



ASIAN DISASTER REDUCTION CENTER  
VISITING RESEARCHER 2022



# SEISMIC MONITORING, SEISMIC HAZARD, RISK ASSESSMENT AND EARTHQUAKE EARLY WARNING SYSTEM IMPLEMENTATION AS A PART OF SEISMIC RISK REDUCTION

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## General information of Republic of Armenia



<b>Official name</b>	Republic of Armenia (RA), briefly – Armenia
<b>Name in official language</b>	Hayastani Hanrapetutyun, briefly – Hayastan
<b>Head of the State</b>	President
<b>Legislative power</b>	Unicameral National Assembly
<b>Official language</b>	Armenian (is part of Indo-European family of languages)
<b>Capital</b>	Yerevan
<b>Administrative and territorial unit</b>	Marz (total number of 10), communities (total number of 502) Including: Urban: 49, in which Yerevan with its 12 administrative districts
<b>National currency</b>	Dram (international currency code - AMD)
<b>Territory</b>	29.74 thousand square km
<b>Population</b>	3.0 Million
<b>Neighboring countries</b>	North - Georgia South - Iran East - Azerbaijan South-West - Nakhichevan (Azerbaijan) West – Turkey
<b>The highest peak</b>	Aragats mountain - 4090 m
<b>The lowest altitude</b>	Debed river canyon - 375 m
<b>The greatest extent</b>	from North-West to South-East comprises 360 km from West to East 200 km 65 km
<b>Region</b>	north latitudes of subtropics
<b>Climate</b>	4 seasons dry, continental
<b>Time zone</b>	Greenwich mean time + 4 hours

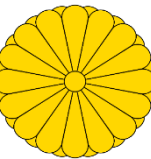


Source: Getty Images/iStockphoto

Geographical Map of Japan



## General information of Japan



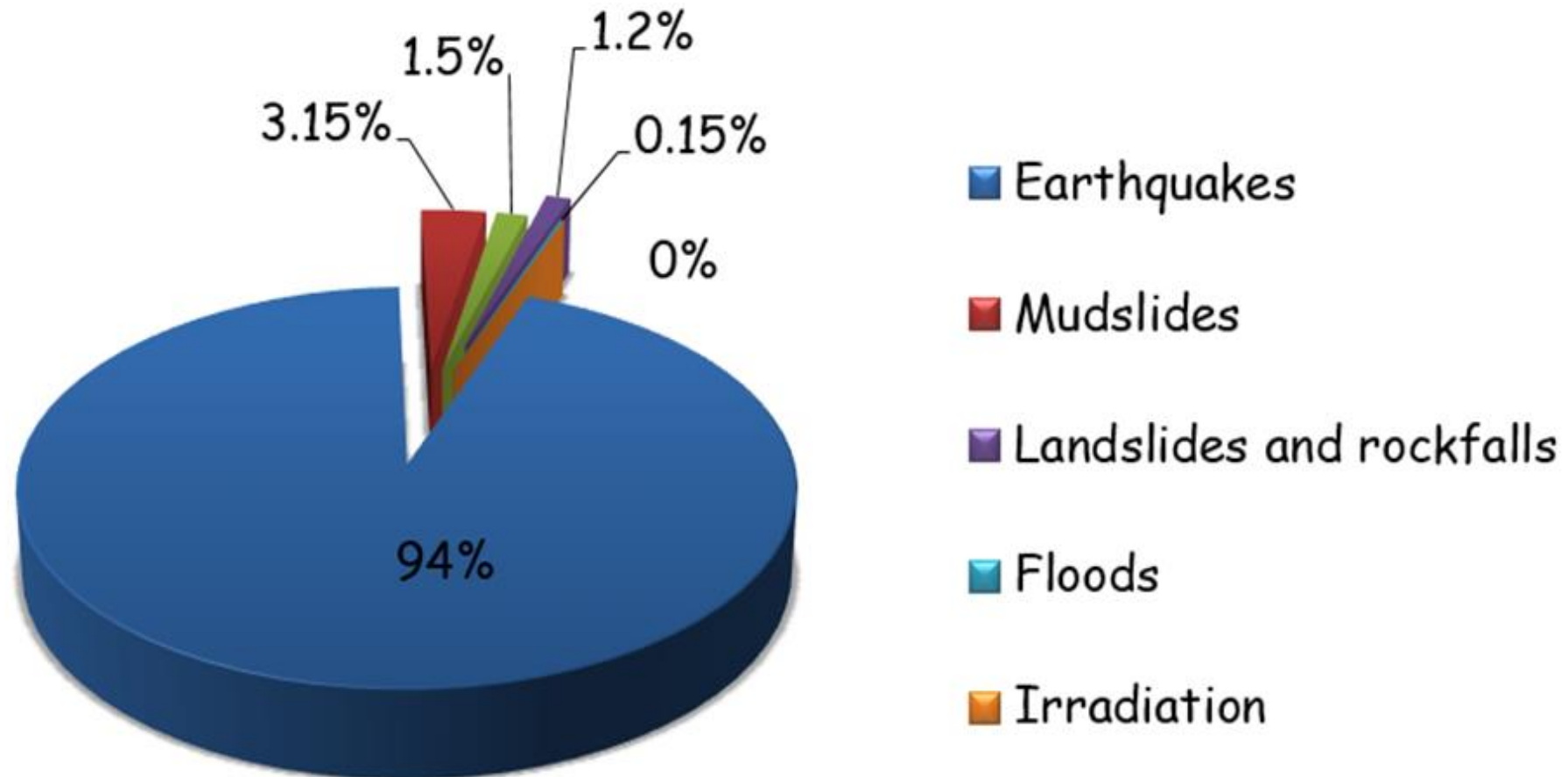
<b>Official name</b>	Japan
<b>Name in official language</b>	日本国, Nippon-ko or Nihon-ko
<b>The Anthem</b>	"Kimigayo"
<b>Capital</b>	Tokyo
<b>National language</b>	National language Japanese
<b>Government</b>	Unitary parliamentary constitutional monarchy
<b>- Emperor</b>	Akihito
<b>- Prime Minister</b>	Shinzō Abe
<b>Administrative and territorial unit</b>	Region (total number of 8), Prefecture (total number of 47)
<b>National currency</b>	Yen (international currency code - JPY)
<b>Territory</b>	377.944 square km
<b>Population</b>	125.50 Million
<b>Highest point</b>	Mount Fuji 3776 m
<b>Lowest point</b>	Hachiro-gata 4 m
<b>Natural resources</b>	Negligible mineral resources, fish the largest consumers of fish and tropical timber, contributing to the depletion of these resources in Asia and elsewhere
<b>Climate</b>	4 seasons Humid subtropical South: subtropical climate North: subarctic climate
<b>Time zone</b>	Greenwich mean time + 9 hours



