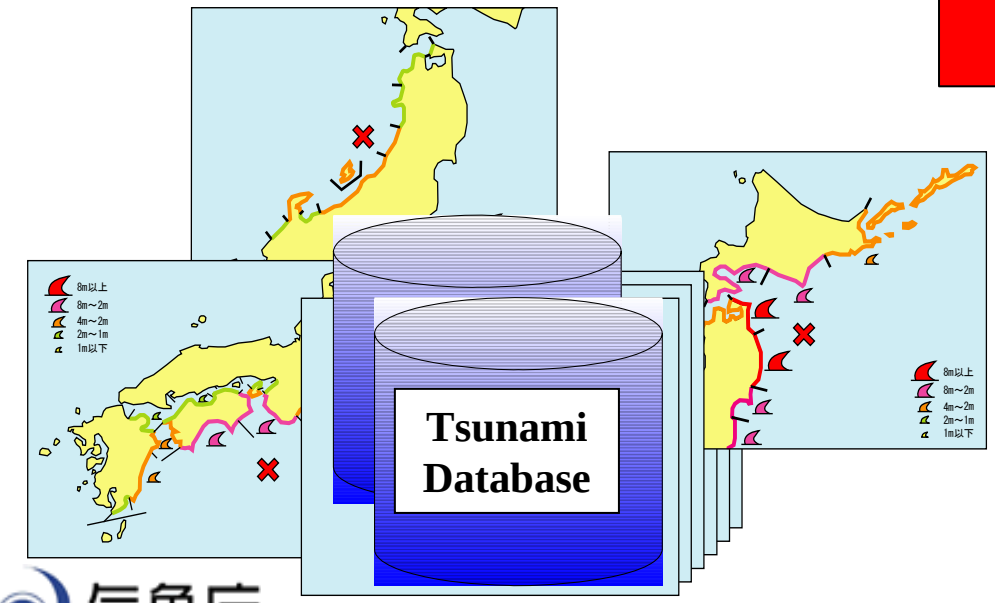
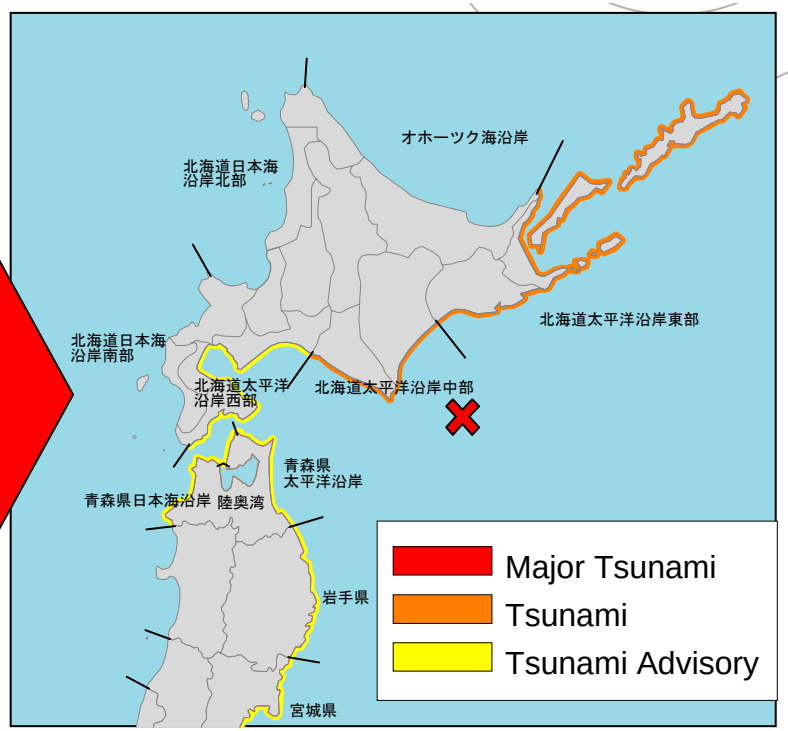
Tsunami Warning

Referring to the determined location and magnitude of the earthquake, the system searches tsunami database and picks up the most appropriate scenario from the database.



