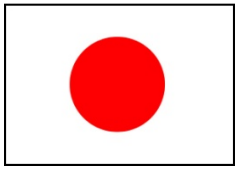
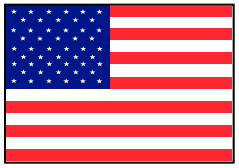
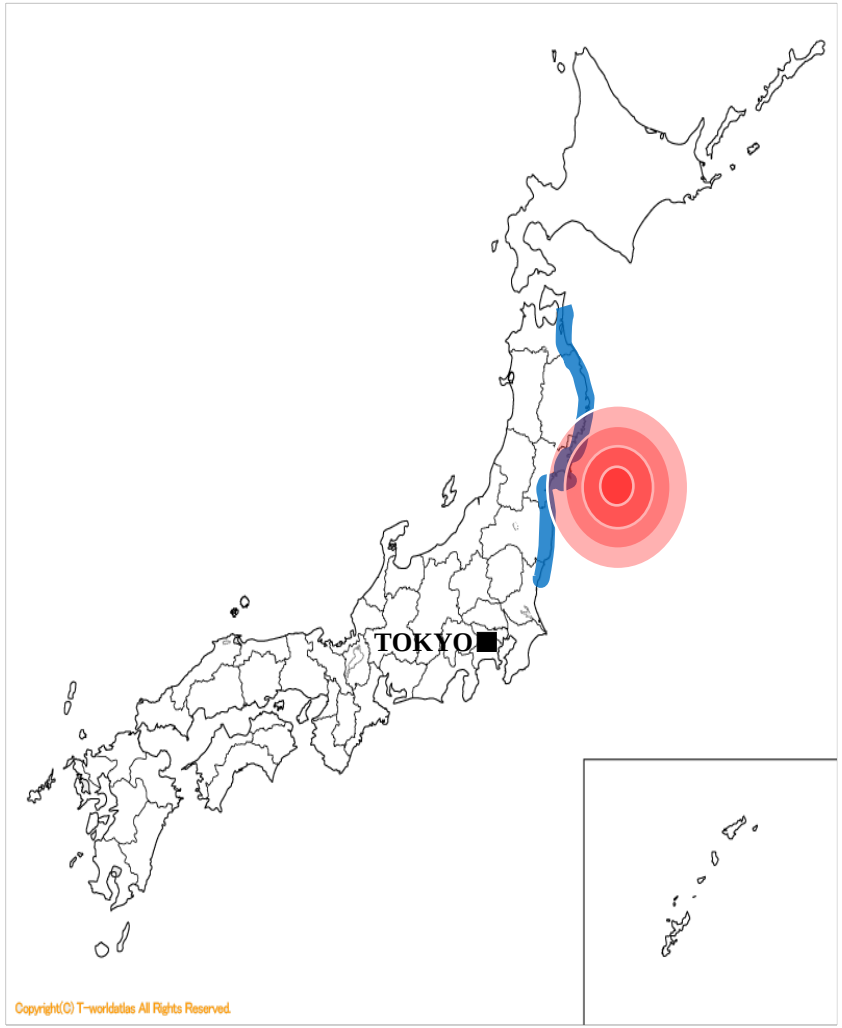
Earthquake Early Warning System in Japan

December 11, 2014

Masato Watanabe
Consul General of Japan in San Francisco

Immediate Impact of the 3/11/2011 Disaster



Earthquake Magnitude: 9.0

Deceased: 15,800+

Injured: 6,000 +

Missing: 3,200+

Evacuees: 470,000+

Estimated Economic Damage

Approx. 16.9 trillion Yen (US $212 billion) *or 3.38% of GDP*

(Reference)
Japan's GDP: 500 trillion Yen (US $5.9 trillion)

Buildings (housing, offices, plants, machinery, etc.)	Approx. 10.4 trillion yen (US $109.4 billion)
Lifeline Utilities (water service, gas, electricity, and communication and broadcasting facilities)	Approx. 1.3 trillion yen (US $13.7 billion)
Social infrastructure (rivers, roads, harbors, drainage, and airports, etc.)	Approx. 2.2 trillion yen (US $23.1 billion)
Other (including agriculture, forestry and fisheries)	Approx. 3.0 trillion yen (US $39.4 billion)

*estimated by the Cabinet Office of Japan (June 24, 2011)

Current Status of Evacuees

Evacuees are resettling and relocation to permanent housing has begun.