Source: <https://en.wikipedia.org/wiki/File:Tokyo.jpg>

## DISASTER MANAGEMENT IN ARMENIA

The loss caused by different types of disasters in Armenia

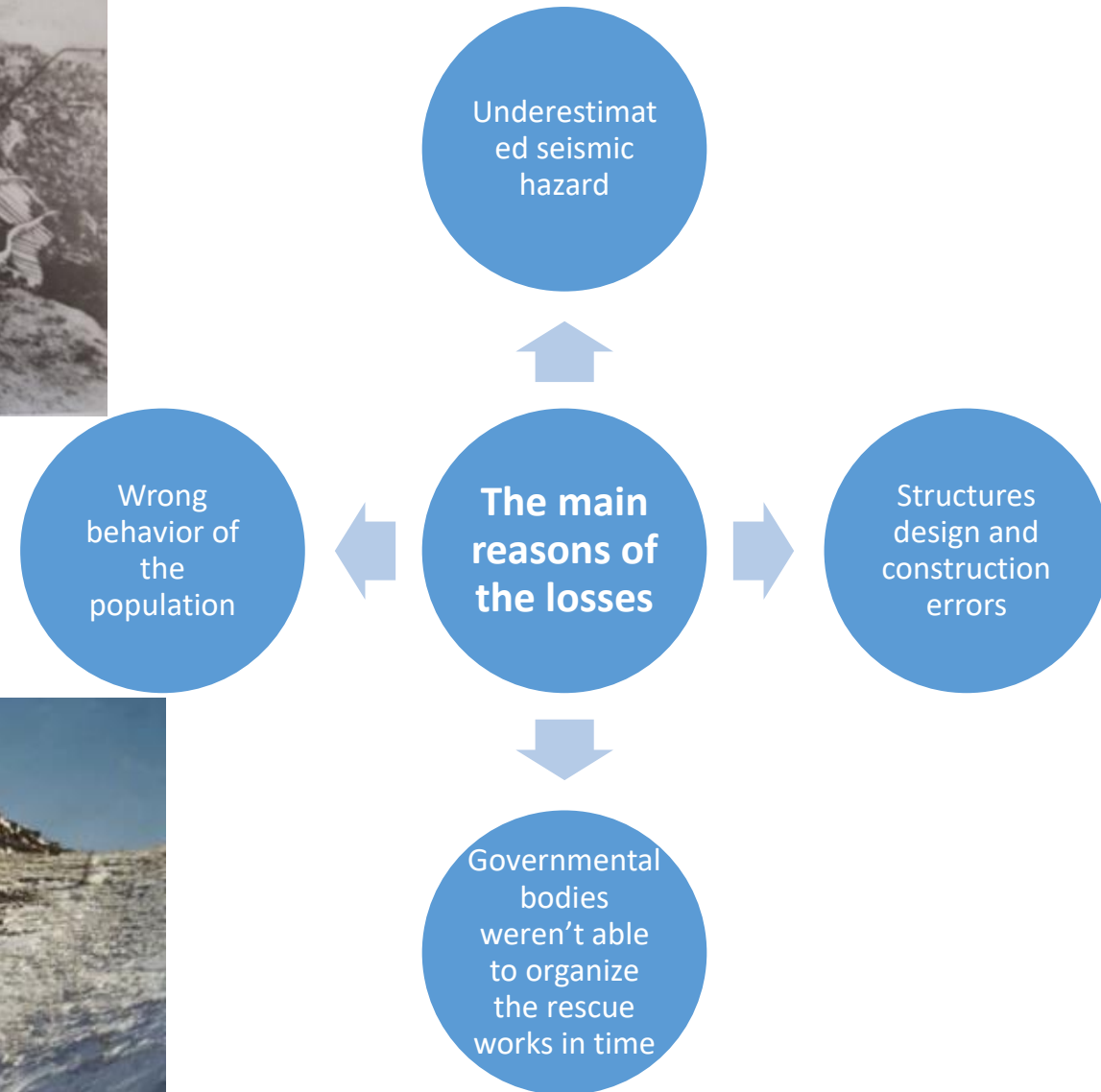


# Spitak Destructive Earthquake

December 7, 1988 at 07:41:22.7 GMT (11:41:22.7 local time)



The most devastating seismic event was the 1988 Spitak earthquake in Armenia that killed 25,000 people, injured 15,000, left 517,000 people homeless, caused significant damage to several cities, and resulted in direct economic losses of \$14.2 billion.



# Regional Survey for Seismic Protection



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graph TD; A[Regional Survey for Seismic Protection] --- B[Complex Department for Seismic Hazard Assessment]; A --- C[Department of Observation Network and Monitoring]; A --- D[Department of Work with Population]; A --- E[Department of Earthquake Engineering];
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Complex Department  
for Seismic Hazard  
Assessment

Department of  
Observation Network  
and Monitoring

Department of Work  
with Population

Department of  
Earthquake Engineering

## *RSSP develops various means for earthquake disaster management:*

- ❖ Develops the basic directions of state policy in the field of seismic protection;
- ❖ Provides seismic risk assessment;
- ❖ Coordinates activities performed in the field of seismic risk reduction in the territory of the RA;
- ❖ Organizes preparedness and training of the population to cope with strong earthquakes;
- ❖ Coordinates and controls the execution of the state programs in the field of seismic risk.



## Laws and regulations

Seismic Protection activities are regulated by a number of laws and legislative acts and national programs of the Republic of Armenia after Spitak 1988 Earthquake:

<b>Law of Republic of Armenia</b>	
The Law of the Republic of Armenia on Seismic Protection	2002
<b>Resolutions of Government</b>	
The Complex Program of Seismic Risk Reduction in the Territory of Armenia	1999
The complex program of seismic risk reduction in Yerevan city	1999
<b>Regulation</b>	
Regional Survey for Seismic Protection	2017

Other normative documents, regulating organization of seismic protection have been also developed. Some of them are as follows:

- ❖ New seismic building codes;
- ❖ Principles of Seismic Microzoning;
- ❖ Instruction on conducting of observations in seismic, geophysical and other stations;
- ❖ The procedure of the expert analysis and providing the information about earthquake threat to the Government of RA.

## Disaster Management Strategy based on the Hyogo Framework of Action and Sendai Framework for DRR

MES develops National DRR Strategy, Crisis Management Centers and National Disaster Observatory. Armenia has also registered a progress in the implementation of HFA, and among the key developments towards establishment of decentralized DRR system has been decree of the MES on appointment of Heads of MES Regional Representations as HFA implementation focal points at the country 11 regional (marz) level.

Crisis Management Centers in Yerevan



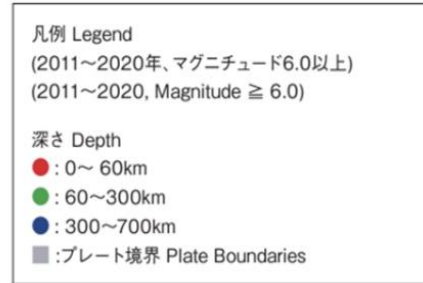
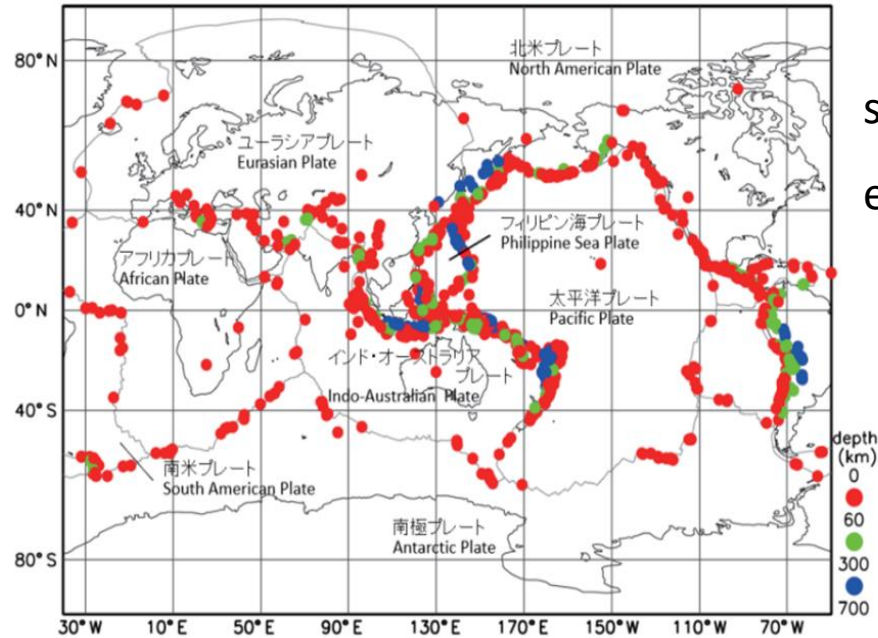
Crisis Management Centers in Marzes



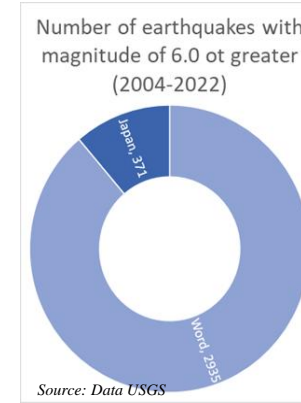
# DISASTER MANAGEMENT IN JAPAN

## 世界の震源分布とプレート World Geographical Distribution of Hypocenters and Plates

Japan is located in the Circum-Pacific Volcanic Belt or “Ring of Fire” where seismic and volcanic activities occur constantly. Nearly 12.6% of the world’s earthquakes of magnitude 6 or greater have occurred in or around Japan.

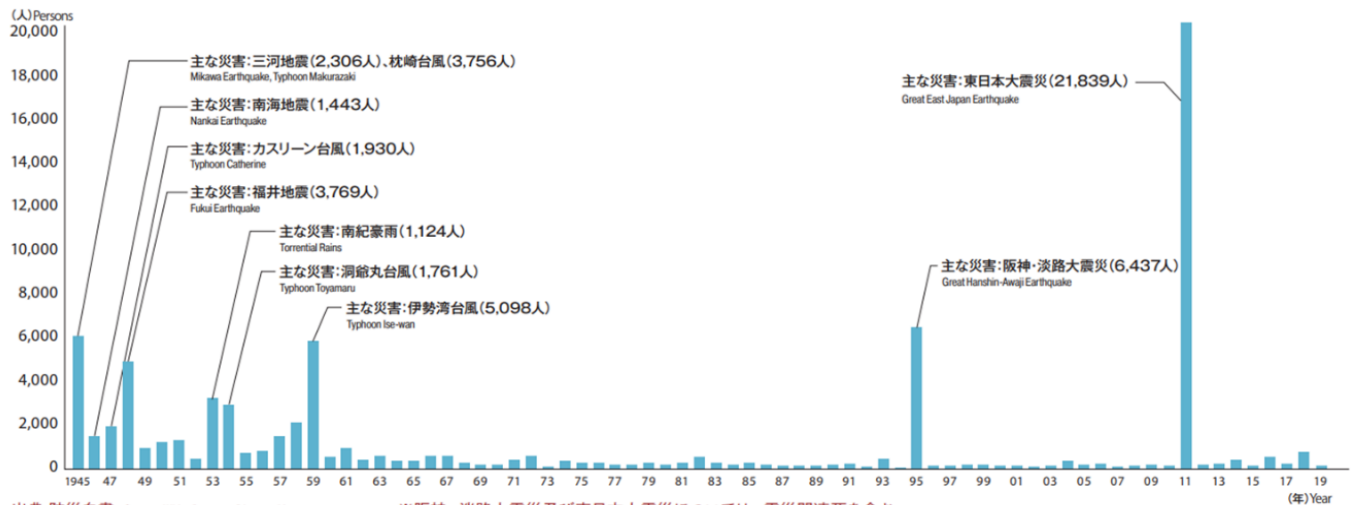


出典:防災白書 Source: White Paper on Disaster Management  
注:2011年から2020年に発生したマグニチュード6.0以上の地震の震源を分析  
Note: Analysis of magnitude 6.0 and greater earthquakes' epicenters from 2011 to 2020.



