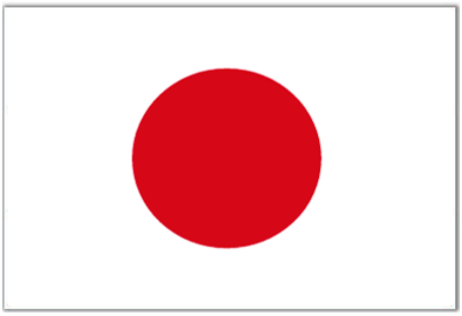

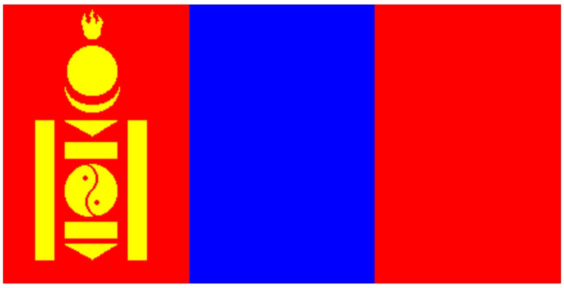

Asian Disaster Reduction Center

Research paper

Earthquake early warning systems

Visiting researcher 2013A in term of August 13-November 22, 2013

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Disclaimer

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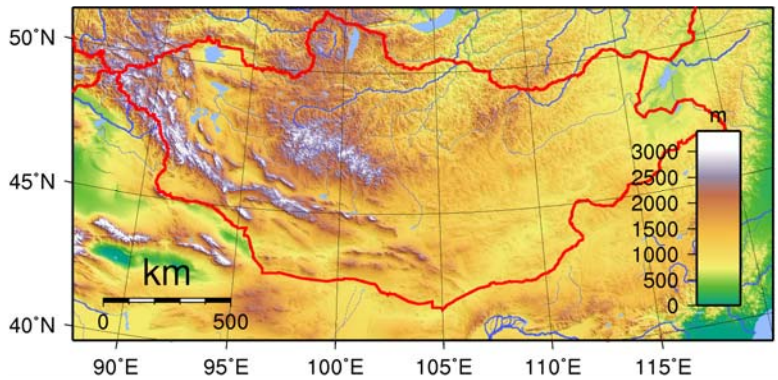
1. General Information

Mongolia is located between 41° and 52°N latitude and between 87º and 120º E longitude. Mongolia is a land area of 1,564,100 sq km. largest city, is home to about 45% of the population. Mongolia's political system is a parliamentary republic. The capital is Ulaanbaatar. 96 percent of 2,647,545 population are the Mongolian, the rest being Kazakh, Chinese, and Russian. The country contains very little arable land, as much of its area is covered by steppes, with mountains to the north and west and the Gobi Desert to the south. Approximately 30% of the population are nomadic or semi-nomadic. The predominant religion in Mongolia is Tibetan Buddhism, and the majority of the state's citizens are of Mongol ethnicity, although Kazakhs, Tuvans, and other minorities also live in the country, especially in the west.

1.1 Geographical Data

Mongolia is a landlocked country in Central Asia, strategically located between China and Russia. The terrain is one of mountains and rolling plateaus, with a high degree of relief. Overall, the land slopes from the high Altay Mountains of the west and the north to plains and depressions in the east and the south. The western Mongolia on the Chinese border is the highest point (4,374 metres). The lowest is 518 metres, an otherwise undistinguished spot in the eastern Mongolian plain. The country has an average elevation of 1,580 metres. The landscape includes one of Asia's largest freshwater lakes (Lake Khuvsgul), many salt lakes, marshes, sand dunes, rolling grasslands, alpine forests, and permanent mountain glaciers. Northern and western Mongolia are seismically active zones, with frequent earthquakes and many hot springs and extinct volcanoes. The nation's closest point to any ocean is approximately 960 kilometres (600 mi) from the country's easternmost tip bordering northern China to Chongjin in North Korea along the coastline of the Sea of Japan.

Topography



Mongolia has three major mountain ranges. The highest is the Altai Mountains, which stretch across the western and the southwestern regions of the country on a northwest-to-southeast axis. The Khangai Mountains, mountains also trending northwest to southeast, occupy much of central and north-central Mongolia. These are older, lower, and more eroded mountains, with many forests and alpine pastures. The Khentii Mountains near the Russian border to the northeast of Ulaanbaatar, are lower still. Much of eastern Mongolia is occupied by a plain, and the lowest area is a southwest-to-northeast trending depression that reaches from the Gobi Desert region in the south to the eastern frontier. The rivers drain in three directions: north to the Arctic Ocean, east to the Pacific, or into the deserts and the depressions of Inner Asia. Rivers are most extensively developed in the north, and the country's major river system is that of the Selenge, which drains into Lake Baikal. Some minor tributaries of Siberia's Yenisei River also rise in the mountains of northwestern Mongolia. Rivers in northeastern Mongolia drain into the Pacific through the Argun and Amur (Heilong Jiang) rivers, while the few streams of southern and western Mongolia do not reach the sea but run into lakes or deserts.

1.2 Climate information

Mongolia is high, cold, and dry. It has an extreme continental climate with long, cold winters and short summers, during which most precipitation falls. The country averages 257 cloudless days a year, and it is usually at the centre of a region of high atmospheric pressure. Precipitation is highest in the north, which averages 200 to 350 millimetres (7.9 to 13.8 in) per year, and lowest in the south, which receives 100 to 200 millimeters (3.9 to 7.9 in). The extreme south is the Gobi Desert, some regions of which receive no precipitation at all in most years. The name Gobi is a Mongol word meaning desert, depression, salt marsh, or steppe, but which usually refers to a category of arid rangeland with insufficient vegetation to support marmots but with enough to support camels. Mongols distinguish Gobi from desert proper, although the distinction is not always apparent to outsiders unfamiliar with the Mongolian landscape. Gobi rangelands are fragile and are easily destroyed by overgrazing, which results in expansion of the true desert, a stony waste where not even Bactrian camels can survive.

Average temperatures over most of the country are below freezing from November through March and are about freezing in April and October. January and February averages of −20 °C (−4 °F) are common, with winter nights of −40 °C (−40 °F) occurring most years. Summer extremes reach as high as 38 °C (100.4 °F) in the southern Gobi region and 33 °C (91.4 °F) in Ulaanbaatar. Most of Mongolia is covered by discontinuous permafrost (grading to continuous at high altitudes), which makes construction, road building, and mining difficult. All rivers and freshwater lakes freeze over in the winter, and smaller streams commonly freeze to the bottom. Ulaanbaatar lies at 1,351 meters (4,432 ft) above sea level in the valley of the Tuul River. Located in the relatively well-watered north, it receives an annual average of 310 millimetres (12.2 in) of precipitation, almost all of which falls in July and in August. Ulaanbaatar has an average annual temperature of −2.9 °C (26.8 °F) and a frost-free period extending on the average from mid-June to late August.

1.3. Administrative system

Mongolia is divided into 22 major administrative units comprising of 21 aimags and the capital city of Ulaanbaatar. All are governed by 'Khurals', or elected bodies. Aimag populations range between 12,500 and 122,000 people. They also vary in size with the largest covering as much as 165.4 square kilometres of territory. An aimag consists of up to 27 'soums', including the aimag centre. Soums in turn are comprised of 'baghs'. In Mongolia there are 331 soums and 1550 baghs. Also the capital city,Ulaanbaatar, is subdivided into 121 districts called 'khoroos'.

In the country, the aimag centre is the administrative seat of local government, and the home of the aimag's legal bodies, theatres, hospitals, businesses, schools and industry. Most of the aimag population work in light industry, services and small business enterprises. Bagh populations tend to work in agricultural and animal husbandry. Baghs residents mainly lead a nomadic life. They migrate with their herds depending on the change in season and weather conditions. Typically their seasonal camps are located within the borders of their soum and baghs, though droughts, dzuds, and other natural disasters, can push them to different areas.

In Aimags, the capital city, Soums and Duuregs there shall be Khurals (Assemblies) of representatives of the citizens of respective territories;

In Baghs and Khoroos - general meetings of citizens.

between the sessions of the Khurals and general meetings their Presidiums shall assume administrative functions.

Khurals of Aimags, the capital city, Soums and Duuregs enjoy considering and deciding all problems, which do not depend on higher stage of Khurals or other organizations, in its territory. The main form of local self-government is the Khural. In between the sessions of the Khural and general meetings the presidiums shall assume administrative functions. The memberships of the Khurals as well as those of aimags, the capital city, soums and duuregs, baghs and Khoroos are different. For example: In aimags and the capital city Khurals' Presidium of Representatives of Citizens is composed of 5-9 members, whereas, in soums and duuregs 5-7 and in baghs and horoos 3-5 members, including the chairman and secretary respectively. Regular meeting of the Khurals of

Aimags, the capital city, Soums and Duuregs shall be convened once every year and of the Khurals of Baghs and Khoroos shall be convened less than twice every year.

1.4 Demographic data

Mongolia is a parliamentary republic. The president is directly elected. The people also elect the deputies in the national assembly, the State Great Khural, which chooses the prime minister, who nominates the Cabinet in consultation with the president. The Khural confirms the ministers.

Mongolia is divided into 21 provinces (aimags), which are in turn divided into 329 districts (sums). The capital Ulaanbaatar is administrated separately as a capital city (municipality) with provincial status.

Number of population 2009-2012

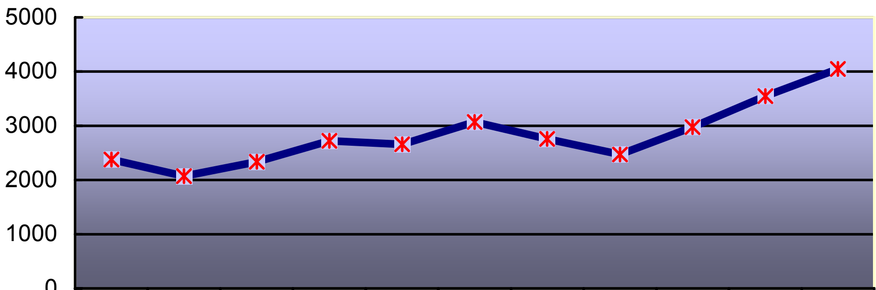
Area	2009	2010	2011	2012
Western	367.948	361.171	356.662	358.587
Khangai	523.554	522.684	522.752	526.981
Central	439.282	446.814	453.453	461.614
Eastern	188.104	187.333	187.680	189.915
Ulaanbaatar	1.172.227	1.220.620	1.265.770	1.302.615
Total	2.691.115	2.738.622	2.786.317	2.839.711

Nationality	**noun:** Mongolian(s) **adjective:** Mongolian
Ethnic groups	Mongol (mostly Khalkha) 94.9%, Turkic (mostly Kazakh) 5%, other (including Chinese and Russian) 0.1% (2000)
Religions	Buddhist Lamaist 50%, Shamanist and Christian 6%, Muslim 4%, none 40% (2004)
Languages	Khalkha Mongol 90% (official), Turkic, Russian 10% (1999)

Source: National Statistics Office of Mongolia

2. Natural hazards in Mongolia

Mongolia is a country where the following natural disasters occur frequently: meteorological such as blizzard; heavy snow; dust storm; "zud"; rain water flood; dibasic flow; snow melt flow; and others such as earthquake; wildfire; drought; and desertification.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Line 1	2377	2068	2338	2722	2659	3072	2759	2468	2976	3548	4047

Figure 2.1 Number of hazards in Mongolia /2002-2012/
Source: National Emergency Management Agency of Mongolia

A natural disaster is a natural phenomenon or phenomena occurred covering relatively large territories and leading to human casualties or substantial damages to property and causing thereby serious obstacles to smooth operation of the society. Whether this or that phenomenon is a natural disaster or not depends upon not only its intensity but much more upon its socio-economic and ecological consequences. In view of this, the issue of natural disaster shall be considered in association with the social economic situation at the level of a given country's development, the people's life styles, infrastructure development, etc. For example, the phenomenon of so called "white zud" (severe winter conditions) when pastures are snow-drifted due to heavy snowfalls taken place in winter-spring seasons is referred to the category of natural disaster only under the conditions of our country with its transhumance cattle-breeding economy and would not be regarded as a natural disaster in any other countries with the settled type of civilization.

2.1. Natural hazards likely to affect

The global warming and climate changes are possibly to become the following negative influence:

- Decrease the rainfall and increase the air temperature
- Summer rainfall types (cloudburst, gentle and continuous rain etc.) changes slowly
- The overheat will be occur during the summer season
- land degradation, increase of water evaporation
- Glaciers melts could cause and increase the sudden floods danger

As above mentioned, the frequency of the natural disaster increase the social existence, further, country's economy will still depend on environmental and climate changes.

Mongolian most populated provinces that situated near the bigger river blanks and also the nomads that move frequently around the 4 seasons, especially in fall and summer season on the mount gap, dry pebbles, valley, nearby river are causing and increasing in the flood risk.

2.2. Recent major disasters

- Flood in 2009:

Flash which occurred in 16 July 2009 in Tseel sum of Govi Altai province. 18 people killed.

- Dzud 2009-2010:

Dzud is the Mongolian term for a severe winter weather disaster that places livestock and pastoral livelihoods at risk. In the severe dzud of 2009-2010, around 20-30% of Mongolia's livestock perished, affecting the livelihoods of over a quarter of the country's human population.

A dzud, an extreme winter phenomenon with temperatures -40 -47 degrees C

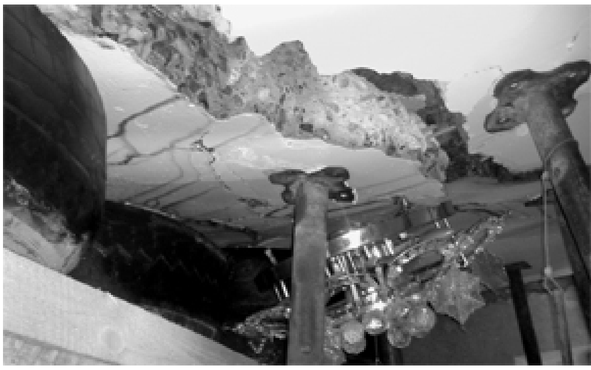
That was affected 80.9 % area of Mongolian total area. Perished 9.7 million livestock. Damage is 526 billion MNT, spent 30.2 billion MNT.

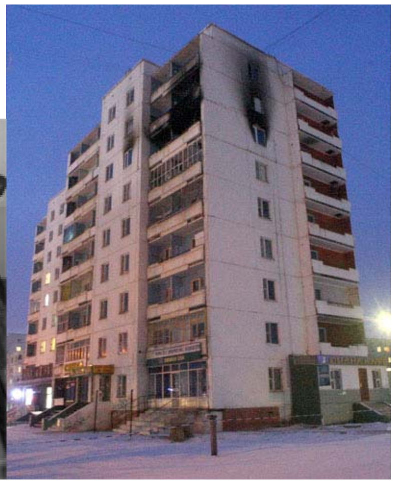
More than 1.6 million people have been affected and where 100,000 homes have been damaged.

- Explosive in 2012:

Gas 5 liter contain explosives in apartment Darkhan sum of Darkhan province in 21 January 2012.

3 person injured.Apartment Evacuated more 100 people of 33 household.





This is a ceiling

- Explosion occurred in Flour factory Darkhan sum of Darkhan province in 26 January 2012. 30 meter high 500 ton contain wheat construction destroyed to explosive. One person injured.

This is Flour factory

- Steppe fire in 2012:

Fires occurred Bayandun soum of Dornod province in 4 May 2012.

4 firefighters killed when they was work to extinguish. 1 firefighter injured.

3. Disaster Management system

The Law on Disaster Protection was created in June 2003. In the Mongolian Constitution Article 6-(4) stipulates that the State regulates the economy of the country with a view to ensure economic security of the nation, the development of all modes of production, and social development of the population. There are laws on civil defense, air pollution, use of water resource, hydro-meteorology and environmental monitoring.

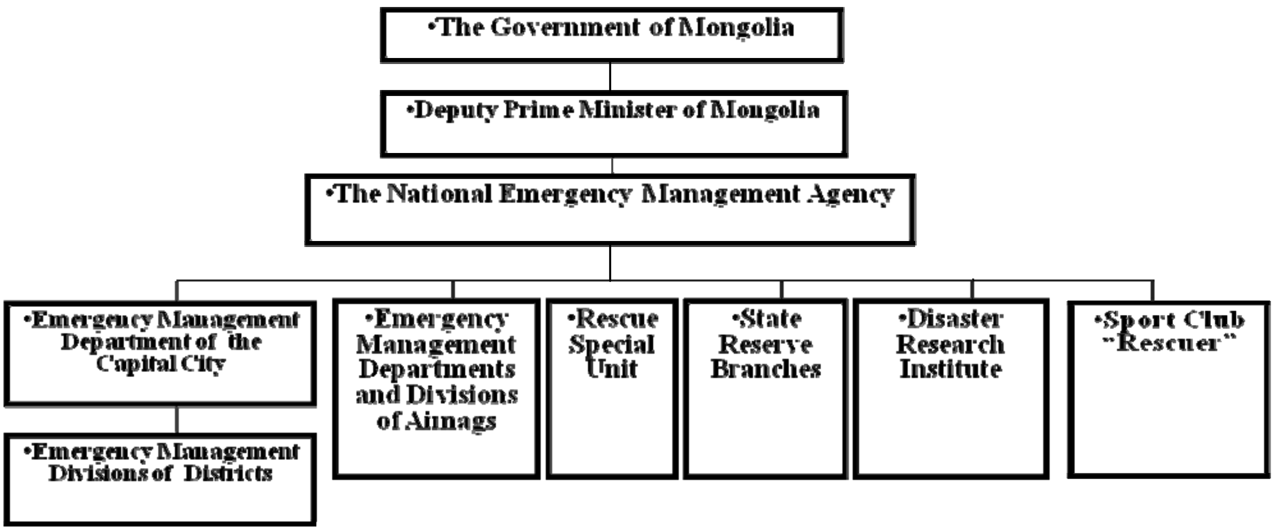


Chart 1. Structure of Emergency Management Service's organization

Source: National Emergency Management Agency of Mongolia

3.1. Legal system and Framework

The Law on Disaster Protection was approved by the Parliament of Mongolia on 20 June, 2003. Following the Law on Disaster Protection, Mongolian Government established the National Emergency Management Agency (NEMA) on 7 January, 2004. According to the Law on Disaster Protection, NEMA is responsible for implementation of the State disaster protection policy and legislation, as well as for the professional organization of nation wide activities.

The role of the National Emergency Management Agency of Mongolia is defined primarily by four basic laws: 1) The Law on Disaster Protection, 2) Law on Fire Safety, 3) The Law on State Reserve. It is through these four major laws and other emergency directives that NEMA will be called on to provide oversight, coordination and direct assistance in the event of a major catastrophe.

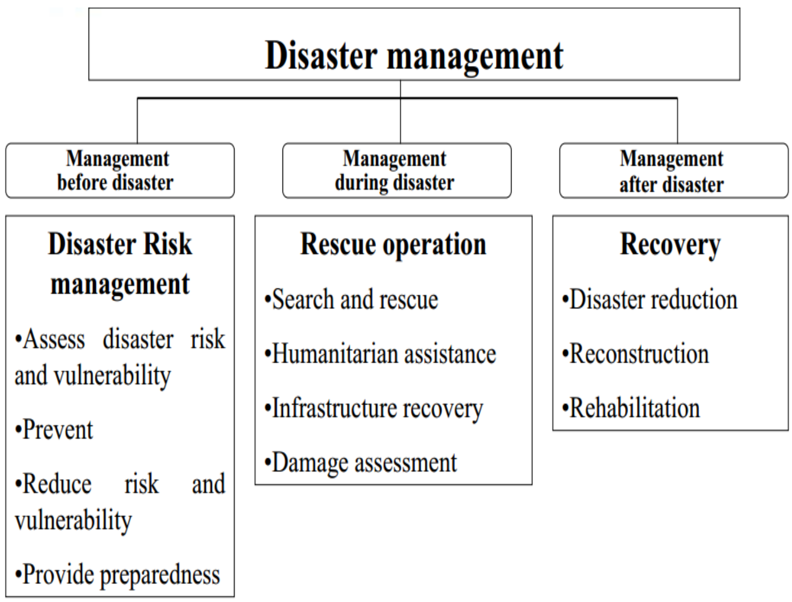
Amended Laws:
•Law on Government of Mongolia;
•Law on Management and Financing of State Agency;
•Law on State service;
•Law on Pension and Benefits of Military Serviceman etc.
The Earthquake Preparedness plan has been developed by the National Emergency Management Agency of Mongolia and the National Research Center of Astronomy and Geophysics, and approved by the Government in 2010.

Legal Documents:
•On implementation activities of Law on Disaster Protection
•On Establishment of State Disaster Protection Service
•On Approving Personnel of State Emergency commission and its activities
•On Emergency service day
•Program on Strategy and Structure changes of NEMA
•Rule of NEMA
•Rule of Internal Affairs of NEMA
•Regulation on Guard service of NEMA
•Regulation on Parade
•Regulation on Discipline

3.2. Structure of Disaster management

The state administrative organization in charge of disaster protection is the organization responsible for the implementation of the state disaster protection policy and the legislation on disaster protection and the organization of nation-wide disaster protection activities and provision with professional management.

The disaster protection resources shall be emergency management institution, disaster protection state services, entities and enterprises and specialized units and volunteers (from the Law on Disaster Protection).

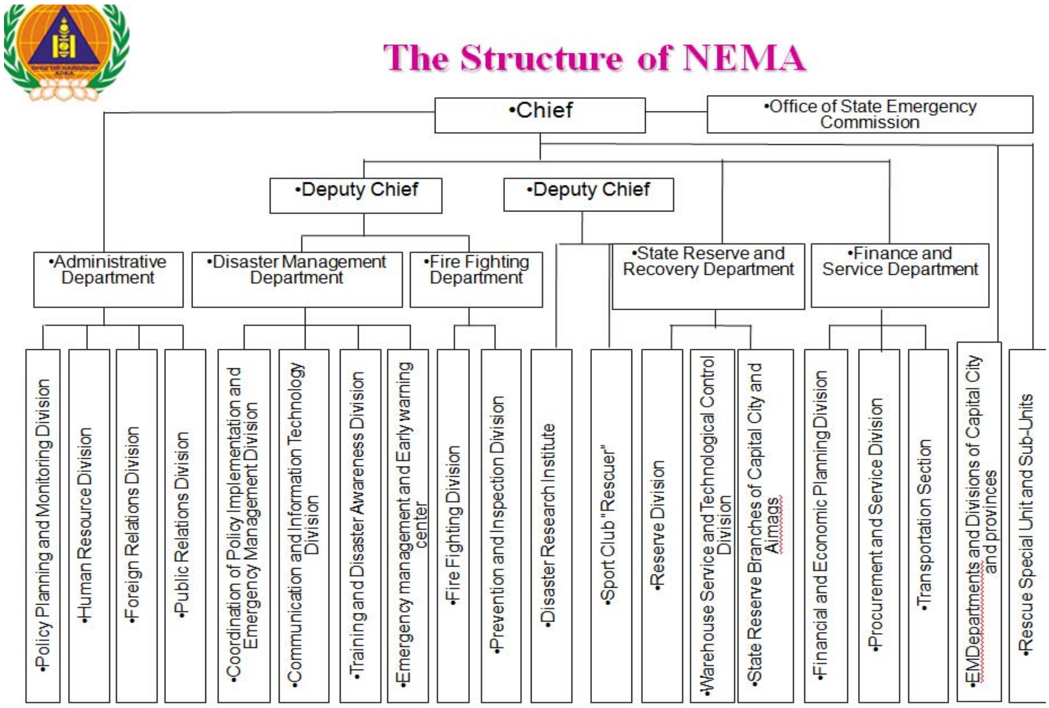


Source: National Emergency Management Agency of Mongolia

Emergency resources
National emergency management agency

Totally 3299 emergency personnel (rescuers and firefighters) nationwide working in a local emergency management divisions or departments.

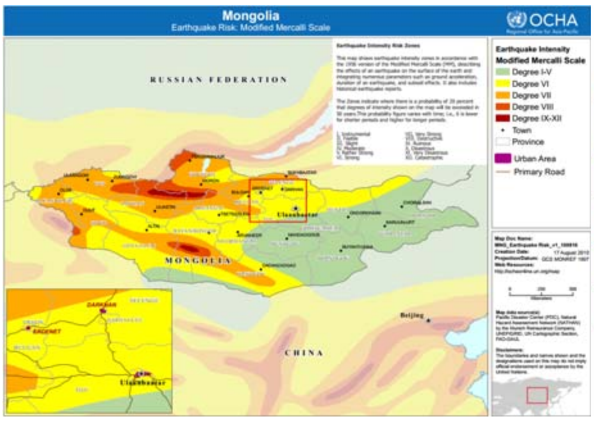
- On duty Emergency Motor Depot where the emergency trucks are dispatched and repaired.
- Rescue Special Unit (SAR team’s and Firefighters)
- Firefighting stations in each area
- Additional resources possibly mobilized by the Armed force in accordance with the mutual agreements.

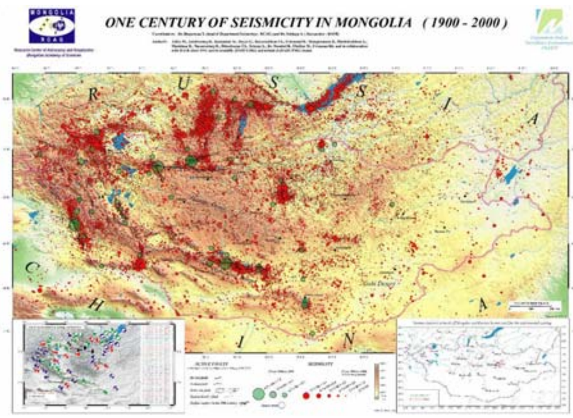


Source: National Emergency Management Agency of Mongolia

3.3. Earthquake disaster countermeasures

Mongolia has experienced four major earthquakes (Ms>8) and many more moderate earthquakes (Ms 5.3-7.5) in this century. The seismic activity in Mongolia is related to its location between the compressive structures associated with the collision of the Indian-Australian plate with the Eurasian plate on the one hand and the extensional structure associated with the Baykal rift system on the other. The historical records (1903 onward) of the seismicity in Mongolia show a high concentration of seismic activity along the Mongolian-Altay and Gobi-Altay ranges and the north western boarder with Russia and around Mogod east of Hangay mountain





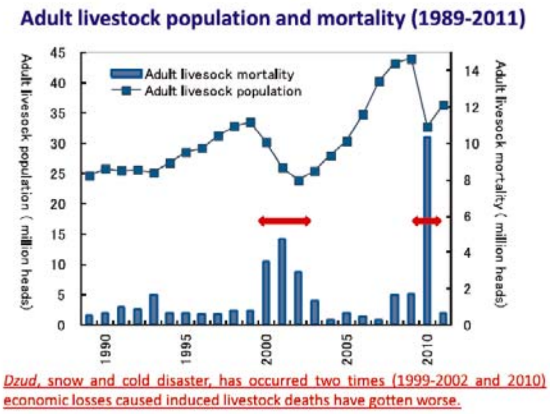
The project “Strengthening the Capacity of Earthquake Risk Reduction” is implemented by the Japan International Cooperation Agency.

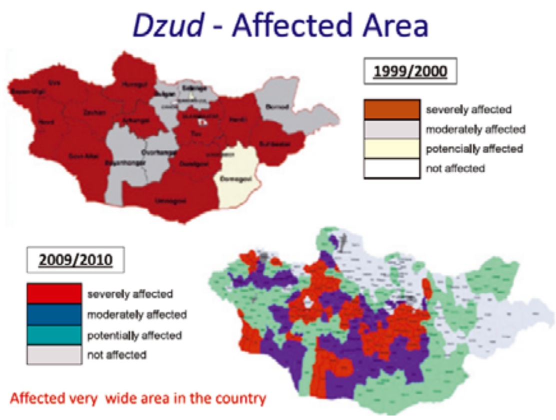
This project is aiming to enhance earthquake prevention in UB city and to increase the coordination and cooperation between government agencies as well as reinforcing the disaster response plan and jointly implemented by the Governor’s Office of the Municipality, National Emergency Management Agency, JICA, and 8 governmental organizations and 7 municipality departments as well as Science Academy of Mongolia which is 16 organization in total.

3.4. Dzud disaster countermeasures

Mongolian government is now identifying effective ways to reduce the risk of dzud and bring improvements to the animal husbandry sector. The parliament approved in 2010 the “Mongolian National Livestock Program”, which settled relevant issues and contained a comprehensive plan for the next 10 years.

First phase is in 2010-2015, second phase is in 2016-2021.





Source: National Agency Meteorology and Environmental Monitoring of Mongolia

3.5. Fire disaster countermeasures

In an average year occur the 50-60 forest fires and 80-100 steppe fires.

Since 1987 the Information and Computer Center of Ministry for Nature and the Environment daily receives the AVHRR (Advances Very High Resolution Radiometer) data from NOAA meteorological satellite, which can be used to detect and monitor the forest and steppe fire over whole territory of Mongolia.

Fire monitoring in Mongolia is essential for all kind of land-use planning and forest management. To detect and monitor wildfires and to support fire management activities with real time information on fire events is of high priority.

3.6. Disaster reduction awareness enhancement and disaster knowledge dissemination

National emergency management agency organized many kind of training. For example:

- "International Fire Forum" organized in cooperation with NEMA and FDMA, Japan in 2011
- "Incident Command System" training organized by the USA Forest Service in 2012.
- NEMA and Forest Unit joint training “Accident management system” in Bulgan province in 2013.
- "10th Meeting on Regional Consultative Committee on Disaster Management" organized in 2013 in cooperation with NEMA and ADPC

3.7. Improvement of environment for disaster reduction volunteer activities

"Transferring Earthquake Preparedness Measures of Japan and Conducting Evacuation Drills" project implemented in National emergency management agency in 2010-2011.

Project activities:

1. Preliminary Meeting in Mongolia
2. Study Tour in Japan for the official of NEMA, the implementing agency
3. Trainings and Workshops in Mongolia
   - Training for officials of National emergency management agency (NEMA) "Basic knowledge of earthquake & disaster management"
   - Training for school teachers "Basic knowledge for earthquake preparedness education"
   - Lectures for students "Basic knowledge for earthquake preparedness"
   - Evacuation Drill
   - Disaster Management Exercise with Fun "Iza! Kaeru Caraban!"

