ASIAN DISASTER REDUCTION CENTER

VISITING RESEARCHER 2015A

(AUGUST-NOVEMBER 2015)

SEISMIC MONITORING, SEISMIC HAZARD ASSESSMENT AND DISASTER INFORMATION ACQUISITION PROCESSING AND ANALYSIS, PROVIDING TO OFFICIALS, DESCISION MAKERS AND PUBLIC.

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Disclaimer

This report was compiled by an ADRC visiting researcher (VR) from ADRC member countries.

The views expressed in the report do not necessarily reflect the views of the ADRC. The boundaries and names shown and the designations used on the maps in the report also do not imply official endorsement or acceptance by the ADRC.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to the governments of both Japan and Armenia in giving me the tremendous opportunity to participate in this program.

Especially my thanks and best regards to all of those who devoted their time and efforts to education and training in the field of disaster management.

I am also thankful to Armenian NSSP administrative group, who recommended me to join the program of ADRC Visiting Researcher 2015A.

And finally, I would like to express my appreciation to the ADRC staff, who made my time in Japan an experience that has far surpassed my every expectation.

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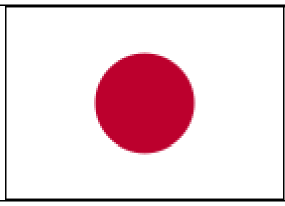
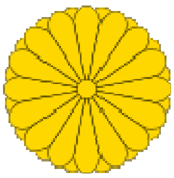
1. GENERAL INFORMATION OF ARMENIA AND JAPAN

1.1 General information of Republic of Armenia

Official name	Republic of Armenia (RA), briefly – Armenia. (Armenian: Հայաստանի Հանրապետություն)
Location	 South Caucasus region of Eurasia, at the crossroads of Western Asia and Eastern Europe
National flag	 Red-Armenian Highlands, Armenians' incessant struggle for survival, Christian faith, liberty and independence. Navy- the aspiration of the Armenian nation to live under the peaceful sky. Orange- the talent for creative work and diligence of the Armenian people.
Coat of arms	
Name in official language	Hayastani Hanrapetutyun, briefly - Hayastan

Head of the State	President
Legislative power	one-chamber National Assembly
Official language	Armenian (is part of Indo-European family of languages)
Capital	Yerevan
Administrative and territorial unit	Marz (11 Marzes in all including Yerevan city)
National currency	Dram (international currency code - AMD)
Territory	29.74 thousand square km
Neighbouring countries	north- Georgia south- Iran east- Azerbaijan west- Turkey
Average elevation above sea level	1800 m
The highest peak	Aragats mountain - 4090 m
The lowest altitude	Debed river canyon - 380 m
The greatest extent	365 km
Region	north latitudes of subtropics
Climate	dry, continental
Average temperature	in January - -6.8°C, in July - +20.8°C
Time zone	Greenwich mean time + 4 hours

1.2 General information of Japan

Official Name	Japan (Japanese: 日本 Nihon or Nippon; formally 日本国 Nippon-koku or Nihon-koku, literally the State of Japan)
Location:	 Eastern Asia, island chain between the North Pacific Ocean and the Sea of Japan, east of the Korean Peninsula
Flag	
Imperial Seal	
Geographic coordinates:	36 00 N, 138 00 E
Map references:	Asia
Area:	total: 377,835 sq km land: 374,744 sq km water: 3,091 sq km note: includes Bonin Islands (Ogasawara-gunto), Daito-shoto, Minami-jima, Okino-tori-shima, Ryukyu Islands (Nansei-shoto), and Volcano Islands (Kazan-retto)
Area - comparative:	slightly smaller than California
Land boundaries:	0 km

Coastline:	29,751 km
Climate:	varies from tropical in south to cool temperate in north
Terrain:	mostly rugged and mountainous
Elevation extremes:	lowest point: Hachiro-gata -4 m highest point: Mount Fuji 3,776 m
Natural resources:	negligible mineral resources, fish
Natural hazards:	many dormant and some active volcanoes; about 1,500 seismic occurrences (mostly tremors) every year; tsunamis; typhoons
Environment - current issues:	air pollution from power plant emissions results in acid rain; acidification of lakes and reservoirs degrading water quality and threatening aquatic life; Japan is one of the largest consumers of fish and tropical timber, contributing to the depletion of these resources in Asia and elsewhere
Environment - international agreements:	party to: Antarctic-Environmental Protocol, Antarctic-Marine Living Resources, Antarctic Seals, Antarctic Treaty, Biodiversity, Climate Change, Climate Change-Kyoto Protocol, Desertification, Endangered Species, Environmental Modification, Hazardous Wastes, Law of the Sea, Marine Dumping, Ozone Layer Protection, Ship Pollution, Tropical Timber 83, Tropical Timber 94, Wetlands, Whaling
Geography - note:	strategic location in northeast Asia
Time zone:	JST (UTC+9) /Summer (DST) not observed (UTC+9)

2. DISASTER MANAGEMENT POLICY IN ARMENIA

2.1 Natural Hazards in Armenia

Armenia is one of the most disaster prone countries in the world. It is at high risk of natural hazards, owing to high levels of exposure and vulnerability.

Meteorological disasters have become more frequent and intense in the last few decades. Floods, mudslides and debris flows threaten half of the country's territory, mainly in medium-altitude mountainous areas, where they typically occur once every three to ten years.

Risks associated with geophysical hazards are significant. The landslide hazard zone covers one-third of the country, primarily in foothill and mountain areas. As Armenia lies in one of the most seismically active regions of the world, the earthquakes have affected large numbers of people and caused significant economic losses.

Earthquakes	**94%**
Mudslides, Landslides, rockfalls, Floods, Irradiation	**6%**

2.2 Spitak Earthquake 1988

Devastating Earthquake

Time: December 7, 1988 at 7.41.22.7 GMT (11.41.22.7 local time)

Coordinates of epicenter: latitude 40.92°N, longitude 44.23°E

The depth of the hypocenter: 10-15 km

The magnitude of the earthquake: 7.0

The intensity at the epicenter:10 (MSK-64 intensity scale)

The earthquake hit 40 % of the territory of northern part of Armenia, densely populated region with 1 ml people. 21 towns and 342 villages were destructed, 514 000 people were left without shelter, 250 000 people were injured and 12 500 people were hospitalized. Number of victims was about 25 000. Particularly in Gyumri (15 000-17 000) and in Spitak (4000) number of victims was more than anywhere else. 17% funds of dwellings were destroyed, the work of 170 industrial companies were halted, the great losses were caused to villages and agro industrial complexes as well as to the architectural, historical and cultural monuments, 917 public buildings were destroyed.

The rescue activities were systemized only two or three days later. From the first second the earthquake strike, the population carried out restless rescuing works. Anyhow the absence of their experience and sometimes the lack of basic knowledge on actions in emergency caused real difficulties for the efficiency of rescue operations. Even there were cases when the public unawareness brought to life losses. Also there was a need of rescue equipment.

2.3 National Survey for Seismic Protection (Armenian NSSP) at the Ministry of Territorial Administration and Emergency Situations of the Republic of Armenia (MTAES of RA)

MTAES of RA is a republican body of executive authority, which in line with such competences as are vested in it by laws and other legal acts, develops, implements and coordinates RA government's policy in the area of civil defense and protection of the population in emergency situations.

MINISTRY OF EMERGENCY SITUATIONS OF ARMENIA					
Rescue Service (including Crisis Management Center- the main body for planning, co-coordinating and implementing measures related to natural and other forms of disasters)	National Survey for Seismic Protection (Armenian NSSP)	Hydro-meteorology and Monitoring State Service	National Technical Safety Center	Atmospheric Phenomena In Active Service Impact	State of Emergency Crisis Management Academy

"NSSP" AGENCY			
"Northern Survey For Seismic Protection" State Non-Commercial Organization	"Southern Survey For Seismic Protection" State Non-Commercial Organization	"Western Survey For Seismic Protection" State Non-Commercial Organization	"Eastern Survey For Seismic Protection" State Non-Commercial Organization

The 1988 Spitak Destructive Earthquake reveals that there is no seismic protection system at all and the Government RA and people were helpless to withstand the disaster.

First, Armenian NSSP was founded in 1991 with the aim to organize population as well as buildings and structures seismic protection. It takes various measures for earthquake disaster management.

NSSP's main goal is seismic risk reduction in Armenia, the population residence hazard mitigation and the state economic and social loss reduction results from earthquake. It has developed two long-term Strategic National Programs on seismic risk reduction in Armenia and in Yerevan city. Today NSSP is not only a national but also a keystone international center.