Number of evacuees

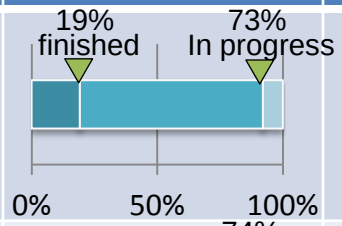
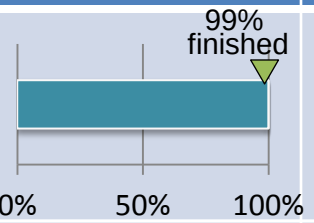
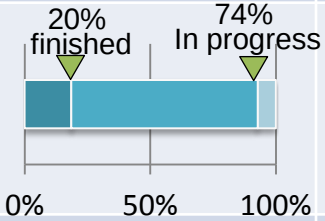
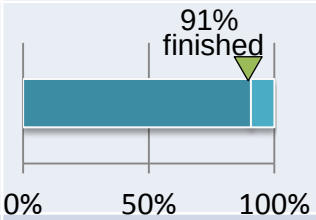
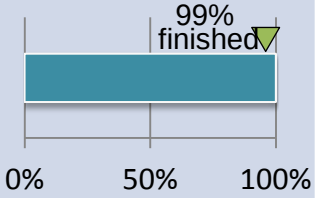
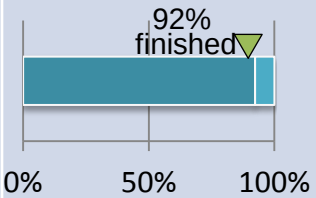
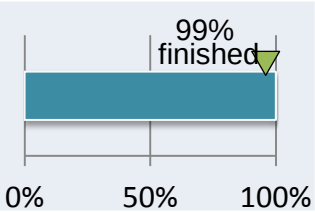
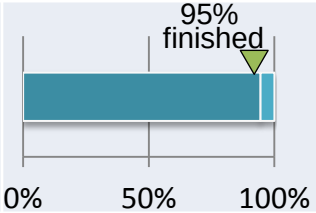
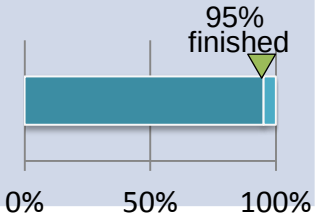
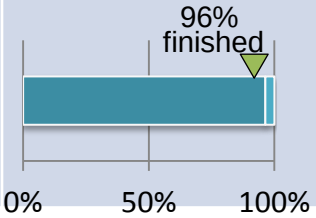
	3 days after the 3/11 disaster (3/14/2011)	Now (as of 9/11/2014)			
		Total	House	Relatives or Acquaintances	Hospital
Number of evacuees	Approx. 470,000	243,040	226,387	16,141	512

Breakdown of temporary housing where evacuees live (as of 9/11/2014)

	Number of houses	Number of people
Public housing	7,579	20,339
Private housing	43,890	104,130
Temporary housing	41,387	89,327
Total	92,856	213,796
(Total from 2013)	*(110,475)*	*(263,310)*