In addition, because of geographical, topographical and meteorological conditions, the country is subject to frequent natural disasters such as typhoons, torrential rains and heavy snowfalls, as well as earthquakes and tsunami.

## 自然災害による死者・行方不明者数の推移 The Number of Deaths and Missing Persons Caused by Natural Disasters



出典:防災白書 Source: White Paper on Disaster Management

※阪神・淡路大震災及び東日本大震災については、震災関連死を含む  
Note: With regard to the Hanshin-Awaji Earthquake and the Great East Japan Earthquake, those figures include earthquake-related deaths.

# Great Hanshin-Awaji Earthquake or Kobe earthquake

January 17, 1995, at 05:46 JST (16 January at 20:46 UTC)



This was Japan's worst earthquake in the 20th century after the Great Kanto earthquake in 1923, which claimed 140,000 lives. Approximately 6,434 people lost their lives, about 4,600 of them were from Kobe. It caused approximately ten trillion yen (\$100 billion) in damage.



# Great East Japan Earthquake or Tohoku earthquake

March 11, 2011, 14:46 JST (05:46 UTC)

The Great East Japan Earthquake 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.



On 10 March 2015, a Japanese National Police Agency report confirmed 15,894 deaths, 6,152 injured, and 2,562 people missing across twenty prefectures, as well as 228,863 people living away from their home in either temporary housing or due to permanent relocation.

*Source: <https://www.npa.go.jp/english/Statistics.html>*



The earthquake triggered powerful tsunami waves, which reached heights of up to 40.5 meters (133 ft) in Miyako in Tohoku'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.



# Laws and regulations

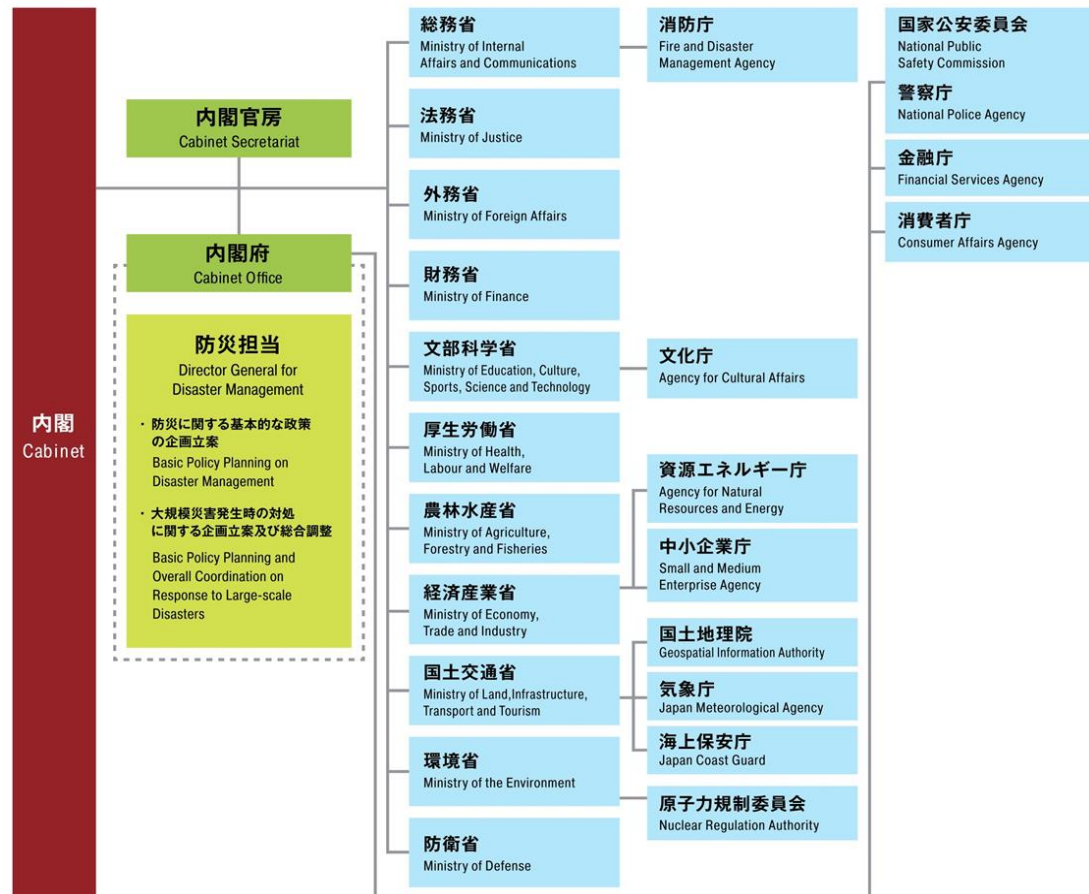
Disasters that triggered law/system introduction		Disaster Management Laws		Explanation	
1940	1945	Typhoon Ida (Makurazaki)			
	1946	The Nankai Earthquake			
	1947	Typhoon Kathleen	47	The Disaster Relief Act	
	1948	The Fukui Earthquake	49	The Flood Control Act	
1950	1959	Typhoon Vera (Ise-wan)	50	The Building Standards Act	
1960	1961	Heavy Snowfalls	60	Soil Conservation and Flood Control Urgent Measures Act	
			61	Disaster Countermeasures Basic Act	
			62	Central Disaster Management Council established	
			63	Basic Disaster Management Plan	
1964	The 1964 Niigata Earthquake	62	Act on Special Financial Support to Deal with Extremely Severe Disasters		
1967	Torrential Rains in Uetsu	66	Act on Special Measures for Heavy Snowfall Areas		
1970	1973	Mt. Sakurajima Eruption	73	Act on Provision of Disaster Condolence Grant	
	1976	Mt. Asama Eruption		Act on Evacuation Facilities in Areas Surrounding Active Volcanoes (Act on Special Measures for Active Volcanoes (1978))	
	1978	The 1978 Miyagi Earthquake	78	Act on Special Measures Concerning Countermeasures for Large-Scale Earthquakes	
1980			80	Act on Special Financial Measures for Urgent Earthquake Countermeasure Improvement Projects in Areas for Intensified Measures	
			81	Amendment of Order for Enforcement of the Building Standard Law	
1990	1995	The Southern Hyogo Earthquake (The Great Hanshin-Awaji Earthquake)	95	Act on Special Measures for Earthquake Disaster Countermeasures	
			96	Act on Promotion of the Earthquake-proof Retrofit of Buildings	
	1999	Torrential Rains in Hiroshima	97	Amendment of Disaster Countermeasures Basic Act	
		Tokaimura Nuclear Accident (The JCO Nuclear Accident)	98	Act on Special Measures for Preservation of Rights and Profits of the Victims of Specified Disasters	
2000	2000	Torrential Rains in Niigata, Fukushima	00	Act on Promotion of Sediment Disaster Countermeasures for Sediment Disaster Prone Areas	
			01	Amendment of the Flood Control Act	
	2004	Torrential Rains in the Tokai Region The 2004 Chuetsu Earthquake		02	Act on Special Measures for Promotion of Tohankai and Nankai Earthquake Disaster Management
				03	Specified Urban River Inundation Countermeasures Act
				04	Act on Special Measures for Promotion of Disaster Management for Trench-type Earthquakes in the Vicinity of the Japan and Chishima Trenches
				05	Amendment of the Flood Control Act
	2008	Iwate-Miyagi Inland Earthquake		06	Amendment of the Act on Promotion of Sediment Disaster Countermeasures in Sediment Disaster Prone Areas
				11	Partial amendment of the Act on Promotion of Sediment Disaster Countermeasures in Sediment Disaster Prone Areas
	2011	The 2011 Tohoku Earthquake and Tsunami (The Great East Japan Earthquake)		11	Act on Promotion of Tsunami Countermeasures
				12	Act on Development of Areas Resilient to Tsunami Disasters
				13	Amendment of Disaster Countermeasures Basic Act
	2014	Heavy Snowfall Hiroshima Landslide Disaster Mt. Ontake Eruption		14	Act for Establishment of the Nuclear Regulation Authority
				15	Amendment of Disaster Countermeasures Basic Act
				16	Act on Reconstruction from Large-Scale Disasters
				17	Amendment of the Act on Promotion of the Earthquake-proof Retrofit of Buildings
	2016	Kumamoto Earthquake Typhoon Lionrock in 2016		18	Amendment of the Flood Control Act and River Act
				19	Act on Special Measures for Land and Building Leases in Areas Affected by Large-scale Disaster
	2018	Typhoon Faxai in 2019 Typhoon Hagibis in 2019		20	Amendment of the Act on Special Measures for Promotion of Nankai Trough Earthquake Disaster Management
				21	Amendment of the Act on Special Measures for Promotion of Tohankai and Nankai Earthquake Disaster Management
	2020	Heavy Rain Event of July 2020		22	Act on Special Measures against Tokyo Inland Earthquake
			23	Amendment of the Act on Promotion of the Earthquake-proof Retrofit of Buildings	
2021			24	Amendment of the Flood Control Act and River Act	
			25	Act on Special Measures for Land and Building Leases in Areas Affected by Large-scale Disaster	

In order to 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. It is a national priority to protect national land as well as citizens' lives, livelihoods, and property from natural disasters.