The Armenian NSSP is monitoring about 40 geophysical, geochemical, hydrochemical, electromagnetic etc. parameters through National Observation Network incorporating about 150 stations. The monitoring systems involve in the global IRIS, Vayq network, Guralp network READINESS, CTBTO and COSMOS networks which enable to change and disseminate data on seismic hazard.

The main objectives and the aims of Armenian NSSP are as follows:

- ✓ provision of seismic hazard monitoring in the territory of Armenia
- ✓ assessment of the seismic hazard and seismic risk of the territories
- ✓ seismic risk reduction
- ✓ assessment of the levels of caused seismicity
- ✓ assessment of other secondary hazards connected with the seismic hazard.

2.4 The Legal Authority in Seismic Risk Reduction

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

Law of Republic of Armenia	
The Law of the Republic of Armenia on Seismic Protection	2002
Resolutions of Government	
The Complex Program of Seismic Risk Reduction in the Territory of Armenia	1999
The complex program of seismic risk reduction in Yerevan city	1999
The Resolution of the Government of RA on establishment of the list of critical important and general facilities in the field of seismic protection	2003
Regulation	
"National Survey for Seismic Protection" Agency	2008

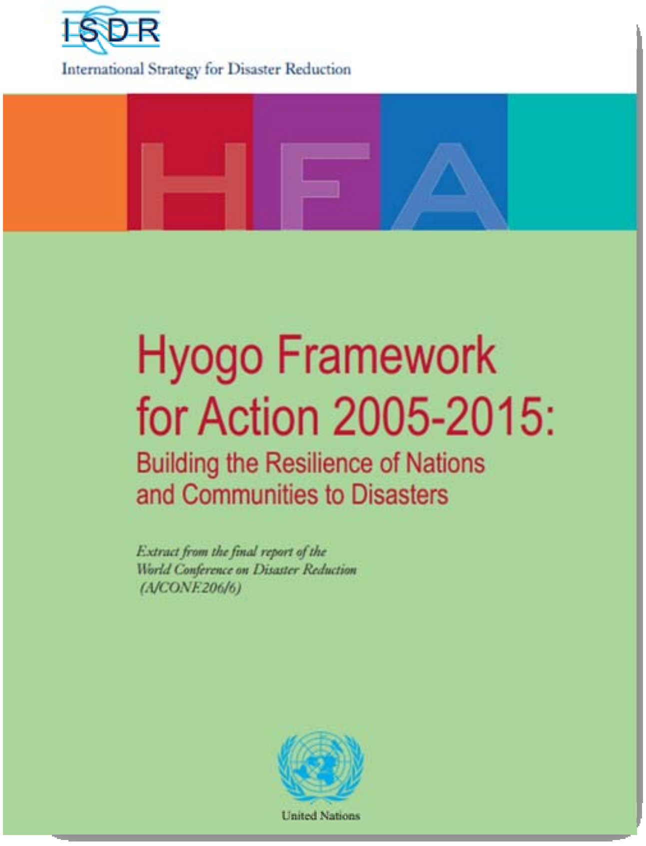
2.5 Disaster Management Strategy based on the Hyogo Framework of Action (HFA)

Natural hazards threatening Armenia urge the need of development and strengthening of DRR system in Armenia. This process implies involvement of all the potential of the country, which can be achieved through elaboration of Disaster Risk Reduction National Platform (DRR NP). DRR system is a framework of functions and processes with the aim to reduce population's vulnerability to disaster risks. It is aimed at prevention or reduction of negative impacts of hazards and contributes to sustainable development of the society. Fund for DRR NP was established in 2010. The Head of the Board is MTAES of RA. The goal of the DRR NP is to establish a multi-spectral mechanism with involvement of all stakeholders.

MTAES of RA has established a Crisis Management Center as the main body for planning, co-coordinating and implementing measures related to natural and other forms of disasters (complementary to a National Platform on Disaster developed in cooperation with UNDP).

Crisis Management Center in Yerevan

Coping with disasters globally is possible only with joint efforts and partnerships. Armenia is considered as a high-risk country, prone to disasters such as earthquakes, landslides, hailstorms, droughts, floods, etc.



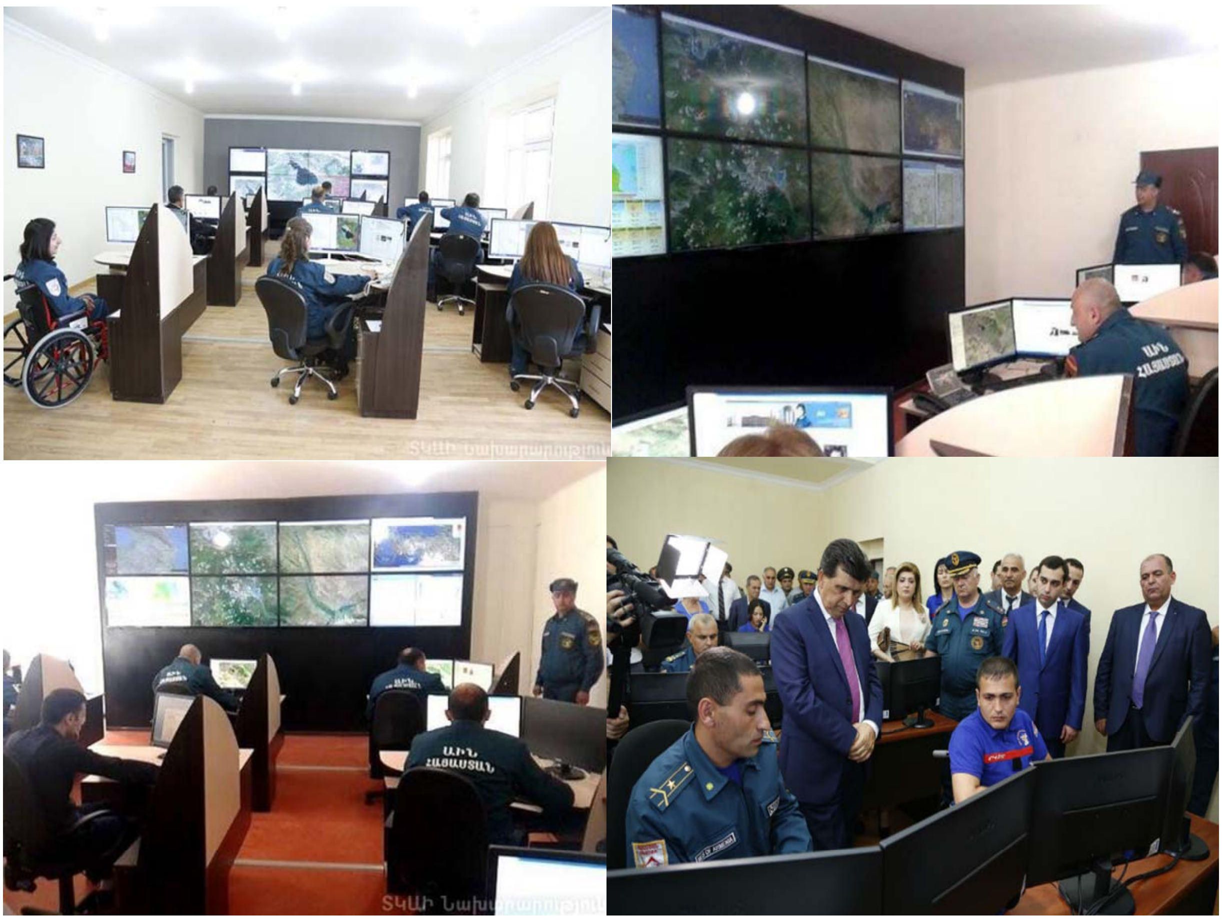
The Government of RA recognizes the threats to country development posed by natural hazards. Since 1991 It has worked to address DRR and to increase disaster response and recovery capacities for the sustainable development of the country. Armenia is committed to achieving the strategic goals of the HFA 2005-2015 "Building the Resilience of Nations and Communities to Disasters" and has taken a number of significant initiatives in this regard.

The cooperation of MTAES of RA with international organizations and local partners proved to be successful and productive over the years. Their efforts in DRR has become a priority in Armenia, thus contributing to the sustainable development of the country. It will be needed to mention the cooperation with JICA, ADRC, UNDP, UNISDR, BCPR, UNICEF, World Bank, Red Cross Movement and a number of partner countries such as Sweden, Switzerland, USA, Russia, etc.