Current Status of Reconstruction of Public Infrastructure

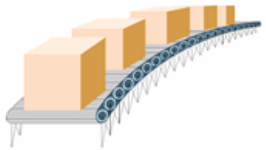
As of September 2014

Items	Progress	Current Status	Items	Progress	Current Status
Breakwaters		Damaged: 468 Fixed: 90 In progress: 341	National roads [km]		Damaged: 1,161 Fixed: 1,159
Coastal disaster prevention forests [km]		Damaged: 140 Fixed: 26 In progress: 104	Railroads [km]		Damaged: 2,330.1 Fixed: 2,113.7
Levees		Damaged: 2,115 Fixed: 2,113	Seaports		Damaged: 131 Fixed: 121
Sewage plants		Damaged: 73 Fixed: 72	Hospitals		Damaged: 182 Reopened: 172
Water purification plants		Damaged: 184 Fixed: 175	Schools		Damaged: 2,308 Reopened: 2,224

Earthquake Early Warning System

The Earthquake Early Warning System is aimed at mitigating earthquake-related damage by enacting countermeasures such as promptly slowing down trains, controlling elevator speeds, and enabling people to quickly protect themselves in various environments such as factories, offices, houses, and near cliffs.

Controlling trains



Controlling factory lines
--> To mitigate damage

Preventing
traffic accidents

Controlling elevators
--> To prevent people from being trapped

At home
--> To enable personal protection

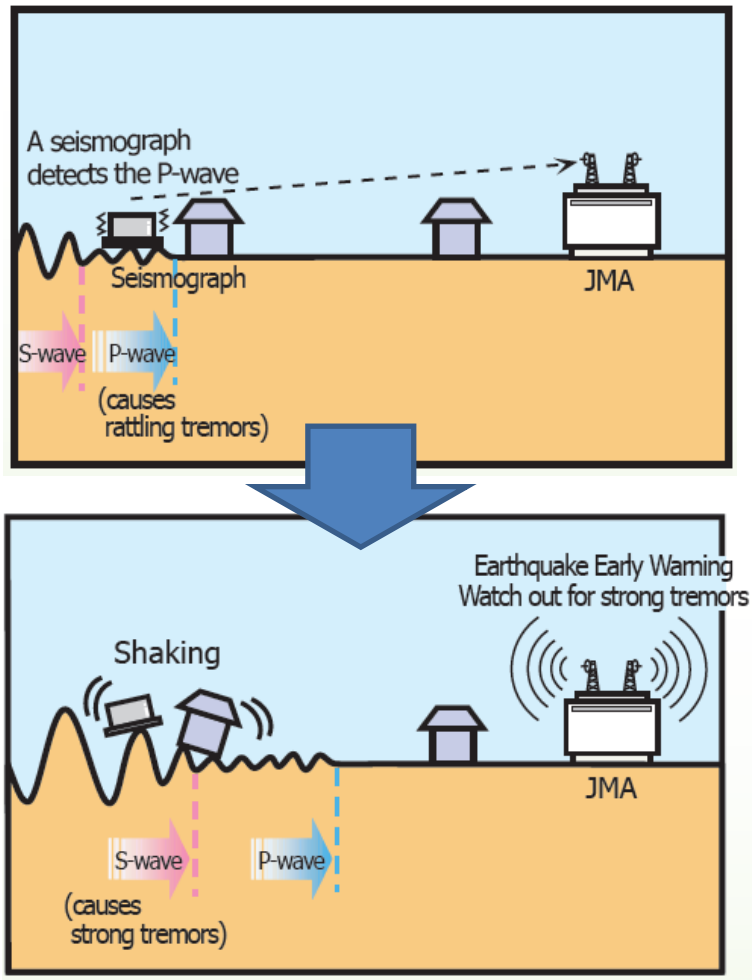
Assisting workers performing
hazardous tasks
--> To ensure safety