3.8. Disaster reduction activities of corporations

"Strengthening the Disaster Mitigation and Management System in Mongolia" is a project co-implemented by UNDP and the National Emergency Management Agency (NEMA) in 2002-2011.

The overall project goal is to contribute to the sustainability of the country's development gains by reducing risks and vulnerabilities through enhanced government capacity, and wider partnerships with other sectors and regions.

The "Strengthening the Disaster Mitigation and Management System in Mongolia" Phase 3 (April 2008-December 2011) is the successor of Phase 2 (2005-2007; US $ 900,000) and Phase 1 (2002-2005; US $ 725,000).

Phase 3 aimed to consolidate and expand the results from Phases 1 and 2. The overall goal was to contribute to sustaining development gains of the country by reducing risks and vulnerabilities through enhanced government capacity and wider partnerships with other sectors, and regions. The principal objectives were:

1) Support implementation of the long-term strategy of Mongolia for disaster risk management to minimize vulnerability and improve preparedness;

2) Enhance institutional capacity for disaster management and emergency response;

3) Assist in adapting to climate change that adversely affects sustainable development of the country, especially those in the rural environments. Phase 3 covered NEMA's national structure including 21 aimag (province) and 9 Ulaanbaatar district branches. The number of sums involved increased from 8 to 12 representing 6 aimags (up from 4). Two districts in Ulaanbaatar were selected to pilot novel urban disaster risk management efforts.

Self-Help Groups are for Mongolia a new kind of voluntary organization of motivated citizens supported by the project in the form of a paid coordinator/facilitator and training, e.g., about risk mapping and assessment, first aid, search and rescue, firefighting, early warning, organizational development, financial management. The groups also received some equipment and materials for firefighting, communication, and public awareness raising, and one small grant to begin one or more disaster risk reduction activities according to a well-elaborated plan.

4. Disaster Management Strategy, Policy, Plan

Strategic Goal 1

A risk management policy of disaster and natural environment is reflected in the program of implementation of the government established as a result of the election and also integrated into the Governor's action of plan in the local level, as well as the 5 year term of "Comprehensive National

Development Strategy of Mongolia", which the program of implementation is revised annually.
In particular, there are more than 10 articles are included in the program of implementation of the government which is focused to reinforce the implementation of disaster prevention, risk reduction, preparedness and reducing vulnerabilities.

Strategic Goal 2

Considering the importance of strengthening the capacity of overcoming the natural and manmade disasters at the local level, the emergency management branches in each 21 aimags /administrative unit/ are functioning for disaster mitigation and also obliged to organize the activities such as disaster prevention, post-disaster early recovery, risk and vulnerability reduction, analyzing the overall disaster response operation after the disaster. The emergency management branch operates with the status of implementing agency under the local governor's office, and is state funded.
In order to protect the vulnerable groups of the population and to improve the livelihood /animal husbandry and agriculture/ of the population, and to strengthen the capacity of disaster response at the local level, the Government of Mongolia is creating partnership groups through coordinating the efforts of herder households.
In the framework of implementing the community based disaster management activities, over 40 herder partnership groups established aiming to reduce the disaster risk which involved 600 herders from 300 herder households and as a result of funding the herders with issuing the micro-loan, herders have established there own joint disaster relief fund, which strengthened their capacity of responding to disaster phenomena and livelihood is increased 10-50 percent.

Strategic Goal 3

The capacity to cope with disasters is being enhanced at the national and local levels by establishing disaster risk reduction funds with a certain amount of government investment that are to be used for recovery measure in case a major disaster hits.

Government issued rules about "Disaster early warning", "Evacuation", "Mobilization" in 2011.

Ikh hural adopted "State Disaster Protection policy", "State Programme on Strengthening the Disaster Protection Capacity" in 2011.

- State Disaster Protection policy is based on Mongolia Constitution and National Security abidance principle Mongolia legislation and International contract adherence qualified basic document.

- State Disaster Protection policy more focus on strengthening disaster management system, train public on safety living education and reduce disaster vulnerability, support efficient participation of Disaster Protection activities through local governance, agencies, private sector and local citizen, improve preparedness, in order to ensure sustainable development of country's socio-economic.

Government of Mongolia adopted resolution about Disaster protection strategy, policy and plan /in 2012-2020/.

- This plan included 5 groups:

1. Community Participation in Disaster Risk Mitigation
2. Risk assessment, analysis and disaster risk mitigation
3. Legal system upgrade
4. Early warning system upgrade
5. Disaster protection capacity strengthen

- National second plan for Community Participation in Disaster Risk Mitigation
- Government adopted to reform Disaster protection national 13 services in 2012.
  Added Mining and Population and social protection services

Chapter 2. Disaster Management System in Japan

1. General Information

Japan is an island nation in East Asia. Located in the Pacific Ocean, it lies to the east of the Sea of Japan, People's Republic of China, North Korea, South Korea and Russia, stretching from the Sea of Okhotsk in the north to the East China Sea and Taiwan in the south. The characters that make up Japan's name mean "sun-origin", which is why Japan is sometimes referred to as the "Land of the Rising Sun".

Japan consists of forty-seven prefectures, each overseen by an elected governor, legislature and administrative bureaucracy. Each prefecture is further divided into cities, towns and villages.

Japan has a total of 6,852 islands extending along the Pacific coast of Asia. The main islands, from north to south, are Hokkaidō, Honshū, Shikoku and Kyūshū. The Ryūkyū Islands, including Okinawa, are a chain to the south of Kyūshū. Together they are often known as the Japanese Archipelago. About 73 percent of Japan is forested, mountainous, and unsuitable for agricultural, industrial, or residential use. As a result, the habitable zones, mainly located in coastal areas, have extremely high population densities. Japan is one of the most densely populated countries in the world.

The islands of Japan are located in a volcanic zone on the Pacific Ring of Fire. They are primarily the result of large oceanic movements occurring over hundreds of millions of years from the mid-Silurian to the Pleistocene as a result of the subduction of the Philippine Sea Plate beneath the continental Amurian Plate and Okinawa Plate to the south, and subduction of the Pacific Plate under the Okhotsk Plate to the north. Japan was originally attached to the eastern coast of the Eurasian continent. The subducting plates pulled Japan eastward, opening the Sea of Japan around 15 million years ago. Japan has 108 active volcanoes. Destructive earthquakes, often resulting in tsunami, occur several times each century. The 1923 Tokyo earthquake killed over 140,000 people. More recent major quakes are the 1995 Great Hanshin earthquake and the 2011 Tōhoku earthquake, a 9.0-magnitude quake which hit Japan on March 11, 2011, and triggered a large tsunami.

A major feature of Japan's climate is the clear-cut temperature changes between the four seasons. In spite of its rather small area, the climate differs in regions from a subarctic climate to a subtropical climate. The side of the country which faces the Sea of Japan has a climate with much snow in winter by seasonal winds from the Siberia. Most of the areas have damp rainy season from May to July by seasonal winds from the Pacific Ocean. Japan is frequently visited by typhoons from July to September.

2. Natural hazards in Japan

Japan is located in the circum-Pacific mobile zone where seismic and volcanic activities occur constantly. The number of earthquakes and distribution of active volcanoes is quite high. The geological formation with plate boundaries of the Pacific plate, the Philippine Sea plate, the Eurasian plate, and the North American plate make Japan an earthquake-prone country. Also because of its geographical, topographical, and meteorological conditions, it is subject to other frequent natural disasters such as typhoons, torrential rains, and heavy snow.

However, with the progress of society's capabilities to address disasters and the mitigation of vulnerabilities to disasters by developing disaster management systems, promoting national land conservation, improving weather forecasting technologies, and upgrading disaster information communications systems, disaster damage has shown remarkable declining tendency.

The disaster management system has been developed and strengthened following the bitter experiences of large-scale natural disasters and accidents.

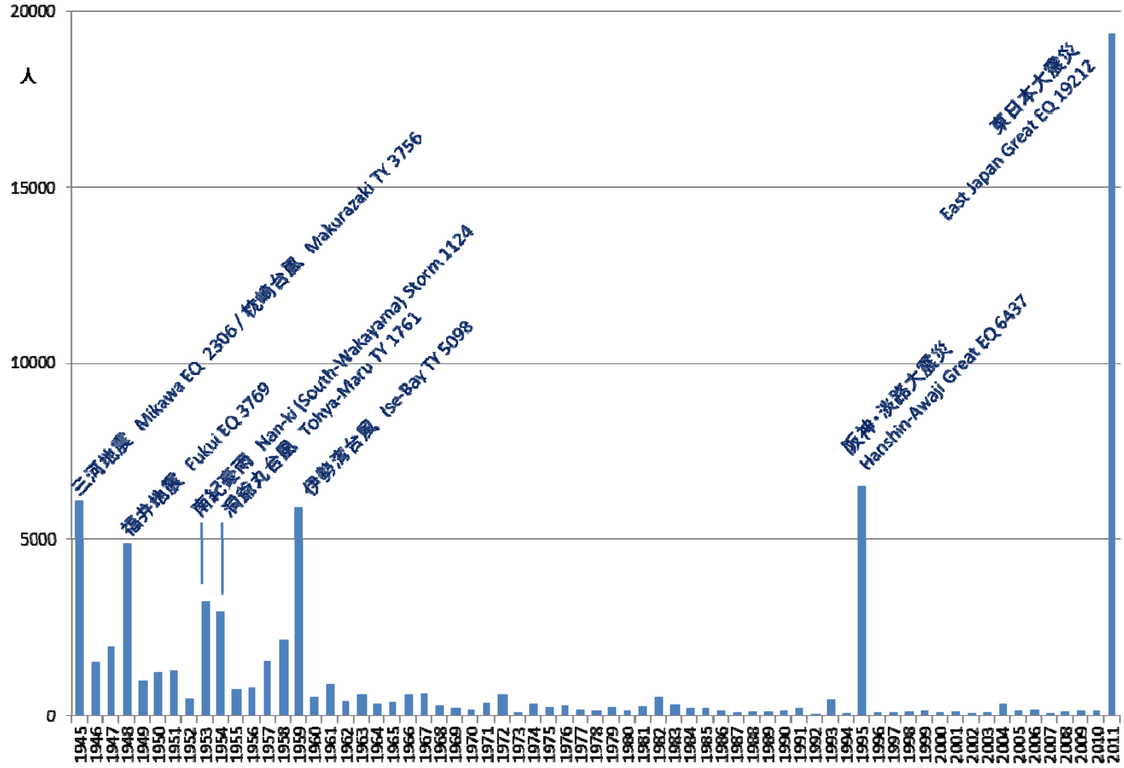
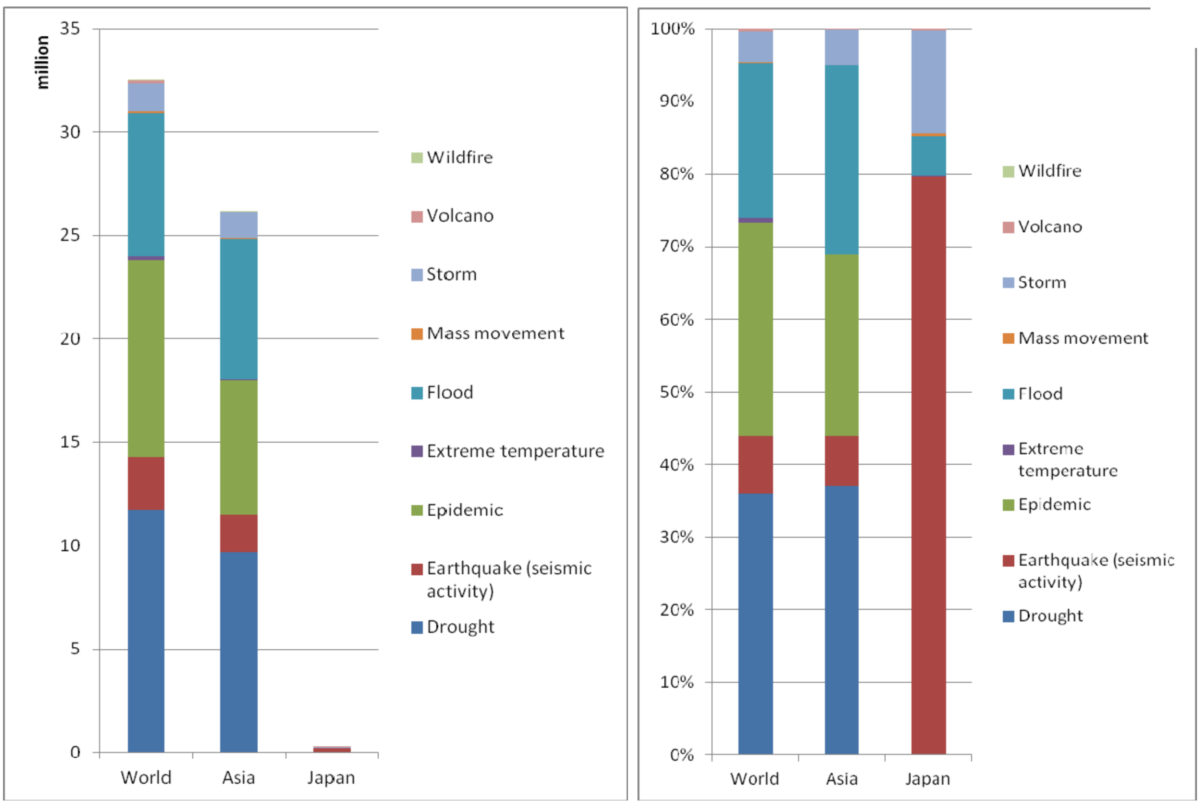


Figure 2.1. The Number of People Killed or Missed by Natural Disasters



2.2. Death Toll by Natural Hazard Type (1900 - present) Source:Lecture of disaster management in Japan

2.3 Recent Major Disasters in Japan

2.3.1 Great Hanshin-Awaji Earthquake (January 1995)

The Great Hanshin earthquake occurred on Tuesday, January 17, 1995, at 05:46 JST (January 16 at 20:46 UTC) in the southern part of Hyogo Prefecture, Japan. It measured 6.8 on the moment magnitude scale (USGS) and Mj7.3 (adjusted from 7.2) on JMA magnitude scale. The tremors lasted for approximately 20 seconds. The focus of the earthquake was located 16 km beneath its epicenter on the northern end of Awaji Island, 20 km away from the city of Kobe.

It killed 6,434 people; injured 43,792; destroyed 104,906 houses; half destroyed 144,274 houses; and partially destroyed 390,506 houses. The fires that broke out because of the earthquake burned down an area of 835,858 square meters.

2.3.2 Great East Japan Earthquake/ Tsunami (March 2011)

The 2011 earthquake off the Pacific coast of Tohoku, also known as the 2011 Tohoku earthquake or the Great East Japan Earthquake, was a magnitude 9.0 (M_w) undersea megathrust earthquake off the coast of Japan that occurred at 14:46 JST (05:46 UTC) on Friday, 11 March 2011, with the epicenter approximately 70 kilometers (43 mi) east of the Oshika Peninsula of Tohoku and the hypocenter at an underwater depth of approximately 30 km (19 mi). It was the most powerful known earthquake ever to have hit Japan, and one of the five most powerful earthquakes in the world overall since modern record-keeping began in 1900. The earthquake triggered powerful tsunami waves, which reached heights of up to 40.5 meters (133 ft) in Miyako in Tōhoku's Iwate Prefecture, and which in the Sendai area travelled up to 10 km (6 mi) inland. In addition to loss of life and destruction of infrastructure, the tsunami caused a number of nuclear accidents, primarily the ongoing level 7 meltdowns at three reactors in the Fukushima I Nuclear Power Plant complex, and the associated evacuation zones affecting hundreds of thousands of residents.

2.3.3 Typhoon No. 23 (TOKAGE) (October 2004)

Japan is an island nation, surrounded by water. Typhoons are extreme storms that can ravage the islands with high winds and storm surge.

On 20 October 2004, Typhoon No. 23 landed on Japan and caused floods and landslides triggered by record-breaking torrential rain and high wave. Ninety-five (95) people were killed; 555 injured; 909 houses were totally destroyed; more than 18,000 houses were damaged; and about 55,000 were inundated.

2.4 Disaster Management System in Japan

Disaster management in Japan is carried out at every stage of disaster prevention, emergency response to disaster, and recovery and reconstruction following disaster. A special board of inquiry of the Central Disaster Management Council has studied large-scale earthquakes such as the Tokai Earthquake, Tonankai and Nankai Earthquakes, major earthquakes centered in Tokyo, and ocean trench earthquakes occurring in the vicinity of the Japan Trench and Chishima Trench. It is to be hoped that the entire nation will join in the work of disaster preparation.

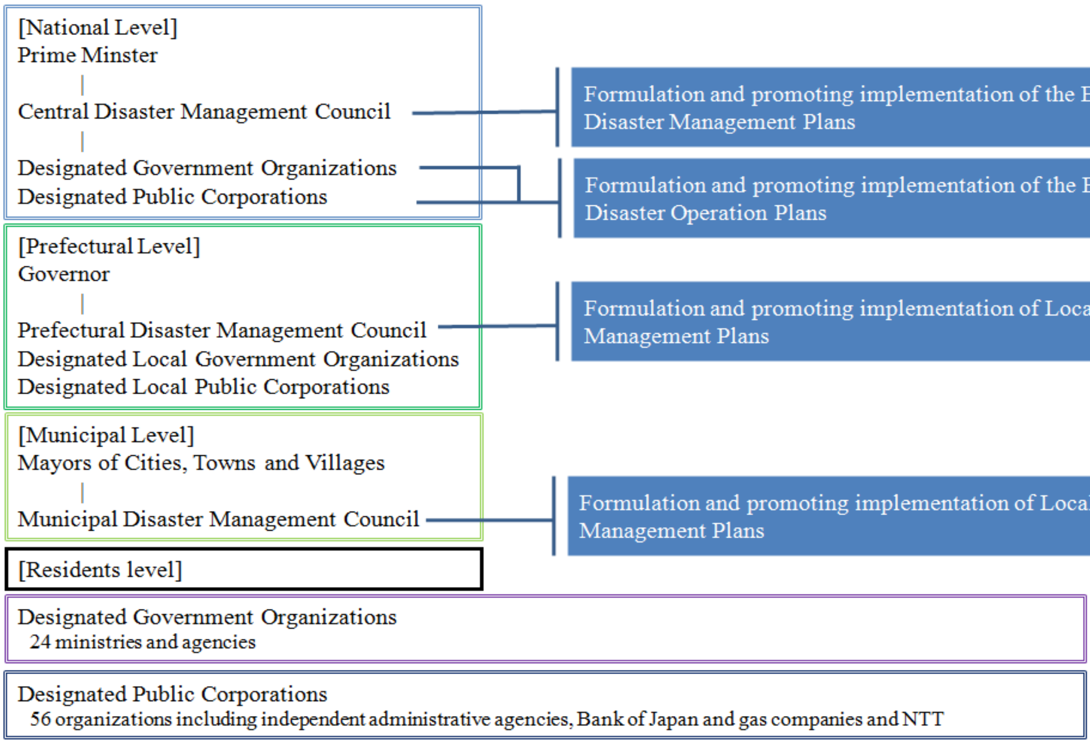


Figure 2.3. Outline of disaster management planning system
Source: Book of disaster management in japan

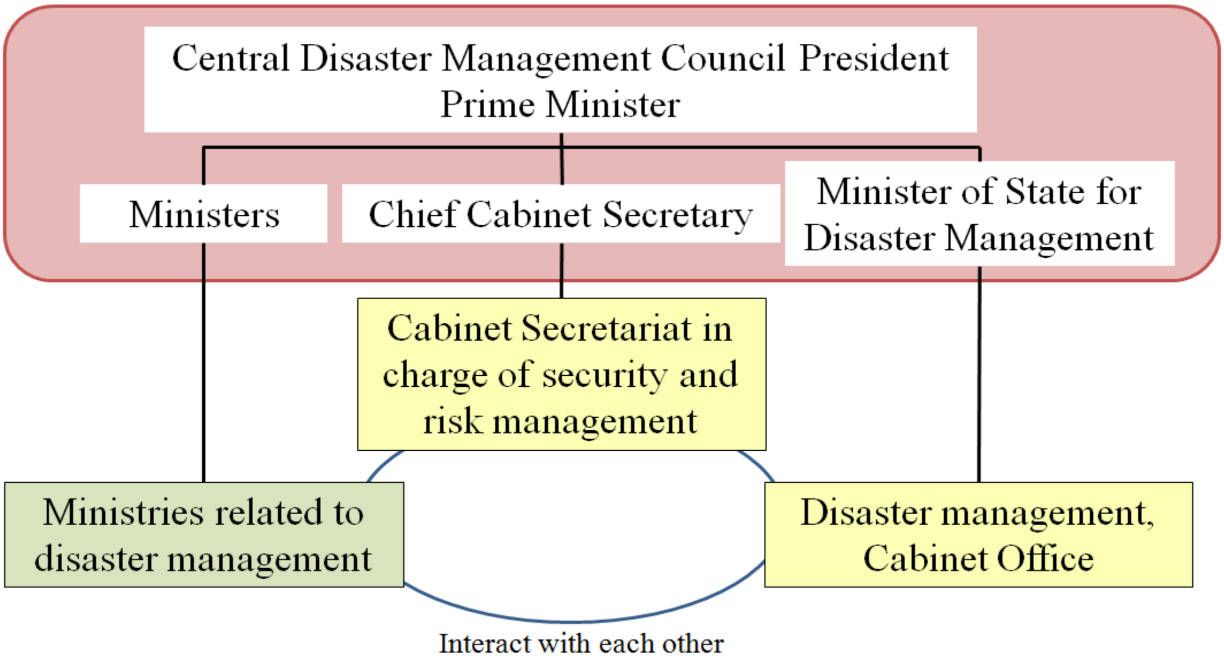
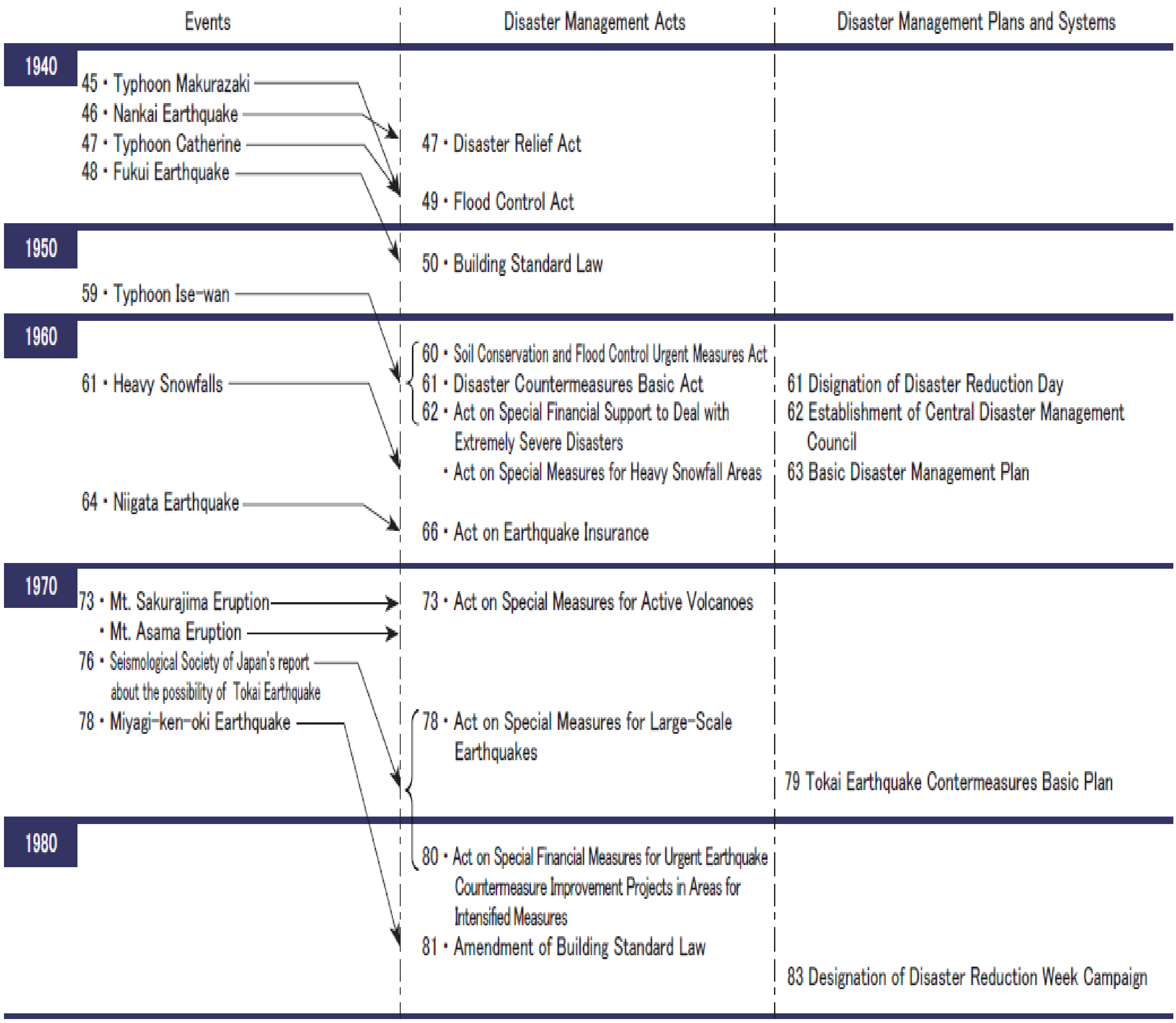


Figure 2.4. Organization of National Government *Source: Cabinet Office of Japan*

3. Progress in Disaster Management Laws and Systems

In Japan, the disaster management system has been developed and strengthened following the bitter experiences of large-scale disasters and accidents.



Year	Disasters and accidents	Laws	Plans
1990	95 • Great Hanshin-Awaji Earthquake	95 • Act on Special Measures for Earthquake Disaster Countermeasures • Act on Promotion of the Earthquake-proof Retrofit of Buildings • Amendment of Disaster Countermeasures Basic Act • Amendment of Act on Special Measures for Large-scale Earthquakes 96 • Act on Special Measures for Preservation of Rights and Profits of the Victims of Specified Disasters 97 • Act on Promotion of Disaster Resilience Improvement in Densely Inhabited Areas 98 • Act on Support for Livelihood Recovery of Disaster Victims	95 Amendment of Basic Disaster Management Plan Disignation of Disaster Reduction and Volunteer Day
	99 • Torrential Rains in Hiroshima • JCO Nuclear Accident	99 • Act on Special Measures for Nuclear Disasters	
2000	00 • Torrential Rains in the Tokai Region	00 • Act on Promotion of Sediment Disaster Countermeasures for Sediment Disaster Prone Areas 01 • Amendment of Flood Control Act 02 • Act on Special Measures for Promotion of Tohnankai and Nankai Earthquake Disaster Management 03 • Specified Urban River Inundation Countermeasures Act	01 Establishment of the Cabinet Office 03 Policy Framework for Tokai Earthquake Policy Framework for Tonankai and Nankai Earthquakes Tokai Earthquake Countermeasures Basic Plan
	04 • Niigata-Fukushima Torrential Rains, etc. 04 • Niigata-ken-Chuetsu Earthquake	04 • Act on Special Measures for Promotion of Disaster Management for Trenchtype Earthquakes in the Vicinity of the Japan and Chishima Trenches 05 • Amendment of Flood Control Act • Amendment of Act on Promotion of Sediment Disaster Countermeasures for Sediment Disaster Prone Areas • Amendment of Act on Promotion of the Earthquake-proof Retrofit of Buildings 06 • Amendment of Act on the Regulation of Residential Land Development	04 Tonankai and Nankai Earthquake Countermeasures Basic Plan 05 Tokai Earthquake Disaster Reduction Strategy Tonankai and Nankai Earthquake Disaster Reduction Strategy Policy Framework for Tokyo Inland Earthquakes 06 Policy Framework for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches Tokyo Inland Earthquake Disaster Reduction Strategy Basic Framework for promoting a Nationwide Movement for Disaster Reduction 08 Disaster Management Strategy for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches 09 Chubu and Kinki regions Inland Earthquake Countermeasures Basic Plan

伊勢湾台風，1959 Ise-wan Typhoon, 1959
写真提供：岐阜県 Photo: Gifu Prefecture

長崎豪雨災害，1982 Torrential Rains in Nagasaki, 1982
写真提供：長崎市 Photo: Nagasaki City

Figure 3.1. *The experiences of large-scale natural disasters and accidents*
Source: Book of disaster management in Japan

Disaster countermeasures are taken based on the Disaster Countermeasures Basic Act and various disaster management related laws.