As a result of the mentioned activities, the Government of RA set DRR as a priority and the first steps to form the DRR culture are already established in the country. The best evidence of it is the fact that thanks to UNDP, Armenia became the first country in the region where by the Government's decision the "ARNAP' national DRR platform was established.

MTAES 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 MTAES on appointment of Heads of MTAES Regional Representations as HFA implementation focal points at the country regional (marz) level.

Crisis Management Centers in Marzes



Based on Japanese earthquake experiences, JICA has been supporting Armenian earthquake disaster prevention through "Seismic Risk Assessment and Risk Management Planning Project" by utilizing Japanese technology.

The main goal of "Seismic Risk Assessment and Risk Management Planning Project" is to reduce vulnerability to large-scale earthquakes in the capital city of Yerevan, where a third of the country's population is concentrated, by providing assistance in preparing risk management plans which cover all viewpoints surrounding disaster management cycle from prevention, emergency response to recovery/reconstruction. Real Time Information System on Seismic Intensity was installed at the Crisis Management Center of MTAES which aims: to promote disaster prevention actions of the citizens through publicity of disaster information and to raise public awareness towards disaster prevention. The project also focuses on awareness raising activities for citizens.

2.6 Disaster Education and Human Resource Development

In Armenia various governmental and other organizations have been involved in DRM Education, within the framework of the HFA. MTAES of RA is a executive authority, which in line with competences vested by laws and other legal acts, develops, implements and coordinates RA government's policy in the area of civil defense and protection of the population in emergency situations.

The ARNAP Foundation (Disaster Risk Reduction National Platform), Crisis Management Center (CMC) and Crisis Management State Academy (CMSA) have been established for dealing with various aspects of Disaster Risk Reduction.

National Survey for Seismic Protection of MTAES RA (Armenian NSSP) 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.

Basic tasks of seismic risk reduction are:

- ✓ reduction of territories vulnerability;
- ✓ raising population knowledge and preparedness;
- ✓ training of trainers in government bodies and local authorities;
- ✓ creation of earthquake early warning system;
- ✓ ensuring medical preparedness;
- ✓ organization of relief and rehabilitation of population and sustainable recovery;

The state training system includes the following subsystems, which are done regularly:

- ✓ training of target groups beginning from kindergartens and schools:
- ✓ educational programs, methodical manuals, relevant interactive materials;
- ✓ TV and radio programs, publications in mass media;
- ✓ social-psychological preparedness.

The state training system ensures the reliability and availability of the given information.

The stage of recovery of a zone suffered from strong earthquake is the intermediate between the stages of an emergency seismic situation and reconstruction. The duration and the strategy of recovery stage defined by the Government RA.

The one of the main principles of the accomplishment of recovery works is based on the creation of the conditions for population active participation in recovery works in the disaster zone.

The purpose of aid rendering to the population and its rehabilitation is the reduction of material and psychological losses of the state after an earthquake.

Rendering of aid to the population and its rehabilitation is a multi-stage process: operative (first few days), short-term (first month), mid-term (first year) and long-term (more than one year).

Disaster education at kindergartens and schools




Disaster education at companies and municipalities



Rendering of aid to the population and its rehabilitation are based on the following principles:

- ✓ preliminary planning of works amount on rendering aid and rehabilitation before the catastrophe and their adjustment right after the catastrophe;
- ✓ active participation of government bodies and local authorities and society.

The Government RA established National Strategy of DRR in RA in March 2012, which will be implemented by the mutual efforts of the following organizations: Armenian Red Cross, Oxfam, UNICEF and Save the Children.

The Ministries of Territorsl Administration and Emergency Situations and Education and Science, ARNAP Foundation and CMSA frequently organize competition the "School Disaster Preparedness Plan". On International Civil Protection Day of March 1, implements lecturs, trainings and drills. Armenia collaborating with ADRC (since 2000) and JICA (since 2007) in the frame of various projects and programs implements the research, education and training for the DRR specialists who acquired and shared valuable Japanese experience.

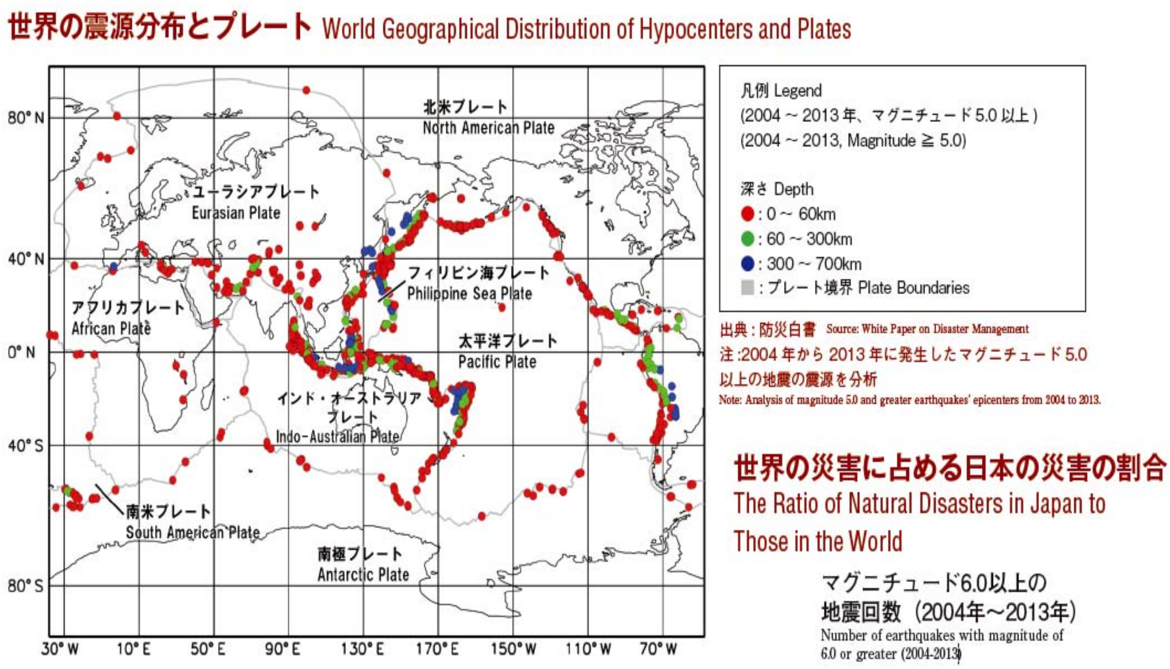
Ministry of Science and Education together with the Ministry of Territorial Administration and Emergency Situations in the frame disaster risk reduction program will submit to National Assembly proposals and additions for the Law “On Public Education” aiming at inclusion disaster risk reduction elements in the school curricula.

3. DISASTER MANAGEMENT POLICY IN JAPAN

3.1 Natural Hazards (Earthquakes)

Japan is located in the Circum-Pacific Mobile Belt where seismic and volcanic activities occur constantly. Although the country covers only 0.25% of the land area on the planet, the number of earthquakes and active volcanoes is quite high. 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.

Every year there is a great loss of people's lives and properties in Japan due to natural disasters. Until the second half of 1950s, largescale typhoons with earthquakes caused extensive damage and thousands of casualties. Thereafter, with the progress of society's capabilities to respond to disasters and mitigate vulnerabilities to disasters by developing disaster management systems, promoting national land conservation, improving weather forecasting technologies, and upgrading disaster information communications systems.