Suspending work in progress
--> To avoid mistakes

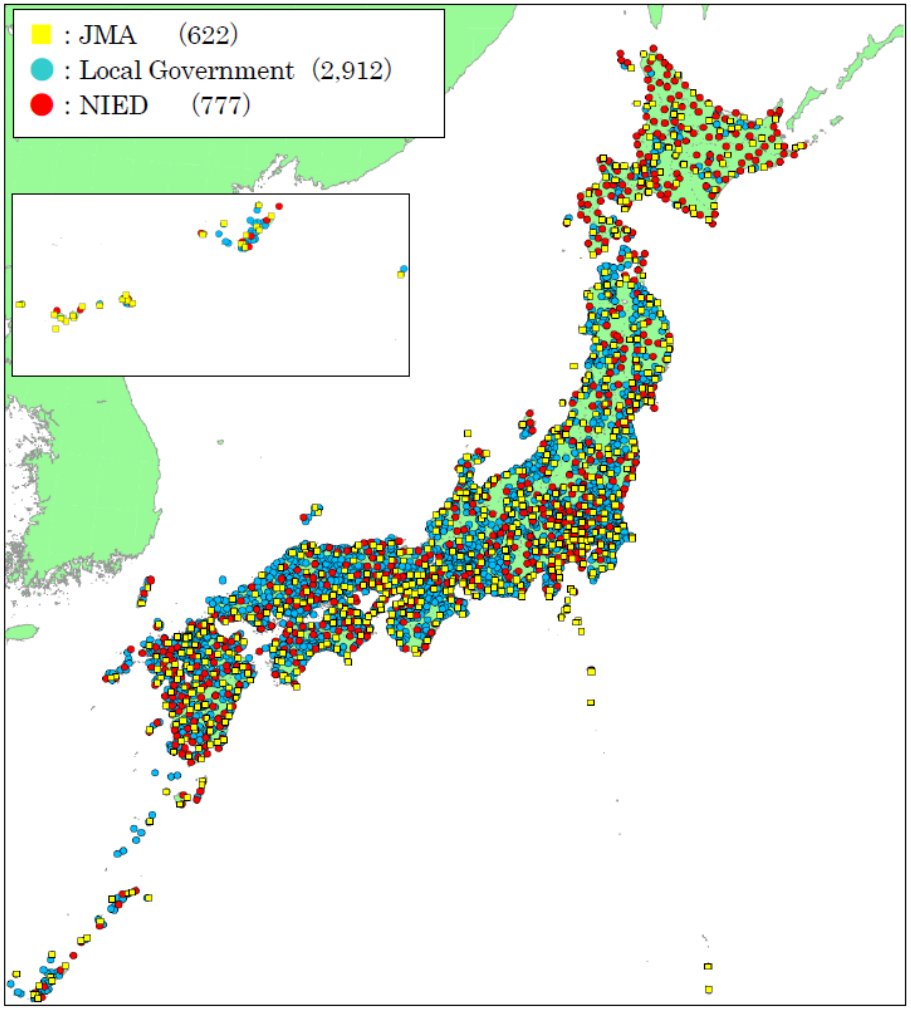
Alerting schools and assembly halls
--> To facilitate evacuation

Earthquake Early Warning System

The Earthquake Early Warning System utilizes the velocity differential between 2 seismic waves: the Primary wave (P wave) and Secondary wave (S wave). The S wave is slower but much stronger than the P wave. By detecting the P wave, warnings before the S wave hits.