Basic Acts

1) Disaster countermeasures Basic Act (1961)
2) Act on Prevention of Marine Pollution and Maritime Disaster (1970)
3) Act on Disaster Prevention in Petroleum Industrial Complexes and other Petroleum Facilities (1975)
4) Act on Special Measures for Large-scale Earthquakes (1978)
5) Act on Special Measures for Nuclear Disasters (1999)
6) Act on Special Measures for Promotion of Tonankai and Nankai Earthquake Disaster Management (2002)
7) Act on Special Measures for Promotion of Disaster Management for Trench-type Earthquake in the Vicinity of the Japan and Chishima Trenches (2004)

Disaster Prevention and Preparedness

1) Erosion Control Act (1897)
2) Building Standard Law (1950)
3) Forest Act (1951)
4) Act on Temporary Measures for Disaster Prevention and Development of Special Land Areas (1952)
5) Meteorological Services Act (1952)
6) Seashore Act (1956)
7) Landslide Prevention Act (1958)
8) Act on Special Measures for Disaster Prevention in Typhoon-prone Areas (1958)
9) Act on Special Measures for Heavy Snowfall Areas (1962)
10) River Act (1964)
11) Act on Prevention of Steep Slope Collapse Disaster (1969)
12) Act on Special Measures for Active Volcanoes (1973)
13) Act on Special Financial Measures for Urgent Earthquake Countermeasures Improvement Projects in Areas for Intensified Measures (1980)
14) Act on Special Measures for Earthquake Disaster Countermeasures (1995)
15) Act on Promotion of the Earthquake-proof Retrofit of Buildings (1995)
16) Act on Promotion of Disaster Resilience Improvement in Densely Inhabited Areas (1997)
17) Act on Promotion of Sediment Disaster Countermeasure for Sediment Disaster Prone Areas (2000)
18) Specified Urban River Inundation Countermeasures Act (2003)

Disaster Emergency Response

1) Disaster Relief Act (1947)
2) Fire and Disaster Management Organization Act (1947)
3) Japan Coast Guard Act (1948)
4) Fire Services Act (1948)
4) Flood Control Act (1949)
3) Police Act (1954)
3) Self-Defense Forces Act (1954)

Disaster Recovery and Reconstruction

1) Forest National Insurance Act (1937)
2) Act on Temporary Treatment of Rental Land and Housing in Cities (1946)
3) Agriculture Disaster Compensation Act (1947)
4) Act on Interim Measures for Subsidizing Recovery Projects for Agriculture, Forestry and Fisheries Facilities Damaged Due to Disasters (1950)
5) Small-Medium Business Credit Insurance Act (1950)
6) Act on National Treasury Share of Expenses for Recovery Projects for Public Civil Engineering Facilities Damaged Due to Disasters (1951)
7) Public Housing Act (1951)
8) Fishing Boat Damage Compensation Act (1952)
9) Railway Improvement Act (1953)
10) Act on National Treasury Share of Expenses for Recovery of Public School Facilities Damaged Due to Disasters (1953)

11) Act on Interim Measures for Financing Farmers, Woodsmen and Fishermen Suffering from Natural Disasters (1955)
12) Airport Act (1956)
13) Small-scale Business Equipment Installation Financial Support Act (1956)
14) Act on Special Financial Support to Deal with Extremely Severe Disasters (1962)
15) Fisheries Disaster Compensation Act (1964)
16) Act on Earthquake Insurance (1966)
17) Act on Special Financial Measures for Group Relocation Promotion Projects for Disasters Mitigation (1972)
18) Act on Payment of Solatia for Disasters (1973)
19) Act on Special Measures for Reconstruction of Disaster-stricken Urban Areas (1995)
20) Act on Special Financial Measures for Reconstruction of Jointly Owned Buildings in Disaster-stricken Areas (1995)
21) Act on Special Financial Measures for Preservation of Rights and Profits of Victims of Specified Disasters (1996)
22) Act on Support for Livelihood Recovery of Disaster Victims (1998)
23) The Japan Finance Corporation Act (2007)

3.1 Establishment of Comprehensive Disaster Management System: Disaster Countermeasures Basic Act

To protect national land as well as citizens' lives, livelihoods, and property from natural disasters is a national priority. The turning point for strengthening the disaster management system came after the immense damage caused by the Ise-wan Typhoon in 1959, and led to the enactment of the Disaster Countermeasures Basic Act in 1961, which formulates a comprehensive and strategic disaster management system. The disaster management system has been further strengthened following the lessons learned from large-scale disasters such as the Great Hanshin-Awaji Earthquake.

Japan's disaster management system addresses all of the disaster phases of prevention, mitigation and preparedness, emergency response as well as recovery and rehabilitation. With clear roles and responsibilities of the national and local governments, the relevant stakeholders of the public and private sectors cooperate in implementing various disaster countermeasures.

Main Contents of the Disaster Countermeasures Basic Act

1) Definition of responsibilities for disaster management
2) Disaster management organizations
3) Disaster management planning system
4) Disaster prevention and preparedness
5) Disaster emergency response
6) Disaster recovery and rehabilitation
7) Financial measures
8) State of Disaster Emergency

3.2 Basic Legal Frameworks of Disaster Management in Japan

In applying to all of the disaster phases of prevention, mitigation and preparedness, emergency response as well as recovery and rehabilitation, relevant laws and regulations were enacted including Disaster Countermeasures Basic Act (1961) which is the cornerstone of legislation of disaster management which set out the basic for measures for disaster risk reduction, emergency response, post-disaster recovery and reconstruction. It was formulated in 1961, after the happening of Typhoon Ise-wan in 1959 that caused more than 5,000 fatalities. Following acts are the other relevant acts associated with disaster countermeasures Basic Act (1961);

- Erosion Control Act (1897), Disaster Relief Act (1947), Building Standard Law (1950)
- Landslide Prevention Act (1958), River Act (1964), and Act on Special Measures for Large-scale Earthquakes (1978).

(1) Erosion Control Act 1897:

To clearly define the responsibilities of the national and local governments and other public organizations to take necessary measures for preventing sediment-related disaster from the generation and discharge of unstable sediment due to natural events, such as heavy-rain induced landslides and river-bed erosion, to ensure a sound environment and maintain the function of river in flood control and water use, and thus to contribute to the conservation of the national land and the stability of the people's livelihood.

(2) Disaster Relief Act 1947:

The purpose of this law is to allow the national government to take necessary emergency relief measures in case of disaster in cooperation with local municipal governments, the Japan Red Cross, and other relevant organizations. Distribution of foods and drinking water, Supply of clothing, bedding, and other basic necessities, Medical and natal care, Rescue of disaster victim , Emergency repairs of housing subject to disaster, Distribution and/ or loan of funding, equipment, and materials required to maintain livelihoods, Distribution of school supplies , Interment and other matters as specified by government ordinance.

(3) Building Standard Law 1950:

In Article 39 of the law, the municipal government is allowed to designate the area with considerable risk due to tsunami, storm surge, and flood and so on as disaster prone areaǁ by its local ordinance. And it shall be determined in the above ordinance that necessary items for disaster Prevention in the disaster prone area such as prohibition against building a residence or restriction concerning to build a building.

(4) Land slide Control Act 1958:

To provide the measures for preventing landslides or slag heap collapses to avoid or mitigate damage from those hazards, and thus to contribute to the conservation of the national land and the stability of the people's livelihood.

(5) River Act 1896:

The law is to clearly define the responsibilities of the national and local governments and other public organizations to take necessary measures for comprehensive river management, through which disaster due to floods and storm surges will be prevented, rivers will be in proper use, the regular functions of river water will be maintained, and river environment will be improved and conserved, which will contribute to the conservation and development of the national land, and thus ultimately to enhance public welfare. This law specifies the administration's responsibilities about river management.

3.3 Mission of the Cabinet Office

Along with a series of reforms of the central government system in 2001, the post of Minister of State for Disaster Management was newly established to integrate and coordinate disaster reduction policies and measures of ministries and agencies. In the Cabinet Office, which is responsible for securing cooperation and collaboration among related government organizations in wide-ranging issues, the Director-General for Disaster Management is mandated to undertake the planning of basic disaster management policies and response to large-scale disaster, as well as conduct overall coordination.

Additionally, taking into account the lessons learned from the Great Hanshin-Awaiji Earthquake, the Cabinet Secretariat system was also strengthened, including the appointment of the Deputy Chief Cabinet Secretary for Crisis Management and the establishment of the Cabinet Information Collection Center, to strengthen risk management functions to address emergencies such as large-scale disasters and serious accidents. Thereby, the Cabinet Office has a role in supporting the Cabinet Secretariat regarding disaster management matters.

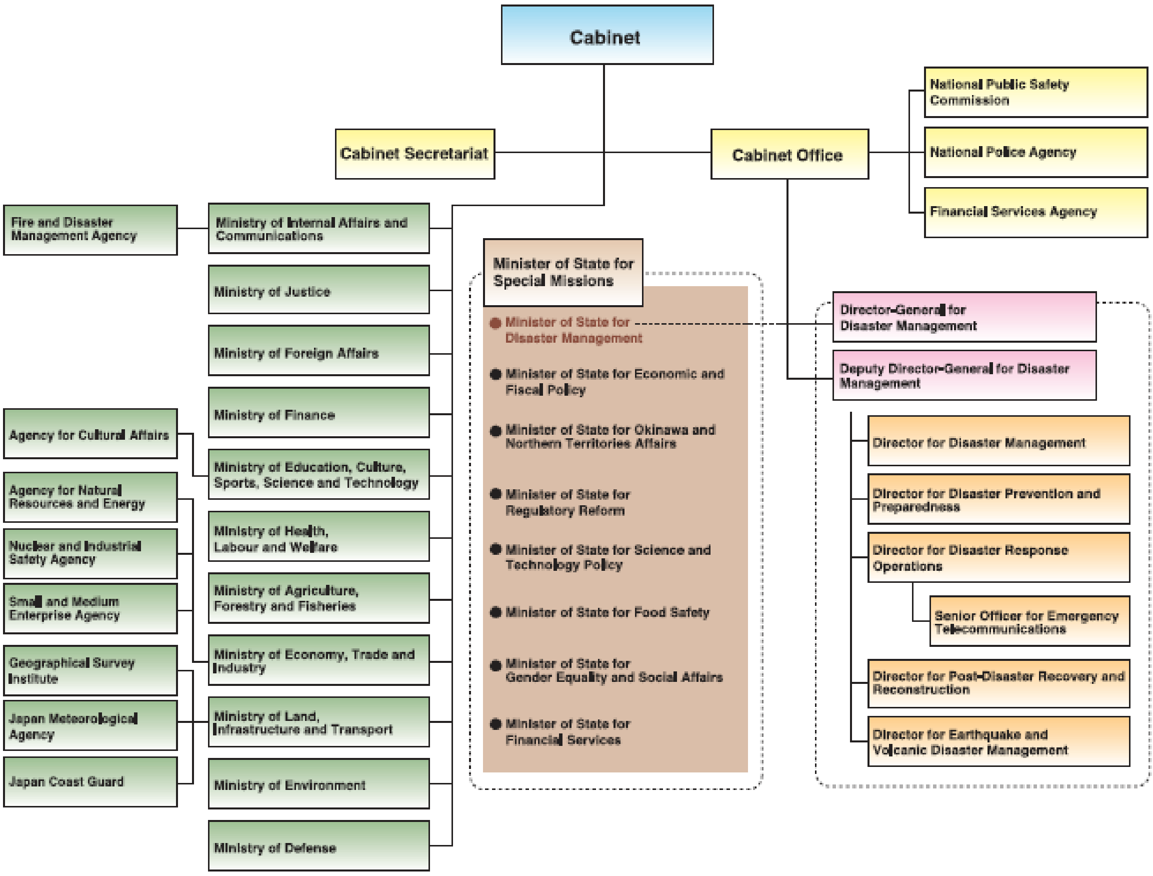


Figure 3.2. Organization of National Government and Cabinet Office (Disaster management)
Source: Cabinet Office, Government of Japan

3.4 Central Disaster Management Council

The Central Disaster Management Council is one of the councils that deal with crucial policies of the Cabinet, and is established in the Cabinet Office based on the Disaster Countermeasures Basic Act. The council consists of the Prime Minister, who is the chairperson, Minister of State for Disaster Management, all ministers, heads of major public institutions and experts. The council promotes comprehensive disaster countermeasures including according to requests from the Prime Minister or Minister of State for Disaster Management.

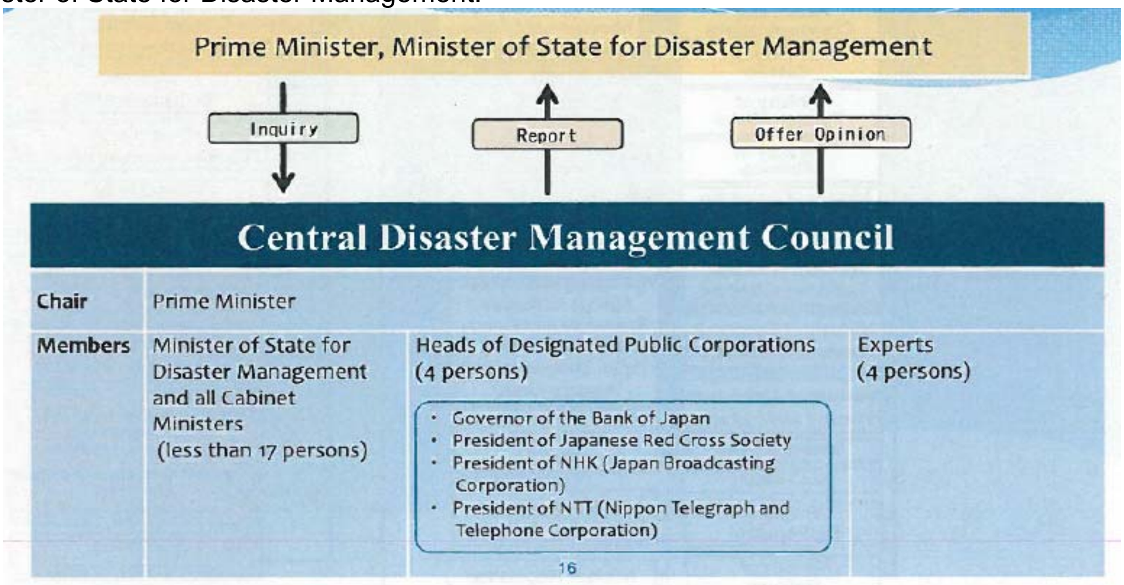


Figure 3.3. Structure of Central Disaster Management Council
Source: Cabinet Office, Government of Japan

3.5 Disaster Management Planning System

Disaster Management Planning System

1) Basic Disaster Management Plan: This plan is a basis for disaster reduction activities and is prepared by the Central Disaster Management Council based on the Disaster Countermeasures Basic Act.

2) Disaster Management Operation: This is a plan made by each designated government organization and designated public corporation based on the Basic Disaster Management Plan.

3) Local Disaster Management Plan: This is a plan made by each prefectural and municipal disaster management council, subject to local circumstances and based on the Basic Disaster Management Plan.

Basic Disaster Management Plan

The Basic Disaster Management Plan states comprehensive and long-term disaster reduction issues such as disaster management related systems, disaster reduction projects, early and appropriate disaster recovery and rehabilitation, as well as scientific and technical research.

The plan was revised entirely in 1995 based on the experience of the Great Hanshin-Awaji Earthquake. It now consists of various plans for each type of disaster, where tangible countermeasures to be taken by each stakeholder such as the national and local governments, public corporations and other entities are described for easy reference according to the disaster phases of prevention and preparedness, emergency response, as well as recovery and rehabilitation.

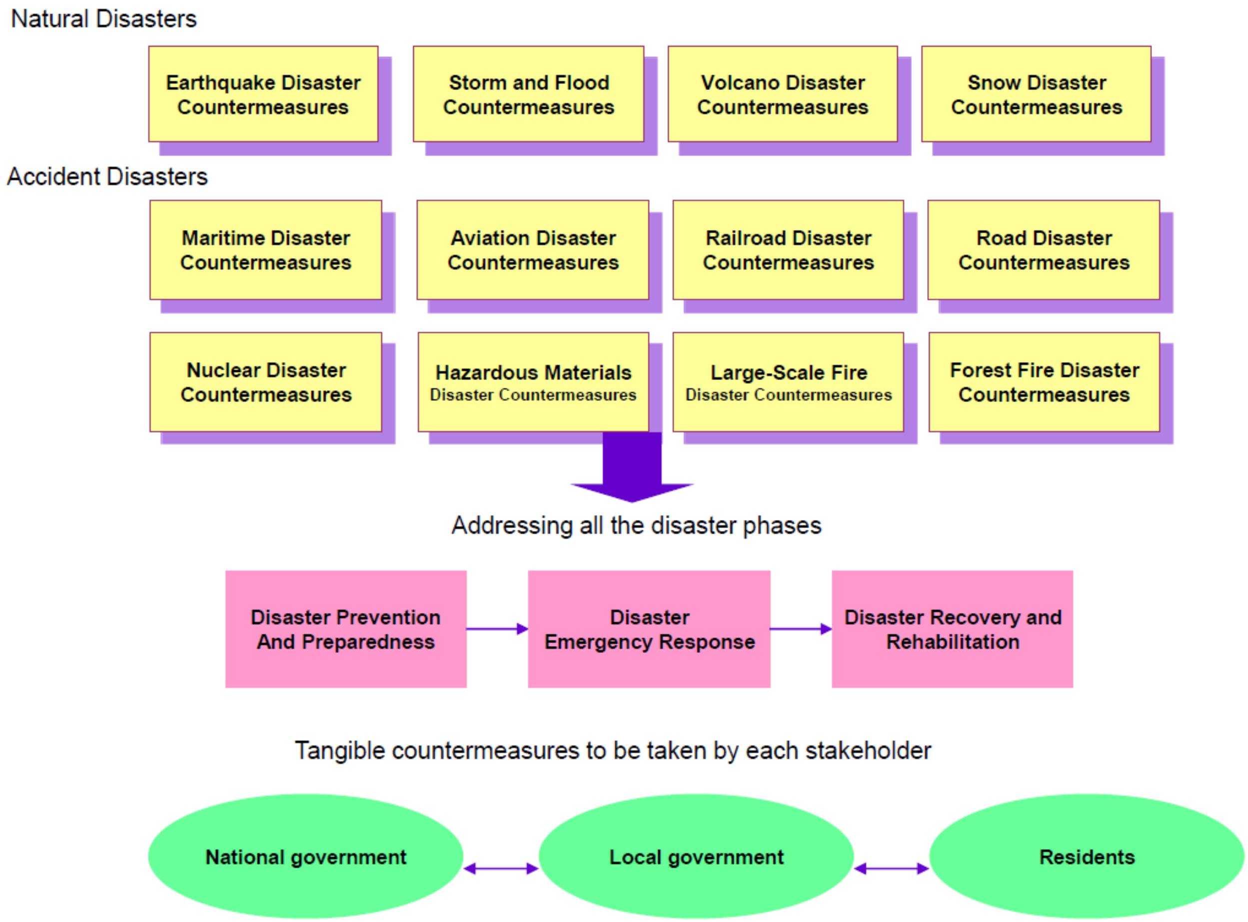


Figure 3.4 Structure of basic disaster management plan
Source: Book of disaster management in Japan

3.6 Disaster Management Structure

Disaster Management of Japan is categorized into 3 levels including national, regional and municipal level. The significance of each level is delineated as follows:

1) National Level: The Prime Minister is the National Commander through the National Disaster Management Council, and the designed government organizations (23 ministries and agencies), and designated public cooperation (63 organizations including independent administrative agencies, Bank of Japan, Japanese Red Cross Society, NHK, electricity and gas companies and NTT). In this connection, the national council is responsible for formulation and promoting the implementation of the Basic Disaster Management Plan. Meanwhile, the other two designed agencies of government and public cooperation are responsible for formulation and implementation of the Disaster Management Operation Plan.

2) Prefectural Level: The Governor is the commander ordering via the Prefectural Disaster Management Council, and designed government organization and public corporations in local. The prefectural council will conjunctionally work with the mentioned designed agencies to formulate and promote the implementation of Local Disaster Management Plan.

3) Municipal Level: In this level, the Mayor of City, Town and Village is the commander, as the same of Governor in prefectural level, will take function through Municipal Disaster Management Council to formulate and promote the implementation of Local Disaster Management Plan.

3.7 Earthquake Disaster Countermeasures

(1) Earthquake Disasters in Japan

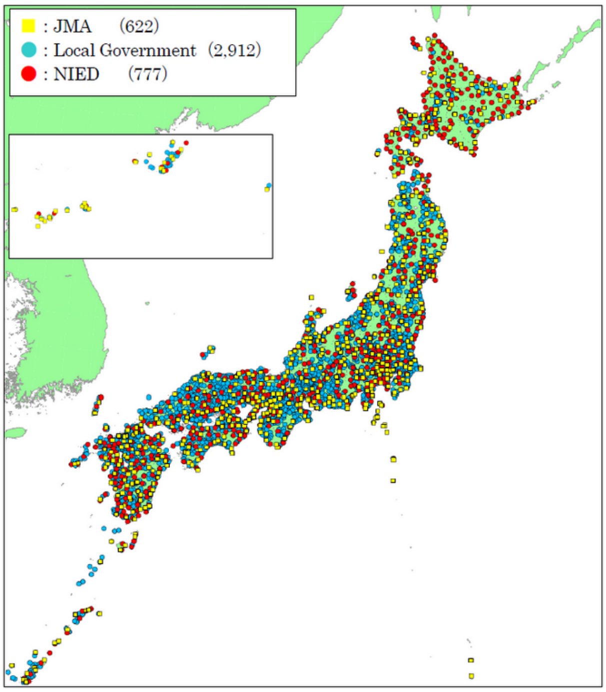
Japan is located at a point on the earth's surface where four of more than 10 tectonic plates covering the globe are crushed against each other, making it earthquake prone. More than 20% of the world's earthquakes (magnitude 6 or greater) have occurred in or around Japan.

Japan is well acquainted with the massive inter-plate earthquakes produced by plate subduction (such as the Great Kanto Earthquake of 1923) and the inland crustal earthquakes caused by plate movements (such as the Great Hanshin-Awaji Earthquake of 1995)

(2) Observation system

In order to constantly monitor seismic activity, the Japan Meteorological Agency ((JMA) and other relevant organizations install and maintain seismometers that are used for estimating the location of the epicenter and magnitude of an earthquake as well as for tsunami warnings, and seismic intensity meters that measure the intensity of ground motion, in numerous places nationwide. As soon as an earthquake occurs in or around Japan, the JMA analyzers P-wave at seismometers placed close to the hypocenter. If an earthquake of intensity 5 or greater is forecasted, Earthquake Early Warning (EEW) information is issued. Within about two minutes, it issues a seismic intensity information report for earthquakes of intensity 3 or greater, and within about five minutes issues an earthquake information report indicating the epicenter and magnitude of the earthquake and the seismic intensity in the municipalities where strong shaking was observed.

Source: Japan Meteorological Agency



Sites of seismic intensity meters (as of January 5, 2012)

To monitor earthquakes, JMA operates an earthquake observation network comprised of about 200 seismographs and 600 seismic intensity meters. It also collects data from over 3,600 seismic intensity meters managed by local governments and the National Research Institute for Earth Science and Disaster Prevention (NIED).

When an earthquake occurs, JMA immediately issues information on its hypocenter, magnitude and observed seismic intensity.

Regarding trench-type earthquakes, based on the related laws and regulations, appropriate actions where various countermeasures need to be strengthened, the reinforcement of observation systems, and the formulation of a plan of action by relevant government organizations and private corporations. In addition, preparations such as improvements in evacuation sites and firefighting facilities are being promoted based on laws specifying special financial measures.

With regard to each large-scale earthquake, including the Tokyo Inland Earthquake, the Central Disaster Management Council has conducted examinations to clarify the characteristics of the earthquake, estimate the damage and identify necessary countermeasures. The following set of plans and strategies for each large-scale earthquake are now being developed: the "Policy Framework," a master plan that includes a range of activities from preventive measures to post-disaster response and recovery; the **"Earthquake Disaster Reduction Strategy, "**to determine an overarching goal of damage mitigation and strategic targets based on the damage estimation; and the **"Guidelines for Emergency Response Activities,"** which describes the actions to be taken by related organizations. It is necessary to keep working on countermeasures nationwide, as has been witnessed by the examples of the major earthquakes of Hanshin-Awaji and Niigata-ken-Chuetsu, because such a disaster can occur anywhere in Japan. Committee on Earthquake Disaster Reduction in Local Cities is examining possible countermeasures.

(4) Countermeasures against Tokai Earthquake

Strain on the earth's crust along the Suruga Trough has been building up for approximately 160 years, ever since the Ansei-Tokai Earthquake in 1854. Therefore, it is believed that there is a high possibility of a Tokai Earthquake occurring.

A Tokai Earthquake is the only earthquake at present with a possibility of being predicted just before it occurs. The areas for intensified measures against earthquakes (160 municipalities in eight prefectures as of April 2010) were designated under the **Act on Special Measures for Large-scale Earthquakes**, where the observation system has been reinforced and the earthquake response system in the case of a prediction report being announced has been developed.

Data presumed to be effective for earthquake prediction are monitored in real-time by the **Japan Meteorological Agency**. Upon detecting any abnormality in the data, observation, caution and prediction information regarding an earthquake in the Tokai region will be announced. The Prime Minister will then issue a warning declaration based on the earthquake prediction report and implement necessary measures including establishment of the Earthquake Disaster Warning Headquarters.

The Central Disaster Management Council drew up the **"Earthquake Countermeasures Basic Plan"** containing basic policies for actions to be taken in response to a warning declaration based on the act, and relevant organizations have their own plans accordingly. When relevant local governments carry out urgent projects to improve facilities for mitigating possible damage caused by the Tokai Earthquake based on their own plans, special measures will be taken such as increasing national government subsidies and fiscal measures for the local governments based on the **Act on Special Financial Measures for Urgent Earthquake Countermeasure Improvement Projects in Areas for Intensified Measures."**

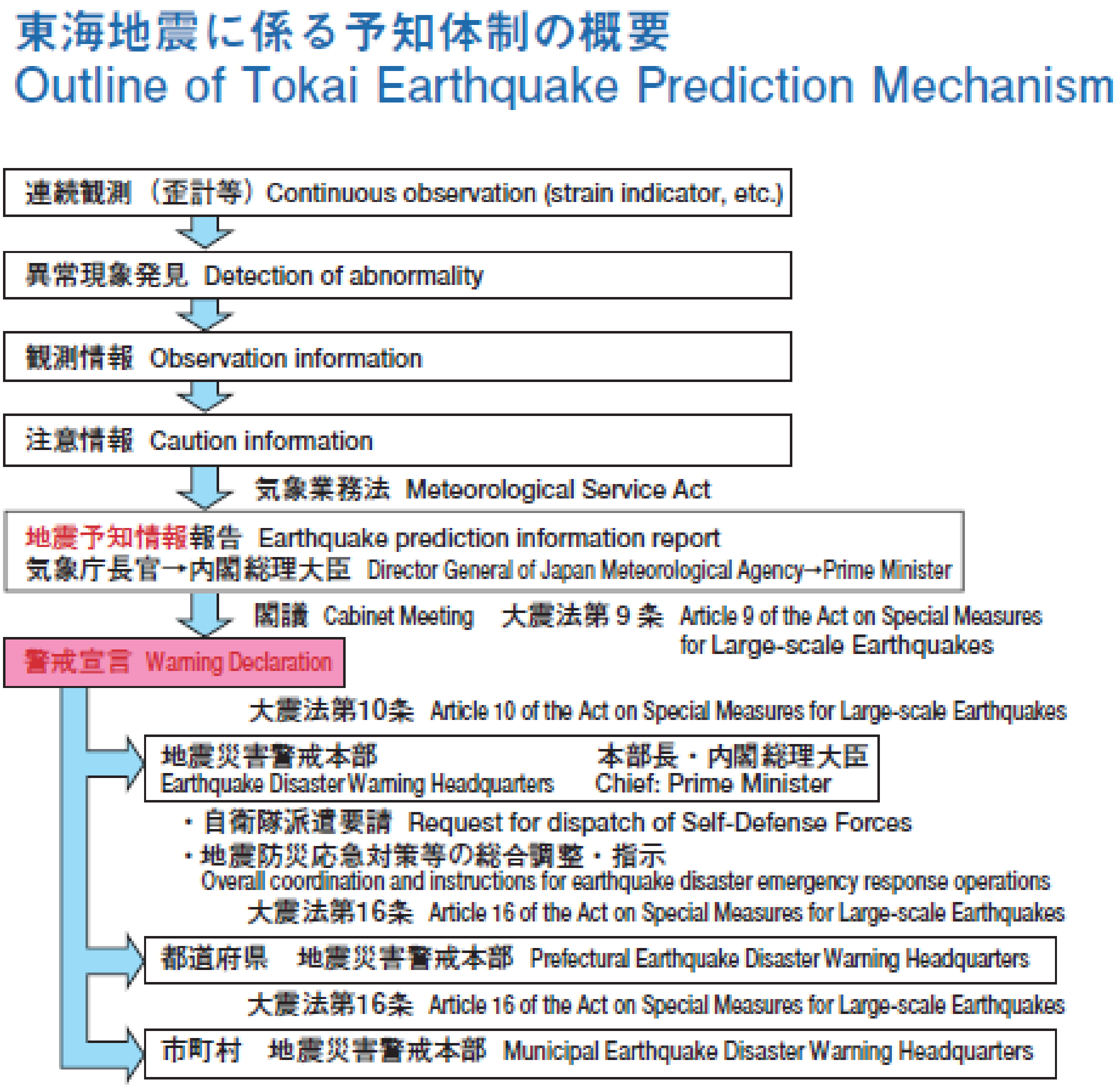
Regarding countermeasures against Tokai Earthquake, the Central Disaster Management Council reviewed the probable epicenter area in 2001, and the areas forintensified measures were expanded in 2002, based on various observation data and scientific expertise accumulated over the past quarter of a century following the enactment of the **Act on Special Measures for Large- scale Earthquakes.**

Furthermore, the Central Disaster Management Council published the outcome of its damage estimation in 2003, which made it clear that there may be extreme and wide-area damage including about 9,200 people killed in the case of no forewarning.

In the same year, the council also decided the **"Policy Framework for Tokai Earthquake,"** containing such main issues as implementation of urgent earthquake-resistant construction measures, reinforcement of community capabilities against disasters, and **establishment of a tangible disaster management system in the case of a warning declaration.**

Based on this policy framework, the Tokai Earthquake Disaster Reduction Strategy was formulated in 2005. These guidelines set clear goals: a 50% reduction in the number of deaths and the value of economic losses from earthquakes in the region and an increase in the number of earthquake-resistant homes to 90% of the housing stock, within 10 years.

Furthermore, the **"Guidelines for Tokai Earthquake Emergency Response Activities"** were formulated in 2003 (revised in 2006), and the activities of each disaster management related organization were determined in terms of each level, such as at the time of caution information, warning, declaration and disaster occurrence. Based on these guidelines, a detailed plan of action was formulated for units engaged in search and rescue, firefighting and medical activities when a warning declaration is made or an earthquake suddenly occurs.



Source: Book of disaster management in Japan

(5) Countermeasures against Tonankai and Nankai Earthquakes

Tonankai and Nankai Earthquakes with a magnitude of 8 or greater have occurred at intervals of 100 to 150 years. Most recently, the Tonankai Earthquake and Nankai Earthquake occurred in 1944 and 1946, respectively, and therefore it is anticipated that the next ones will occur in the first half of this century. The Central Disaster Management Council announced a damage estimate in 2003 after examining the possible epicenter zone, strength of tremors and distribution of tsunami wave height. It said that the maximum number of deaths could be approximately 18,000, of which about 8,600 may be attributable to tsunamis.

In the same year, the council established **the "Policy Framework for Tonankai and Nankai Earthquakes,"** the contents of which included establishing the tsunami disaster management system and wide-area disaster management support system, and promoting the planned urgent prevention countermeasures as the main items.

Additionally, based on the **Act on Special Measures for Promotion of Tonankai and Nankai Earthquake Disaster Management,** the countermeasures promotion areas for the Tonankai and Nankai Earthquakes were designated in 2003 (21 prefectures and 403 municipalities as of April

2006) . **The" Tonankai and Nankai Earthquake Countermeasures Basic Plan"** was also drafted in 2004.