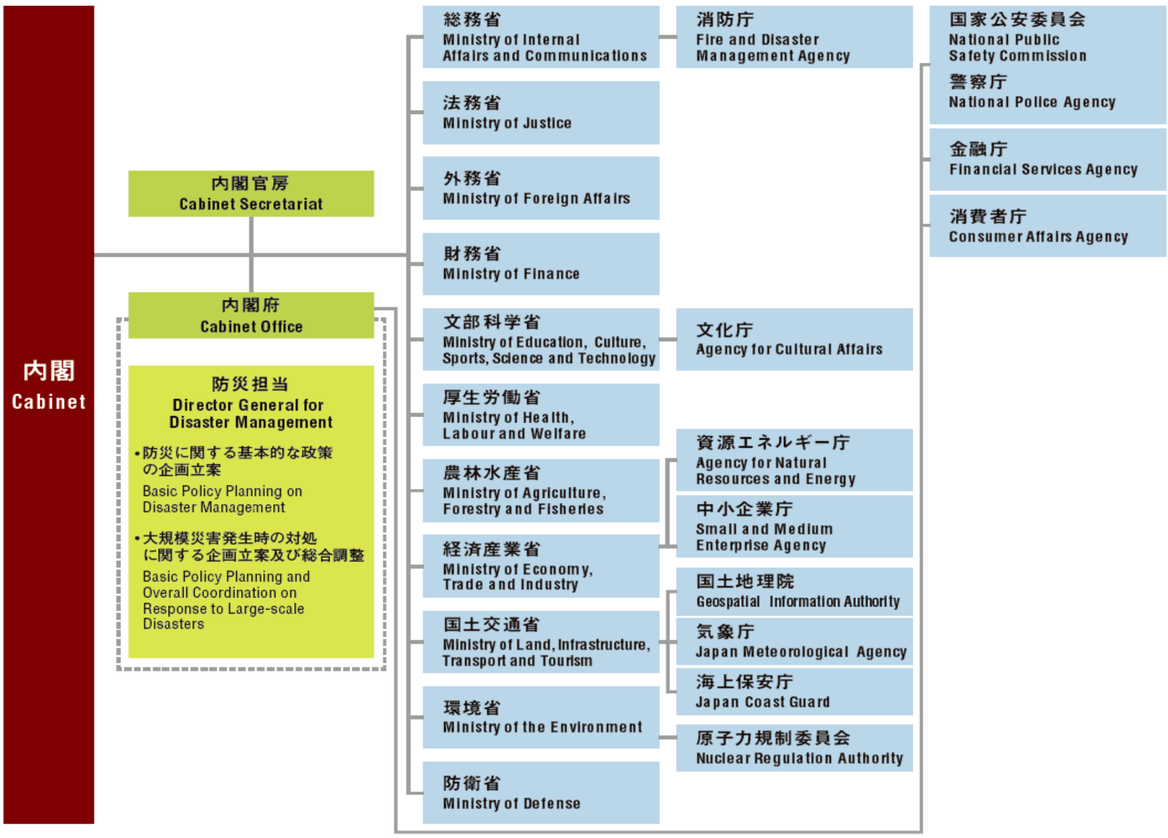
3.2 Disaster management

Mission of the Cabinet Office

Japan’s legislation for disaster management system, including the Disaster Countermeasures Basic Act, addresses all of the disaster phases of prevention, mitigation and preparedness, emergency response as well as recovery and reconstruction with roles and responsibilities among the national and local governments clearly defined, it is stipulated that the relevant entities of the public and private sectors are to cooperate in implementing various disaster countermeasures.

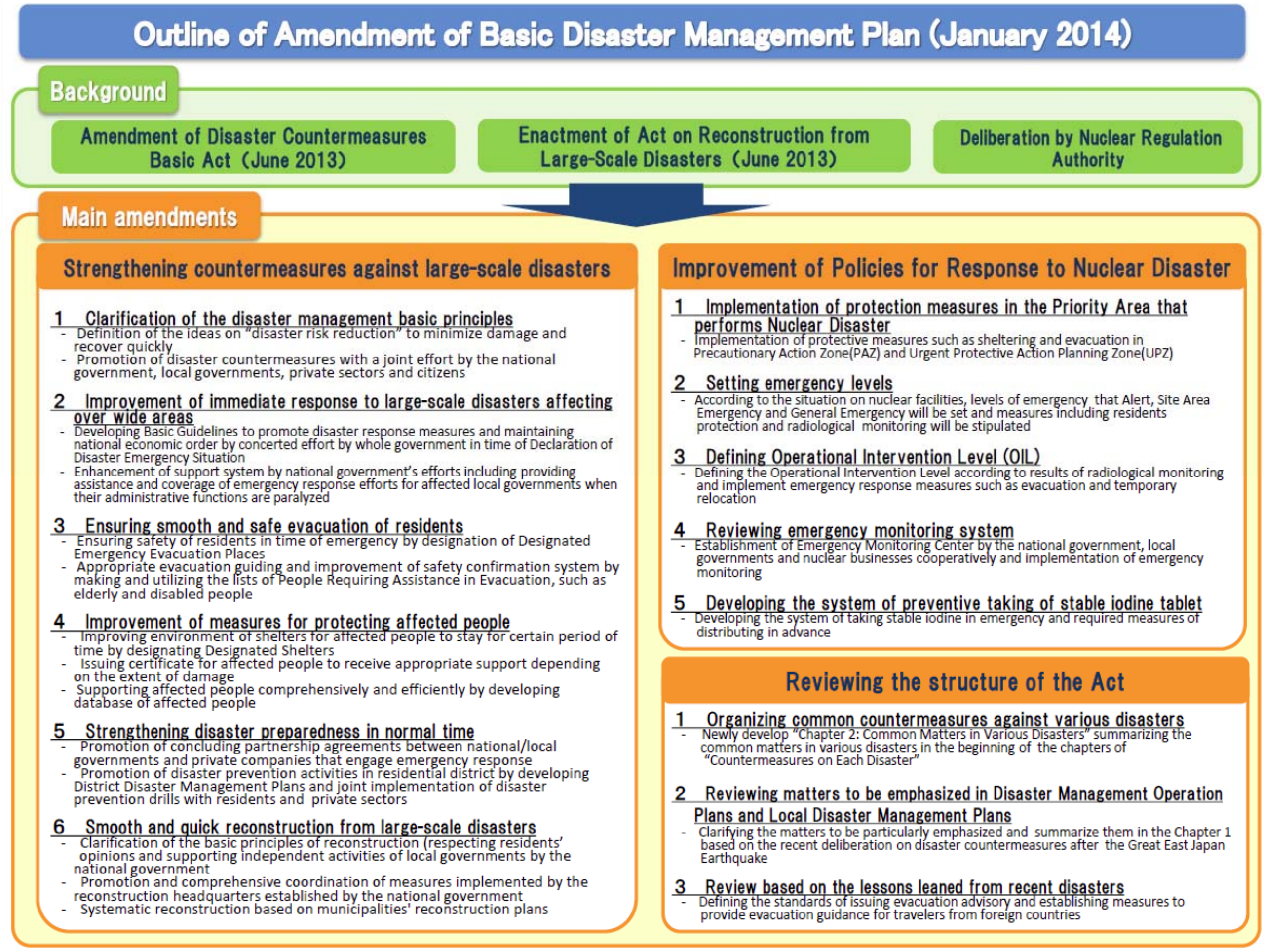
Along with a series of reforms of the central government system in 2001, the post of Minister of State for Disaster Management was newly established to integrate and coordinate disaster risk management policies and measures of ministries and agencies. In the Cabinet Office, which is responsible for securing 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 disasters, as well as conduct overall coordination.

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



Basic Disaster Management Plan

The Basic Disaster Management Plan is a comprehensive and longterm 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. The plan was revised entirely in 1995 based on the experiences of the Great Hanshin-Awaji Earthquake. It defines responsibilities of each entity such as the national and local governments, public corporations and other entities. It consists of various plans for each type of disaster, where specific countermeasures to be taken by each entity are described according to the disaster management phases of prevention and preparedness, emergency response, as well as recovery and reconstruction.



3.3 Disaster risk reduction

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

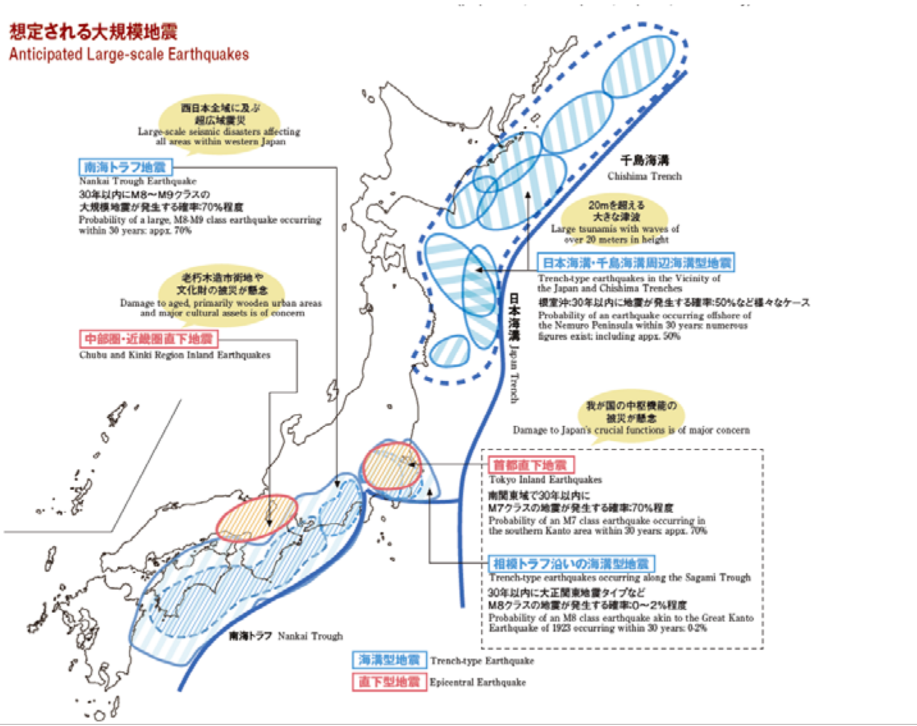
Japan has suffered great damages from the massive inter-plate earthquakes produced by plate subduction (such as the Great East Japan Earthquake of 2011) and the inland crustal earthquakes caused by plate movements (such as the Great Hanshin-Awaji Earthquake of 1995).