Tsunami Warning



Issuance of tsunami warning which contains estimated arrival time and height at each coastal region (66 regions in Japan)

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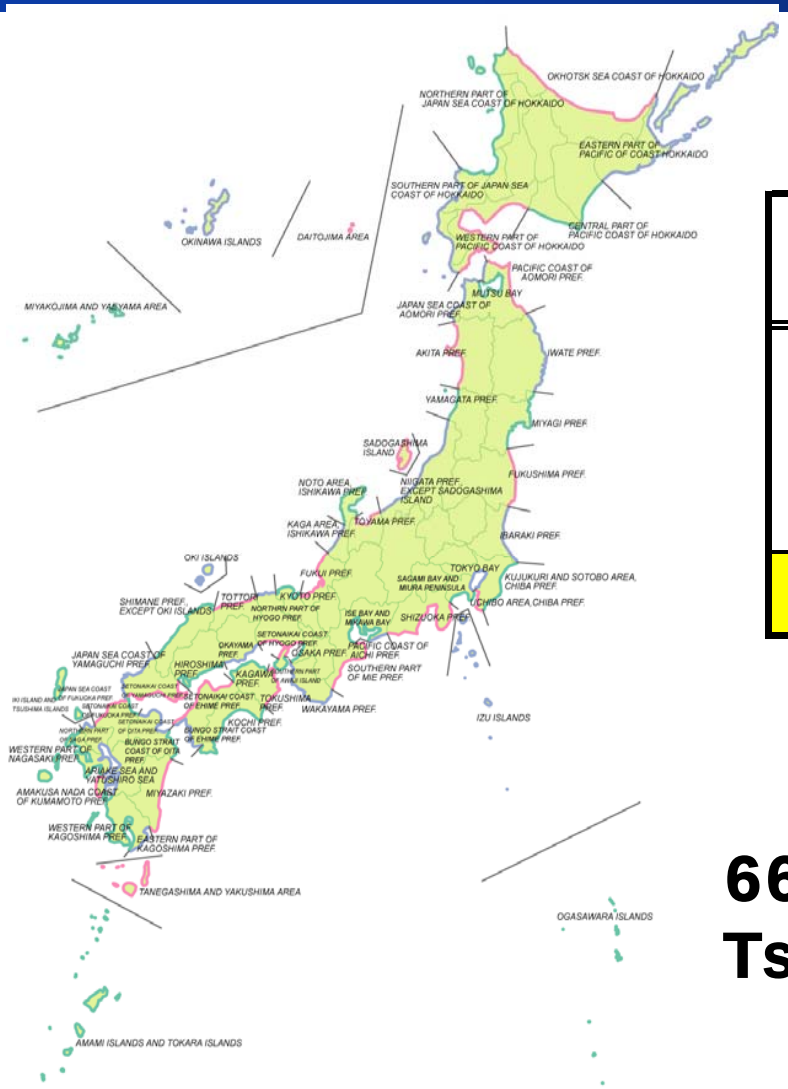
Tsunami Warning



Type of Tsunami Bulletin		Estimated Tsunami Height
Tsunami Warning	Major Tsunami	"3m", "4m", "6m", "8m", "over 10m"
	Tsunami	"1m", "2m"
Tsunami Advisory		"0.5m"

66 Regional Blocks for Tsunami Warning / Advisory

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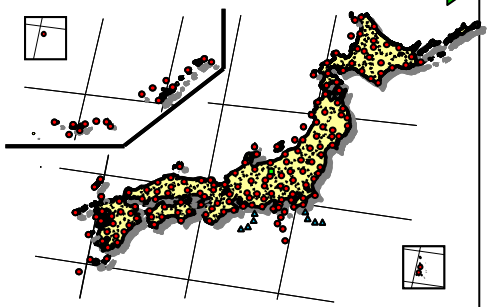
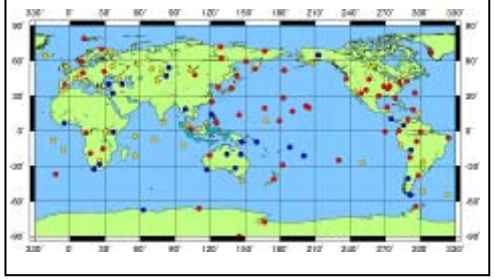
Northwest Pacific Tsunami Advisory Center