The relevant organizations have their own plans accordingly.

In 2005, the Central Disaster Management Council drafted the **"Tonankai and Nankai Earthquake Disaster Reduction Strategy,"** which sets forth an overarching goal of halving the estimated deaths and economic loss within a 10-year period, as well as the strategic targets to create a tsunami hazard map in all the relevant municipalities in the same period. In 2006, **the "Guidelines for Tonankai and Nankai Earthquake Emergency Response Activities"** were drafted. In 2007, a plan was drafted to decide specific details of such activities, based on the 2006 Guidelines.

(6) Countermeasures against Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches

There have been many large-scale earthquakes of M7 or M8 scale occurring in the vicinity of the Japan Trench, extending in the oceanic areas from off of Eastern Chiba to Sanriku, and in the vicinity of the Chishima Trench, extending from the areas off Sanriku, Tokachi and Etorofu Island. There are many types of earthquakes in this area, such as the Meiji-Sanriku Earthquake Tsunami in 1889, which caused enormous damage from a giant tsunami, and the Miyagi-ken-oki Earthquake, which occurs at intervals of approximately 40 years. The Central Disaster Management Council chose eight of these earthquakes as subject matter for strengthening disaster countermeasures and examined the strength of tremors and distribution of tsunami wave height, and announced the estimated damage in 2006. In the same year, the council established the **"Policy Framework for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches,"** focusing on issues such as the promotion of tsunami disaster countermeasures, the construction of towns capable of withstanding tremors, and addressing problems unique to snowy or cold areas. Additionally, based on the **Act on Special Measures for Promotion of Disaster Management for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches,** the countermeasures promotion areas for these earthquakes were established (5 prefectures and 119 municipalities included as of April 2006), and the **"Countermeasures Basic Plan for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches"** was drafted. The relevant organizations have their own plans based on the basic plan.

These measures were followed by the drafting of the **"Guidelines for Emergency Response Activities in the Countermeasures for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches" in 2007** and the **"Disaster Management Strategy for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches" in 2008.**

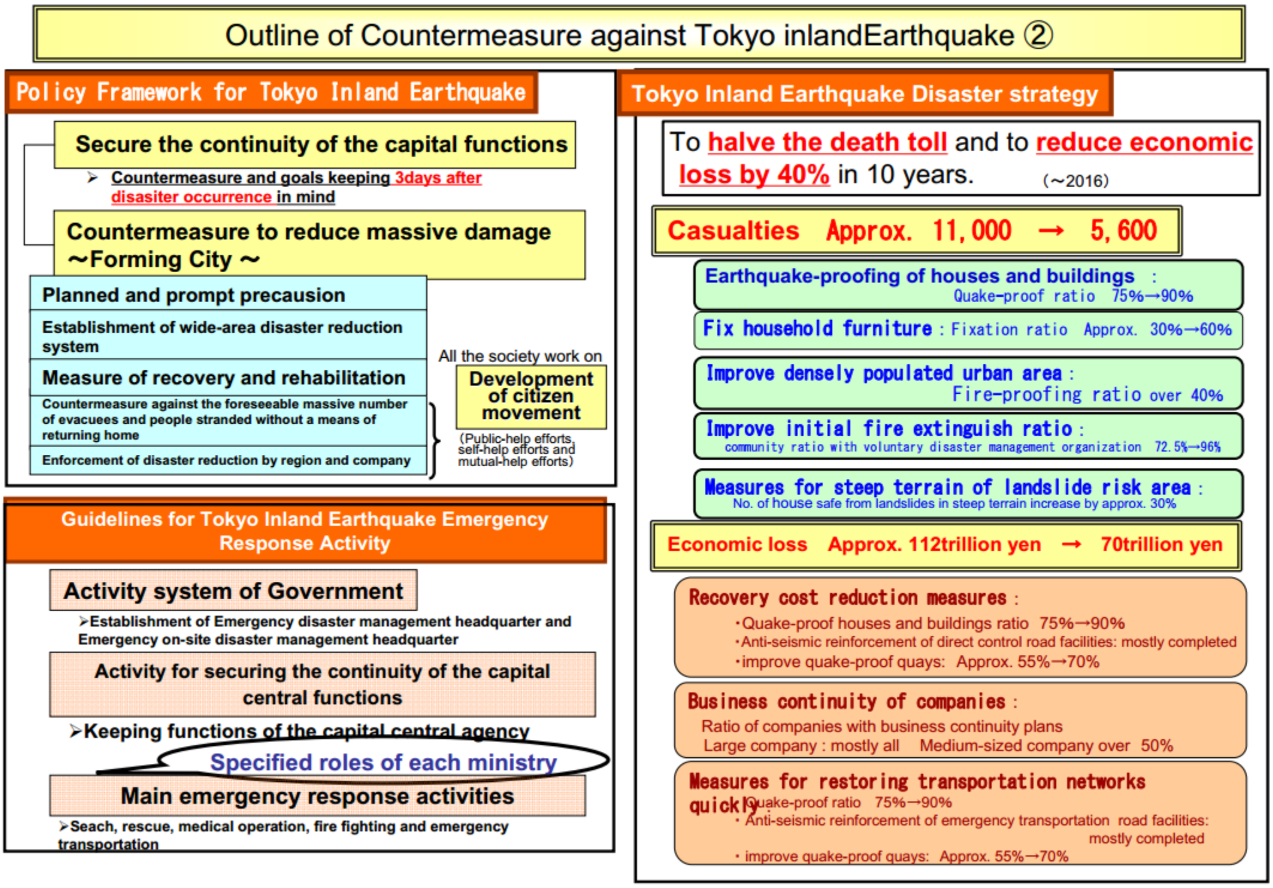
(7) Countermeasures against Tokyo Inland Earthquakes

It is believed that in the capital area (Tokyo), massive trench-type earthquakes with a magnitude of 8 or greater, like the Great Kanto Earthquake (1923), will occur at intervals of 200-300 years. Additionally, it is presumed that several Tokyo Inland Earthquakes of M7 scale will occur before a M8 scale earthquake, and the imminent possibility of such an event in the first half of this century has been pointed out.

Many types of Tokyo Inland Earthquakes are assumed due to various possible epicenters and the complicated mechanism of the occurrence. The Central Disaster Management Council has carried out damage estimations for 18 types of Tokyo Inland Earthquakes, and assumed extensive damage including a death toll of approximately 11,000 people, total collapse of 85,000 buildings and a maximum economic loss of 112 trillion yen in the earthquake with an epicenter in the northern part of Tokyo Bay (assumed scale of M7.3).

In 2005, the Council established the P**olicy Framework for Tokyo Inland Earthquakes**, with the main items being to secure the continuity of the capital functions and countermeasures to reduce massive damage. In 2010, this policy framework was revised to include specific measures to handle large numbers of evacuees or travelers unable to return to their homes. Additionally, in 2006, the council drafted the **Tokyo Inland Earthquake Disaster Reduction Strategy**, with general goals of halving the death toll and reducing the economic loss by 40%, as well as strategic goals such as increasing the proportion of earthquake-resistant houses and buildings to 90% of total housing stock and increasing the fixed furniture rate to 60% within 10 years.

That same year, the Council also drafted the **Guidelines for Tokyo Inland Earthquake Emergency Response Activities**. Plans specifying specific activities were then drawn up on the basis of these guidelines.



Source: Book of disaster management in Japan

(8) Countermeasures against Chubu and Kinki regions inland earthquakes

It is thought highly probable that earthquakes will strike the Tonankai and Nankai regions in the first half of this century. Seismologists believe a broad area of central Japan from Chubu to Kinki has entered an active period, raising the risk of increased seismic activity. Based on past examples, seismic activity in inland western Japan regions tend to both presage and follow earthquakes in the Tonankai and Nankai regions.

In the Chubu and Kinki regions, which are densely urbanized, the damage from a large-scale earthquake would be extremely extensive. When the Central Disaster Management Council drafted estimates of probable damage from five types of earthquake in the Chubu region and eight in Kinki, it concluded that an earthquake in the Uemachi fault zone would cause horrific devastation: an estimated 42,000 deaths, almost a million collapsed buildings and economic damage of 74 trillion yen. The toll from a major tremor in the Sanage- Takahama fault zone could reach 11,000 dead, 300,000 collapsed buildings and economic damage of 33 trillion yen.

To prepare for such a disaster, in 2009 the Central Disaster Management Council launched **the Chubu and Kinki regions Inland Earthquake Countermeasures Basic Plan**. This scheme seeks chiefly to grapple with the unique challenges of minimizing harm in the event of a major quake in Chubu or Kinki, including disaster countermeasures in areas of dense concentrations of wooden homes and steps to minimize damage to cultural assets.

(9) Earthquake-proofing of Houses and Buildings

More than 80% of the casualties in the Great Hanshin-Awaji Earthquake were caused by building collapse. Similarly, damage estimates assume that building collapse will be the cause of a large number of deaths in future large-scale earthquakes. Unfortunately, it is estimated that some 21% of existing residences are insufficiently earthquake-resistant, as they were built before 1981, when stricter earthquake-resistant building codes were introduced. Also, about 30% of schools and 40% of hospitals lack adequate earthquake-resistant construction.

In view of this situation, the Central Disaster Management Council drafted the "Urgent Countermeasures Guideline for Promoting the Earthquake-resistant construction of Houses and Buildings" in 2005, which stipulates that earthquake-resistant construction throughout the country should be urgently and strongly enforced in close cooperation with related ministries as a national priority.

In line with this, the Act on Promotion of the Earthquake-proof Retrofit of Buildings was amended to strengthen measures such as the development of a promotion plan for improving earthquake-resistant construction by local governments. Additionally, the subsidy system that provides financial support to promote earthquake-resistance diagnosis and retrofit has been expanded, and tax reduction measures to promote earthquake-resistant retrofit of residences and commercial buildings have been established.

The Cabinet Office has released the “Map of Weak Subsurface Layers Nationwide,” indicating weakness against earthquake tremors in 1km2 blocks throughout Japan. It has also summarized a method for each municipality to produce an “Earthquake Disaster Hazard Map” that indicates subsurface layer weakness in 50m2 blocks and the danger of building collapse, and is working on disseminating this method.

Hyogo Earthquake Engineering Research Center:

Construction of this facility began in 1999 and will be completed in 2005. Therefore, this facility will begin to make its contribution ten years after the Hyogoken Nanbu (Kobe) Earthquake.

The world's largest shaking table, which can simulate high level ground motions, is taking shape in Japan. The opportunities and challenges provided through this facility are great. It will be a focus of full-scale testing of structures due to high-intensity earthquakes.

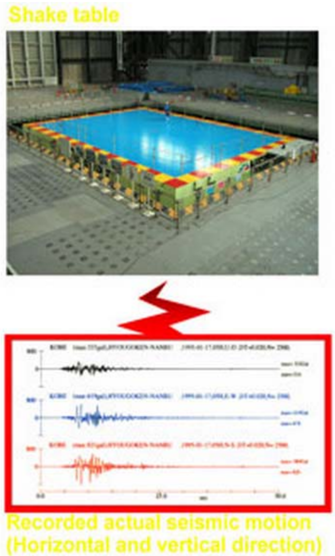


Table Size	20m x 15m	
Payload	12MN(1200tonf)	
Driving Type	Accumulator Charged/Electro-Hydraulic Servo Control	
Shaking Direction	X, Y - Horizontal	Z - Vertical
Max. Acceleration (at Max. Loading)	900cm/s²	1500cm/s²
Max. Velocity	200cm/s	70cm/s
Max. Displacement	±100cm	±70cm
Max. Allowable Moment	Overturning : 150MN-m	Yawing : 40MN-m

Source: Hyogo Earthquake Engineering Research Center

(10) Tsunami Countermeasures

Surrounded by water on all sides with long andcomplex coastlines, Japan is highly vulnerable to earthquake-generated tsunamis. In reality, there has been severe damage caused by various tsunamis in the past, including the Meiji-Sanriku Earthquake Tsunami (1896), Nihon-kai-Chubu Earthquake (1983), and Hokkaido Nansei-oki Earthquake (1993).

In addition to local tsunamis generated by earthquakes near the coast, Japan has also suffered major damage from the onslaught of distant tsunamis generated by open-sea earthquakes. In 1960, a tsunami generated by the Chile Earthquake crossed the Pacific Ocean and reached the shores of Japan about 22 hours later, killing 142 people.

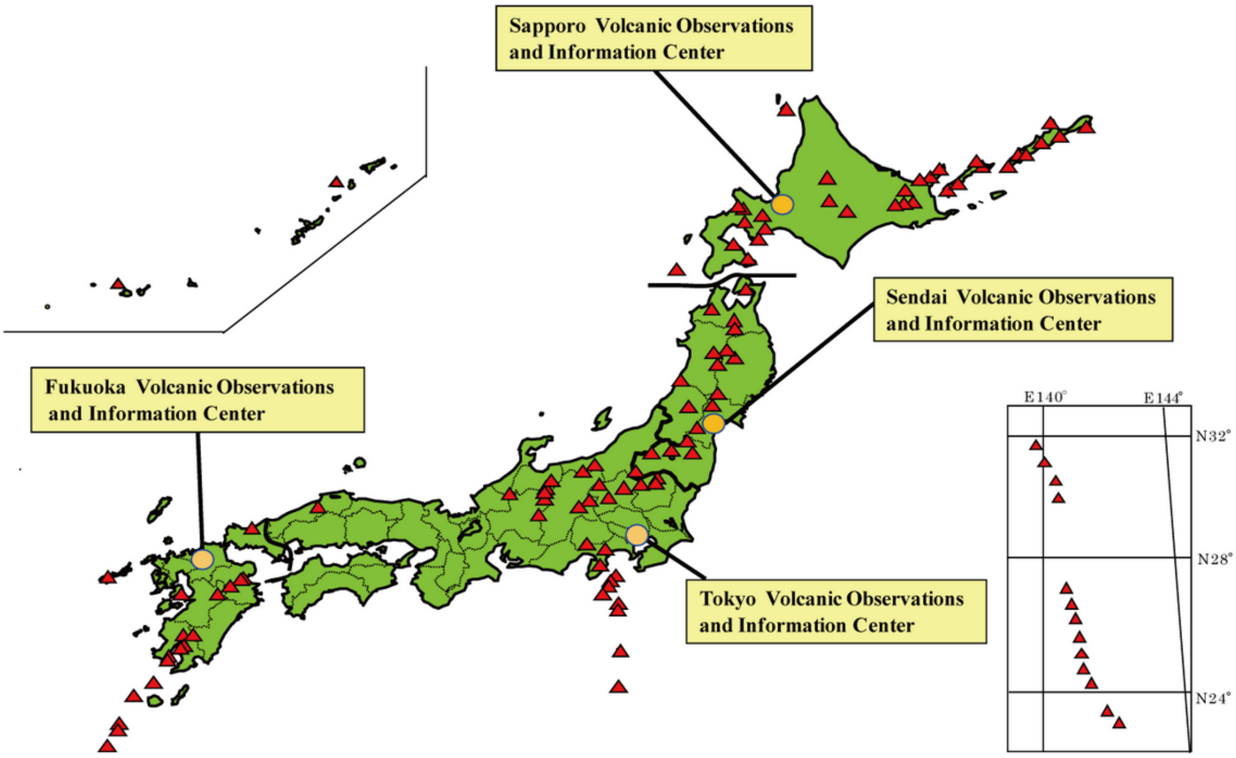
When a tsunami is expected to cause coastal damage, the Japan Meteorological Agency issues a tsunami warning or advisory within 2-3 minutes after the earthquake and then follows up with announcements about the estimated height and arrival time of the tsunami. The information is transmitted immediately to disaster management organizations and media outlets, and further forwarded to residents and maritime vessels.

Tsunami countermeasures, such as expediting the announcement/transmission of tsunami forecasts and improving coastal embankments (tidal embankments) and tide prevention gates, have been carried out. The Cabinet Office, in cooperation with relevant ministries has prepared guidelines for the creation of a tsunami hazard map and the designation/development of tsunami evacuation buildings by local governments, and is working on disseminating the guidelines.

(11) Volcano Disaster Countermeasures

(1) Volcano Disasters in Japan

There are 110 active volcanoes in Japan; on average, a total of 15 volcanic events (including eruptions) occur every year, some of which seriously hinder human life. To continuously monitor this volcanic activity, JMA deploys seismographs and related observation instruments in the vicinity of 47 volcanoes that are remarkably active.



Active volcanoes in Japan

Source: Japan Meteorological Agency

2) Continuous Monitoring of Volcanoes and Broadcasting of Eruption Alert

JMA deploys a network of seismometers, telephoto cameras and angle meters ranged around 47 volcanoes throughout Japan (selected by the **Coordinating Committee for Prediction of Volcanic Eruptions**, an organization of academics and related government agencies), and monitors the volcanoes continuously, 24 hours a day. If an eruption affecting the caldera periphery or populated areas is predicted, an eruption warning is issued. For a group of 29 of these volcanoes (as of February 2011) that are especially close to populated areas, five volcano alert levels are assigned according to the status of volcano activity, each clearly connected to a specific set of disaster countermeasures: Evacuate; Prepare to Evacuate; Entry Restricted, and so on.

(3) Volcano Disaster Management Councils, Volcano Hazard Maps, Evacuation Plans

Based on the Policy on Volcano Management Related to Evacuation in the Event of Eruption, compiled in March 2008 by the Cabinet Office, the following actions are being taken.

1) Volcano Disaster Management Councils, a wide-area coordinating framework consisting of various volcano- related government agencies, are established at 24 volcanoes. Core groups, consisting of prefectural and local government officials, meteorological observatory personnel, the Sabo (Soil Erosion Control) Department, and volcanologists, lead the activities of the Volcano Disaster Management Councils.

2) Based on a variety of eruption scenarios, the Volcano Disaster Management Councils **draft volcano hazard maps** pointing out areas at risk of dangerous eruption phenomena for 40 volcanoes.

3) The Volcano Disaster Management Councils promote **the drafting of specific and practical evacuation plans**. These plans specify when to begin evacuation, areas likely to require evacuation, and evacuation routes and methods.

(12) Storm and Flood Countermeasures

(1) Storm and Flood Disasters in Japan

Japan is prone to a variety of water and wind-related disasters including flooding, landslides, tidal waves and storm hazards, owing to meteorological conditions such as typhoons and active weather-front systems and geographical conditions such as precipitous terrains and steep rivers, as well as settlement conditions in which many of the cities are built on river plains. One-half of the population is concentrated in possible inundation areas, which account for about 10% of the national land.

Although there has been a large reduction in the area inundated by floods owing to soil conservation and flood control projects over many years, the amount of general assets damaged in flooded areas has increased in recent years. Additionally, as a long-term trend, there is an increasing tendency of downpours throughout the country.

(2) Observation System

The Japan Meteorological Agency observes meteorological phenomena that cause storm and flood disasters using the **Automated Meteorological Data Acquisition System (AMeDAS)**, which automatically measures rainfall, air temperature and wind direction/speed, weather radar, and geostationary meteorological satellites. These are used to announce forecasts and warnings to prepare against disasters (weather warnings and advisories for individual municipalities began in May 2010).

The rainfall and the water levels in rivers are observed by the Ministry of Land, Infrastructure, Transport and Tourism and prefectural governments utilizing visual observation methods, mechanical observation equipment, and a wireless telemeter system that transmits automatically observed data from remote locations. **Flood forecasts and water level information are provided utilizing the Internet and mobile phones.**

(3) Comprehensive Storm and Flood Countermeasures

In order to reduce damage caused by severe weather disasters, structural measures such as improving rivers, dams and sewage systems, and non-structural measures such as preparing hazard maps and providing disaster information, must be promoted in an integral manner.

As non-structural countermeasures, the warning and evacuation systems of the possible inundation areas and landslide prone areas have been developed in accordance with the **Flood Control Act and the Act on Promotion of Sediment Disaster Countermeasures for Sediment Disaster Prone Areas**. Both laws were amended in 2005 to intensify measures including the familiarization of hazard maps and the identification of a method to disseminate disaster information to facilities caring for those who require assistance at the time of a disaster like elderly people in the municipal disaster management plans.

Based on the Flood Control Act, some 368 rivers subject to flood warning and 1,488 rivers subject to water-level notifications are designated. Of these, inundation risk areas are currently designated and published for 1,768 rivers and streams (as of February 2010). Moreover, municipalities that include such areas are encouraged to prepare and disseminate flood hazard maps. Currently some 1,137 municipalities are doing so (as of February 2010).

(4) Countermeasures against Large-scale Floods

In light of a rising trend in heavy downpours in recent years, a strong need exists to fortify measures for rapid, effective evacuation and relief, in anticipation of large-scale flood disasters. The Central Disaster Management Council published a series of disaster scenarios in 2008, detailing the anticipated damage in the event of a number of possible cases. These included heavy downpours causing destruction of the fortified weirs along the banks of the Tonegawa and Arakawa Rivers in the Tokyo metropolitan area. At worst, such a catastrophe could leave up to 2,600 people dead and another 1.1 million people stranded. To minimize the damage in such an event, the Central Disaster Management Council is moving forward with the formation of a network for countermeasures against flood disasters.

(13) Snow Disaster Countermeasures

(1) Storm and Flood Damage in Japan

Japan is a bow-shaped archipelago filled with steep mountain ranges. When cold winds blow in from Siberia in winter, the warm current flowing up the eastern coast from the south brings heavy snowfalls to the Sea of Japan side of the country. Among the seasonal problems that result every year are falls by people removing snow from their roofs, avalanches, and obstruction of traffic and city functions due to snow accumulation.

In the winter of 2005–06, ferocious winds brought tremendous snowfalls to every part of the Sea of Japan coastline. Many people were injured from falls as they cleared snow from their roofs, while others were pinned by snow falling from rooftops or even by collapsing roofs. The death toll reached

152 the second-worst total for snow-related deaths since the end of World War II. Fatal accidents continued in subsequent years, with 47 people perishing in the winter of 2006–07, 21 in 2007–08 and 56 in 2008–09.

(2) Outline of Snow Disaster Countermeasures

Measures are being taken to prevent accidents that result in injury, **improve the avalanche warning system,** and remove snow for securing road traffic networks at the time of heavy snowfall.

Against avalanches, comprehensive measures including avalanche prevention projects for protecting communities, risk communication efforts about dangerous locations among residents, and improvement of the warning and evacuation system, are taken.

Furthermore, as heavy snowfall areas account for approximately half of the national land, based on the Act of Special Measures for Heavy Snowfall Areas, measures have been introduced to secure traffic and communications, protect agricultural and forestry industries, and improve living environmental facilities and national land conservation facilities.

In recent years deaths from snow removal operations, especially removal of snow from roofs, have grown numerous, and a disproportionate number of the fatalities have been people 65 years and over. The Cabinet Office has responded by advising on how to avoid accidents while clearing snow, and conducting public-awareness campaigns through various related organizations and agencies, particularly municipal governments.

3.8 Disaster reduction awareness enhancement and disaster knowledge dissemination

(1) Promotion of Efforts for Disaster Reduction

In order to reduce disaster damage, there must be close combination of self–help efforts rooted in the awareness of people and companies; mutual-help efforts of various community-based stakeholders; and public-help efforts made by the national and local governments.

To deploy efforts wherein individuals, families, communities, corporations and other various groups and entities participate in continuous activities and investments for mitigating disaster damage, in 2006 the **Central Disaster Management Council published a Basic Framework for a Nation-wide Movement for Disaster Reduction - Actions with Added Value to Security and Safety.**

(2) Disaster Reduction Week Campaign

The national government has designated September 1st of each year as Disaster Reduction Day, and the period from August 30th to September 5th as Disaster Reduction Week. A variety of events such as the Disaster Reduction Fair, various seminars, disaster reduction drills and exercises, and disaster management poster contests are held throughout the country to disseminate disaster knowledge.

(3) Disaster Education

Disaster education in schools is important for learning necessary disaster knowledge from childhood. It is therefore taught in various school curriculums. Social education at community level including town-watching and hazard-mapping programmes in which residents participate are also important. The Cabinet Office promotes disaster education including through sharing good examples of disaster education programs.

3.9 Improvement of environment for disaster reduction volunteer activities

The Great Hanshin-Awaji Earthquake launched an enormous outpouring of volunteer assistance activity, from both within and outside the afflicted areas. In the following disasters, large numbers of volunteers have rushed to aid and comfort the victims and assist in the reconstruction and restoration of disaster-stricken regions.

The government has designated each January 17 “Disaster Reduction and Volunteer Day,”and the week from January 15 to January 21“Disaster Reduction and Volunteer Week.”During this one-week period, seminars, lectures, exhibitions and other events are held to promote the spread of volunteer and autonomous disaster reduction activities when disasters occur. These events take place throughout Japan, with the close cooperation of local governments and other related entities.

To provide a supportive environment for disaster reduction volunteer activities, the Cabinet Office provides information volunteers can use in their efforts, as well as facilities for the exchange of information and views. The Cabinet Office also provides local government receiving volunteer assistance with information and expertise, and promotes wide-area collaboration among disaster management volunteer activities when disasters strike.

3.10 Disaster reduction activities of corporations

In response to disasters, corporations are required to secure the safety of their customers and employees, and continue their business activities which contribute to mitigate social and economic difficulties in disaster situation. The Cabinet Office promotes the enhancement of disaster reduction activities of corporations.

(1) Promotion of Business Continuity Plans of Corporations

When earthquakes and other disasters cause enterprise activity to stagnate, the impact affects not only individual companies, but also employment levels and the overall economy of the stricken region. Through trade and commerce with businesses in other areas, the economic damage can affect other regions as well. In this context, promoting the drafting and implementation of business continuity plans (BCPs) is extremely vital. By outlining a management strategy for ensuring the continuation of business in the event of a disaster, BCPs can ensure the stability of Japan's society and economy while creating an image of reliability for Japanese companies abroad.

In 2005 the Japanese government, through a special committee of the Central Disaster Management Council, drew up and began circulating a set of "business continuity guidelines."The government set a target of convincing "virtually all large companies and 50% of medium-sized companies" to draft BCPs (as stipulated in Earthquake Disaster Management Strategies and New-growth Strategy and Plans). In this way Japan's central government has played a critical role in encouraging the drafting and implementation of BCPs in the private sector.

(2) Encouraging the Evaluation of Corporate Disaster Reduction Activities

For private enterprises, recognizing the role of companies in the event of a disaster (ensuring the safety and security of employees, preventing secondary disasters, maintaining business continuity, contributing to and living in harmony with local communities) and working to promote disaster management activities is of crucial importance.

To encourage companies to engage in disaster management activities, markets and local communities must give appropriate recognition to enterprises that take an active part in these activities.

The government is disseminating information for this purpose. It has prepared a self-evaluation table entitled"Business Measures for Disaster management," as well as "Disclosure on Disaster management Measures: Explanations with Examples." Using an evaluation system based on the items in the self-evaluation table, the Development Bank of Japan (DBJ) has developed a lending facility with a rating system for operations that promote disaster management. The DBJ is implementing this system as an incentive to encourage companies to conduct disaster management activities.

Chapter 3. Early Warning System in Mongolia

1. Information and communication system

The information and communications technology sector of Mongolia is comprised of telecommunications, information technology, radio and television broadcasting and postal services.

National fiber optic network of Mongolia is extended to reach all 21 province centers and over 151 soums. The telecommunication sector has been subject to reforms since the end of 1990.

1. Fixed line communication: Still play a role in improving information and communications service. "Telecom Mongolia" is the national telecommunications company of Mongolia that provides a wide range of telecommunication product offerings such as internet services, cable TV networks, radio and TV broadcasting to Mongolian customers. In 1995, Telecom Mongolia was partially privatized and opened to foreign investment. The company has telecommunication lines and networks in every corner of Mongolia including 21 provinces, 315 soums and UB city.

Main activities:

- Traditional telecommunication
- Next-generation network telecommunication
- F-zone wirless telecommunication
- Internet service provider

Area	2009	2010	2011	2012
Western	9.357	8,146	6,533	6,465
Khangai	15,800	14,630	12,969	11,748
Central	18,599	17,864	15,928	15,502
Eastern	4,221	3,686	3,239	2,979
Ulaanbaatar	94,885	98,867	93,135	112,696
Total	**142,862**	**143,193**	**131,804**	**149,390**

Figure 1.1 Number of telecommunication points
Source: National Statistics Office of Mongolia

2. Mobile communication: Two GSM system operators /Mobicom and Unitel LLC/ and two CDMA system operators /Skytel LLC and G-Mobile LLC/ are providing mobile communications services in Mongolia.

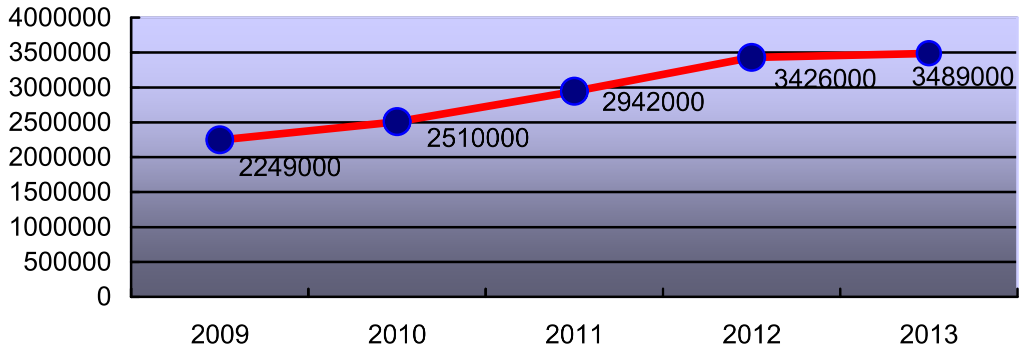


Figure 1.2 Total mobile users in 2009-2013 Source: National Statistics Office of Mongolia

Mobicom Corporation is the largest mobile phone operator in Mongolia. It was established as a joint Mongolian-Japanese venture on 18th March of 1996, to be the first Mongolian cell phone service.

Skytel Group was founded in 1999 and was a joint venture between private Mongolian and Korean firms until December 2010 when it became a 100% national enterprise with equal shareholders of Altai Holding and Shunkhlai Group.

Unitel is a Mongolian Corporate Group of ICT companies. It was founded on December 23, 2005 as BSB consortium as GSM mobile phone operator, and began operations on June 26, 2006.