It has been pointed out with a great sense of urgency that Japan can be struck by large-scale earthquakes in the near future, in areas such as Nankai Trough, the Japan and Chishima Trenches, and directly below Tokyo and the Chubu and Kinki regions.

With regard to the Nankai Trough Earthquake, earthquakes around the ocean trench such as Japan Trench and Chishima Trench, and Tokyo Inland Earthquake, the government designated the areas where disaster reduction measures are to be taken in accordance with relevant laws and regulations. Also, the government is developing a plan concerning how to accelerate disaster reduction measures by administrative entities and private businesses.

The Central Disaster Management Council has developed the " Policy Framework for Large-scale Earthquake Disaster Prevention and Reduction " a master plan of the countermeasures for the large scale earthquake, 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 specific actions to be taken by related organizations.

It is possible that an earthquake other than these large scale ones can hit any place in Japan as with the cases in the past 30 years. A guideline for the countermeasures against earthquakes by local municipalities has been compiled covering every step of the disaster response levels (preparation, initial response, response, and recovery).



3.4 Disaster Education and Human Resource Development

Human Resources Development

The Cabinet Office started a ,,program for developing disaster management specialists,, for the purpose of developing and training people ,,who can respond to the emergency promptly and appropriately,, and ,,who can form a network between the national and local entities.,,

Specifically, it provides training programs to employees of local public organizations who are engaged in services at the Cabinet Office and take lectures from various organizations related to disaster management. It also conducts training programs organized at the Ariake-no-Oka Main Wide-area Disaster Management Base Facility, such as ,,Training on comprehensive management,, tailored for core management personnel level, “ Themed trainings ” for specialists who are in charge of specific disaster field, and “ Basic training on disaster management ” for those who have recently appointed as disaster management personnel. In addition, it organizes trainings in various locations under a theme which is specific to characteristics of each location.

Disaster Reduction Drills and Exercises

In order to improve the disaster resilience of the community and to reduce disaster damages, there must be close cooperation among individuals, families, local community, businesses and relevant entities, to build momentum for a nationwide movement. The Government has designated the 1st day of September as the ,,Disaster Preparedness Day,,and the week including this day as the Disaster Preparedness Week, and carries out various events to raise awareness and readiness about the disaster. Disaster drills and ,,disaster reduction fairs,, are held in various parts of Japan.


兵庫県
HYOGO

Disaster Education

Education about disaster reduction is quite important for enabling individuals to have correct understanding about natural disasters, and be able to act on their discretion to prevent and reduce damages from a disaster. In the Great East Japan Earthquake, a case of an elementary school was reported to have safely evacuated based on their daily education of the past disasters and training about evacuation. Thus, importance is recognized to enhance education and training at schools and in local communities so that people are nurtured to be equipped with correct understanding about prevention and escape from the disaster.

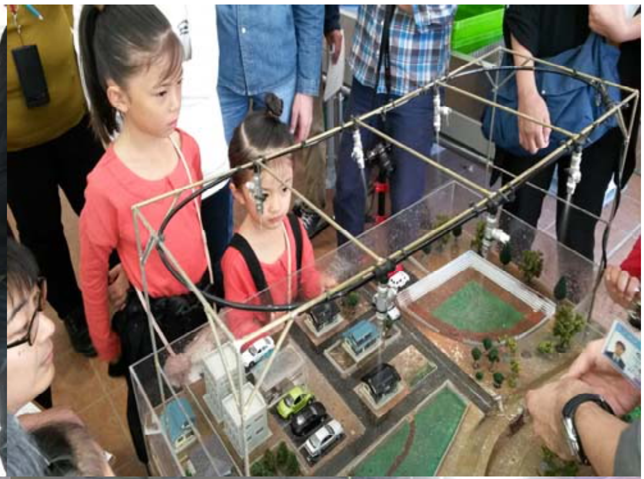
In order for school children to be able to learn and acquire knowledge and practical skills about disaster reduction, Fire and Disaster Management Agency has compiled ,,Challenge! Disaster Reduction 48,, a textbook for school teachers and leaders. Ministry of Education, Culture, Sports, Science and echnology (MEXT) compiled a ,,Guide to Make a Disaster Reduction Manual for Schools (Earthquake and sunami),, and ,,Development of a Disaster Reduction Education to Nurture Power to Live On,, demonstrating the direction of the school education in disaster reduction, and to enhance the disaster education at school.

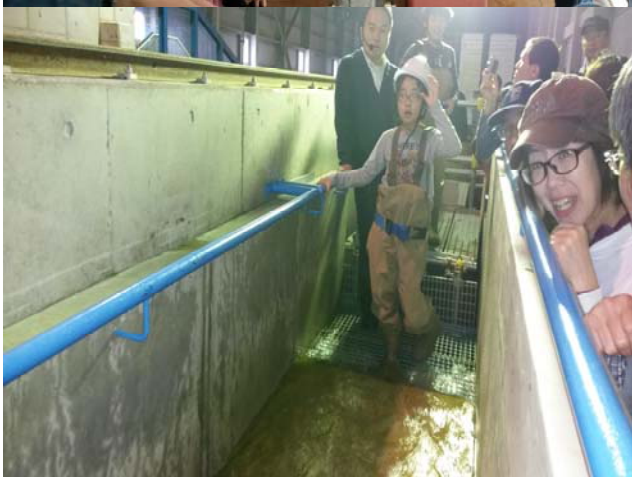
Further, in order to enhance the disaster reduction education in local communities and schools nationwide, the Cabinet Office is carrying out a campaign ,,Disaster Reduction Education Challenge Plan,, to nurture positive environment for more proactive disaster reduction education by picking up active local groups, schools and individuals who demonstrated better disaster reduction plans and actions, give support to them, and publicize the achievements (including education methods, materials used, precautions, contacts), through the Office's web site, intending that such plans and programs be widely recognized and utilized throughout the nation .

Ⅰ. レクチャー：ファシリテーターが、大雨による災害と気象台から発表される防災情報について説明します。

Ⅱ. グループワーク：グループ毎に異なった条件（地形・住居・家族構成）設定の下、大雨災害時における各ステージでどのような行動を取るのか話し合います。

Ⅲ. まとめ・発表：グループワークでの話し合いをまとめてグループ毎に発表し、意見交換を行います。また、ファシリテーターが各班の発表にコメントします。





3.5 Asian Disaster Reduction Center (ADRC)

The Asian Disaster Reduction Center was established in Kobe, Hyogo prefecture, in 1998, with mission to enhance disaster resilience of the member countries, to build safe communities, and to create a society where sustainable development is possible. The Center works to build disaster resilient communities and to establish networks among countries through many programs including personnel exchanges in this field. Main activities of ADRC:

Information Sharing on Disaster Reduction

Learning from Disasters and Benefiting from Information

1. Provision of information on the latest disasters, disaster preparedness of member countries, and good practices
2. Promotion of GLIDE (Global unique disaster ID Entifer)
3. Disaster management support system (Sentinel Asia Project)
4. Organization of international conferences

Human Resources Development

Disaster Risk Reduction begins with Capacity Building

1. Organizing conference, workshops and trainings on disaster risk reduction
2. Program for inviting visiting researchers from member countries

Building Communities Capabilities

Community Participation is a Key to Effective Disaster Reduction

1. Development and dissemination of tools for encouraging community participation
2. Support for the acivities of Asian Disaster Reduction and Response Network (ADRRN)

Visiting Researcher ADRC 2015

4. SEISMIC MONITORING AND EARLY WARNING SYSTEM

4.1 Seismic monitoring, seismic hazard assesment and disaster information acquisition processing and analysis, providing to officials, decision makers and public in Armenia

Data Acquisition Processing and Analysis department of NSSP, has been carrying out operative duties (24 hours) since its foundation, dealing with data acquisition from geophysical, geochemical, seismic network as well as with the acquired data analysis. The department implements process of operative and manual assessment of the main parameters of earthquake.