Japanese Seismic Network



Global Seismic Network



Tide Gauge Network

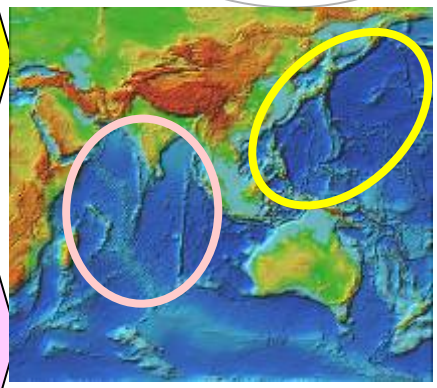
JMA Headquarters

- Analysis of seismic data
- Estimation of tsunami height and arrival time

Through the Global Telecommunication System of WMO, E-mail and/or Facsimile

Northwest Pacific Tsunami Advisory

Tsunami Watch Information for Indian Ocean



Information Exchange
- Magnitude
- Hypocenter (Focus)
- Tsunami Information

Pacific Tsunami Warning Center (PTWC)

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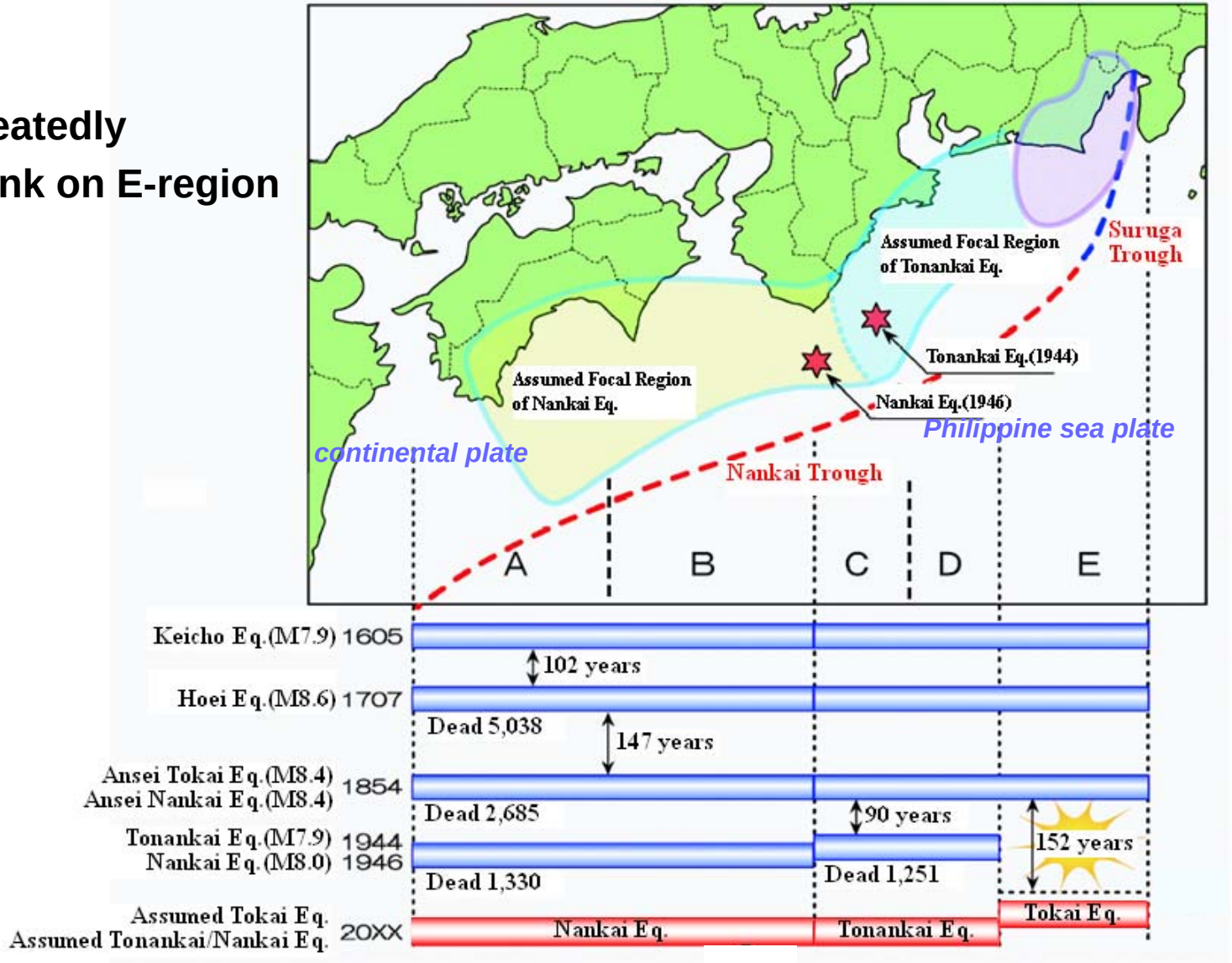
Earthquake Prediction in the Tokai area