G-Mobile LLC is, as of 2008, Mongolian's newest mobile phone operator. It is focusing its operations in rural areas. It uses CDMA2000 at 450 MHz and provides internet services with cell phones as modem or proper modem.

3. Internet service: The first Internet Service Provider (ISP) started providing Internet services in Mongolia in 1996 with 64kbps through VSAT technology. The internet was first brought to Mongolia by DataCom in January 1996. Since then, various internet-based services such as e-mail, internet connections, internet faxing, internet telephone, e-accounts, e-shopping, and internet cafe are available to users in Mongolia. Main Internet service providers in Mongolia such as Magicnet, Datacom, MiComand BodicomputerCo.,Ltd. Also, the number of internet cafes has reached 80. For Internet, Mongolia relies on fiber optic communications with its Chinese and Russian neighbors.

4. Postal service: In the Mongolian postal service market, currently 51 licensed postal operators are running postal service business. There is one state owned company (designated operator) Mongol Post LLC and another 50 private companies.

5. FM radio: Mongolia has a domestic radio service, both wireless and wire, as well as television. Besides the domestic radio service, there is also an international shortwave service.

The two programs of the National Public Radio Broadcaster (NPRB) are transmitted throughout the territory of Mongolia, covering all aimags and soum centers. As it can be seen from the below figure, there are six major coverage areas: in the east in Choibalsan, in the south in Dalanzadgad, in the north in Honhor, in the mid-west in Murun and Altai and in the west in Ulgii.

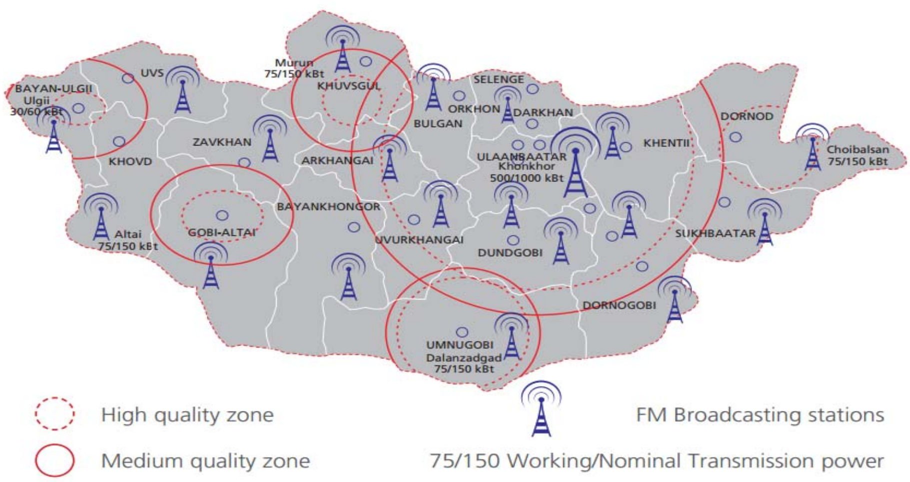


Figure 1.3 Location of FM broadcasting stations
<u>Source: Information Technology, Post and Telecommunication Authority of Mongolia</u>

6. TV broadcasting in Mongolia started in 1967, when the first national television program was aired in Mongolia. There are 99 companies and organizations, which have television broadcasting licenses, including 70 companies to provide cable TV services.

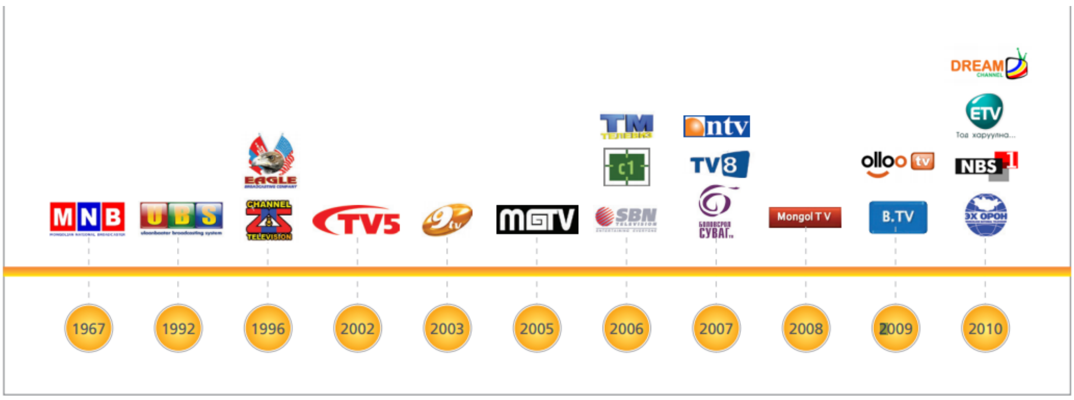


Figure 1.4 Development of TV broadcasters in Mongolia
<u>Source: Information Technology, Post and Telecommunication Authority of Mongolia</u>

2. Earthquake disaster warning system

Mongolian government co-implementing South Korean communications provider KT project of Earthquake Disaster Warning System (EDWS) in 2012-2014. The system will gather, process, and distribute information when disasters occur using wireless or wired connections. National emergency management agency will also be able to send emergency SMS messages nationwide.

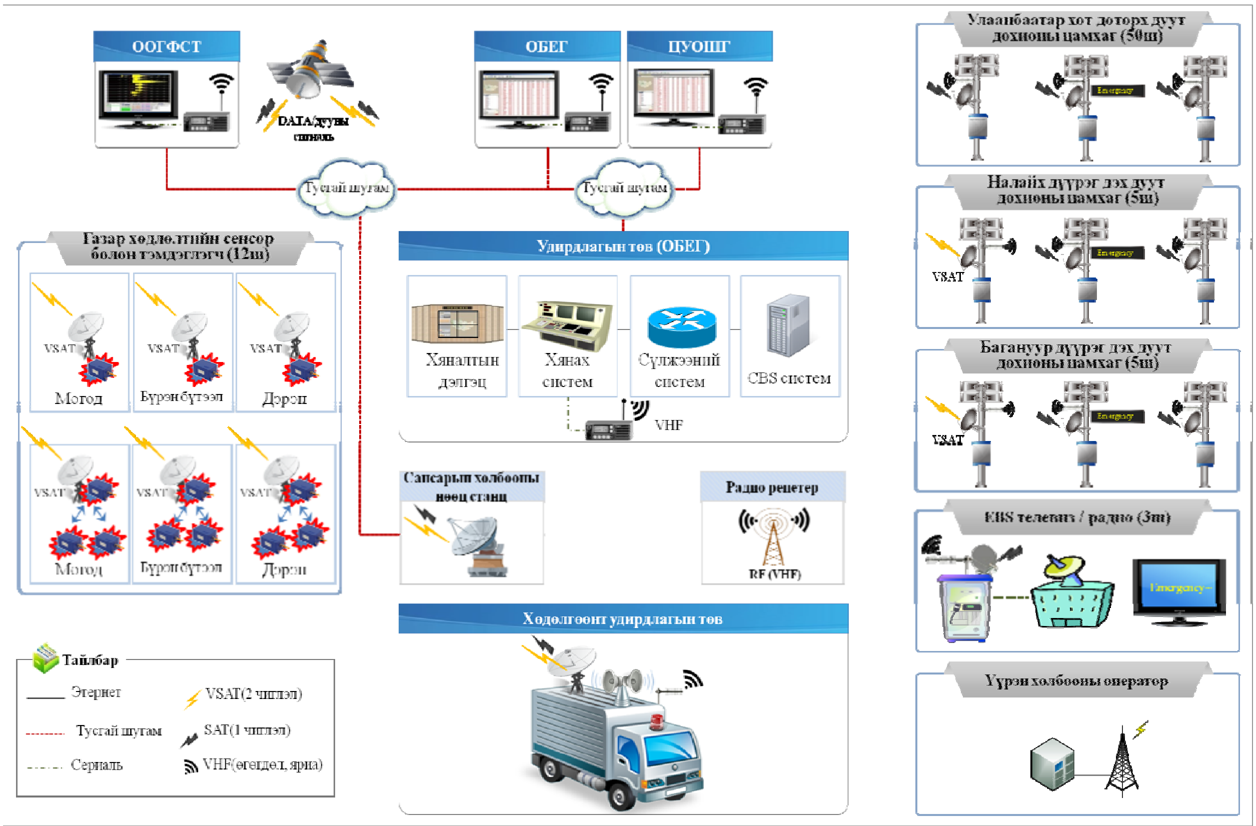


Figure 2.1 General structure of Earthquake disaster warning system
Source: National Emergency Management Agency of Mongolia

Earthquake disaster warning system:
– Cell broadcasting service
– Disaster notification board system
– TV disaster warning broadcasting system
1) CBS (Cell Broadcasting Service) phone disaster notification broadcasting system
- The mobile communication technology that broadcast disaster message to mobile-phone users at base station transceiver subsystem, who have special receivable ID.
- Disaster message transmission to nation-wide or specific area resident users simultaneously at once.

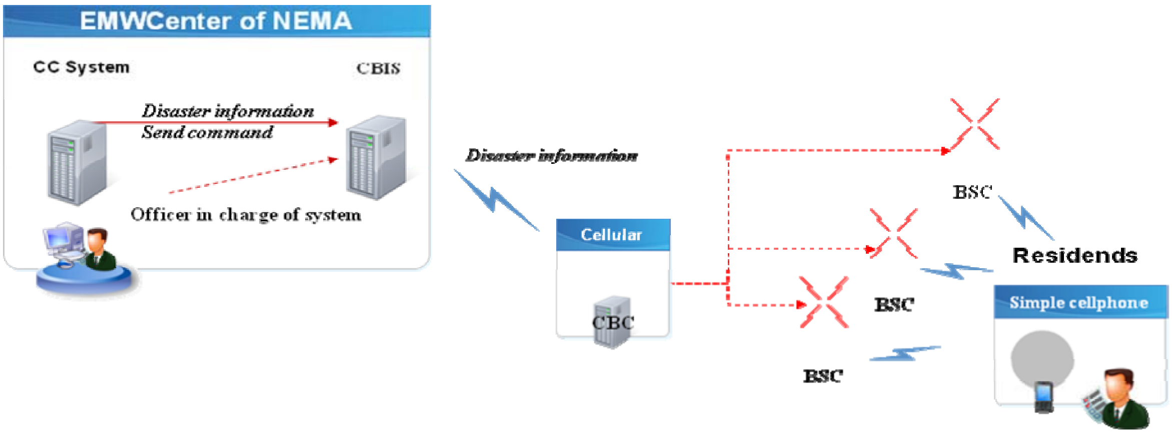
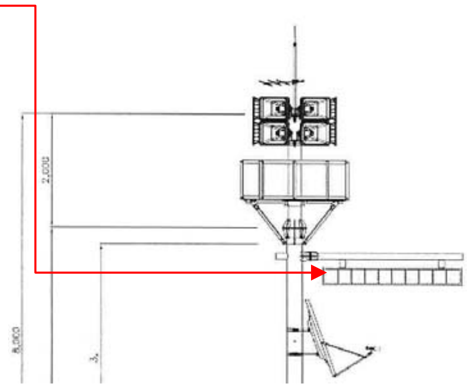


Figure 2.2 Structure of Cell broadcasting service
Source: National Emergency Management Agency of Mongolia

2) Disaster notification board system

Preparing immediate response system toward disaster by notifying and broadcasting rapidly the disaster situation through blowing siren and board messaging, at the normal times, performing national propagation of awareness toward disaster, etc.



3) TV disaster warning broadcasting system

Broadcasting the urgent disaster situation in the form of screen, sound, or screen messages by forcibly automatic turning on TV or changing to disaster warn channel with volume-up through the broadcasting station's casting-equipment

3. Emergency management and warning center

Emergency management and warning centre was established in 5 January 2013 by decision of Government. A total of 20 staff are working.

General duties of EMWC:

EMWC is responsible for end-to-end multi-hazards including earthquake

1) Receiving data
2) Analysis
3) Dissemination of warning message
4) Coordinating and planning
5) Supervising the preparedness and response, and the recovery.

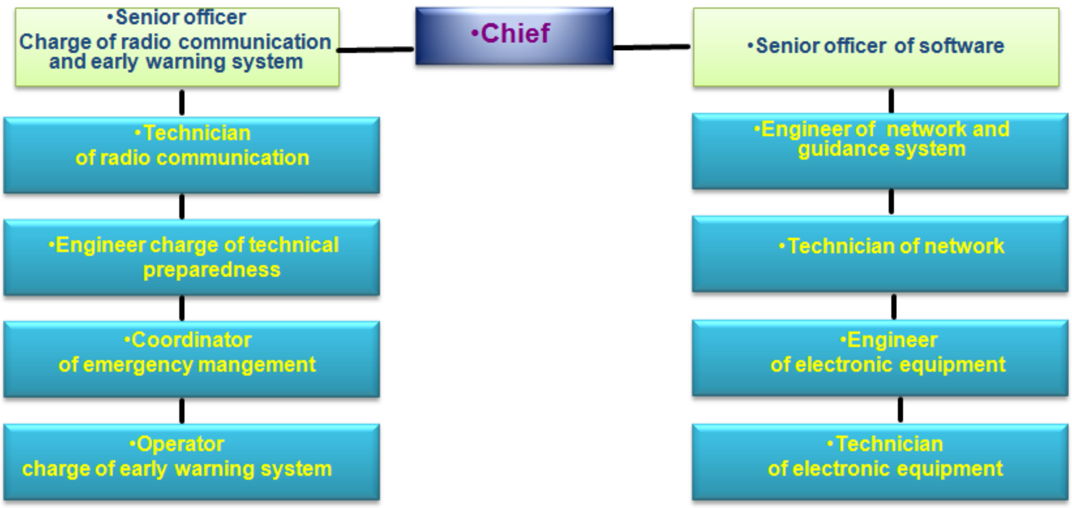


Figure 3.1 Structure of Emergency management and warning center
Source: National Emergency Management Agency of Mongolia

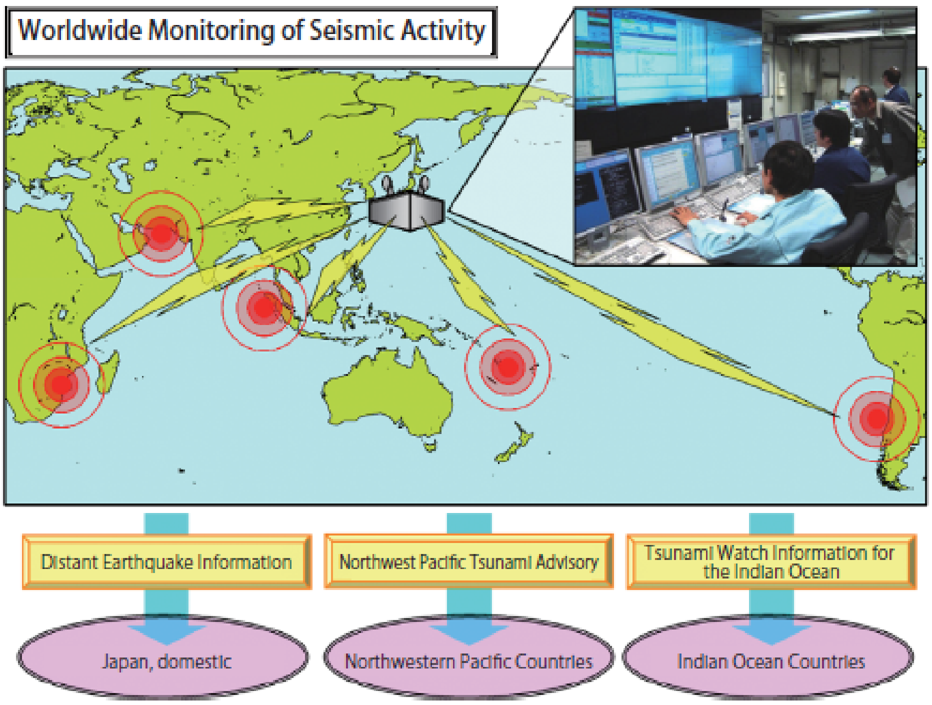
Chapter 4. Early Warning System in Japan

1. Monitoring system in Japan

Distant Earthquake Information and International Tsunami Advisories

JMA monitors seismic activity not only around Japan but also worldwide. If a tsunami generated by a distant earthquake is expected to hit the Japanese coast and possibly cause disastrous conditions, JMA issues Tsunami Warnings/Advisories in the same way as for local tsunamis. When a major earthquake occurs somewhere far from Japan, the Agency issues Distant Earthquake Information to the public.

Tsunamis spread ocean-wide regardless of the borders of countries, and can cause serious damage in multiple coastal areas. In order to protect human life and property against tsunami hazards, we must work together with overseas related organizations. Within a worldwide framework for a tsunami warning system, countries exchange observational data and information to enable earthquake/tsunami detection and measures against expected tsunamis as early as possible. Japan has a wealth of experience and knowledge on tsunamis, and JMA, in such an international partnership role, plays a major part in contributing to tsunami disaster management measures in other countries. When a large earthquake occurs in the Sea of Japan, the northwestern Pacific region or the Indian Ocean, the Agency analyzes the related observation data and quickly provides International Tsunami Advisories to the countries in each region. These advisories contain information on the earthquake and the possibility of tsunamis, and are used in the recipient countries for the implementation of emergency action such as nationwide tsunami warnings and official evacuation.



Source: Japan Meteorological Agency

Earthquake and Tsunami Monitoring

JMA collects real-time data from seismometers, seismic intensity meters, gauge stations and other instruments to monitor earthquakes and tsunamis around the clock. When an earthquake causes serious damage, the Agency dispatches the JMA Mobile Observation Team (JMA-MOT) to assess the situation.

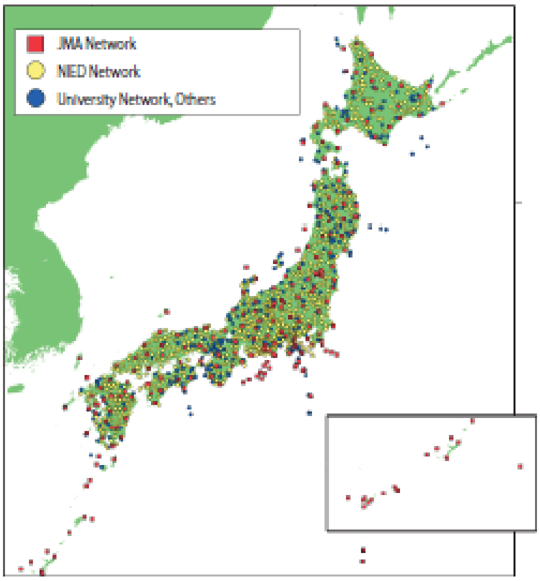
Seismometer Network

When an earthquake occurs, it is important to know its location and magnitude. To achieve this, we need to observe its waves and analyze its hypocenter and magnitude; an instrument used to observe earthquake waves is called a seismometer.

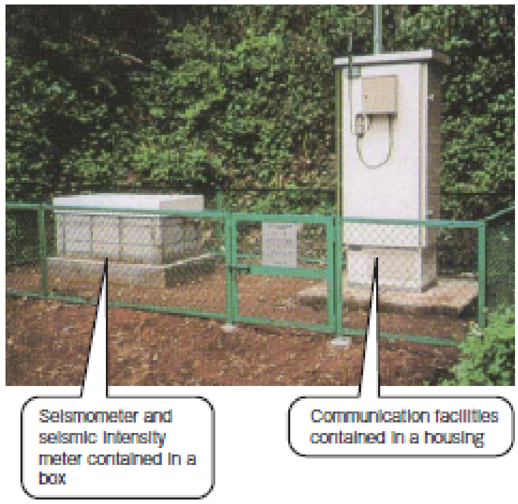
JMA operates a seismic network consisting of about 200 seismometers and collects seismic waveform data in real time around the clock. The Agency also uses seismometers belonging to the National Research Institute for Earth Science and Disaster Prevention (NIED), and issues Earthquake Early Warnings, Tsunami Warnings / Advisories and Earthquake Information.

JMA also collects and analyzes seismic data from NIED, universities and related institutes in order to conduct comprehensive assessment of seismic activity for the promotion of research activities in cooperation with the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The products of this analysis are shared with the relevant organizations.

◆ Seismometer Network



◆ JMA Seismic Station

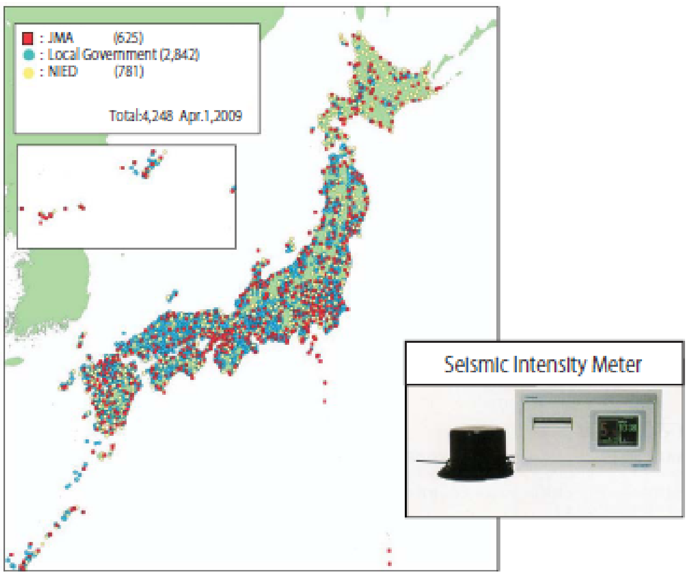


Source: Japan Meteorological Agency

Seismic Intensity Network

A seismic intensity meter is an instrument that measures and records the seismic intensity of ground motion. JMA has installed about 600 seismic intensity meters throughout the country, and also collects seismic intensity data from another 3,600 stations (as of Apr. 1, 2009) operated by local governments and the National Research Institute for Earth Science and Disaster Prevention (NIED). These data are used for Earthquake Information issued by JMA.

◆ Seismic Intensity Network



Source: Japan Meteorological Agency

Tsunami Monitoring Network

When tsunamis are observed, JMA issues tsunami observation information including observation points, tsunami heights and expected times of arrival. The Agency operates about 70 tidal gauge stations and also collects real-time sea-level data from stations operated by the Ports and Harbors Bureau (Ministry of Land, Infrastructure, Transport and Tourism), the Geographical Survey Institute and the Japan Coast Guard. Currently, JMA issues tsunami information using data from about 170 stations.

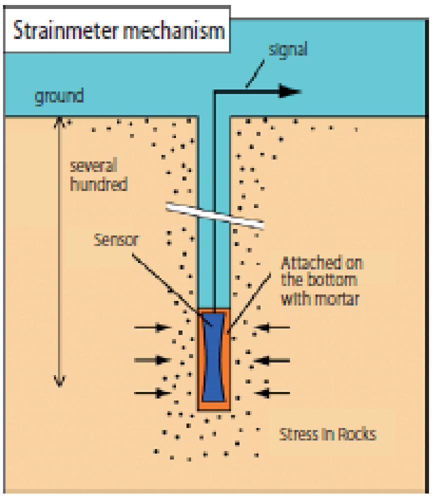
◆ Stilling-well Type Gauge Station

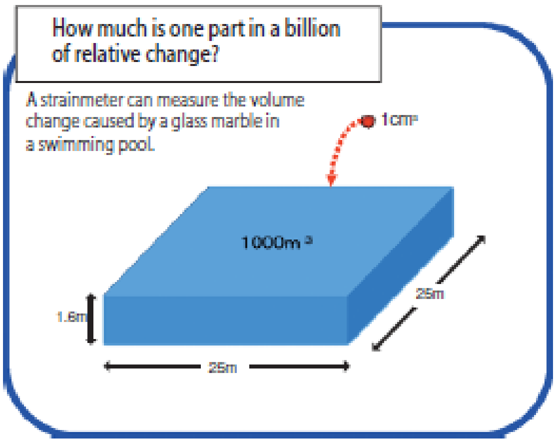
◆ Acoustic Type Gauge Station

Source: Japan Meteorological Agency

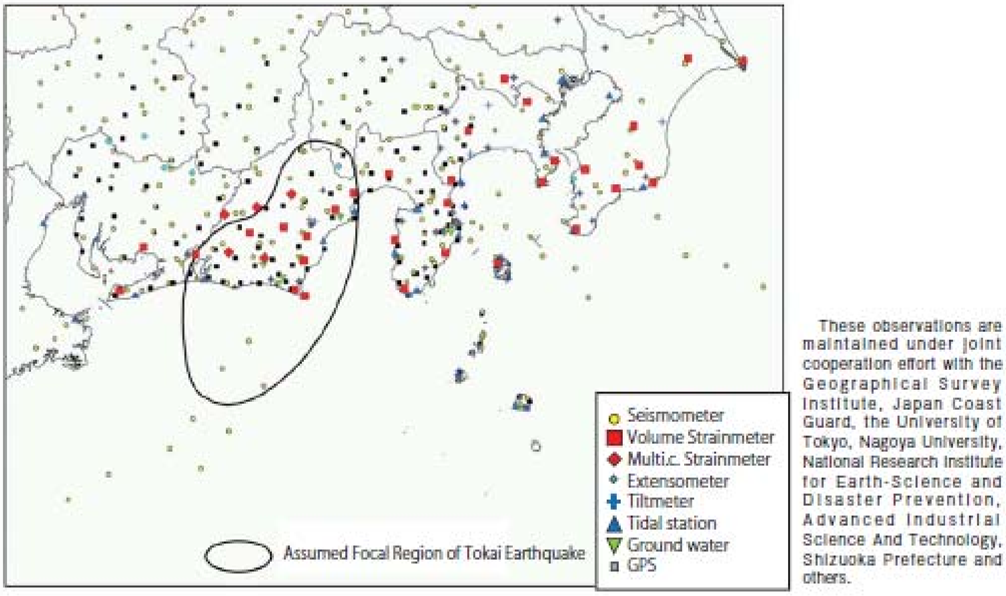
Observation systems for the Tokai Earthquake

Various kinds of instruments, including seismometers, strainmeters and GPS equipment, are installed in and around the assumed focal region of Tokai Earthquake (see the figure below). The observational data in collaboration with related institutes are continuously transmitted to JMA. Strainmeters play an important role in detecting potential pre-slip movement that may be a precursor to the Tokai Earthquake. They measure very minute expansions and contractions in underground rock. A cylindrical sensor is set at the bottom of a borehole several hundred meters in depth. A strainmeter can detect a relative change of one part in a billion of crustal expansion or contraction. This is equivalent to measuring the volume change caused by a glass marble in a swimming pool.





Source: Japan Meteorological Agency



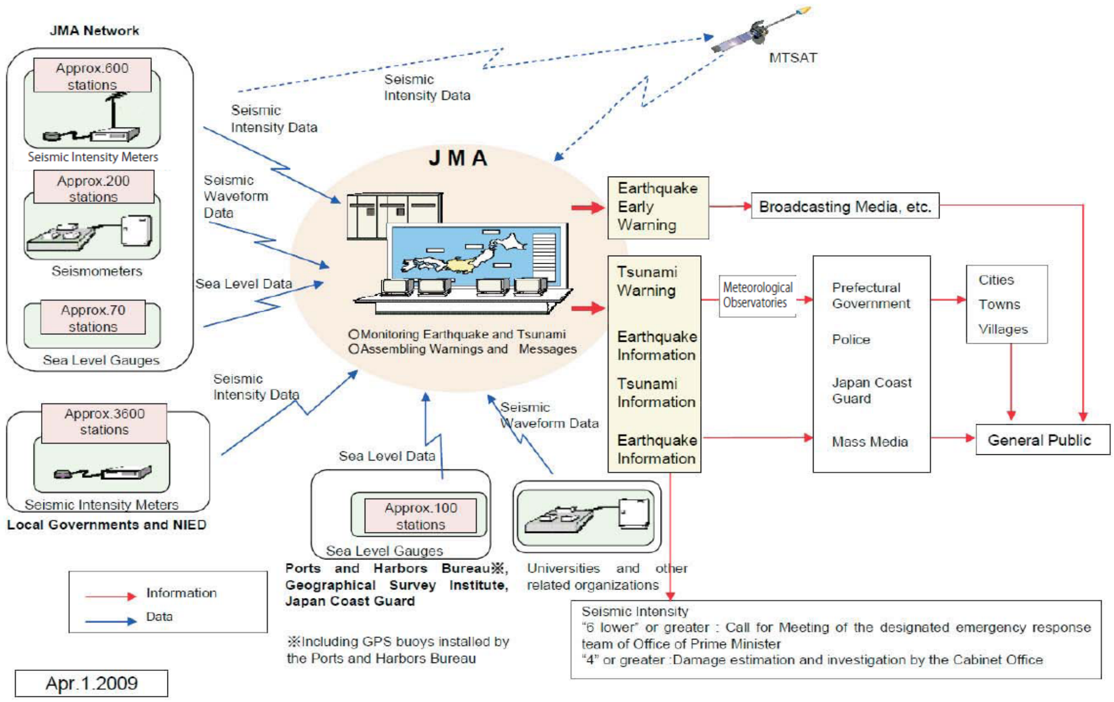
Source: Japan Meteorological Agency

A Data Collection and Processing System for Assured Communication

JMA monitors seismic activity and issues Warnings/Advisories and information on a 24-hour basis. To provide these resources urgently and precisely, JMA needs to collect various seismic data and analyze them quickly. To this end, the Agency operates a comprehensive system called EPOS (the Earthquake Phenomena Observation System). This is responsible for issuing Earthquake Early Warnings, Tsunami Warnings/Advisories, Earthquake Information and Information on the Tokai Earthquake.

Warnings/Advisories and information issued by JMA are transmitted to disaster management authorities, local governments and the broadcasting media over a nationwide computer network immediately. Disaster management authorities and local governments take action to mitigate disasters based on these resources. Such action is also announced to the public through the media and the Internet.

Data Collection and Dissemination of information



Source: Japan Meteorological Agency

Basic knowledge about earthquake and tsunami

Earthquakes and Shaking

What is an earthquake? When people feel the ground shake, they exclaim, "It's an earthquake!" Strictly speaking, what they are feeling is ground motion caused by an earthquake. As a technical term, ground motion is used to distinguish this movement from the earthquake itself. An earthquake is a destructive slip movement inside a rock plate deep under the ground. We call the plane of this movement a fault , and the point at which a destructive slip movement starts is called the hypocenter.

Such destructive slip movements cause vibration that propagates in every direction. Since vibration travels in a wave formation, its movement is called a seismic wave. When the vibration reaches the ground surface, people become aware of earthquake motion. Thus, not all places on the surface of the ground shake at the same time. Locations closer to the hypocenter shake first, while distant areas shake later.