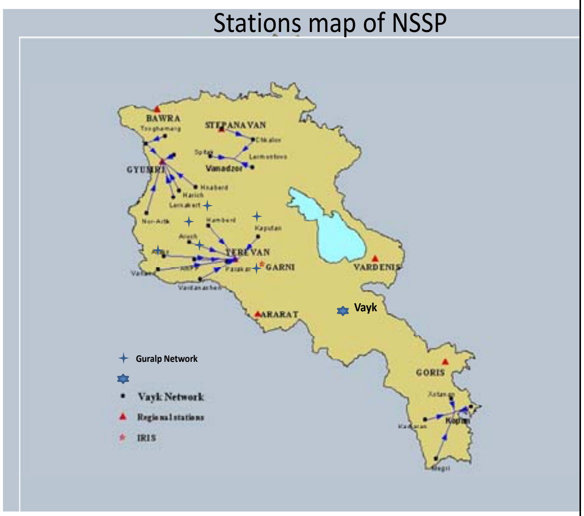
We base some of our researches on the fact that the preparation of earthquakes with various magnitudes is accompanied by the appearance of precursors in various physical fields. We deal with medium-tem, short term and operative probably- seismogenic anomalies as well as co-seismic and post-seismic effects associated with earthquake probability.

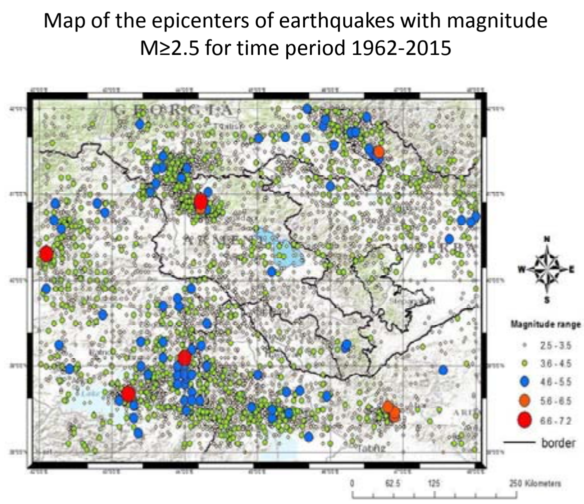
Seismic monitoring

There are multiparameter network of seismic observation and monitoring in Armenia. The network consists of national and international observation stations, which are included in a world global network.

There are four types of seismic network in Armenia:

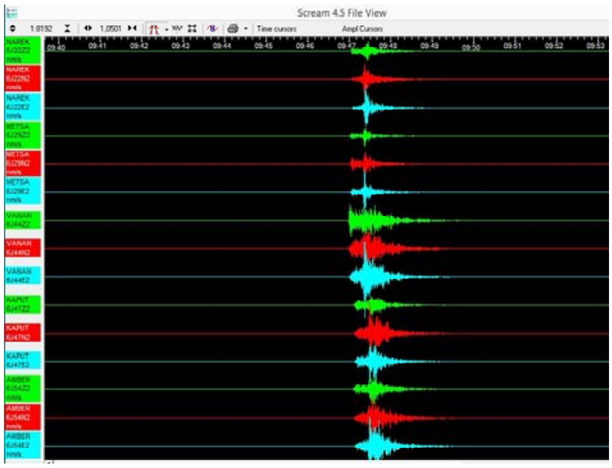
- Guralp Network
- Vayk Network
- Regional Network
- Global Seismograph Network Station (IRIS)





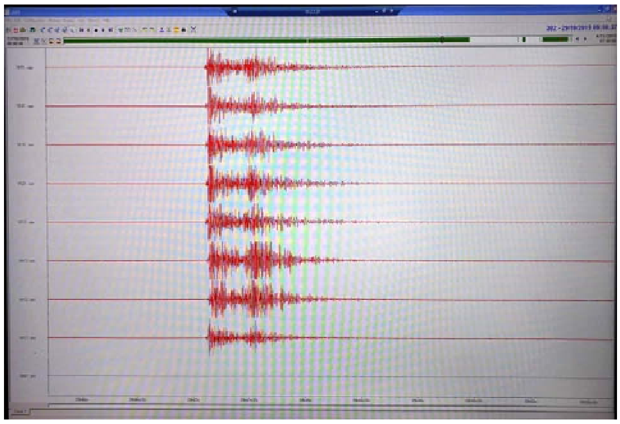
GURALP STATION

Seismic record of Guralp station



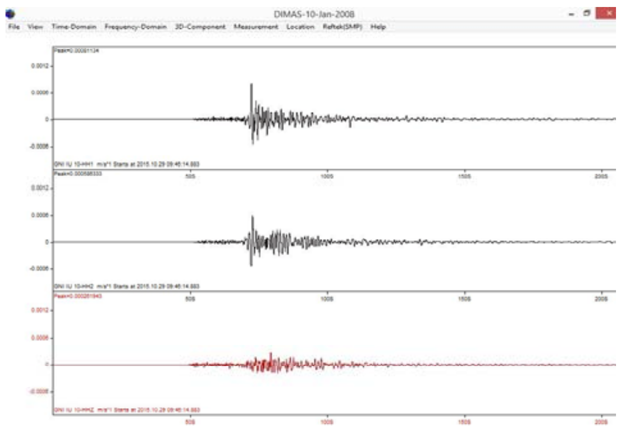
VAYK STATION

Seismic record of Vayk station



NEW BUILDING OF NSSP
IRIS STATION

Seismic record of IRIS station

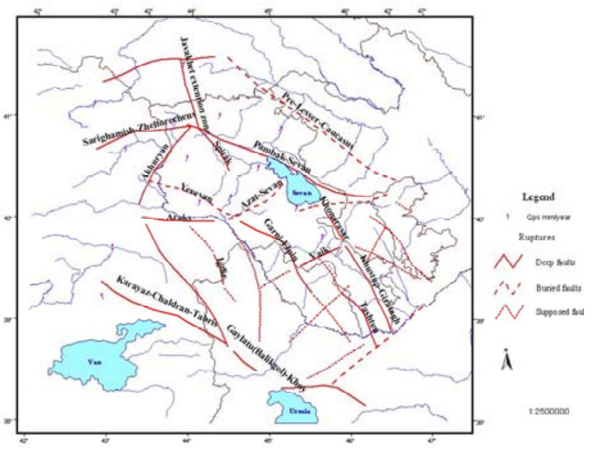


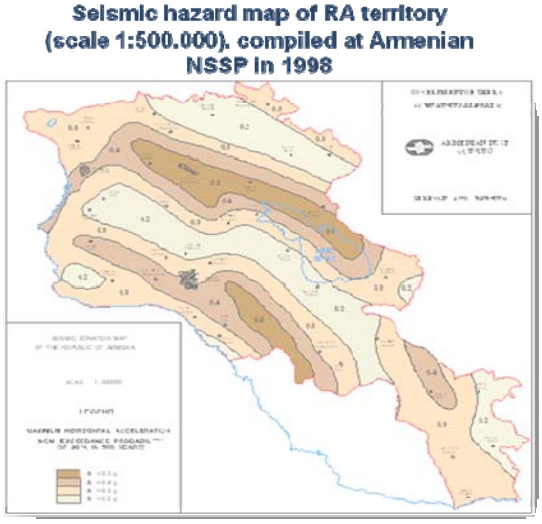
Disaster information acquisition processing and analysis, providing to officials, decision makers and public

Current Seismic Hazard Assessment in Armenia

Seismic hazard refers to the study of expected earthquake ground motions at the earth's surface, and its likely effects on existing natural conditions and man-made structures for public safety considerations. Current seismic hazard assessment in Armenia enable the NSSP. Current seismic hazard assessment defined probability of place, magnitude and time of possible strong earthquake.