Tokai Earthquake: Past Activity

- Occurred Repeatedly
- ~150 years blank on E-region



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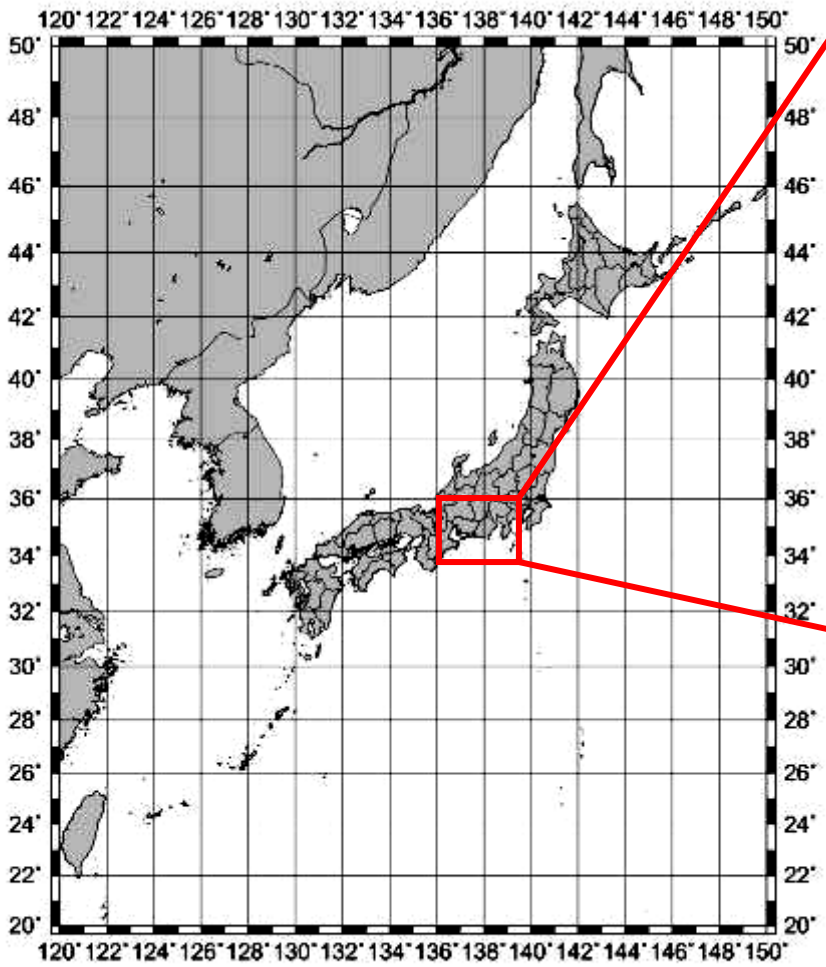
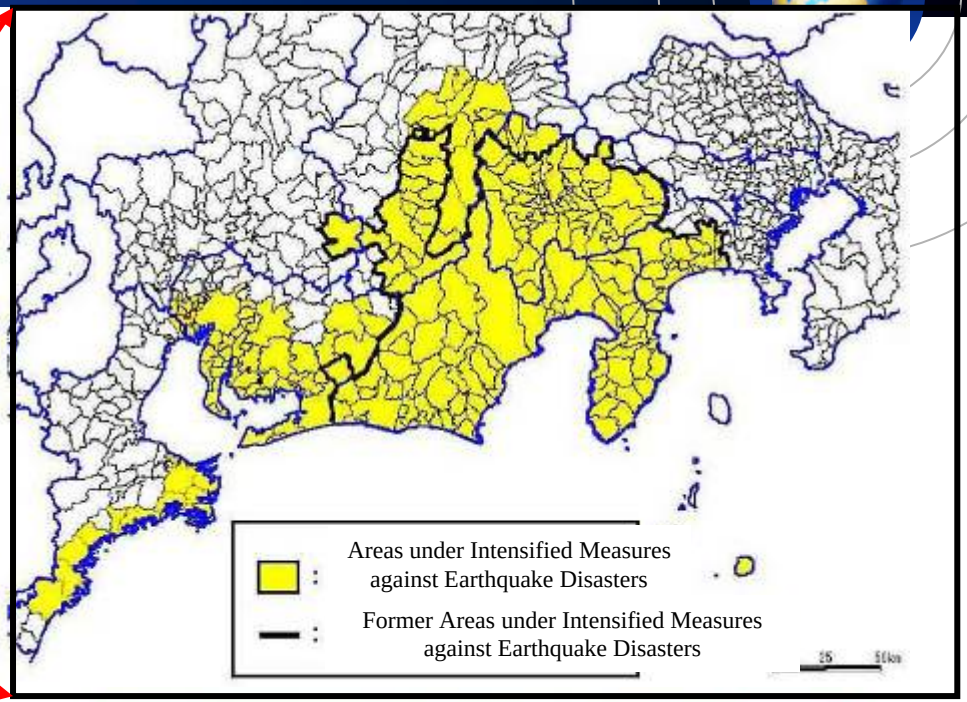
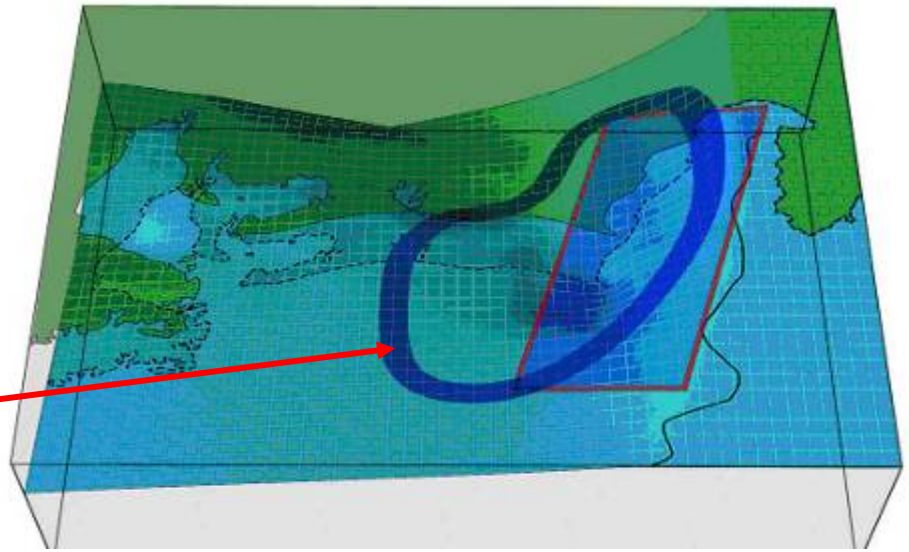
Areas under Intensified Measures against Earthquake Disasters