P wave: 7 km/sec S wave: 4 km/sec

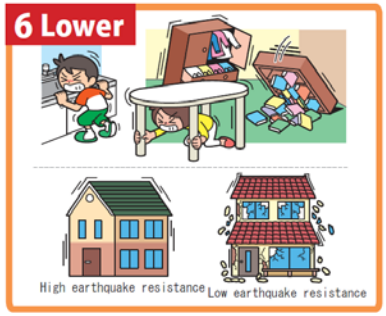


The number of seismic intensity meters

Conditions for Public Announcement of Earthquake Early Warning

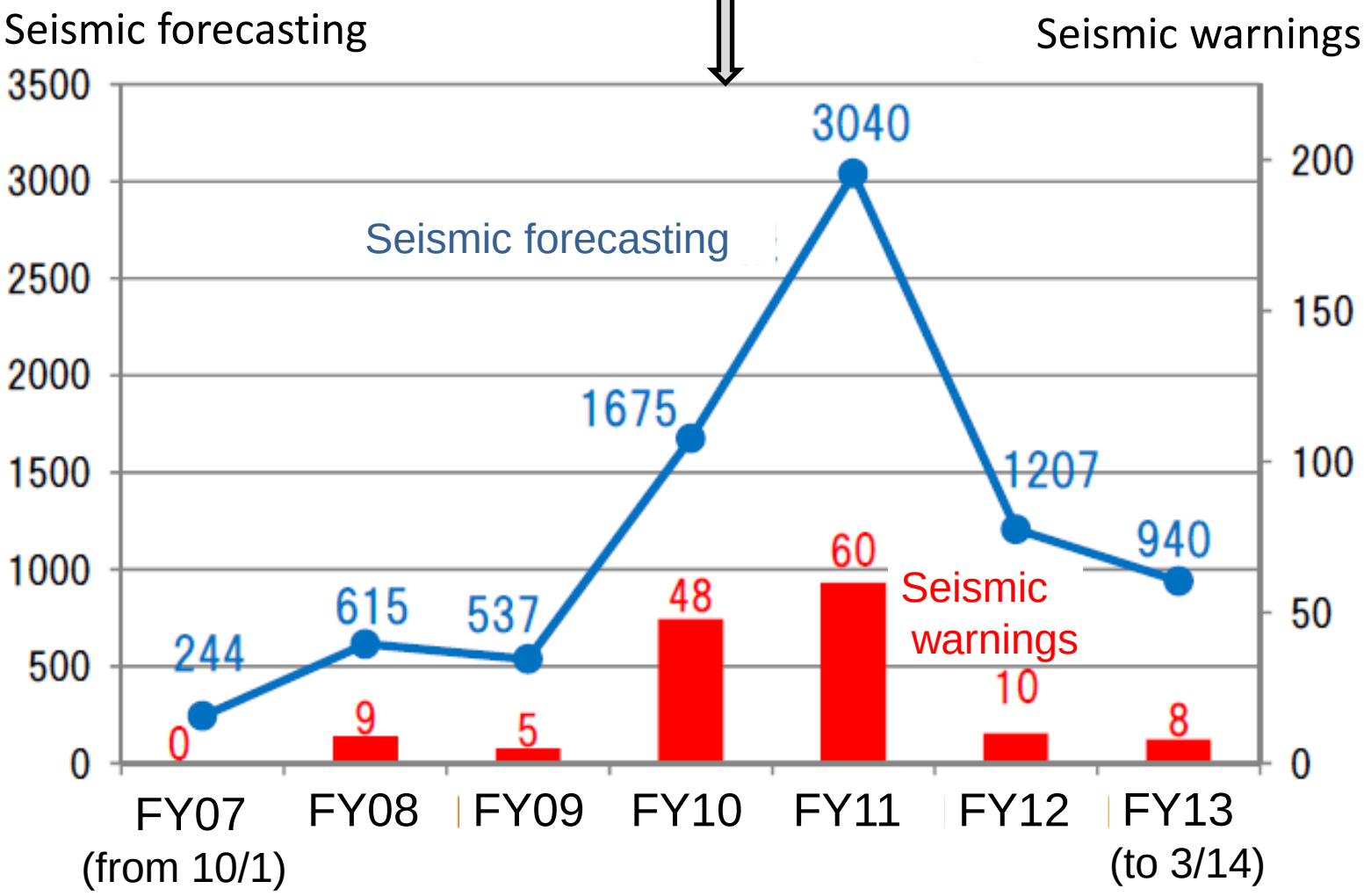
Warning level	Definition
Seismic forecasting [Level 1]	When the earthquake's intensity is anticipated to exceed "3" , its magnitude is anticipated to exceed 3.5, or its wave exceeds 100 gal, the JMA (Japan Meteorological Agency) issues a "Seismic forecasting" for the area where the earthquake is expected to occur.
Seismic warning [Level 2]	When the earthquake's intensity is anticipated to exceed "5 lower" by more than two seismic intensity meters, the JMA issues a "Seismic warning" for the area where severe hazards are likely to occur.
Seismic special warning [Level 3]	When "6 lower" is anticipated by more than two seismic intensity meters, the JMA issues a "Seismic special warning."