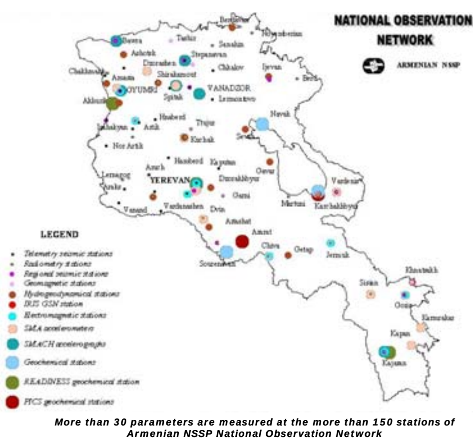
MAP OF FAULTS

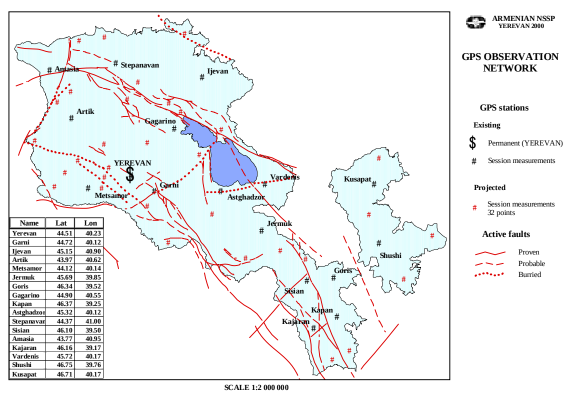




Current seismic hazard assessment includes:

- ✓ Definition of probabilities of current anomalies seismic realization based on testing of strong regional earthquakes (M≥6.0) and local notable earthquakes (M≥3.7) and monitoring time period
- ✓ History analysis using “SeisHelp” (Monitored the time series, the anomalies are selected visually)
- ✓ For seismogene anomalies using “Dynamic Fields”, probability evaluation of the site, time and magnitude of expected earthquake using “Expert” programs
- ✓ Evaluation of crust stress based on monitoring data
- ✓ Complex evaluation of Current seismic hazard based on operative complex map using seismotectonic data and seismic hazart map of RA territory.





In case of prediction of strong earthquake in the territory of Armenia and adjacent areas the Expert of the Armenian NSSP for prediction confirmation has being immediately conveyed early non-urgent actions are being undertaken after based on the decision of the analysis, information, in order, established by a plenipotentiary bodies.

Before expected earthquake, in case of emergency declaring the Armenian NSSP acts according to the relevant approved documents.

After occurred earthquake the main earthquake parameters are defined and the first preliminary announcement is being made, and after main parameters adjusting, the final announcement is being made.

After occurred earthquake, in case of emergency declaration the actions are being undertaken according to the relevant approved documents.

The Armenian NSSP Task Force members

- seismologist-seismotectonist
- seismologist
- geo-technician
- earthquake engineer
- communication engineer
- public awareness expert
- logistics, rescuer
- psychologist

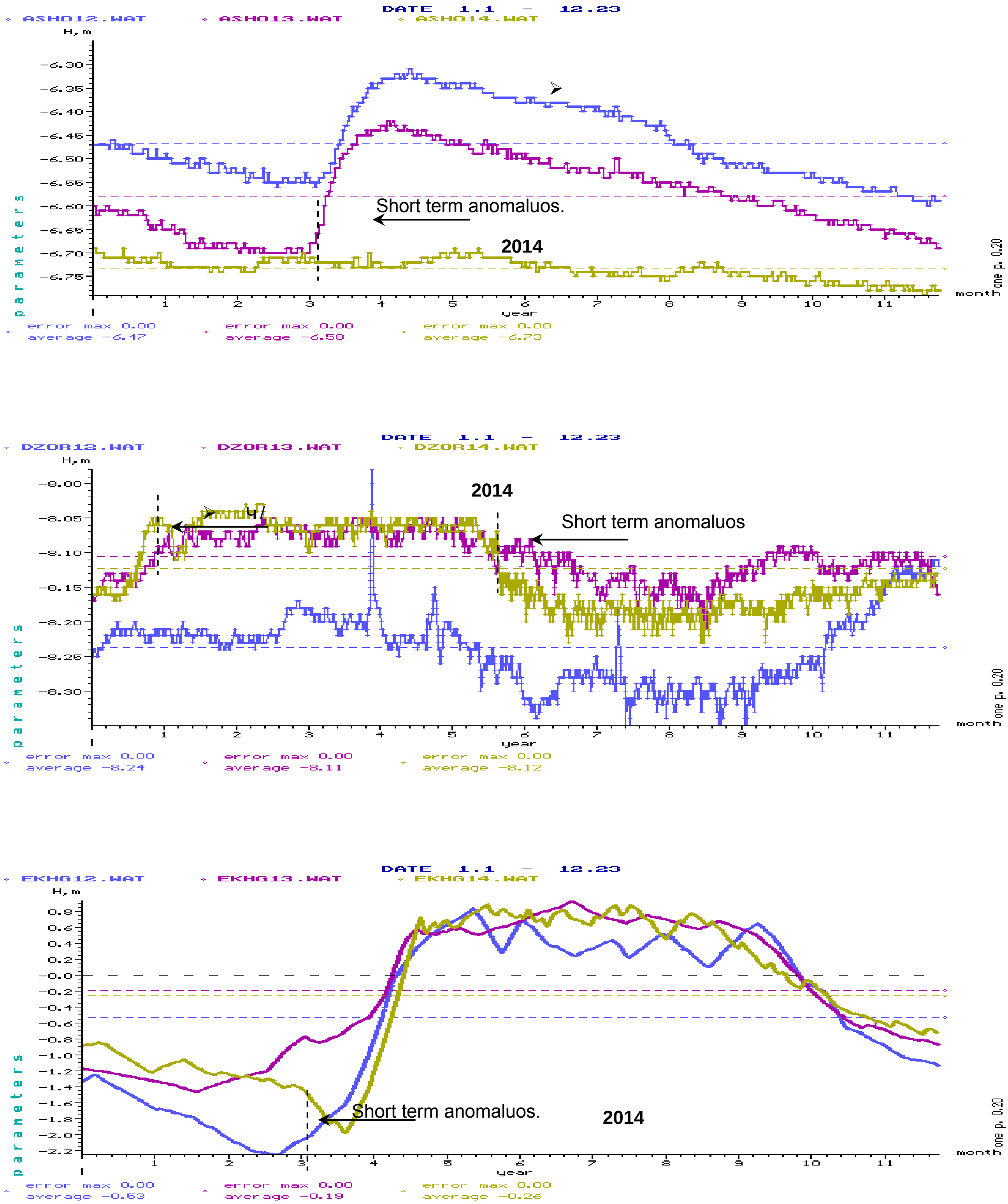
Anomalous concentration as an earthquake-precursor

Preparation of a strong seismic event is known to be associated with an accumulation of gigantic elastic strain energy in the medium.

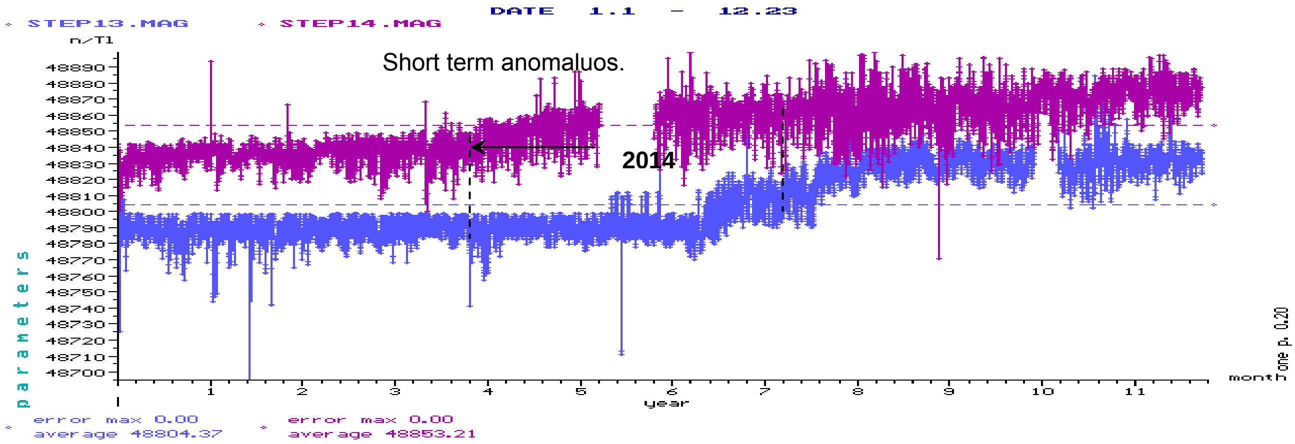
Based on the retrospective analysis of practically all seismic events which had occurred 1983-2015 in Armenia and adjacent territories are systematically tested and based the Catalogue of precursory anomalies. It was supplemented few times, and the anomalies included were critically over estimated and sometimes rejected. Naturally, the Catalogue will be supplemented with the tests of future strong regional and perceptible local earthquakes. The Catalogue is in daily use at the Armenian NSSP for Current seismic hazard assessment.