Assumed source region

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Flow of Information about the Tokai Earthquake

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Earthquake Phenomena Obs. System (EPOS)

Observation Networks of JMA and other Institutes

Detection of Anomaly

・Increase of the anomaly
・Detection of other anomaly

Director-General of JMA ⇔ Earthquake Assessment Committee

Earthquake Prediction Information

Prime Minister ⇔ Cabinet Meeting

Warning Statement

Establishment of Government Headquarters for Earthquake Disaster Prevention

Situation	Action of Public Organizations	Information issued by JMA
	Collection of Information	***Tokai Earthquake Report***
	Preparatory Action	***Tokai Earthquake Advisory*** 
	Establishment of Headquarters for Earthquake Disaster Prevention	***Tokai Earthquake Warning***

Volcano Warning Service

Operation of JMA Volcano Information Service

Disaster Prevention Authorities, Mass Media

General Public

Collaborative work with researchers

Meteorological Observatories

Volcano Information

Volcanic Regular Bulletin

Detailed Analysis of
- Seismic and Geodetic data
- Volcanic fumes activity

Diagnosis of Volcanic Activity

Data Analysis

24 hours Watch

Tiltmeter

Real-time telemeter

Quick look analysis and watch of data
Issuance of Volcano Information

Dispatch of Mobile Observation Team

Mobile Observation Team

Regular survey of volcanoes
Emergency observation of volcanoes

GPS

Infrasonic Microphone

Seismometer

High-sensitive Visual Camera

Volcano Observation & Information Center

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Start of Volcanic warning and volcanic alert level
– Improved volcano information -

On Dec. 1 and after

Start of volcanic warning and volcanic forecast	・Based on an eruption prediction technique improved by technological development and upgraded monitoring/observation systems, the existent volcano information will be announced as volcanic forecast and volcanic warnings. ・Changing “information” to “alert” informs sooner and more accurate transmission as collateral.
Introduction of volcanic alert levels	・Volcanic activities are classified according to the disaster-preventive measures to be taken. ・The alert level is announced with keywords showing the disaster prevention activities such as “evacuation”, “evacuation ready” and “mountain access prohibited”.