Seismic waves

Seismic waves can be either primary waves (P-waves) or secondary waves (S-waves). S-waves propagate more slowly than P-waves, but have a high amplitude and cause damage. P-waves travel at about 7 km/s (25,200 km/h), while S-waves move at about 4 km/s (14,400 km/h). At a point 50 km from the hypocenter, for example, a P-wave will arrive at about 7 seconds after the start of the quake, and an S-wave will arrive at about the 13-second point.

Catching seismic waves

How can we find out where an earthquake occurs ? Vibration propagates as a wave, so the farther a point is from the hypocenter,the later the wave arrives. As a result, if we can pinpoint where earthquake motion appears first among many monitoring sites (seismometers),the hypocenter can be assumed to near that site. In fact, hypocenters are located by considering the subterranean structure (i.e., the structure of the earth s crust) and comparing differences in the appearance times of P-waves and S-waves.

Seismic Intensity and Magnitude

Seismic intensity and magnitude are easily confused because both have similar values. In this section, we explain the difference between them. Seismic intensity describes the scale of the ground motion at a particular location. It varies with the distance from the epicenter and the surface geology at each point. JMA s seismic intensity scale has 10 degrees (0 (imperceptible), 1, 2, 3, 4, 5-lower, 5-upper, 6-lower, 6-upper, 7). Magnitude is a numerical value that represents the scale of a fault slip underground. Large earthquakes have high magnitude.

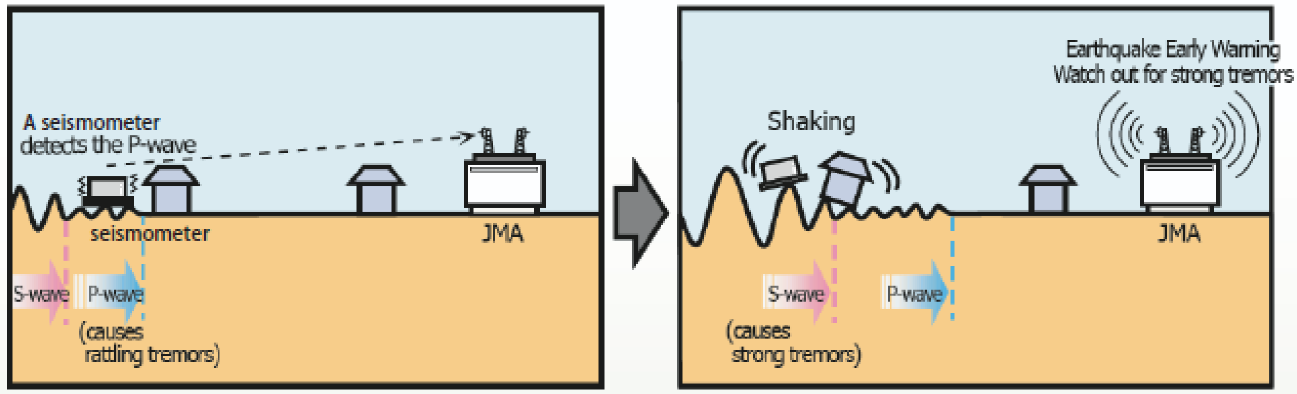
◆ Summary of JMA Seismic Intensity Scale Tables

Source: Japan Meteorological Agency

Principle of Earthquake Early Warnings

Earthquake Early Warnings (EEWs) are issued slightly after an earthquake occurs. They are not earthquake predictions which tell us occurrence of earthquake in advance.

As soon as an earthquake occurs, the EEW system uses seismometers located near the epicenter to calculate the hypocenter, magnitude and P-wave data detected by the area that will be subjected to strong shaking, and provides a first announcement. EEWs are transmitted promptly. A sophisticated observation system to detect seismic waves quickly, technology that enables forecasting from very weak shaking and communication technology for prompt dissemination are the elements that enable JMA to issue EEWs.



Source: Japan Meteorological Agency

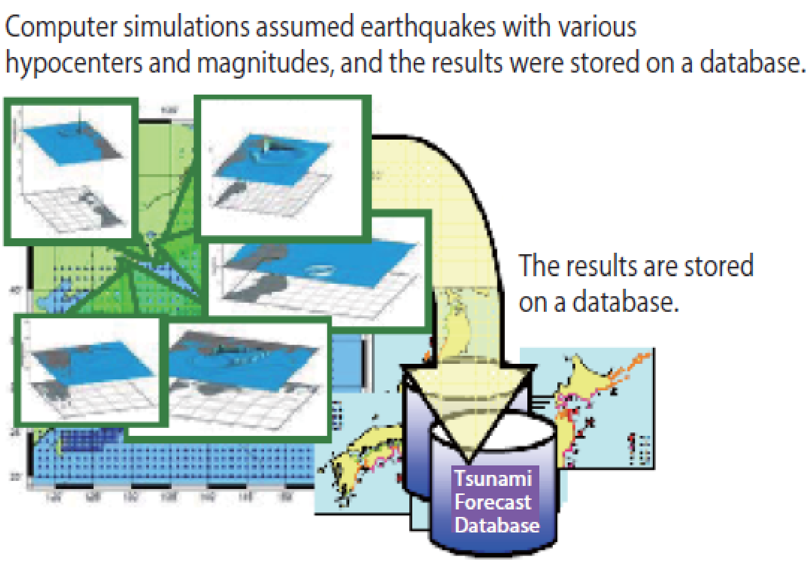
Tsunamis

When large earthquakes occur in ocean areas, the sea floor rises or sinks. Accordingly, massive amounts of water on the sea floor also move up or down, and this movement spreads out in all directions in the ocean. The resulting waves are called tsunamis. Tsunami waves become slower as the sea becomes shallower. As a result, trailing waves catch up with those ahead near the coast, and the tsunami grows much higher. Even if a tsunami does not seem very high in offshore areas, it can turn into a big wave near the coast. If you feel an earthquake in a coastal area or if a Tsunami Warning is issued, evacuate immediately to high ground. Under no circumstances should you go to the seashore to see the tsunami.

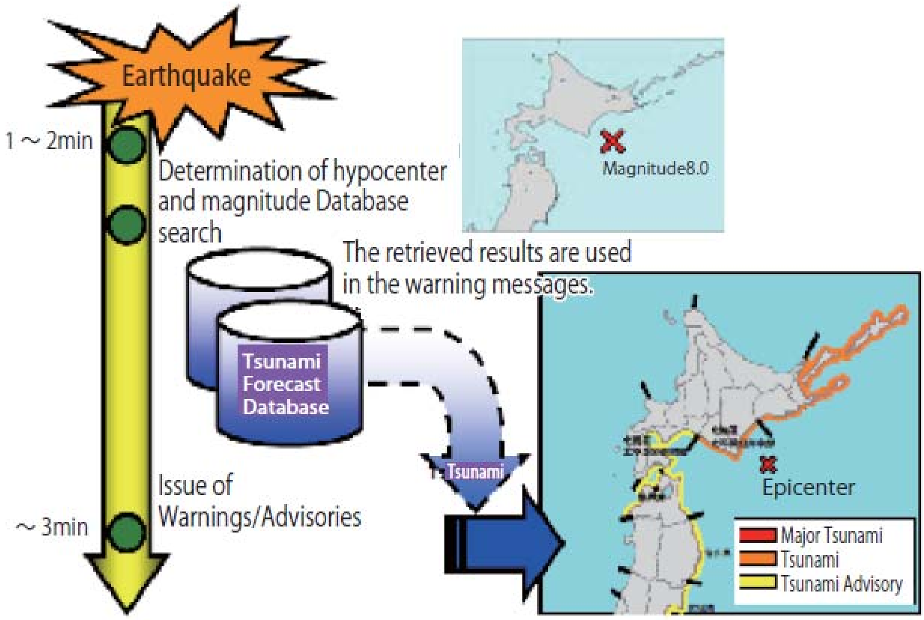
Method of Tsunami Warning

When a large earthquake occurs in a sea area, JMA issues a Tsunami Warning/Advisory. A numerical simulation technique is used to estimate tsunami potential and propagation. After an earthquake occurs, Tsunami Warnings/Advisories must be issued immediately to enable evacuation before the wave strikes coastal areas.

To enable immediate issuance of Tsunami Warnings/Advisories, JMA has conducted computer simulation of tsunamis with earthquake scenarios involving various locations and magnitudes, and the resulting information on tsunami arrival times and heights is stored on a database. If a large earthquake occurs, the operation system quickly calculates its hypocenter and magnitude, searches the tsunami database referring to



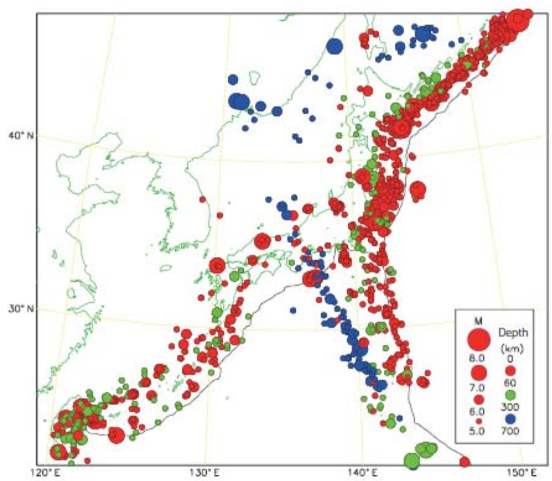
these calculations, and selects the closest-matching results from the database. Using the estimated height of the tsunami for each coastal region, JMA issues a Tsunami Warning/Advisory.



Source: Japan Meteorological Agency

Earthquakes around Japan

Around Japan, oceanic plates called the Pacific Plate and the Philippine Sea Plate subduct beneath the continental plates (the North American Plate and the Eurasian Plate) several centimeters annually. These plate movements cause forces to act in various directions around the country, which is the reason behind the extremely high seismic activity in the area. Around Japan, therefore, oceanic plates subduct beneath continental plates. These continental plates are dragged down as a result, and strain energy is accumulated. When this strain exceeds a certain level, it causes the continental plates to jump up, and tremors known as interplate earthquakes occur. Conversely, tremors generated by strain forces within a plate are called intraplate earthquakes. They occur in subducting plates and shallow underground areas of continental plates. Compared to interpolate earthquakes, intraplate earthquake occurring in shallow underground areas are relatively small, but can cause serious damage if they occur directly below populous areas.



Distribution of earthquakes around Japan from 1998 to 2008 (data from the Japan Meteorological Agency)

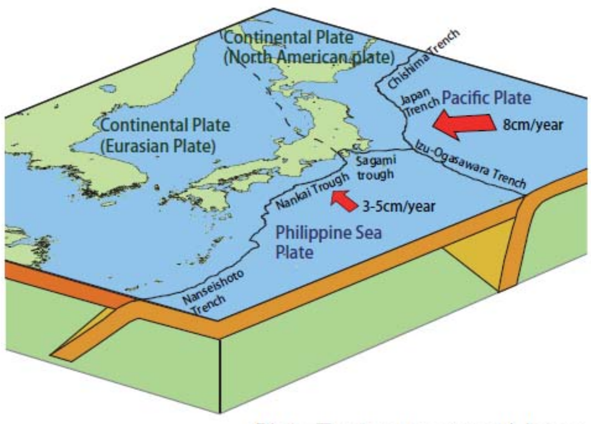
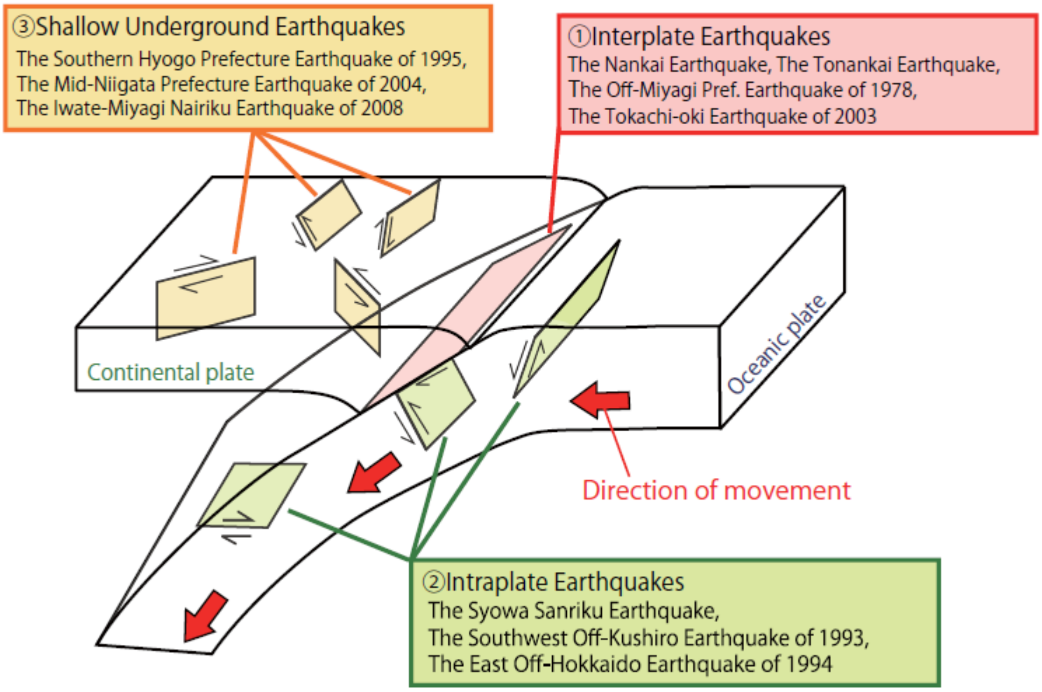


Plate Tectonics around Japan

Source: Japan Meteorological Agency

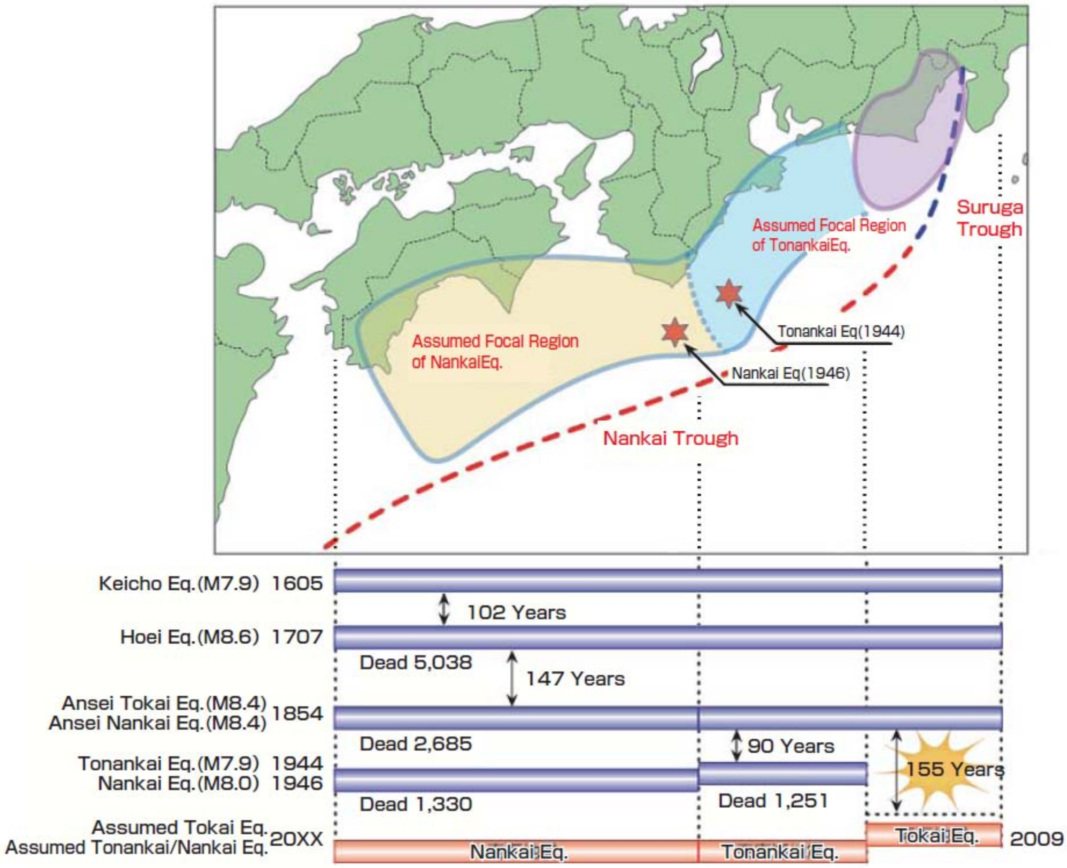


Source: Japan Meteorological Agency

The Tokai Earthquake

The Tokai Earthquake is expected to occur in the near future along the trench near Suruga Bay, and is considered to be as large as M8-class. Large earthquakes of this magnitude have occurred historically every 100 –150 years in the area from the Suruga Trough in Suruga Bay to the trough off Shikoku Island, and are known as Tonankai/Nankai Earthquakes. However, when the last Tonankai Earthquake (1944, M7.9) and Nankai

Earthquake (1946, M8.0) occurred, the crust along the Suruga Trough did not move. Since the trough (in region E of the figure below) has remained motionless for more than 150 years, the Tokai Earthquake is widely expected to occur in the near future.



Source: Japan Meteorological Agency

How is it possible to predict the Tokai Earthquake?

In relation to the Tokai Earthquake, a pre-slip phenomenon (see the figure below) is expected just before the quake itself, and observation systems are in place to detect this slip. If it actually takes place and is successfully detected, JMA will issue warning information on the Tokai Earthquake. However, there is a possibility that the pre-slip could be too slight to be detected by the sensors, so it cannot be said with certainty that the Tokai Earthquake will be predicted.

Why it is thought possible to predict the Tokai Earthquake scientifically

●It is expected to be accompanied by precursory phenomena.

●Observation systems are in place to detect these phenomena.

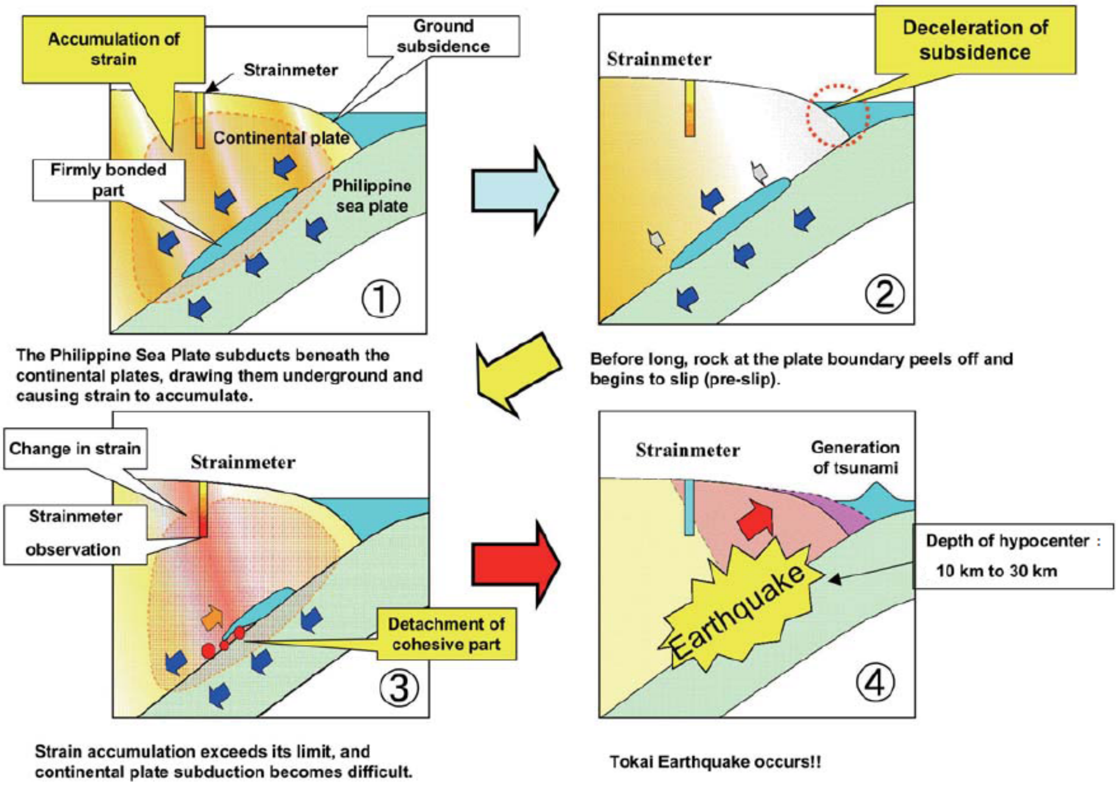
●There are guidelines on deciding based on the pre-slip model whether detected anomalous phenomena are precursory in nature or not.

Tokai Earthquake Generation Scenario

The Tokai Earthquake is expected to occur with the following sequence:Accumulation of strain, Deceleration of subsidence, Pre-slip, Occurrence of Tokai Earthquake. Pre-slip is a phenomenon where part of the hypocentral region (the hard bonded plate boundary in the case of the Tokai Earthquake) peels off and begins to slip.

The key to predicting the Tokai Earthquake is the detection of signs of pre-slip. JMA monitors unusual movement that may accompany pre-slip using strainmeters to predict its occurrence.

◆ Tokai Earthquake Generation and Pre-slip Scenario



Source: Japan Meteorological Agency

What is an Earthquake Early Warning? (緊急地震速報 (Kinkyu Jishin Sokuho) in Japanese)

The Earthquake Early Warning system provides advance announcement of the estimated seismic intensities and expected arrival time of principal motion. These estimations are based on prompt analysis of the focus and magnitude of the earthquake using wave form data observed by seismographs near the epicenter. The Earthquake Early Warning is aimed at mitigating earthquake-related damage by allowing countermeasures such as promptly slowing down trains, controlling elevators to avoid danger and enabling people to quickly protect themselves in various environments such as factories, offices, houses and near cliffs.

The Earthquake Early Warning system provides advance announcement of the estimated seismic intensities and expected arrival time of principal motion.

When a major earthquake occurs, the following information is broadcasted through wireless loudspeaker:

Earthquake Early Warning		A major earthquake is about to occur. A major earthquake is about to occur.
Earthquake and Tsunami Information	Seismic intensity of 4 or more	An earthquake with a seismic intensity of □□ has occurred. Please turn off the gas and extinguish all fire sources. Please turn on the TV or radio and stay calm.
	Large Tsunami Warning	A Large Tsunami Warning has been issued. For those near the ocean, please evacuate to high ground.
	Tsunami Warning	A Tsunami Warning has been issued. For those near the ocean, please evacuate to high ground.
	Tsunami Advisory	A Tsunami Advisory has been issued. For those near the ocean, please be careful.
	The Tokai Earthquake Warning Declaration	A Tokai Earthquake Warning Declaration has just been issued. Please pay attention to the information on TV or radio.
	The Tokai Earthquake Advisory Information	A Tokai Earthquake Advisory Information has just been issued. Please pay attention to the information on TV or radio.

Source: Japan Meteorological Agency

2. Earthquake and Tsunami Warnings/Information in Japan:

When JMA anticipates damage from an earthquake, it issues warnings and forecasts using observed data.

JMA has two kinds of warnings on earthquakes: one is an Earthquake Early Warning, which predicts strong motion, and the other is a Tsunami Warning, which predicts tsunamis. The Agency also issues public advisories and forecasts if the expected level of damage is below the criteria for these warnings to be issued.

1) Earthquake Early Warnings

Earthquake Early Warnings (EEWs) are warnings (or forecasts) of strong motion to be issued several seconds to several tens of seconds before its arrival.

If the estimated seismic intensity is above 5-lower, an EEW is issued to areas where the estimated seismic intensity is 4 or greater through media such as TV and radio.

The main benefit of EEW is that they are issued before the arrival of strong shaking. Strong tremors caused by earthquakes strike suddenly. However, notice of their arrival several seconds to several tens of seconds in advance allows people to take action to protect themselves, such as promptly moving away from windows and shelves or taking cover under a sturdy table. As there are only a few moments before strong tremors arrive, after the issuance of EEW there may be no time to consider how to react on hearing EEW; this makes it important to carry out emergency response drills so that appropriate action can be taken as soon as a warning is given. In areas close to the focus of the earthquake, however, an EEW may not be transmitted before the tremors hit and errors of ±1 or so may be included in the estimated scismic intencity of EEW.

It should be noted that there are such limits to the accuracy of EEW.

◆ Example of an EEW broadcast image (NHK)

Source: Japan Meteorological Agency

◆ EEW

Criterion	Contents	Examples of responses to EEW
Predicted seismic intensity is 5-lower or greater.	Names of areas where seismic intensity is predicted to be 4 or greater	Provided through various media (e.g., TV and radio) to the general public.

2) Tsunami Warnings/Advisories and Tsunami Information

Tsunamis are one of damaging phenomena caused by earthquakes. If a tsunami strikes a coastal area, it can cause death or serious injury to people and damage to buildings.

When an earthquake occurs, JMA estimates whether a tsunami has been generated. If a disastrous tsunami is expected in coastal regions, JMA issues a Tsunami Warning/Advisory for each region (66 individual regions are defined to cover all coastal areas of the country).

Tsunami Warnings/Advisories are categorized into three levels – Tsunami Warning (Major Tsunami), Tsunami Warning (Tsunami) and Tsunami Advisory –according to the estimated tsunami height. JMA also issues information on tsunami details such as estimated arrival time and height. If no damage is expected, a Tsunami Forecast is issued.

Warnings/Advisories may be changed or updated based on observed tsunami heights.

◆ Tsunami Forecast

Forecast of changes in sea level	Indication
No tsunami is expected	A "No tsunami is expected" message is added to the Earthquake Information.
Expected height of sea level change less than 0.2 m.	No damage is expected as changes in sea level will be less than 0.2 m.
Slight sea level changes may still occur after Tsunami Advisory cancellation.	Pay attention when engaging in fishing, swimming or other activities, as changes in sea level may still occur for the time being.

◆ Tsunami Information

Tsunami-related messages	Indication
Tsunami Information (forecast of height and arrival time of initial wave)	Forecasts of the height and arrival time of the initial wave are provided for each forecast region.
Tsunami Information (arrival time of tsunami and high tide)	Information on the estimated time of high tide and forecasts of tsunami arrival times at several points are provided.
Tsunami Information (tsunami observations)	Arrival times and tsunami heights observed at tsunami observation stations are provided.

JMA issues various warnings to alert people to possible catastrophes caused by extraordinary natural phenomena such as heavy rain, earthquakes, tsunami and storm surges. In addition to such warnings, advisories and other bulletins, JMA started issuing **Emergency Warnings** to alert people to the significant likelihood of catastrophes if phenomena are expected to be of a scale that will far exceed the warning criteria.

The criteria for Emergency Warning issuance were determined in response to the views of local governments in charge of disaster management for their own areas. In regard to earthquakes, tsunami and volcanic eruptions, JMA maintains the system of warning nomenclature used until 29 August, 2013 but issues messages in the new classification of Emergency Warnings for high-risk conditions. These include Major Tsunami Warnings, Volcanic Warnings (Level 4 or more) and Earthquake Early Warnings (incorporating prediction of tremors measuring 6-lower or more on JMA's seismic intensity scale).

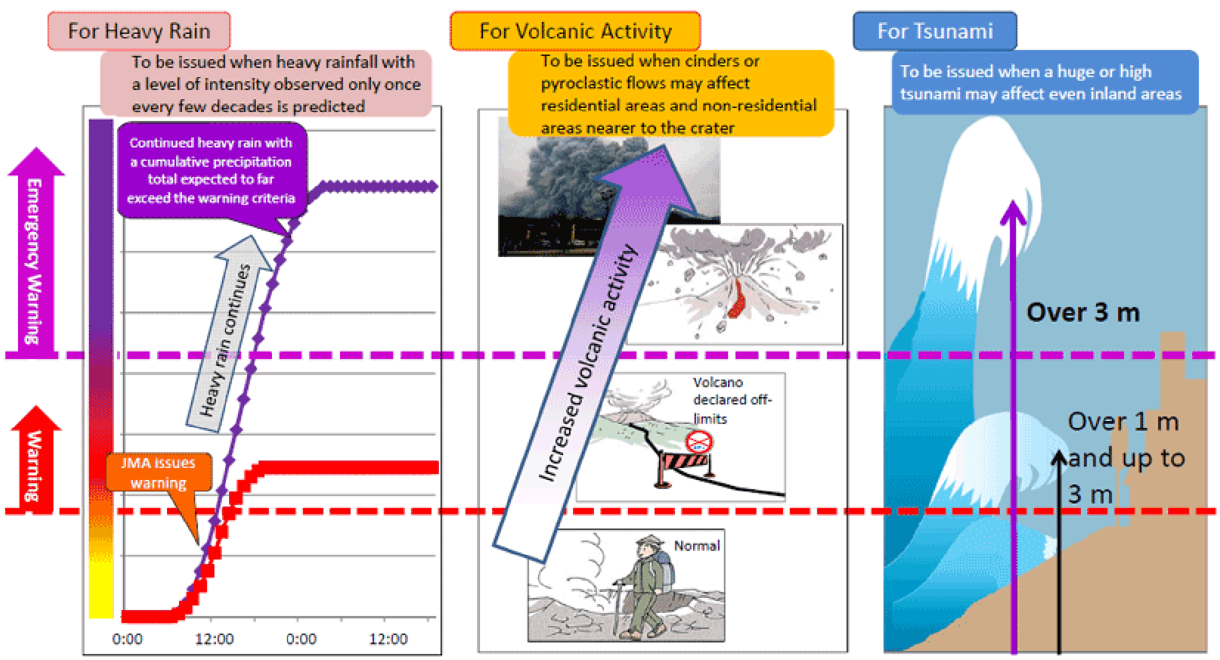
3) Earthquake Information

JMA issues predictive information such as Tsunami Warnings/Advisories and Earthquake Early Warnings as well as earthquake information based on the results of observations.