Seismic intensity describes the scale of the ground motion at a particular location. It varies from point to point depending on the distance from the epicenter and the surface geology. The JMA's seismic intensity scale has 10 degrees (0 [imperceptible], 1, 2, 3, 4, 5 lower, 5 upper, 6 lower, 6 upper, and 7).



Number of Earthquake Early Warnings

The Great East Japan Earthquake occurred on March 11, 2011.
(Magnitude 9.0)



Note: The fiscal year in Japan starts on April 1st and ends on March 31st.

Limitations of the Earthquake Early Warning System

Timing

The window of time from the announcement of an Earthquake Early Warning until the arrival of the main tremors is very short (less than 30 seconds).
In areas that are close to the earthquake's epicenter, the warning may not be transmitted before strong tremors hit.

False alarms

When using data from only one seismograph, false Earthquake Early Warnings may occur as a result of noise from accidents, lightning, or device malfunction.

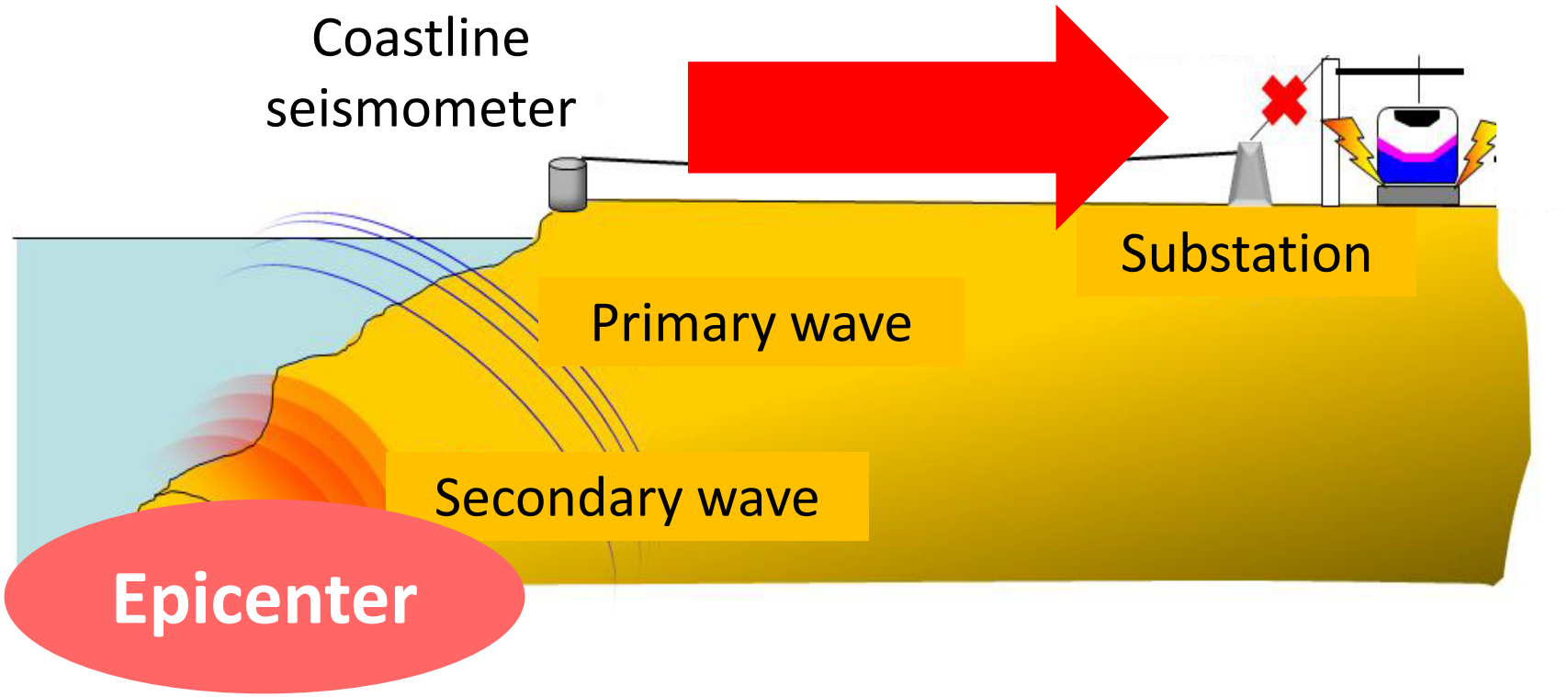
Magnitude estimation

There are limits to the accuracy of estimating magnitude, especially for large earthquakes.
It is difficult to distinguish between earthquakes and provide accurate warnings when multiple earthquakes occur almost simultaneously or in close proximity to each other.

Disaster Countermeasures

Early Earthquake Detection System

Detect P wave → Warning signal to cut power transmission → Power shutdown → Emergency brakes



Damage to High Speed Rail by Major Earthquakes in Japan

	Hanshin-Awaji Earthquake	Niigata Prefecture Chuetsu Earthquake	Great East Japan Earthquake
Date & Time	5:46 AM 1/17/1995	5:56 PM 10/23/2004	2:46 PM 3/11/2011
Magnitude	7.3	6.8	9.0

	Sanyo Shinkansen (Operated by JR West)	Joetsu Shinkansen (Operated by JR East)	Tohoku Shinkansen (Operated by JR East)
Damaged section	Shin Osaka – Himeji (83km)	Urasa - Tsubame Sanjyo (65km)	Omiya –Iwate Numakunai (536km)
Operating passenger trains derailed	0	1	0
Deceased passengers	0	0	0