# Disaster Management

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 largescale disasters, as well as conduct overall coordination.

内閣府及び関係省庁 Cabinet Office and Related Ministries and Agencies



※この図は防災に関する省庁の関係を概念的に表現したものである。This chart conceptually represents the relationship of ministries and agencies related to disaster management.  
 ※東日本大震災からの復興については、復興庁が担当している。The reconstruction from the Great East Japan Earthquake is led and managed by the Reconstruction Agency.

The Basic Disaster Management Plan is a comprehensive and long-term disaster management plan forming a foundation for the Disaster Management Operations Plan and Local Disaster Management Plan. It stipulates provisions for the establishment of the disaster management system, promotion of disaster management measures, acceleration of post disaster recovery and reconstruction measures, and promotion of scientific and technological research on disaster management.

## Outline of the Revised Basic Disaster Management Plan (May 2021)

**Basic Disaster Management Plan** Prepared by the National Disaster Management Council under the Basic Act on Disaster Management, which sets out essential matters such as disaster prevention, damage mitigation and disaster recovery measures.

### Major Revisions

- | Revisions Based on Amendments to the Basic Act on Disaster Management  | Revisions Based on COVID-19 Countermeasures  |
|--|--|
| <ul style="list-style-type: none"> <li>○ <b>Review of Disaster Management Headquarters</b> <ul style="list-style-type: none"> <li>Establish Authorized Disaster Management Headquarters</li> <li>Changed the Chief of the Major Disaster Management Headquarters to the Prime Minister</li> <li>Establish a Disaster Management Headquarters at the stage of "threat of disaster"</li> </ul> </li> <li>○ <b>Creation of Individual Evacuation Plans</b> <ul style="list-style-type: none"> <li>From the perspective of ensuring the smooth and prompt evacuation of those who require assistance evacuating in action, municipalities are now obliged to make efforts to prepare individual evacuation plans</li> </ul> </li> <li>○ <b>Consolidation of Evacuation Recommendations and Evacuation Instructions, etc.</b> <ul style="list-style-type: none"> <li>Consolidate evacuation recommendations and instructions into a single set of evacuation instructions, issue them from the conventional recommendation stage and comprehensively revise the nature of evacuation information</li> </ul> </li> <li>○ <b>Matters Related to Wide-area Evacuation</b> <ul style="list-style-type: none"> <li>Consult among municipalities for the implementation of wide-area evacuation at the stage of "threat of disaster"</li> <li>Conclude support agreements with other municipalities and agreements with transportation companies, etc.</li> <li>Conduct practical disaster drills to ensure smooth evacuation in the event of a large-scale wide-area disaster</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>○ <b>Countermeasures Against Infectious Disease in Shelters</b> <ul style="list-style-type: none"> <li>Maintain health care for evacuees, sanitation and appropriate space in shelters, etc.</li> </ul> </li> <li>○ <b>Conduct Drills for Starting and Operating Shelters</b> <ul style="list-style-type: none"> <li>Proactively conduct drills for opening and operating shelters with consideration for infectious disease countermeasures</li> </ul> </li> <li>○ <b>Promoting Stockpiling of Partitions, etc.</b> <ul style="list-style-type: none"> <li>In addition to masks and disinfectants, promote stockpiling of partitions and other supplies necessary against infectious disease</li> </ul> </li> <li>○ <b>Information Sharing, etc. for Home Care Patients Against COVID-19</b> <ul style="list-style-type: none"> <li>Confirm of whether home care patients are living in risk areas during ordinary times</li> <li>Consider specifically, coordinate and provide information to ensure the evacuation of the home care patient, etc.</li> </ul> </li> <li>○ <b>Countermeasures Against Infectious Disease of Support Staff to the Affected Municipalities, etc.</b> <ul style="list-style-type: none"> <li>Ensure that support staff maintain their health and wear masks, etc.</li> <li>Ensure appropriate office space for support staff, etc.</li> </ul> </li> </ul> |
| <h3>Other Revisions Based on Recent Policy Developments, etc.</h3> <ul style="list-style-type: none"> <li>○ Promote digitalization of disaster response operations</li> <li>○ Ensure smooth evacuation of persons requiring special care by utilizing welfare shelters</li> <li>○ Response in light of the large-scale vehicle standstill caused by last winter's heavy snowfall</li> <li>○ Promotion of "river basin management" through the collaborative efforts of all stakeholders</li> <li>○ Promotion of earthquake countermeasures according to the urgency in the Tokyo Inland Earthquake Emergency Management Areas</li> </ul>   | <ul style="list-style-type: none"> <li>○ Promote disaster prevention efforts in advance and response to complex disasters</li> <li>○ Support under the Disaster Relief Act for necessary expenses of the Disaster Volunteer Center entrusted with volunteer coordination work</li> <li>○ Promote cooperation and collaboration between disaster management volunteers and local governments, residents, NPOs, etc.</li> <li>○ Promote practical disaster risk reduction education that teaches the necessary knowledge of normality bias, etc.</li> <li>○ Reconstruction of livelihoods by utilizing support systems appropriate for each affected person.</li> <li>○ Promote disaster prevention measures based on women's perspectives</li> </ul>  |

# Asian Disaster Reduction Center

The Asian Disaster Reduction Center (ADRC) was established in Kobe, Hyogo Prefecture, in July 1998, with the following mission and objectives: to enhance disaster resilience of the member countries, to build safe communities, and to create a society where sustainable development is possible.



## ADRC Visiting Researcher Program



**Main activities of ADRC**

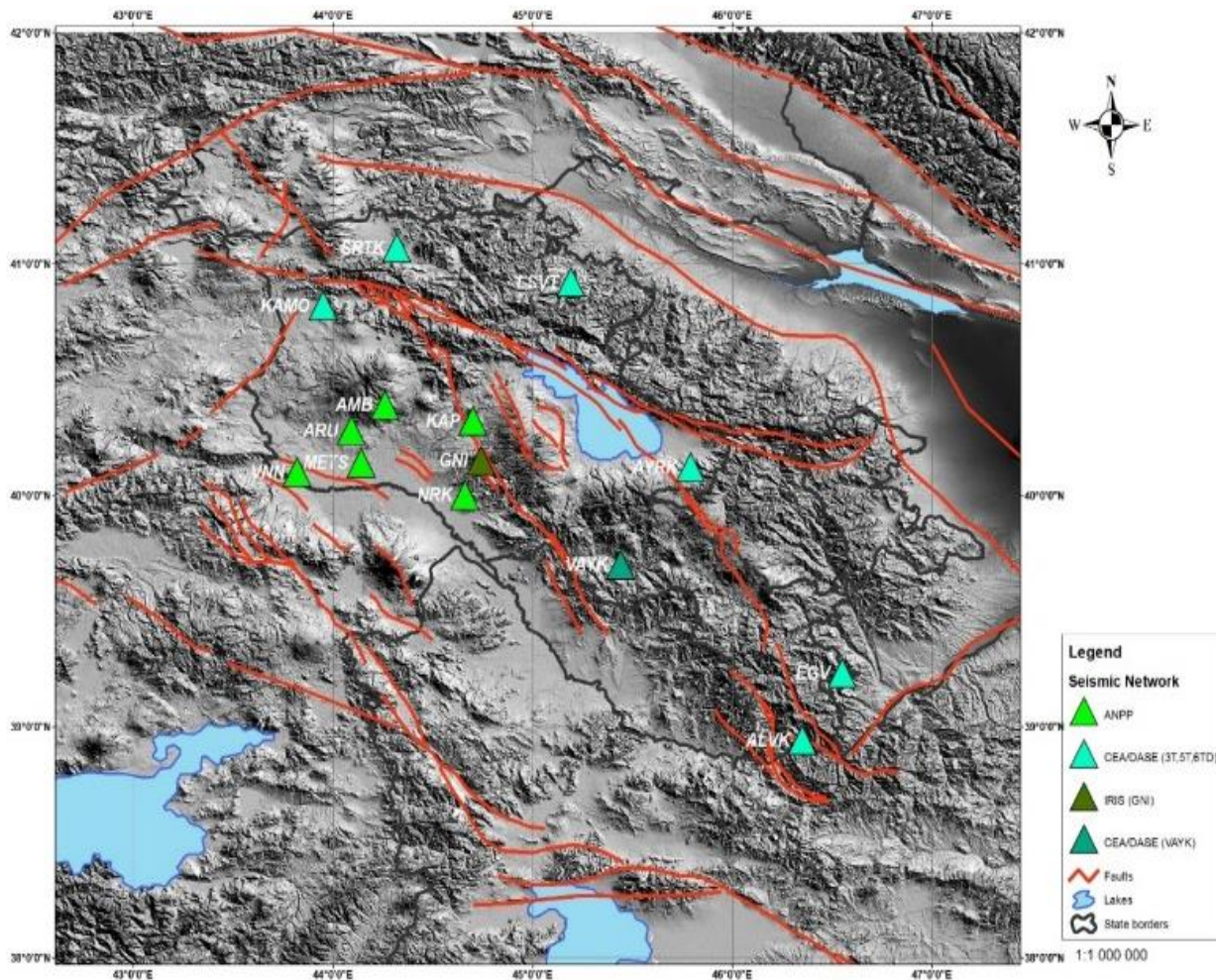
- Information Sharing**
  - Organizing International Conference
  - Promoting GLIDE (Global unique disaster IDentifier)
  - Providing Disaster and DRR Information on Website
  - Sentinel Asia Project
- Human Resource Development**
  - Visiting Researcher Program
  - Conducting Training Courses and Workshops
- Building Community Capabilities**
  - Development and Dissemination of Tools for Encouraging Community Participation
  - Support for the Activities of NGO such as Asian Disaster Reduction and Response Network (ADRRN)
- Cooperation with Other Stakeholders**
  - Conducting DRR Policy Peer Review in cooperation with other stakeholders
  - Promoting Sub-regional Cooperation including of ASEAN