◆ Earthquake Information issued by the JMA

Title	Content and timing of issue
Seismic Intensity Information	Occurrence of an earthquake Regions with seismic intensity of 3 or greater (Issued within two minutes of earthquake occurrence)
Earthquake Information	Earthquake hypocenter and magnitude Remark – either "No threat of tsunami" or "Sea levels may change slightly, but no danger is expected." (Issued when no tsunami forecast is announced.)
Earthquake and Seismic Intensity Information	Earthquake hypocenter and magnitude Cities/towns/villages with seismic intensity of 3 or greater, and those with estimated seismic intensity of 5-lower or greater with no reports from seismic intensity meters
Information on seismic intensity at each site	Earthquake hypocenter and magnitude Sites with seismic intensity of 1 or greater
Information on the number of earthquakes	Number of earthquakes with seismic intensity of 1 or greater (Issued if earthquakes occur repeatedly.)
Shake Map(Estimated Seismic Intensity Distribution Map)	Estimated Seismic Intensity Distribution Map based on seismic intensity data (Issued when seismic intensity is 5-lower or greater.)

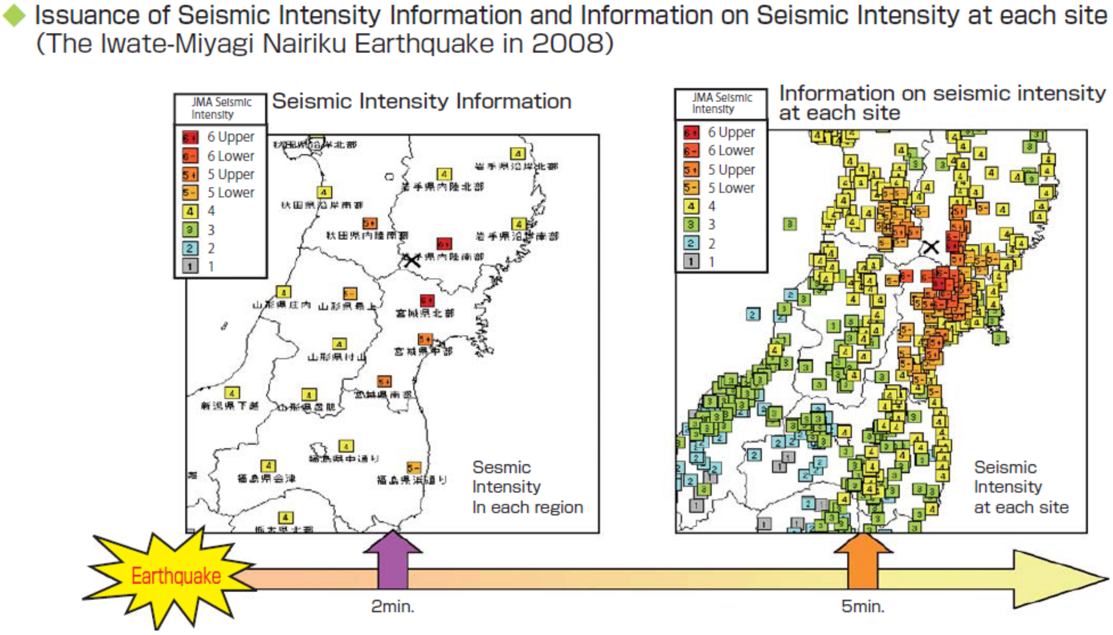
Emergency Warning Overview



Seismic Intensity Information and Information on seismic intensity at each site

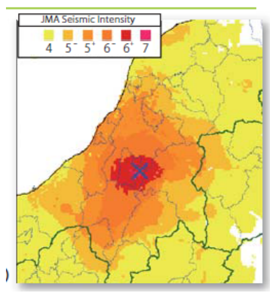
When seismic intensity is 3 or greater, JMA issues Seismic Intensity Information within two minutes to allow emergency action to be taken.

The seismic intensities are disseminated to disaster management organizations and are used as a trigger for their emergency operation. They are also broadcast to the public by TV, radio and other media. For example, the Cabinet Secretariat will call a meeting of the designated emergency response team in the event of a quake with seismic intensity of 6-lower or greater.



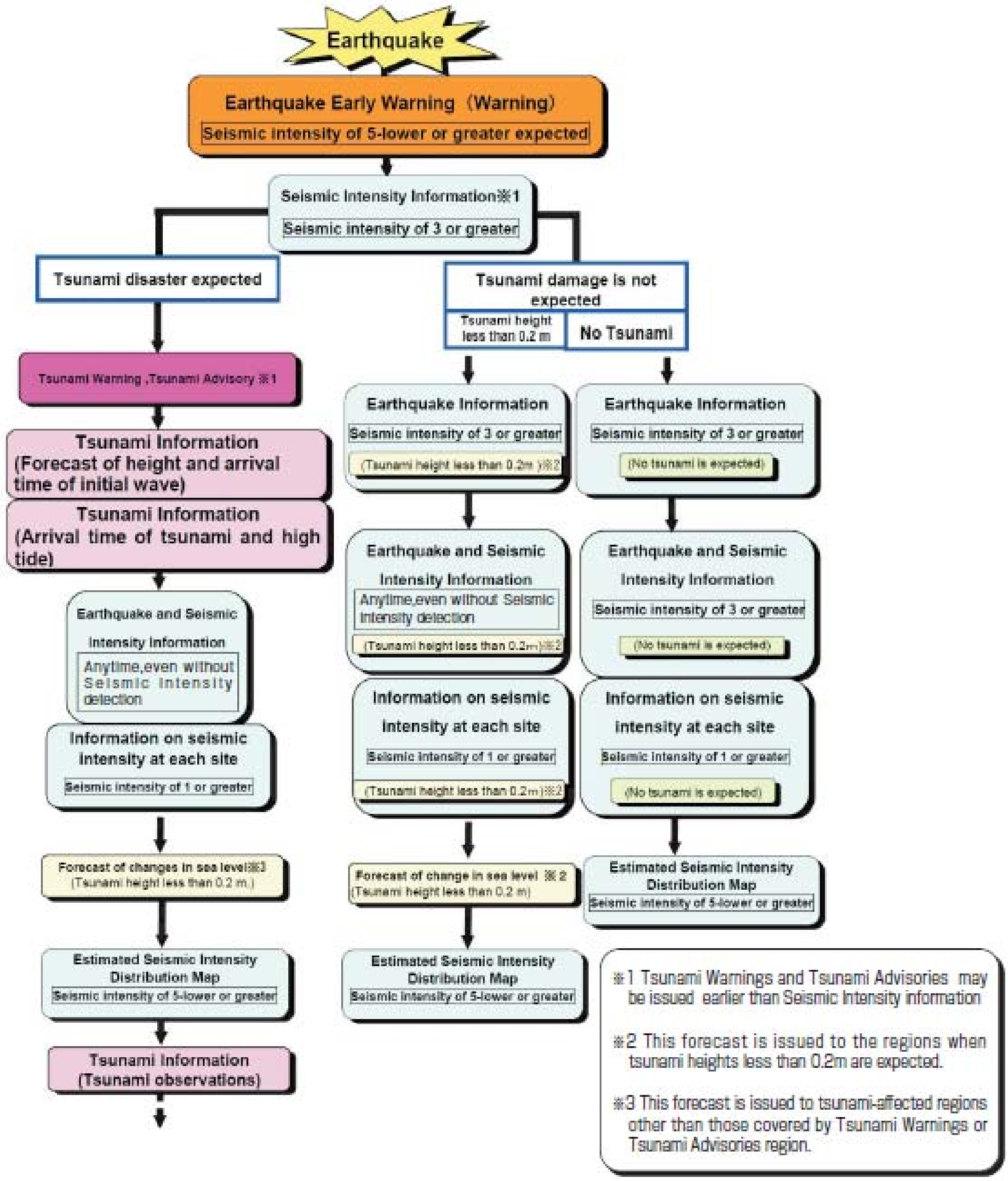
Source: Japan Meteorological Agency

Shake Map (Estimated Seismic Intensity Distribution Map



To enable prompt emergency measures to be taken by disaster management authorities, JMA analyzes seismic intensity taking into account the surface geology for each grid space, and draws an Estimated Seismic Intensity Distribution Map that shows estimated seismic intensity in places without seismic intensity meters. As the analyzed values have a margin of error, users should focus on the extent and distribution of strong ground motion areas rather than the respective estimated value for each grid.

Flow of issuance of information on tsunamis and earthquakes

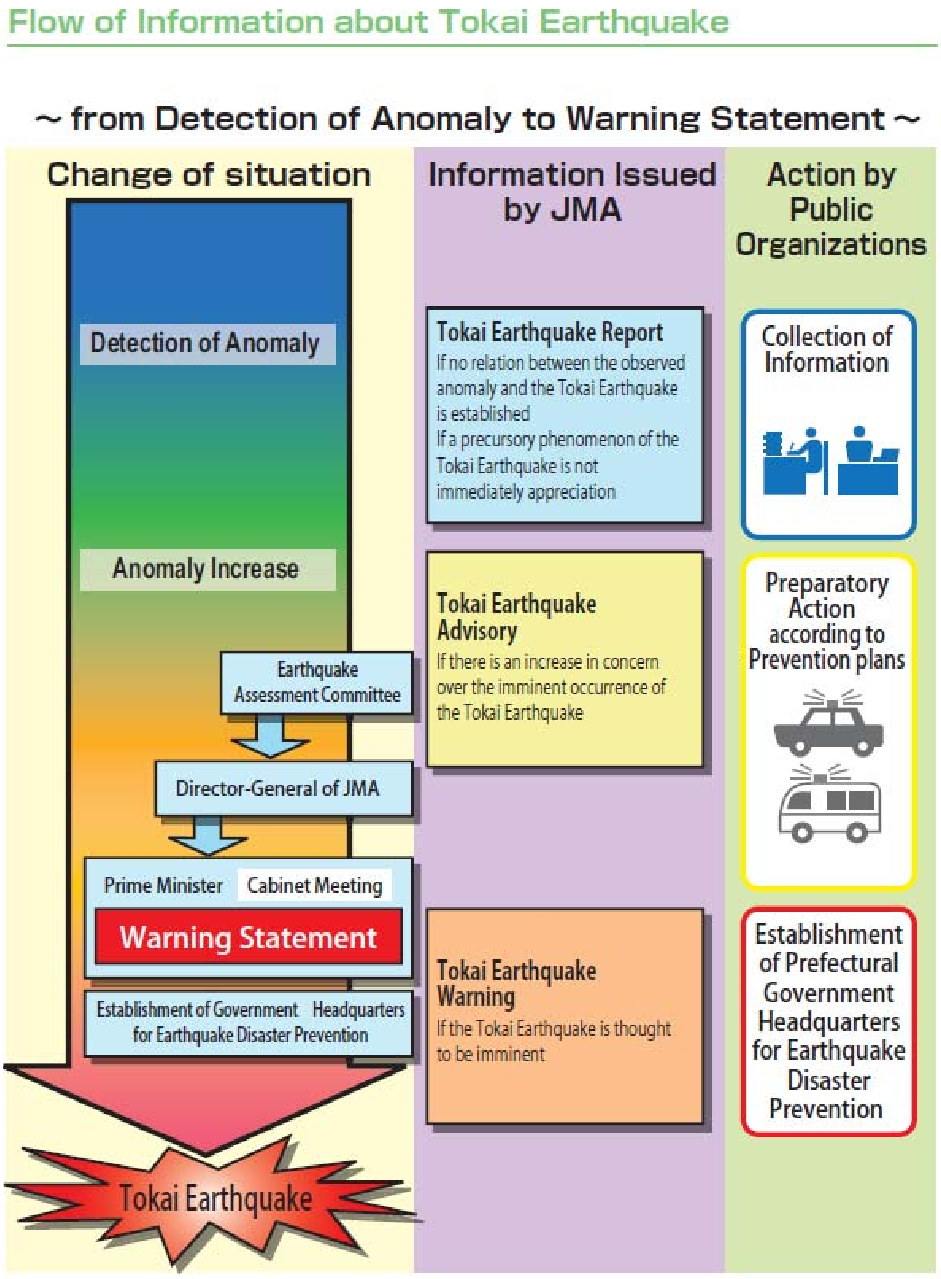


Source: Japan Meteorological Agency

4)Tokai Earthquake Prediction and Information

Information about Tokai Earthquake

In Japan, a large-scale earthquake with a magnitude of around 8 (referred to as the Tokai Earthquake) is widely expected to hit the Tokai region in the near future. In order to predict the occurrence of the Tokai earthquake, JMA has developed a seismic and crustal deformation observation network throughout the region in conjunction with related organizations, and observes data coming from them on around-the-clock basis (see p.16). If anomalous data are detected, JMA issues Information on the Tokai Earthquake bulletins to allow preparatory action and emergency measures for earthquake disaster prevention. These are categorized into three types:Tokai Earthquake Report, Tokai Earthquake Advisory, and Tokai Earthquake Warning .



Source: Japan Meteorological Agency

5) The earthquake early warning system during the Tohoku earthquake

At 14:46:23 JST (Japan standard time) on March 11th, 2011, a 9.0 magnitude earthquake with a maximum seismic intensity of 7 occurred on the north eastern Pacific coast of Honshu, Japan. The seismograph station at Ouri in Ishinomaki City was the first of over 380 seismic stations across Japan to record seismic movement at 14:46:40.2 JST. As shown in table 1, the first earthquake forecast was issued to advanced users 5.4 seconds after the initial detection of p-waves. An earthquake warning was issued to the general public was issued 3.2 seconds after this forecast. A total of 15 forecasts, warnings, and updates were issued within the two minutes of the initial seismic detection. The first warning issued to the public was broadcasted to the Sendai area in central Miyagi prefecture and predicted an earthquake of magnitude 7.2 and seismic intensity of 5-lower. This warning arrived 15 seconds prior to the s-waves arrival in Sendai, which is located 129km west of the earthquake's epicenter. Tokyo, located 373km southwest from the epicenter, received 65.1 seconds of warning before the ground began to shake.

Update number	Notes	Time in JST (hh:mm:ss.s)	Time since first P-wave detection (sec)	Estimated magnitude	Estimated maximum seismic intensity (shindo)	Latitude	Longitude
-	Initial Seismic Detection Time of p-wave	14:46:40.2	-	-	-	-	-
1	**First forecast issued to advanced users**	**14:46:45.6**	**5.4**	**4.3**	**1**	**38.2**	**142.7**
2		14:46:46.7	6.5	5.9	3	38.2	142.7
3		14:46:47.7	7.5	6.8	4	38.2	142.7
4	**First warning issued to the general public**	**14:46:48.8**	**8.6**	**7.2**	**5-lower**	**38.2**	**142.7**
5		14:46:49.8	9.6	6.3	4	38.2	142.7
6		14:46:50.9	10.7	6.6	4	38.2	142.7
7		14:46:51.2	11.0	6.6	4	38.2	142.7
8		14:46:56.1	15.9	7.2	4	38.1	142.9
9		14:47:02.4	22.2	7.6	5-lower	38.1	142.9
10		14:47:10.2	30.0	7.7	5-lower	38.1	142.9
11		14:47:25.2	45.0	7.7	5-lower	38.1	142.9
12	First warning issued for Tokyo area	14:47:45.3	65.1	7.9	5-upper	38.1	142.9
13		14:48:05.2	85.0	8.0	5-upper	38.1	142.9
14		14:48:25.2	105.0	8.1	6-lower	38.1	142.9
15	Final warning update	14:48.37.0	116.8	8.1	6-lower	38.1	142.9

Table 1. Dessimination time
Source: Japan Meteorological Agency

These warnings were broadcasted to the general public using television and radio networks and
were also sent to approximately 52 million people on their cellular devices.

For instance, forecasts sent to East Japan Railway Company caused eleven Tohoku Shinkansen bullet trains to automatically come to a halt seconds before the ground began to shake. Other companies like Otis, an elevator manufacturing company was also able to shut down 16,700 elevators in affected areas as soon as the earthquake forecast was received. In addition, 40 of the 42 elevators in Tokyo's Metropolitan Government Building buildings, which range from 41-243 meters in height, also automatically stopped at the nearest available floor and shutdown to allow for evacuation as a result of JMA's earthquake warnings.

3. Information and communication system

The development of a quick and accurate communications systems is essential for the effective use of disaster early warning information. For this purpose an online system has been built, linking the Japan meteorological agency with disaster management organizations of the national and local governments and media organizations.

Disaster management organizations have also been developing radio communications networks exclusively for disasters: the Central Disaster Management Radio communications System, which connects national organizations; the Fire Disaster Management Radio Communications System, which connects firefighting organizations across the country; and prefectural and municipal disaster management radio communications systems, which connect local disaster management organizations and residents.

The Cabinet Office has established the Central Disaster Management Radio Communications System to link with designated government organizations, designated public corporations and local disaster management organizations, providing communications by telephone, fax, data transmission, TV conferencing and transmission of pictures of disaster situations from helicopters.

Furthermore, to provide backup for terrestrial communications, services such as a satellite mobile telephone communications system for municipal governments have been launched in 2011.

Simultaneous wireless communications systems using outdoor loudspeakers and indoor radio receivers are used to disseminate disaster information to residents. Tsunami and severe weather warnings are widely provided to citizens via TV and radio broadcasts.

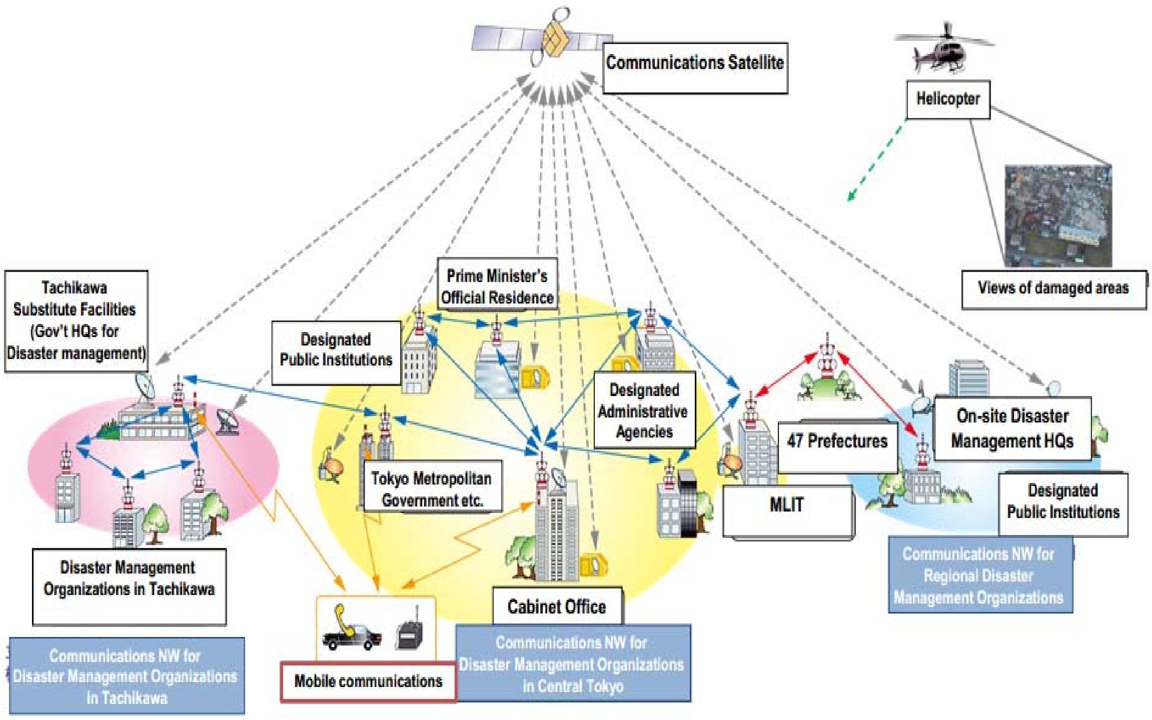


Figure 1.1 The Outline of Central Disaster Management Radio Communications System
Source: Cabinet Office, Government of Japan

3.1. Ministry of land, infrastructure, transport and tourism

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) conducts disaster management policy at national level in relation to flood and sediment disasters as well as town development with regard to safety for both natural and man-made disasters. Alongside with other phases of emergency management the ministry also actively involved in response phase and to this end Disaster Prevention Center was established.

Disaster Prevention Center established in the MLIT performs the following functions:

- Mobilizing leaders, staff members and related department members
- Observing and distributing meteorological information, site images, etc.
- Collecting and sharing information (integrating damage information)
- Exchanging information with ministers' offices, other ministries and agencies, local departments, etc.
- Providing information to the public
- Regional assistance, assistance to local governments

In order to achieve the "zero victim" goal in the face of increasingly intense floods and localized heavy rains caused by climate change, flood forecast centers (provisional name) will be established in regional development bureaus to strengthen risk management measures in, for example, monitoring floods and providing information to municipal governments, the mass media, etc.

Flood forecast centers are to perform such tasks as climate change monitoring, flood risk evaluation and the development of an advanced flood prediction system. To the end following activities are implemented:

- ✧ Collection of point data (e.g. rainfall amounts, water levels and water quality)

Rain observation by ground gauges and *telemetry system* – the data obtained by telemeters are consolidated in one site, such as a regional bureau and a prefectural office, through the linking station. Then, they are sent to each office to update the real-time flood prediction calculations.

- ✧ Collection of area data (rainfall amounts)

Radar rain gauges have been installed at 26 locations throughout the country. The information of 1-km mesh resolution is updated every half an hour and available on the Internet. The radar data are calibrated using the ground data.

- ✧ Collection of image data.

CCTV Network - MLIT Regional Development Bureaus and River Offices have real-time access to 3,900 CCTV images available on IP (Internet protocol) network. CCTV images are used for developing disaster control plans. Fiber-optic network - River Bureau and Road Bureau have jointly laid fiber optics network lines with the total length of 12046 km (as of 2006).

River information systems developed by individual regional development bureaus have been integrated into a national river information system. Regional development bureaus can customize the system according to their requirements.

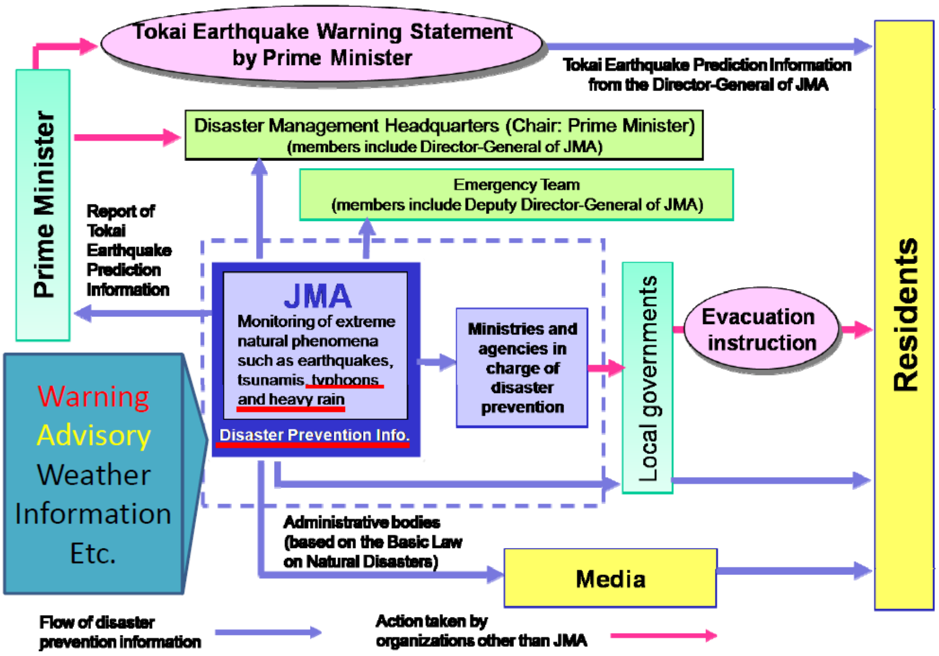
3.2. Japan Meteorological Agency

Japan Meteorological agency is the key body in prediction major natural hazards such as earthquakes, tsunamis, typhoons and volcano eruptions while MLIT is for flood and sediment disasters and cooperation with them is essential for municipalities and other disaster response organizations. It must be noted that application of latest technologies for disaster warning and communication by JMA had greatly improved disaster response system in Japan. In addition, state lifeline agencies, railway companies, NHK has established quick information sharing with JMA and other relevant bodies as well as response mechanism within respective fields of activity.

Massive numbers of voluntary response organizations and people involved in voluntary disaster response shows high level of disaster awareness and social responsibility for disaster reduction in the country. During disaster times acting in collaboration with the professional responders, voluntary teams demonstrate remarkable efforts in psychological support of the affected people and provided basic utilities.

The existing Early warning system, although, has been form during relatively short time period put in place sophisticated mechanism which enables Japan to mobilize forces and resources and respond in a comprehensive manner any large-scale disasters promptly, considerably decreasing damage and loss. Comprehensively elaborated coordination enables to relevant bodies take concerted actions to increases response efficiency. In turn hierarchical supervision granting response bodies with great independence keeps accountability of them high.

JMA is semi-autonomous agency of the MLIT. Besides, function as central weather service agency of Japan, the agency has established comprehensive surveillance and awareness providing mechanism with regard to earthquake, typhoon and volcano hazards. Regarding flood forecast Director-General of JMA In the event of the imminence of a flood or storm surge, the Director-General of JMA informs the Minister of Land, Infrastructure, Transport and Tourism and the prefectural governors concerned of the present state.



Symbol of JMA

Figure 3.1 The role JMA in Disaster Management System of Japan
Source: Japan Meteorological Agency

MLIT informs, jointly with the Director-General of JMA, for a class A river (excluding designated sections), the prefectural governors concerned of

- ✧ water level or discharge if the possibility of flooding is deemed high or
- ✧ water level or discharge, or the flood hazard area and the flood water depth if flooding has already occurred.

Prefectural governors communicate the information received as described above to the flood protection managers and stage gauge managers.

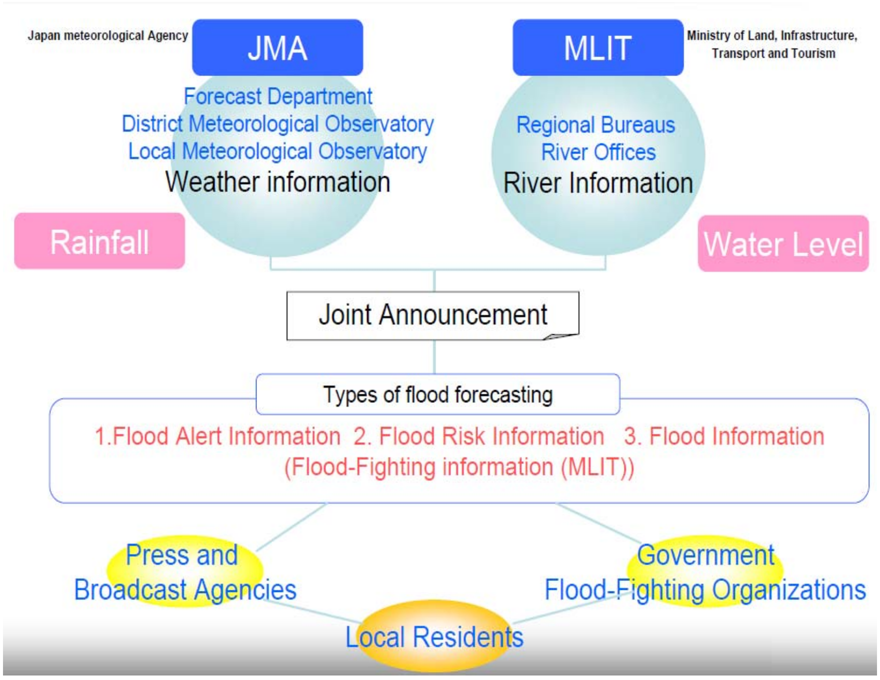


Figure 3.2 Joint flood warning by MLIT and JMA
Source: Japan Meteorological Agency

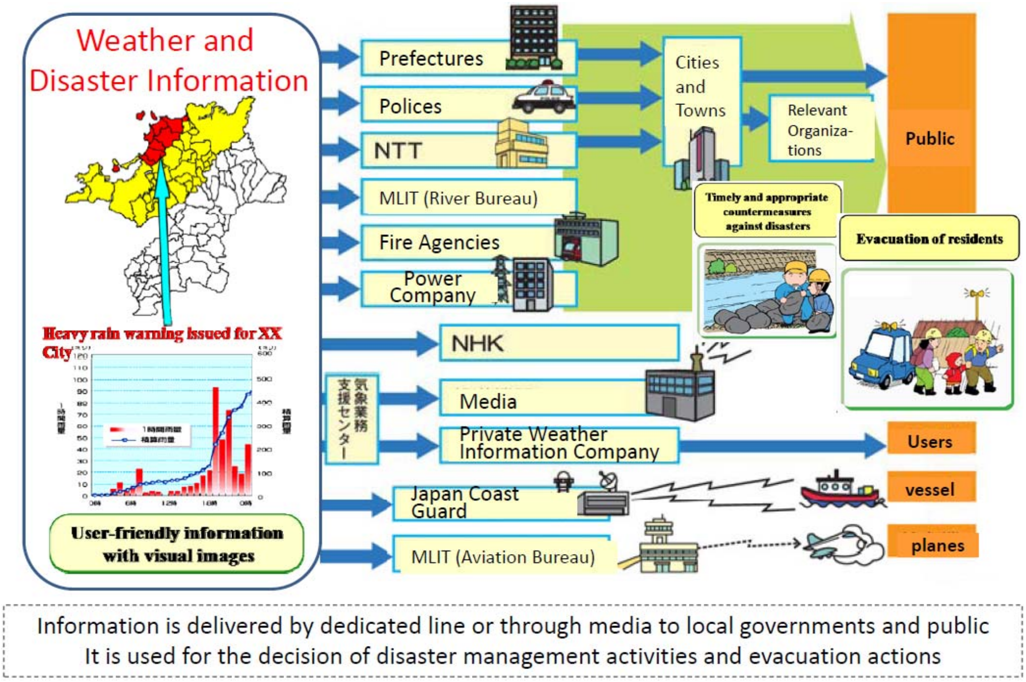


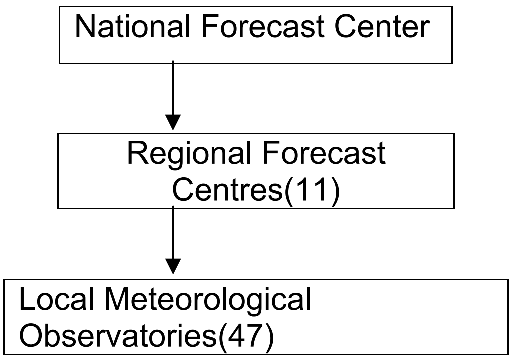
Figure 3.3 Forecasting dissemination

Source: Japan Meteorological Agency

Japan Meteorological Agency is playing the major role in forecasting natural hazard through its advanced monitoring network including satellites. The whole role of activities implements with the following goals in compliance with the Act of Ministry and meteorological services act,

- Prevention and mitigation of natural disasters.
- Safety of transport.
- Development and prosperity of industry.
- Improvement of public welfare.