volcanic warning and volcanic forecast are applied to 108 volcanoes throughout Japan

Volcanoes where the volcanic warning is applied (As of December 1, 2007)

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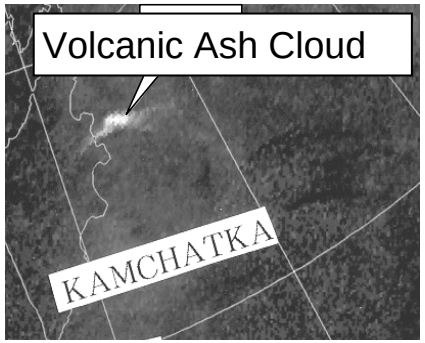
Volcanic warning and Volcanic alert levels

	Target area	Levels & Keyword	Expected volcanic activity
Warning	Residential areas	Level 5 Evacuate	Eruption that may cause serious damage in residential areas, or imminent eruption.
		Level 4 Prepare to evacuate	Possibility or increasing possibility of eruption that may cause serious damage in residential areas.
Near-crater Warning	Non-residential areas near the crater	Level 3 Do not approach the volcano	Eruption or possibility of eruption that may severely affect places near residential areas (threat to life is possible in these areas)
	Around the crater	Level 2 Do not approach the crater	Eruption or possibility of eruption that may affect areas near the crater (threat to life is possible in these areas)
Forecast	Inside the crater	Level 1 Normal	Calm : Volcanic ash emissions or other related phenomena may occur in the crater (threat to life is possible in these areas).

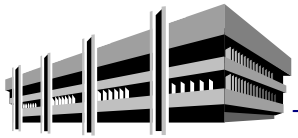
Volcanoes introducing the volcanic alert level (16 volcanoes, as of December, 2007) Tarumae-san, Hokkaido-Komagatake, Iwate-san, Azuma-yama, Kusatsu-Shirane-san, Asama-yama, Mt. Fuji, Izu-Oshima, Kuju-san, Unzen-dake, Aso-san, Kirishima-yama (Shinmoe-dake, Ohachi), Sakurajima, Satsuma-Iojima, Kuchinoerabushima, Suwanosejima)

* In addition, the volcanic alert level will successively be introduced to volcanoes requiring the disaster-prevention measures by coordinating with local public organizations.

Flow-chart of the Issuance of Volcanic Ash Advisory



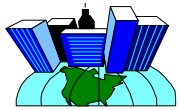
Satellite Image



Meteorological Satellite Center

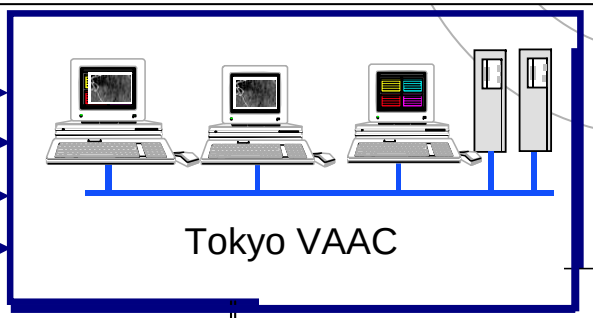
Pilot Report

Domestic Volcano Information



Foreign Volcano Information

- Monitoring and Analysis of Satellite Imagery
- Calculation of Volcanic Ash Forecast Dispersion
- Making and Issuance of VAA



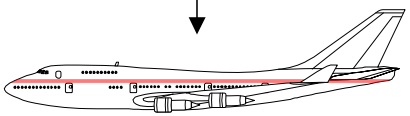
Other VAACs

Tokyo MWO

MWOs in the responsibility area

Aviation Weather Stations

Aviation Authorities



VAA → SIGMET

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Dissemination of Early Warnings

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Early Warnings from JMA

- Earthquake Prediction
- Weather, High tide, Surge Tsunami, Volcanic eruption Flood
- Advisories Weather forecast
- Earthquake Early warning
- Typhoon Forecast Rainfall information Earthquake Information Related Weather info.
- Observational Data
- Marine Warning Airport Warning

Prime Minister

Prefectures

Police

NTT

MLIT

Cities

Towns

Fire stations

Countermeasures

Designated Government Organizations

Designated Public Corporations

N H K

Mass Media

Japan Meteorological Business Support Center

Weather companies

Coast Guard

Civil Aviation Bureau

residents

Comp-anies

Ships

Airplanes