# SEISMIC MONITORING, SEISMIC HAZARD, RISK ASSESSMENT AND EARTHQUAKE EARLY WARNING SYSTEM

## IMPLEMENTATION AS A PART OF SEISMIC RISK REDUCTION IN ARMENIA

### Seismic Networks



**6** High performance, compact, medium-motion broadband **6TD** seismometers

**6** High performance, low noise, compact, broadband **3T** seismometers

**6** High performance, low noise, compact, broadband **5T** accelerometers


**Vayk** array **5** short period (Z comp.) and **1** broad-band **STS2**


**1** Nanometrics Broadband Sensor **Trillium 240**

## Operative Estimation and Notification of Earthquake Parameters

“On January 19 at 09:55 local time (at 05:55 by GMT), the Seismological Network of the Regional Survey for Seismic Protection of the MES of the RA recorded an earthquake at the northern latitude  $38.37^{\circ}$  and eastern longitude  $44.81^{\circ}$  geographic coordinates (20 km north from the city of Salmas, Iran), with 4.6 magnitude and 10 km depth. The tremor measured magnitude 6 points at the epicenter area.

The earthquake was felt in the town of Agarak in Syunik Province with 2-3 points intensity.”.







### LASTQUAKE

the official EMSC earthquakes app

Current time: 2023-03-19 16:41:02 UTC

ANDROID APP ON  


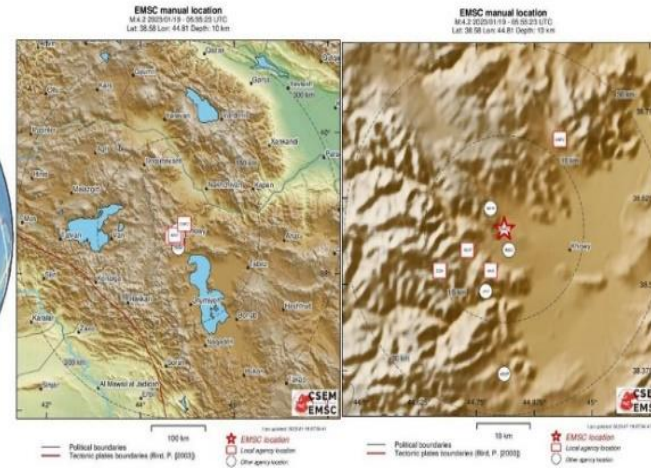
Available on the  


Member access

Name

Pwd

2023-01-19 05:55:24.5	38.52 N	44.67 E	10	M	5.1	A	TURKEY-IRAN BORDER REGION	DDA
2023-01-19 05:55:24.3	38.49 N	44.77 E	10f	mb	4.3	M	TURKEY-IRAN BORDER REGION	GFZ
2023-01-19 05:55:23.2	38.61 N	44.78 E	10f	mb	4.2	M	TURKEY-IRAN BORDER REGION	NEIC
2023-01-19 05:55:23.0	<b>38.58 N</b>	<b>44.81 E</b>	<b>10f</b>	<b>mb</b>	<b>4.2</b>	<b>M+</b>	<b>TURKEY-IRAN BORDER REGION</b>	<b>INFO</b>
2023-01-19 05:55:22.0	38.37 N	44.81 E	10	M	4.6	M	TURKEY-IRAN BORDER REGION	NSSP
2023-01-19 05:55:20.5	38.52 N	44.78 E	5	ML	4.4	M	TURKEY-IRAN BORDER REGION	KAN
2023-01-19 05:55:20.0	38.55 N	44.82 E	9	ML	4.5	A	TURKEY-IRAN BORDER REGION	RSSC
2023-01-19 05:55:19.7	38.55 N	44.73 E	0	ML	4.1	M	TURKEY-IRAN BORDER REGION	IGUT



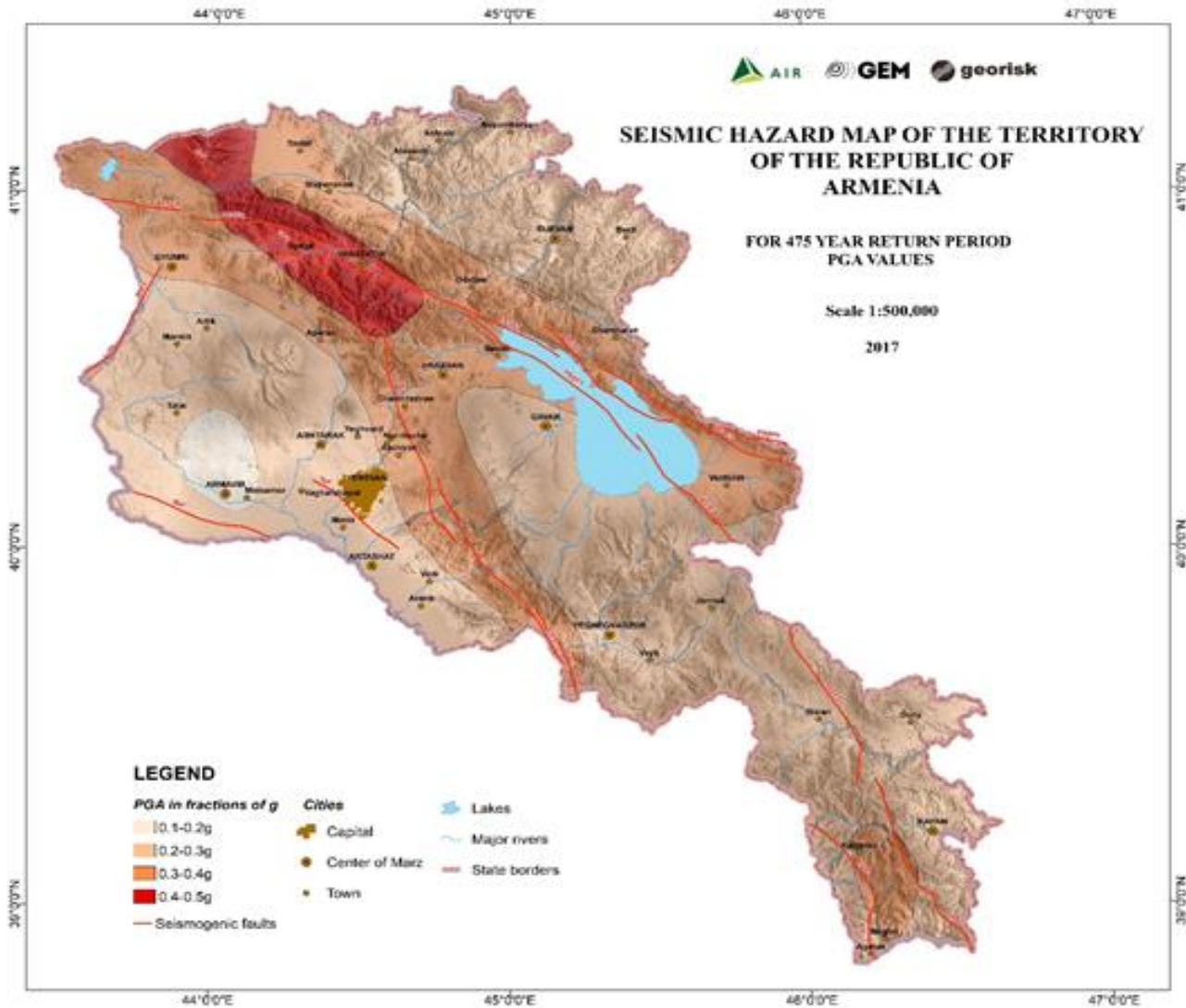
### Location provided by NSSP

Date: Thu, 19 Jan 2023 06:11:09 +0000 (UTC)

Armenian National Survey for Seismic Protection  
 DATE : 19.01.2023  
 UTC TIME : 05:55:22  
 LAT : 38.37  
 LONG : 44.81  
 DEPTH : 10  
 MAGNITUDE : M=4.6  
 REGION : Iran

GNI IP 230119055550.92 72.65 IS  
 AYRK IP 230119055552.85 76.15 IS  
 EGYZ IP 230119055549.02 69.38 IS  
 LSVT IP 230119055604.47 36.37 IS  
 SRTK IP 230119055606.89 40.89 IS  
 NRKZ IP 230119055547.91 68.13 IS  
 ARUZ IP 230119055555.13 80.73 IS  
 KAPZ IP 230119055554.42 78.22 IS  
 VNNZ IP 230119055553.72 78.06 IS