Collapsed viaducts and bridges	8	0	0
Damaged tunnels	4	4	0
Damaged electrical poles	751	108	Approx. 640
Damaged substations	3	1	10
Displaced beams	72	1	2
Days to resume total operation	82 days	67 days	49 days

Thank you, Arigato

1. U.S. and International Assistance

- Rescue teams from 28 countries and regions, and assistance offered from 150 countries around the world
- Massive support from United States: rescue teams, U.S. Armed Forces, nuclear experts

  --Operation Tomodachi: USS Ronald Reagan (aircraft carrier) and 20 naval vessels, approx. 20,000 military personnel, 160 aircraft (helicopters, etc.) utilized in relief and rescue

  --Post-disaster visit by Secretary of State Clinton: support for business and tourism

2. Assistance from the State of California

- Governor Brown issued a statement with condolences and a directive for Cal EMA to make state resources available to the Japanese government immediately after earthquake
- Assembly Speaker Pérez and colleagues held a press conference encouraging Californians to support the Japanese people
- Relief and fundraising efforts by countless communities and individuals

*source: US Department of Defense and Japanese Ministry of Defense

*source: MOFA

Visits to Japan by California Delegations after Earthquakes

Hanshin-Awaji (Kobe) Earthquake (M6.9 / January 17, 1995)

California Legislative Delegation (March 30-April 9, 1996)

--Participants: Senate President pro Tempore Bill Lockyer (former State Treasurer), Senator Hilda Solis (former US Secretary for Labor), Senator Cathie Wright, Assemblymember John Vasconcellos

--Itinerary: Tokyo, Osaka, Kyoto, and Kobe City, Hyogo Prefecture (hardest-hit areas)
Also: Kobe Port and other stricken areas, temporary housing areas

The Niigata Chuetsu-oki Earthquake (M6.6 / July 16, 2007)

CA Seismic Safety Commission Investigative Travel Team
(November 3-10, 2007)

--Participants: Secretary Rosario Marin and the State and Consumer Services Agency, Governor's Office, Alfred E. Alquist Seismic Safety Commission