Framework of Forecast Operation (JMA)



Source: Japan Meteorological Agency

JMA's Meteorological Services

1. Space-based Observation
2. Upper-air Observation
3. Radar Observation
4. Surface Observation
5. Ocean Observation
6. International Data Exchange

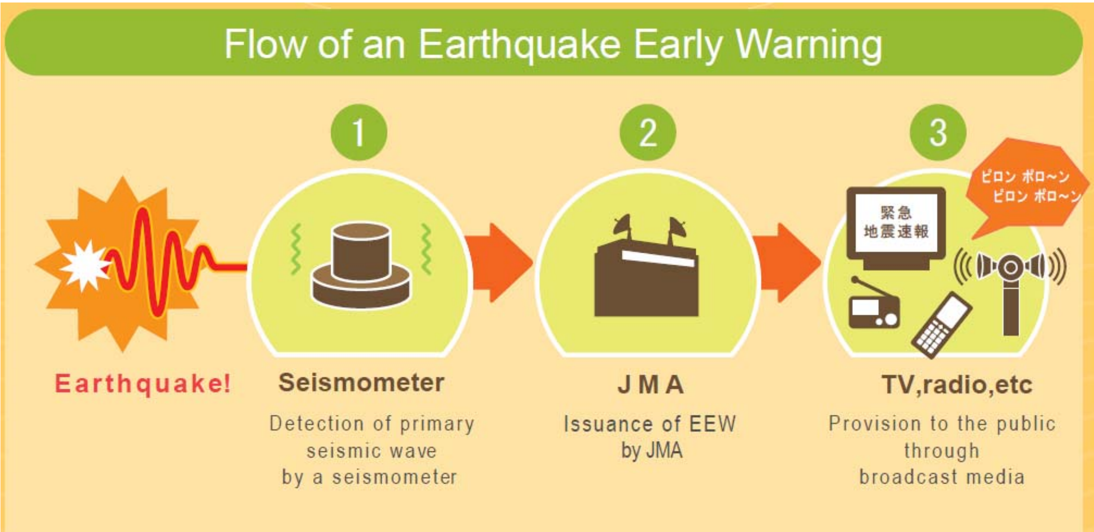
Local meteorological observatory is responsible for issuance of information on weather disaster prevention such as warnings/advisories for each prefecture.

Main Objective of Local Meteorological Observatories:

Disaster Forecasting to save lives

- Collecting weather and EQ data
- Analysis and Prediction of Weather
- Issuing Warnings and Meteorological Information

Earthquake Early Warning (EEW) information announces the estimated hypocenter and magnitude of an earthquake as well as the estimated arrival time of the S-wave (the principal shock) of the earthquake and seismic intensity in each area. This information is made possible by detecting the P-wave near the epicenter and immediately processing the data since there is a difference in the speed of the P-wave, which arrives faster, and the principal shock, which arrives later and causes more severely destructive phenomena. In the case of a large-scale ocean trench-type earthquake, there may be a time lag (several seconds to several tens of seconds) between the issuance of the EEW information and the start of severe shaking (when the S-wave arrives). This can be a critical time to be used for mitigating damage by stopping trains and elevators, extinguishing flames or crawling under tables.



Source: Japan Meteorological Agency

The issuance of EEW information by the Japan Meteorological Agency (JMA) began in October 2007. The JMA initiated the service to provide earthquake warning as mandated under a 2007 revision of the **Meteorological Service Act**.

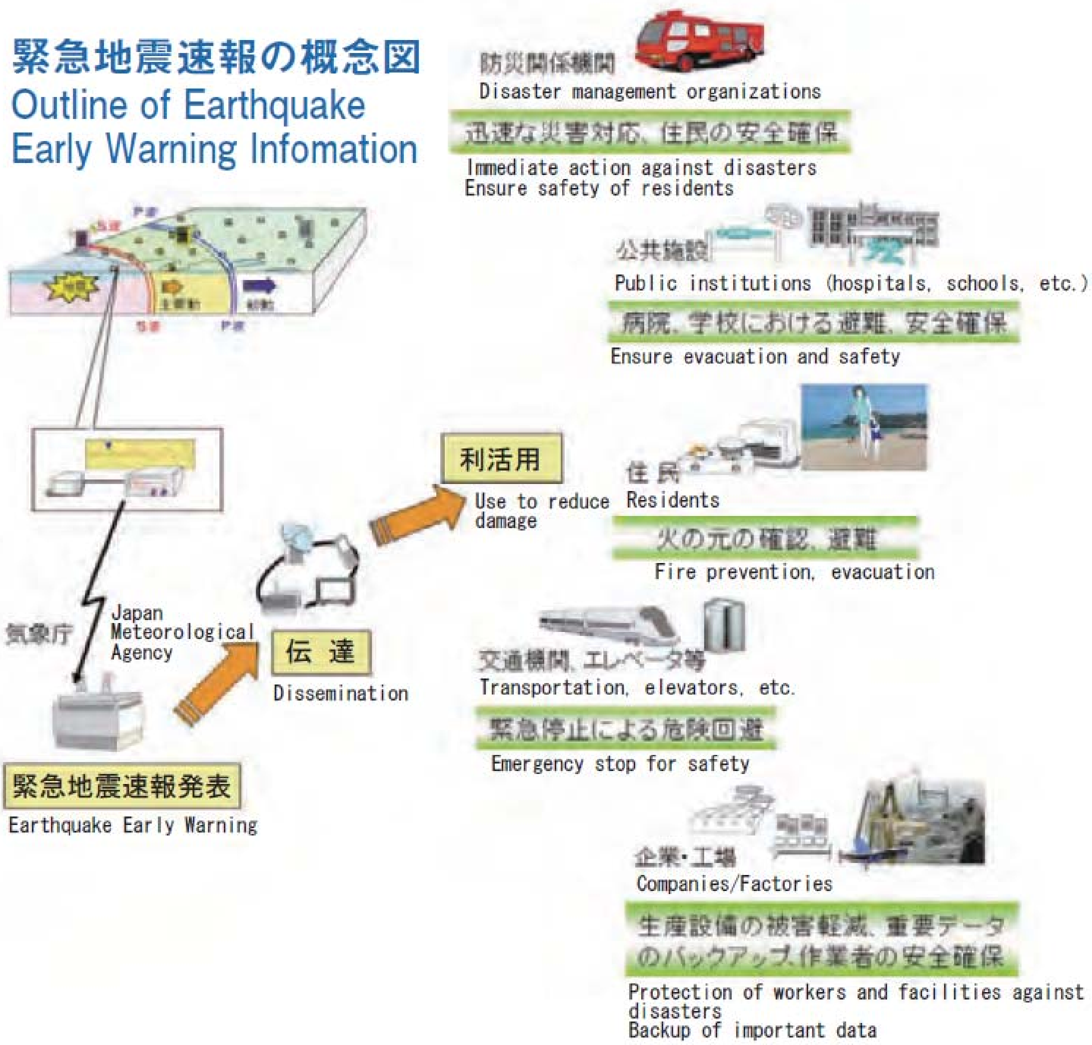


Figure 3.4 Outline of Earthquake Early Warning Information
Source: Cabinet Office, Government of Japan

Observing, Forecasting and Warning of Disaster Risks:

Observation systems that can accurately detect disaster risks in real-time have been progressively improved for establishing early warning systems, supporting the early evacuation of residents and response activities of disaster management organizations, and thereby reducing disaster damage. Organizations involved in disaster reduction, especially the JMA, use 24-hour systems to carefully monitor various natural phenomena and weather conditions.

In addition to announcing observed information related to natural phenomena, the JMA issues a wide range of forecasts, warnings and advisories regarding earthquake-generated tsunamis and severe weather events such as heavy rain.

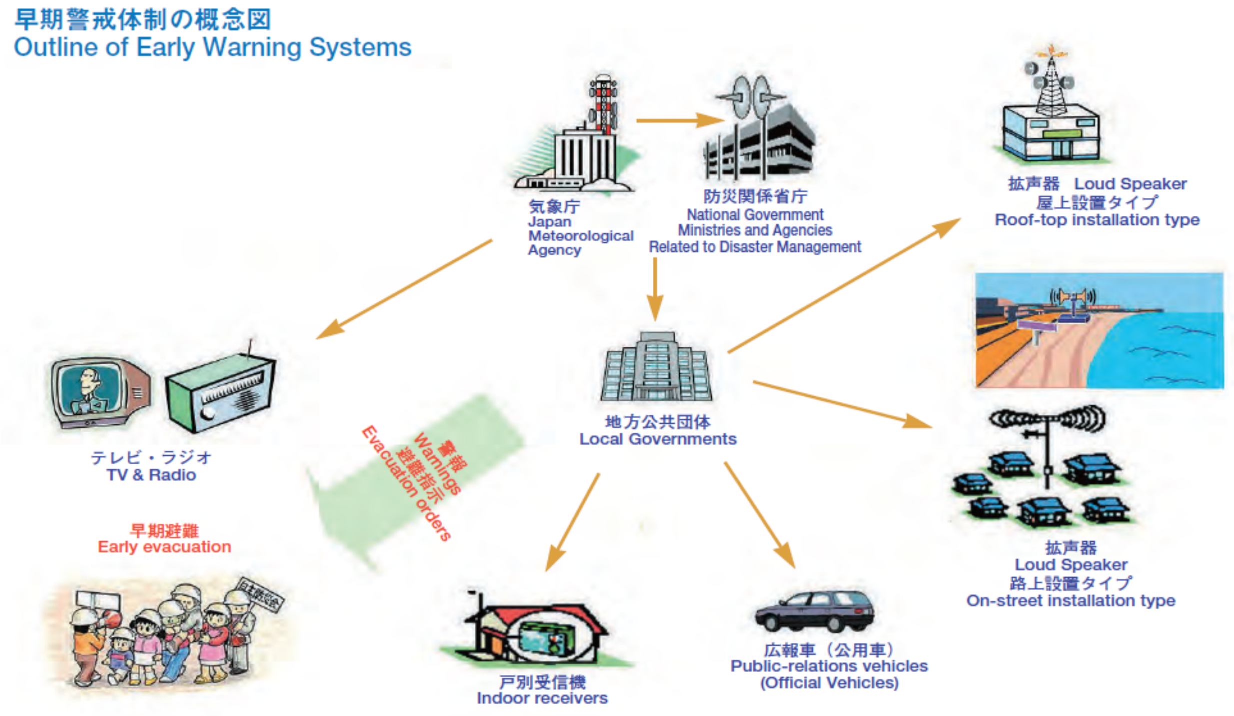


Figure 3.5 The Outline of Early Warning Systems

Source: Cabinet Office, Government of Japan

How to use warnings and Information for disaster prevention:

Japan is one of the most earthquake-prone countries in the world, and has repeatedly suffered serious damage caused by earthquakes and tsunamis.

What would happen if there were no earthquake/tsunami information when a tremor hits? The absence of information on areas that are at risk of tsunami strikes or subject to strong shaking would delay evacuation and emergency response by disaster prevention agencies, and may result in extensive damage.

JMA promptly issues warnings and information on earthquakes and tsunamis to mitigate disasters and protect life and property.

Examples:

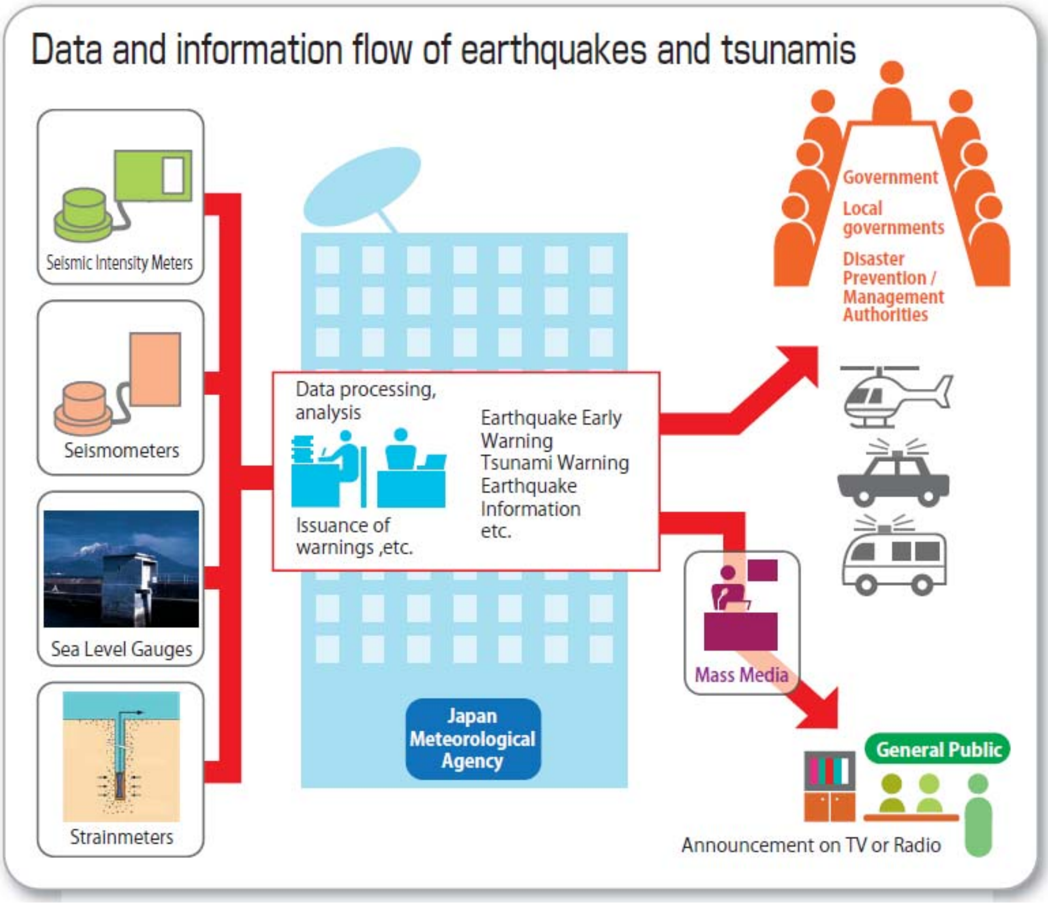
●In the event of large earthquakes, JMA announces earthquake alerts before strong tremors arrive **(Earthquake Early Warnings).**

●In the event of large earthquakes in ocean areas, JMA announces estimated tsunami heights and their arrival times in advance **(Tsunami Warnings/Advisories).**

●In the event of earthquakes, JMA announces hypocenter, magnitude and where strong shaking has been felt **(Earthquake Information).**

To utilize above information, it is very important to understand the announcements made by JMA and to have a certain level of awareness in regard to earthquakes and tsunamis.There is brochure explained about various types of information and warnings and outlines JMA's monitoring network. Basic facts about earthquakes and tsunamis are also included.

The resource aims to help people understand the various types of information issued by JMA to prevent and mitigate disasters caused by earthquakes and tsunamis.



Source: Japan Meteorological Agency

4. J-ALERT system in Japan

This system is a nationwide warning system in Japan launched in February 2007. It is designed to quickly inform the public of various threats. The system was developed in the hope that early warnings would speed up evacuation times and help coordinate emergency response.

1. Outline

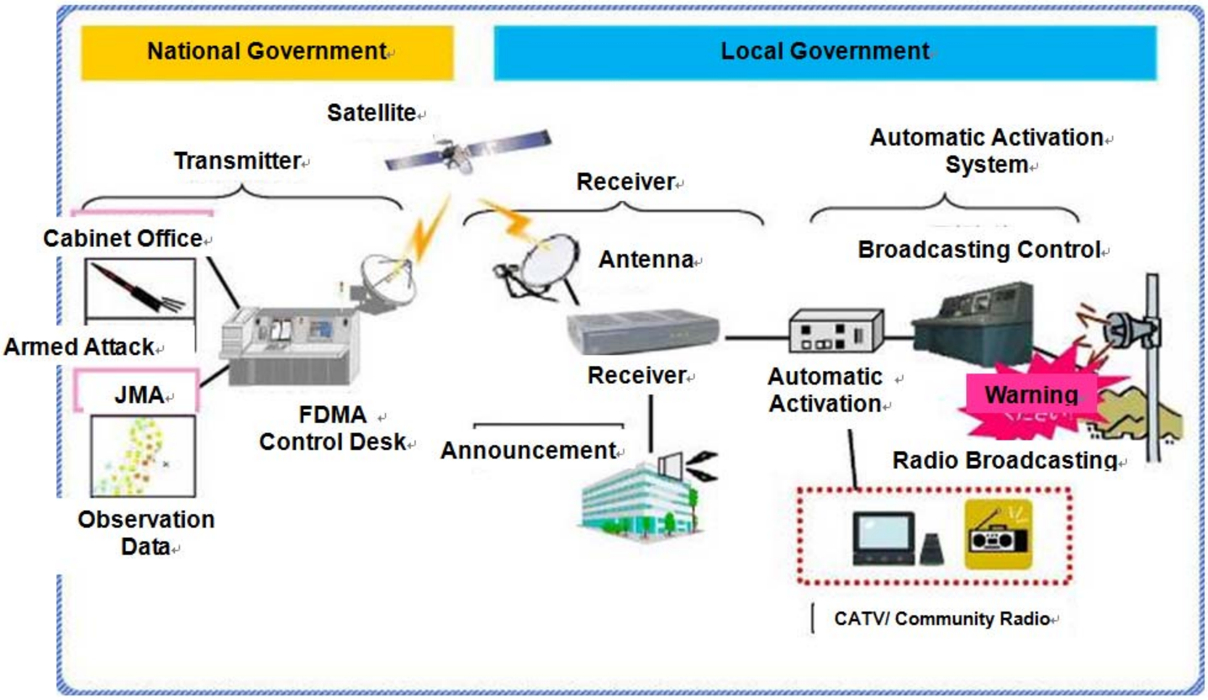
J-ALERTis the system to immediately transmit emergency information such as Emergency Earthquake information, tsunami warning, information of ballistic missiles, which people have no enough time to deal with, is transmitted to the municipalities by using satellite (via the Fire and Disaster Management Agency, the Cabinet Secretariat, and JMA)

2. Development

09 February 2007: Commenced operation of the system
01 October 2007: Started sending the emergency earthquake information
As of March 1 2010, 344 municipalities have introduced a system. (among them, automatic activation system of radio broadcasting and community FM have been introduced to 282 municipalities)

2. Current Initiatives

FY 2009 budget (approximately 900 million yen) was prepared for more sophisticated system, such as audio broadcast of the content, software updates, proper operation management.



Source: http://www.centurysys.co.jp/jalert/

J-ALERT is a satellite based system that allows authorities to quickly broadcast alerts to local media and to citizens directly via a system of loudspeakers. According to Japanese officials it takes about 1 second to inform local officials, and between 4 and 20 seconds to relay the message to citizens. All warnings, except for severe weather warnings, are broadcast in five languages: Japanese, English, Mandarin, Korean and Portuguese.

The warnings were broadcast in these languages during the 11th March 2011 earthquake and tsunami. The severe weather warnings are only broadcast in Japanese.

J-ALERT broadcasts via the **Superbird-B2** communication satellite of JSAT corporation.

The J-ALERT, all country instant alarm system that is promoting the development is Fire and Disaster Management Agency. If a disaster urgent occurs, and then transfer the information disaster disaster prevention radio system such as municipalities, and to disaster information delivery system to residents directly from the Fire Department using a communication satellite. Broadcast radio automatic start equipment has been tested and found to allows us to perform the start-up control for disaster information transmission system to the residents of the municipality disaster prevention wireless systems, etc., to the loudspeaker voice message.

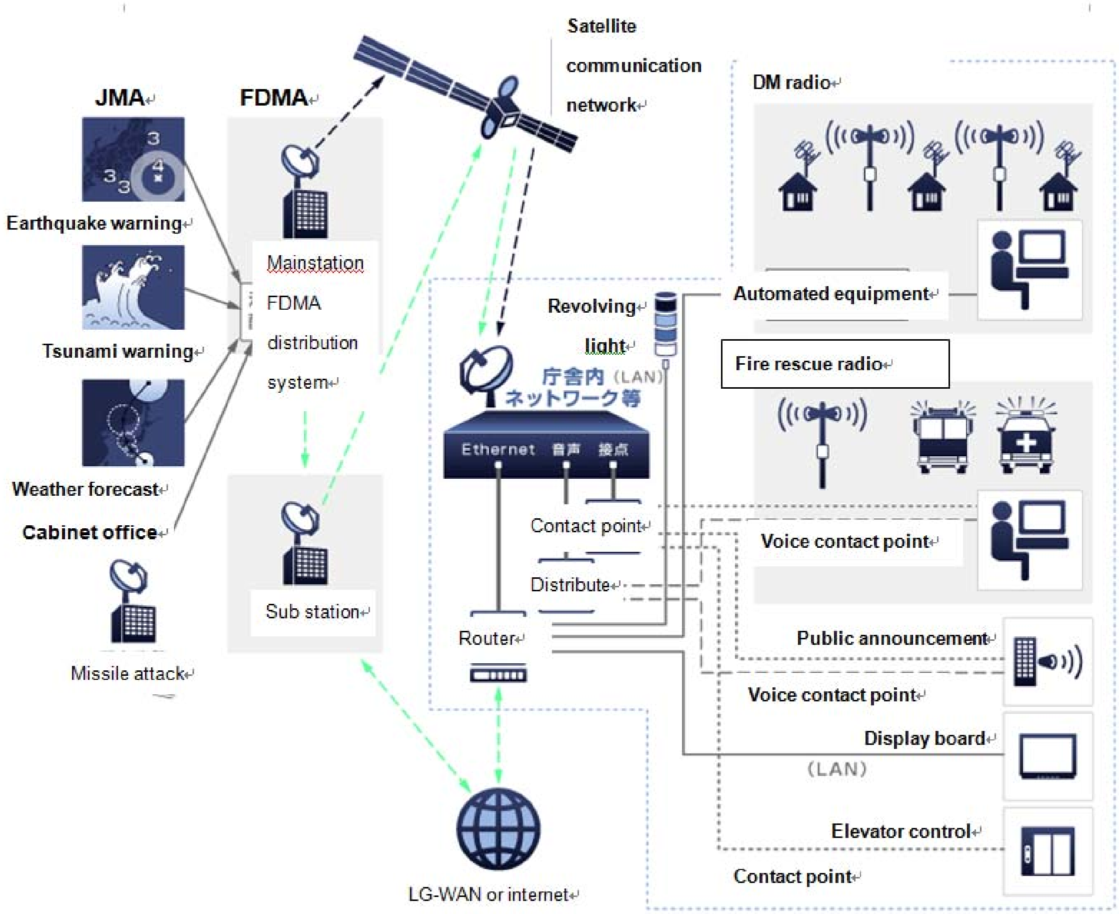


Figure 4.1 Outline of J-ALERT system
Source: http://www.centurysys.co.jp/jalert/

1) Satellite data distribution system

Systems designed to distribute information simultaneously to many sites, They are adopted as nation-wide simultaneous alert systems (J-ALERT) to distribute citizen protection information, weather information, earthquake information, etc. across Japan.

2) Disaster prevention and mitigation system

A wide range of disaster prevention and mitigation systems are available to local governments, including those integrated with J-ALERT, a FWA (fixed wireless access) system, and/or an integrated system for delivering emergency alert emails.

3) Mail distribution service

This is a service of distributing email magazines available to local governments. Under this service, unique email magazines are created and distributed to various terminal devices (such as cell phones, smartphones and personal computers) of local people in regions. Further, information distributed by the nationwide instantaneous warning system (J-ALERT) such as the information related to civil protection, earthquakes and weather conditions is automatically distributed. Besides distribution in Japanese, distribution in English, Chinese, Korean, Spanish and Portuguese is also available, and staff-gathering emails which are useful at the time disaster occurrence can also be available as an option.

4) Multicast content delivery system

Multimedia content such as digital signage, e-learning, digital cinema, and videos can be delivered all at once. Any transmission errors can be recovered automatically. Various features such as grouped delivery, scheduled delivery, delivery confirmation, and resending are also supported. When satellite communications are used, an easy-to-set-up compact receiver is available.

5. Mobile phone distribution

KDDI corporation provides three services, “Disaster message board service”, “Emergency email service” and “Disaster voice message” in the event that a disaster occurs to help confirm the safety of users.

Disaster message board service: This service becomes available when disasters occur, including earthquakes measured a lower 6 or greater on JMA seismic intensity scale. Customers in the disaster stricken area can register their safety information. Registered safety information can be viewed on the internet from all over Japan. Safety information can also be checked from au mobile phones, other carriers mobile phones and PCs. Registrations to disaster message board can be sent to email addresses specified in advance.

Emergency email service: This service broadcasts disaster information to the stricken area. When an earthquake with estimated maximum intensity of 5 or greater is expected, this warning is issued to areas that expected to experience shocks of 4 or greater. Sends evacuation advisories and orders from national and local public organizations in the event of natural disasters such as earthquakes and typhoons and other information relating to the safety of residents. Issued to the area where the highest tsunami waves are expected to be approximately 1 m or greater.

Disaster voice message: This service is for delivering a voice message recorded with an iPhone to your loved ones in the event of large scale disaster, letting them know that you safe. As this service uses packet communications, you can confirm the safety of your family and friends even when voice communication networks are congested in the event of a large scale disaster.

This is ez-guide map software of KDDI corporation

Source: http://www.au.kddi.com

Chapter 5. Conclusion

People-centered early warning systems empower communities to prepare for and confront the power of natural hazards. However, the efficiency of such systems is to be measured in terms of lives saved and reduction in losses, which is directly related to the execution of an anticipated response by the people and institutions once a warning is issued.

The four elements of people centered Early Warning Systems

A complete and effective, people-centered early warning system comprises four inter-related elements, spanning knowledge of hazards and vulnerabilities through to preparedness and capacity to respond. Good governance is encouraged by robust legal and regulatory frameworks and supported by long term political commitment and integrated institutional arrangements. Major players concerned with the different elements should meet regularly to ensure that they understand all of the other components and what other parties need from them.

Effective early warning systems require strong technical foundations and good knowledge of the risks. But they must be strongly people centered – with clear messages, dissemination systems that reach those at risk, and practiced and knowledgeable responses by risk managers and the public. Public awareness and education are critical; in addition, many sectors must be involved. Effective early warning systems must be embedded in an understandable manner and relevant to the communities which they serve.

Risk Knowledge. Risk assessment and mapping will help to set priorities among early warning system needs and to guide preparations for response and disaster prevention activities.

Warning Service. A sound scientific basis for predicting potentially catastrophic events is required. Constant monitoring of possible disaster precursors is necessary to generate accurate warnings on time.

Communication and Dissemination. Clear understandable warnings must reach those at risk. For people to understand the warnings they must contain clear, useful information that enables proper responses. National and community level communication channels must be identified in advance and one authoritative voice established.

Response Capability. It is essential that communities understand their risks; they must respect the warning service and should know how to react. Building up a prepared community requires the participation of formal and informal education sector.

JAPAN

As one of the public corporations designated for disaster management under the Disaster countermeasure basic act, NHK plays the key role in disaster broadcasting and emergency .JMA is the key body in prediction major natural hazards such as earthquakes, tsunamis, typhoons and volcano eruptions while MLIT is for flood and sediment disasters and cooperation with them is essential for municipalities and other disaster response organizations. It must be noted that application of latest technologies for disaster warning and communication by JMA had greatly improved disaster response system in Japan. In addition, state lifeline agencies, railway companies, NHK has established quick information sharing with JMA and other relevant bodies as well as response mechanism within respective fields of activity.

- **Crucial collaboration with JMA and MLIT** - JMA is the key body in prediction major natural hazards such as earthquakes, tsunamis, typhoons and volcano eruptions while MLIT is for flood and sediment disasters and cooperation with them is essential for municipalities and other disaster response organizations.

- **Comprehensive mechanism of emergency broadcasting by national television** –Close collaboration with JMA and established automated emergency warning, huge facilities and equipments in its disposal NHK plays central role in disaster broadcasting and emergency warning.

- Massive numbers of voluntary response organizations and people involved in voluntary disaster response shows high level of disaster awareness and social responsibility for disaster reduction in the country. During disaster times acting in collaboration with the professional responders, voluntary teams demonstrate remarkable efforts in psychological support of the affected people and provided basic utilities.

- The existing Early warning system although has been form during relatively short time period put in place sophisticated mechanism which enables Japan to mobilize forces and resources and respond in a comprehensive manner any large-scale disasters promptly, considerably decreasing damage and loss. Comprehensively elaborated coordination enables to relevant bodies take concerted actions to increases response efficiency. In turn hierarchical supervision granting response bodies with great independence keeps accountability of them high.

-Changes and advancements driven by previous large-scale disasters -based on the lessons of previous national disasters system has undergone both organizational changes and enhancements. Large-scale natural disasters in recent decades, such as, Isewan Typhoon, Great Hanshin-Awaji Earthquake, Great East Japan Earthquake have influenced currents disaster response system in Japan.

- Multilevel emergency response – Depending on the scale of disaster emergency response is conducted on local, prefectural and national levels.

- Effective lifeline crisis management system – recent disasters provided high level of emergency response preparedness and capabilities by lifeline – electricity and gas – providers. Integration of advanced technologies for disaster prediction, control and resilience and comprehensive collaboration with other relevant bodies are the key reasons

MONGOLIA

Provinces and local governments also have emergency management departments. The provincial department of disaster prevention and mitigation is responsible for emergency management at the provincial level.

Mongolia was use in 1970-1980 Civil Ddefence's early warning system with analogy system. Now early warning devices with analogy system disconnect from network, out of date and do not work.

The causes for Early warning problem are

1) Inadequate political commitment.
3) Lack of public awareness and lack of public participation in the development and operation of early warning systems.
4) Lack of decision support systems that could help to avoid overcautious and inefficient cross checking of data.
5) The need for real time connections rather than reliance on the internet.
6) Insufficient budget allocation of disaster risk reduction.
7) One way communication of early warning, no feedback evaluation from community
8) Warning Message understood and trusted but do not know how to respond.

Disaster risk management is a multi-sectorial and cross-cutting issue. Early warning as an essential element of risk management can be successful if all related sectors in local, national, regional and global level work together effectively. Working together requires common objectives and vision, strategic directions, integrated and harmonized approach, and commitment by all actors.