# Seismic Hazard Maps



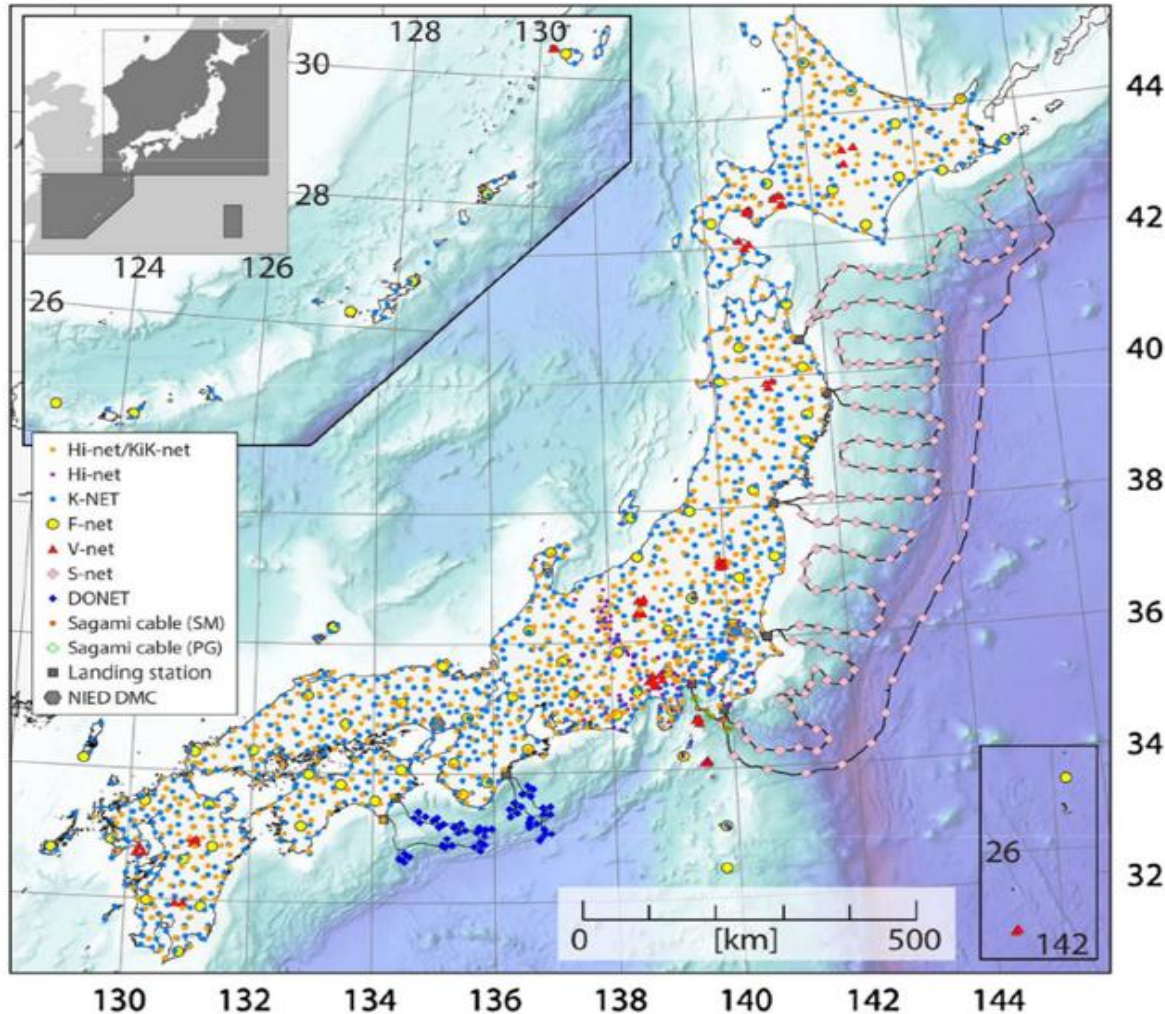
Seismic Hazard Map of the territory of the Republic of Armenia at the scale of 1:500.000 was prepared by probabilistic assessment for 500 m/s velocity of shear wave propagation in soils within the RA area and 475 year return period, corresponding to a 10% probability of exceedance in 50 years.

The new seismic hazard map of the territory of the Republic of Armenia at a scale of 1:500,000 was approved by the order of the Minister of Emergency Situations of the Republic of Armenia and is a regulatory legal act.

# SEISMIC MONITORING, SEISMIC HAZARD, RISK ASSESSMENT AND EARTHQUAKE EARLY WARNING SYSTEM

## IMPLEMENTATION AS A PART OF SEISMIC RISK REDUCTION IN JAPAN

### Seismic Networks

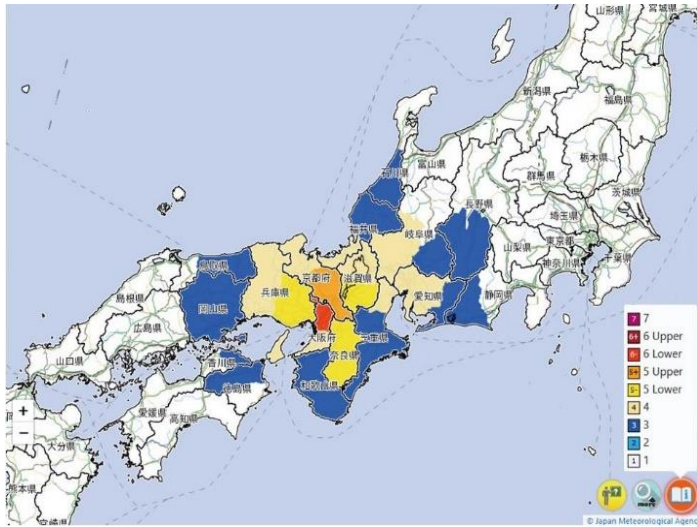


Seismometers - 1800 stations

Seismic intensity meters - 4400 stations

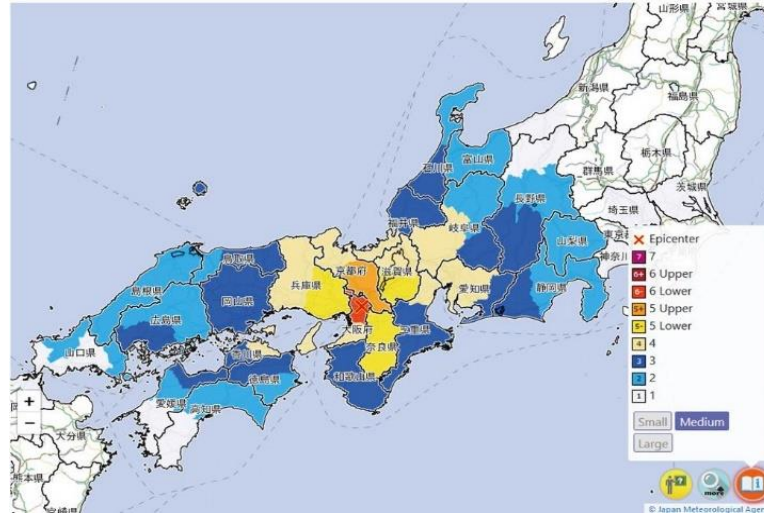
# Information about Earthquake

## ❖ 1.5 min – Seismic Intensity Information

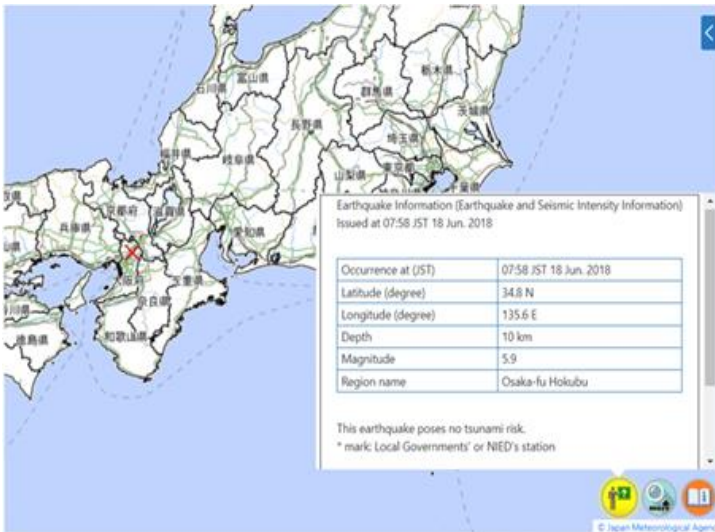


## ❖ After 5 min – Provides 2 types of information

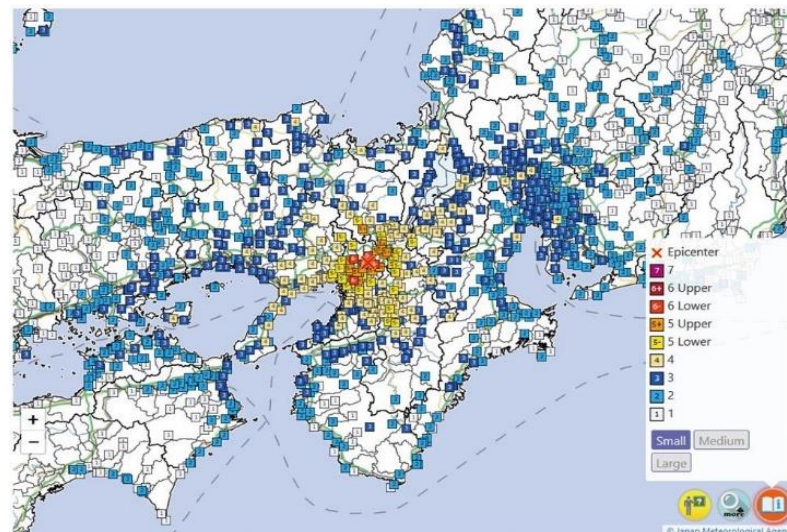
### 1. Earthquake and Seismic Intensity Information



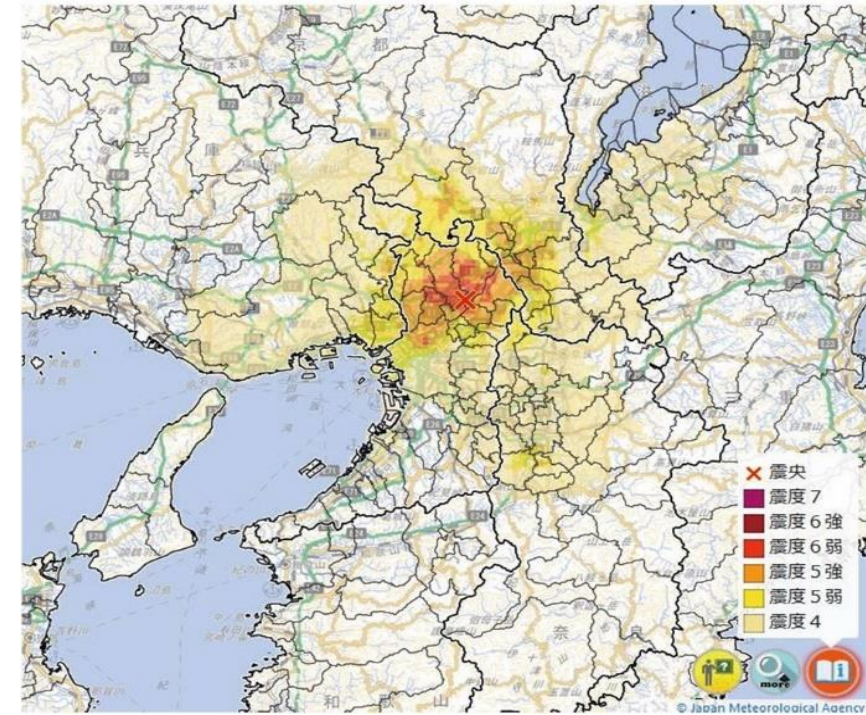
## ❖ After 3 min – Earthquake Information



### 2. Information on Seismic Intensity at each site.



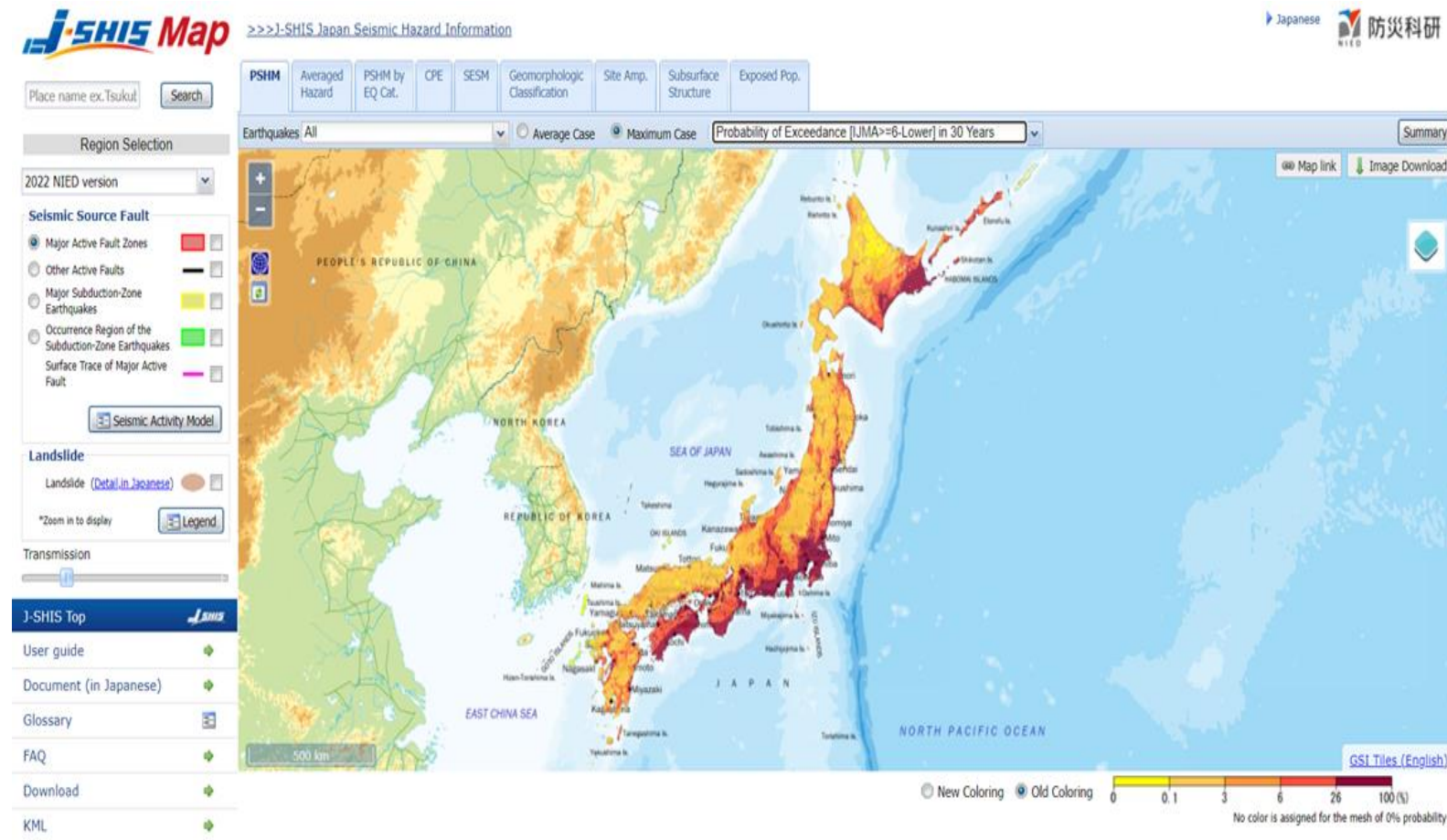
## ❖ After 15 min – Estimated Seismic Intensity Distribution Maps



# Seismic Hazard Maps

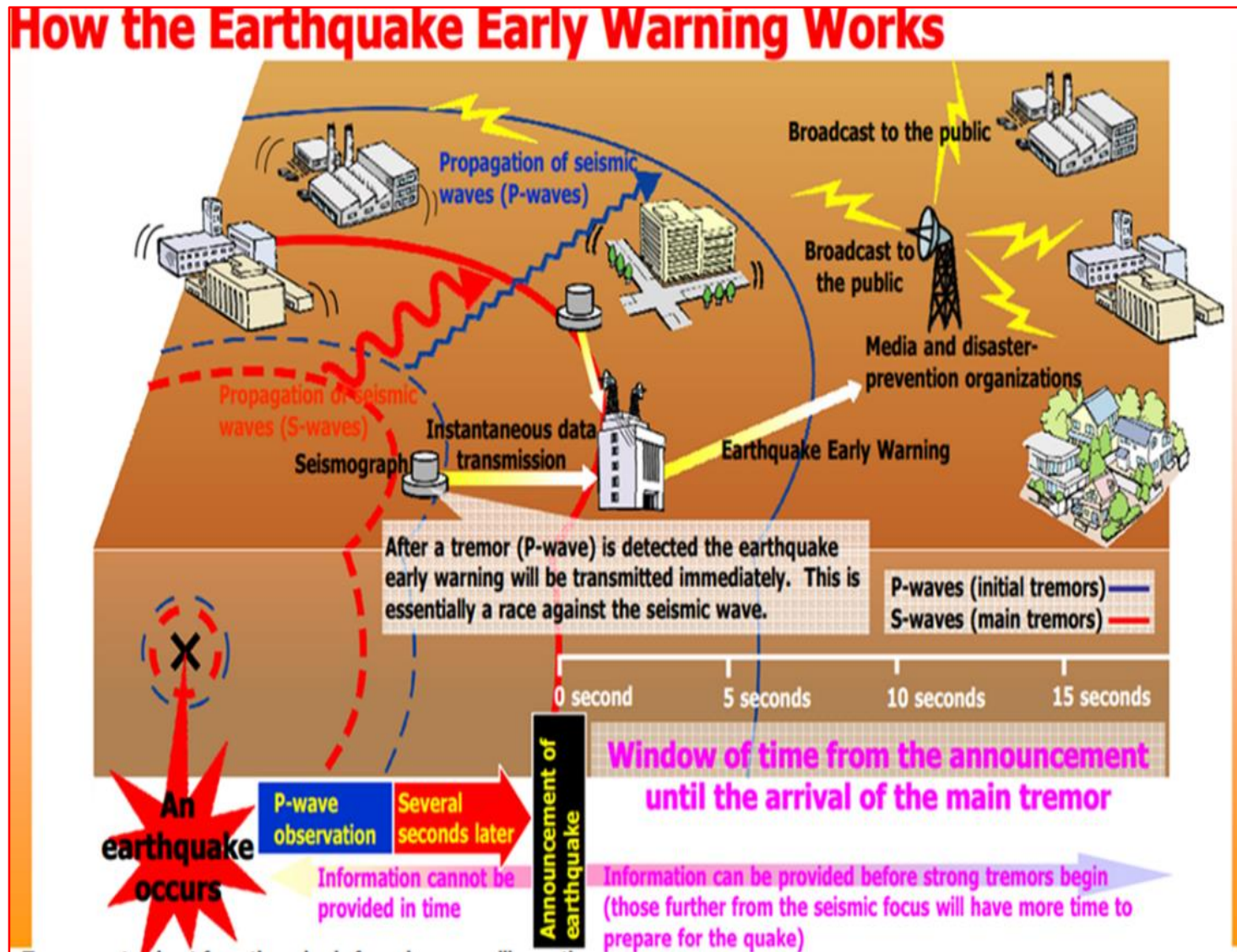
The Seismic Hazard Maps for Japan consist of two types of maps different in nature:

1. Probabilistic Seismic Hazard Maps that combine long-term probabilistic evaluations of earthquake occurrence and strong motion evaluation,
2. Seismic Hazard Maps for Specified Seismic Source Faults (also referred to as Scenario Earthquake Shaking Maps), which are based on strong motion evaluation for scenarios assumed for specific earthquakes.



# Earthquake Early Warnings System

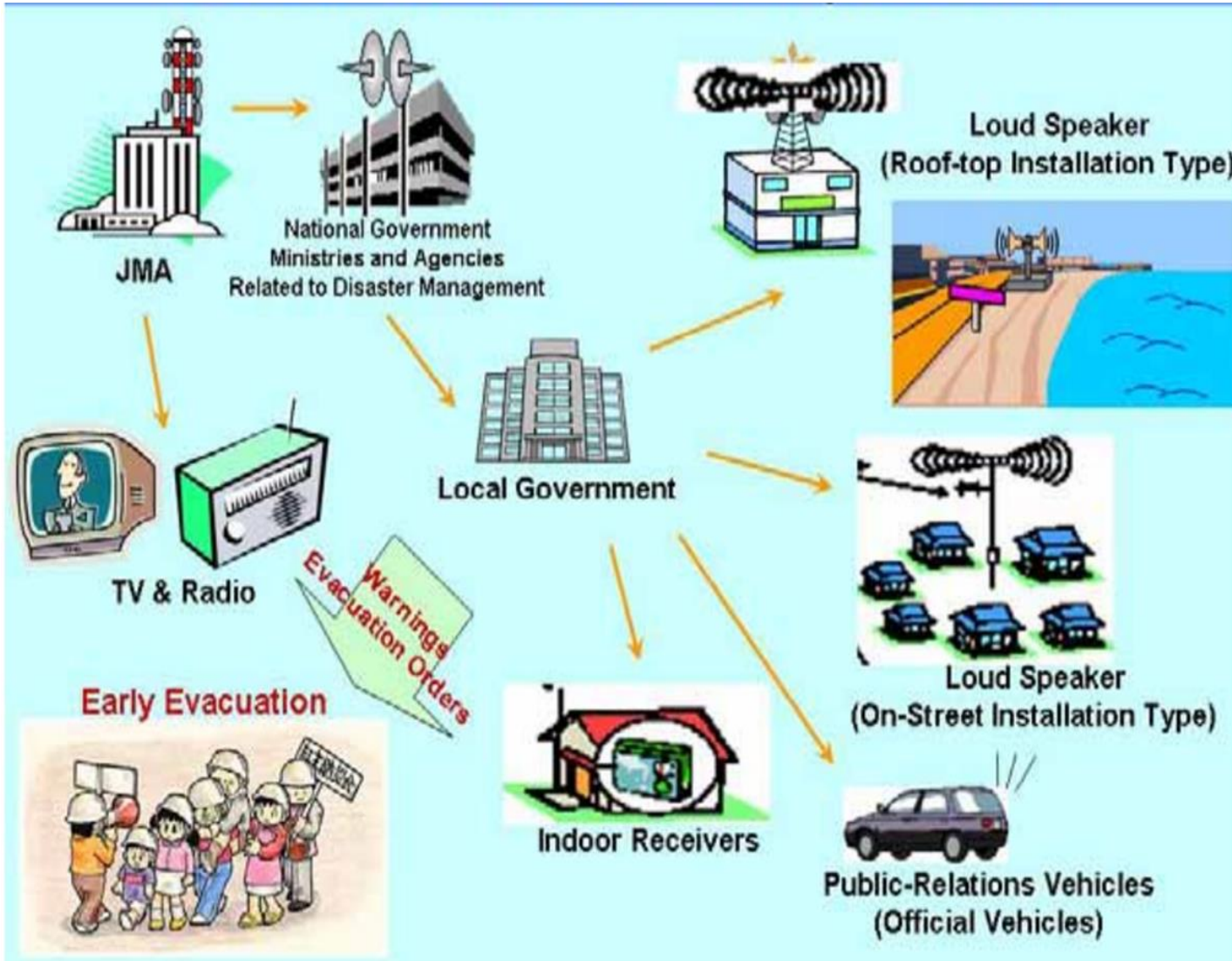
## Early Warning Dissemination Mechanism



**Early Warnings System** system provides advance announcement of the estimated seismic intensities and expected arrival time of principal motion.

This information is based on the estimated hypocenter and magnitude of the earthquake quickly calculated from the P-wave data obtained at seismic stations near the epicenter. The P-wave is a longitudinal wave that propagates 6-7 km/s through the earth's crust, while the S-wave is a transverse wave that propagates 3.5-4 km/s through the earth's crust, arriving later and causing the more severely destructive phenomena. The time lag between the P-wave and the S-wave can make it possible to mitigate earthquake damage by enabling disaster prevention actions to be taken before the major shaking begins (when the S-wave arrives).

## Communication System for Early Warning and Evacuation Order to the people at Risk



The information issued by the JMA is conveyed to prefectures via local meteorological observatories, the Fire and Disaster Management Wireless Networks, or regional satellite communications networks, and then conveyed to municipalities via prefectural systems.

Municipalities have established their own disaster management wireless networks that enable authorities to directly transmit warnings and evacuation orders to residents. The most frequently used tools for disseminating information to the very end users, the residents, are simultaneous wireless communications systems used with outdoor loudspeakers or indoor private radio receivers.



## CONCLUSION

As large-scale natural disasters continue to occur around the world, there is a serious and growing need to improve natural disaster early warning capabilities. For natural disaster early warning systems to be truly useful in mitigating disasters for those who are facing natural disaster risks, they need to:

- ✓ Enable the issuance of prompt and accurate early warning information based on more accurate, real-time measurements of various natural phenomena and scientific data analysis
- ✓ Incorporate systems for sharing warning information among relevant organizations and disseminating it to residents.
- ✓ Incorporate disaster reduction awareness outreach and education activities to ensure that more timely and appropriate disaster reduction actions are taken based on the warning information issued.

It is very necessary and important:

- ✓ **Information Sharing Among Relevant Organizations.** The development of a quick and accurate communications system is essential to the effective use of early warning information.
- ✓ **Partnering with the Telecommunications Industry.** Given the usefulness of mobile phones and the Internet in information distribution, and thus in crisis management and information exchange at the individual level, efforts are being made to actively promote practical applications for the vast array of information technologies that have been developed in recent years.
- ✓ **Disaster Awareness.** Outreach to reduce disaster-related damage, it is important to make residents of at-risk areas aware of safe evacuation methods and nearby evacuation routes and sites ahead of time so that they will take appropriate actions based on early warning information.
- ✓ **Use of Hazard Maps.** Municipalities have to create and distribute hazard maps that show the areas most vulnerable to earthquakes as well as evacuation information.

EEWs provide advance notice of estimated seismic intensities and expected arrival times of principal motion just after an earthquake occurs. The elapsed time between the issuance of the EEW and the start of major shaking will differ significantly depending on a location's distance from the epicenter. EEWs may not be issued in time to areas located just above the hypocenter of an inland earthquake. However, when a large earthquake occurs near an ocean trench, there may be a time lag, albeit a very short one (ten seconds to several tens of seconds), between the issuance of the EEW and the start of severe shaking. This may be just enough time to mitigate damage by triggering emergency stops on trains, plant operations, and elevators, or even just by allowing people to take basic risk-reduction actions, such as extinguishing flames or taking cover under a desk.

To ensure that the best response measures possible are being taken against natural disasters such as earthquakes, tsunamis, typhoons, and torrential rainstorms, we need to conduct accurate and widespread observations of phenomena occurring all over the world and to use those results to develop better policies. For example, in an effort to achieve a system for disaster crisis management that uses earth observation satellites Japan is striving to cooperate and form ties with other countries in the Asia-Pacific region while actively striving to develop a Disaster Management Support System in the Asia Pacific Region.

## Recommendation

- ❖ To improve the earthquakes monitoring system, in particular, to create a single interconnected system between the RSSP and the research institutes of the RA.
- ❖ Create on the earthquakes warning system using the Internet and mobile phones.
- ❖ Create a network of seismic intensity meters stations in Armenia

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