The examples, in particular, the imposing of precursory anomalies of different order, as well as the presence of pre-, co-, post-seismic periods in observed.

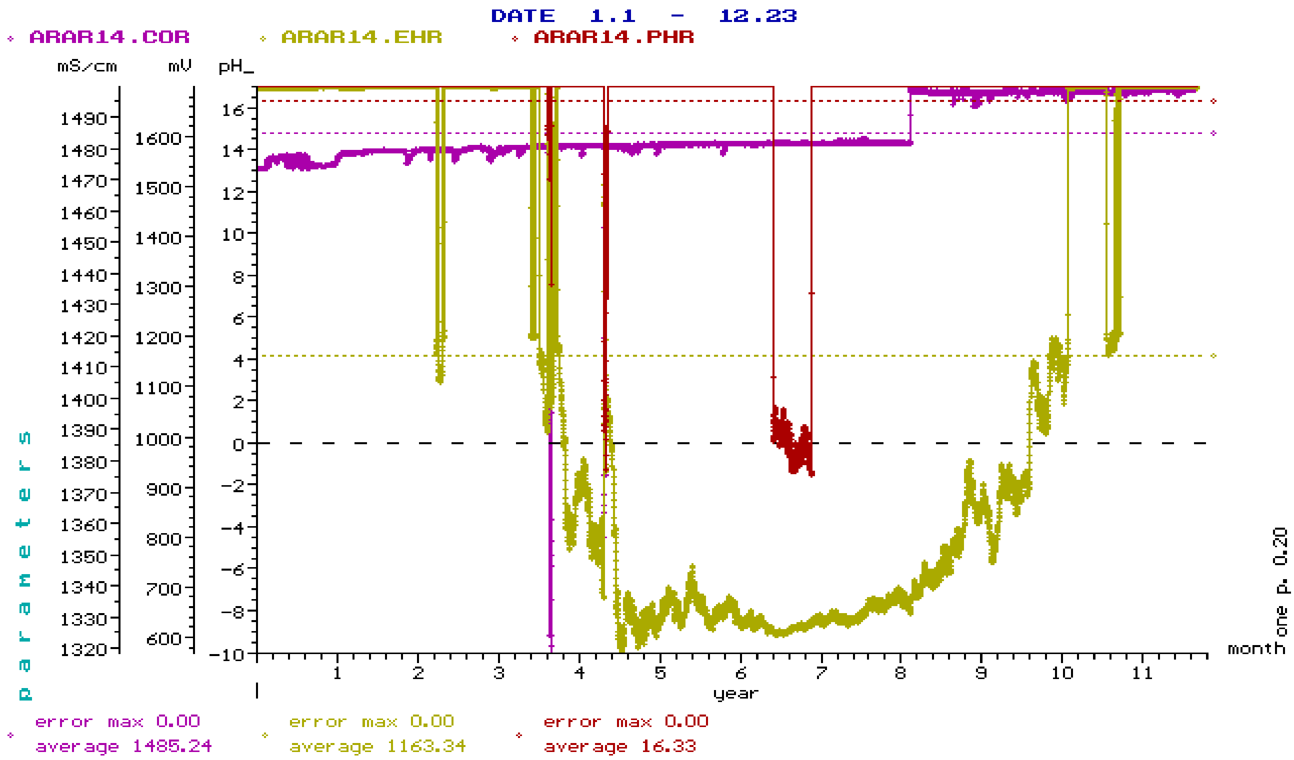
Examples of analyzing the data as anomalous of some stations



Pic 1. Udergraound water level changes Ashotcq (1), Zoraxbyur (2) , Eghegnazor (3) hydrogeodynamical stations



Pic 2. Anomaly changes of geomagnetic field in Stepanakert station



Pic 3. COR–ի, EHR-ի և PHR-ի values anomaly changes in Ararat Readiness geochemical station

During 2014

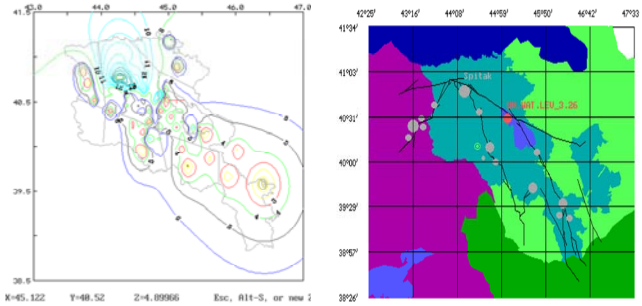
Operatively was determined 141 earthquakes witch announced decision makers.

Using software Seishelp observed and made solution for data of geophysical and geochemical stations.

Using software Expert implemented every day current seismic hazard assessment

Determined operatively, short term, medium term and long tem 55 anomalous from national network stations

Seismic hazard assessment using software EXPERT for hydrodynamic parameters



Expert : 24 hours $\varphi = 40.50^{\circ}$ $\lambda = 45.10^{\circ}$

4.2 Seismic monitoring, seismic hazard assesment and disaster information acquisition processing and analysis, providing to officials, decision makers and public (Early Warning System) in Japan

Seismic monitoring

Located in one of the most active seismic and volcanic zones in the world, Japan is frequently affected by earthquakes and volcanic disasters. Japan Meteorological Agency operationally monitors seismic and volcanic activity throughout the country and issues relevant warnings and information to mitigate damage caused by disasters related to earthquakes, tsunamis and volcanic eruptions.

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).

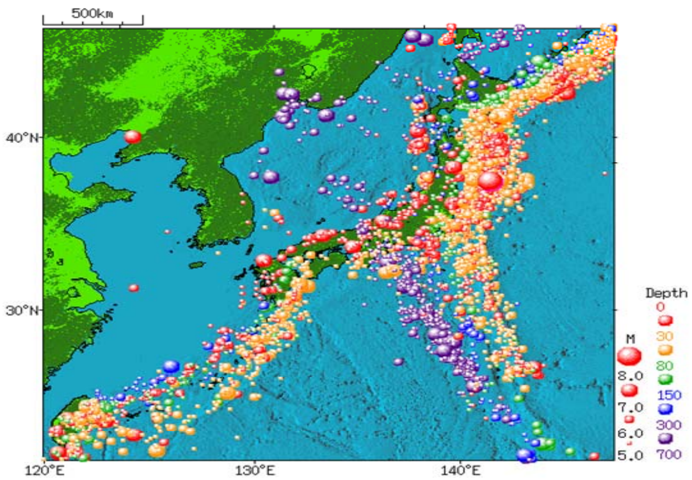
About K-NET and KiK-net

K-NET (Kyoshin network) is a nation-wide strong-motion seismograph network, which consists of more than 1,000 observation stations distributed every 20 km uniformly covering Japan. K-NET has been operated by the National Research Institute for Earth Science and Disaster Prevention (NIED) since June, 1996. At each K-NET station, a seismograph is installed on the ground surface with standardized observation facilities.

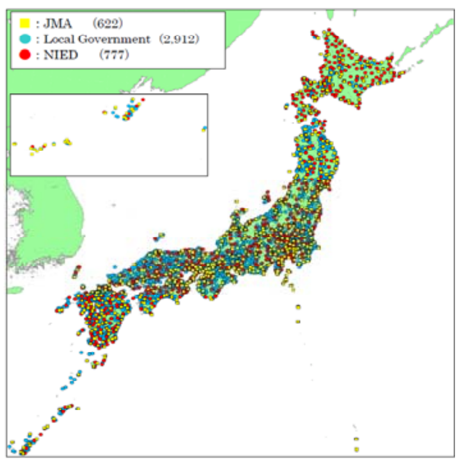
KiK-net (Kiban Kyoshin network) is a strong-motion seismograph network, which consists of pairs of seismographs installed in a borehole together with high sensitivity seismographs (Hi-net) as well as on the ground surface, deployed at approximately 700 locations nationwide. NIED constructed KiK-net under the plan 'Fundamental Survey and Observation for Earthquake Research' directed by 'the Headquarters for Earthquake Research Promotion'.

The strong-motion data recorded by K-NET and KiK-net are immediately transmitted to the data management center of NIED in Tsukuba. The observed strong-motion data are widely available to the public through the internet from this web site.

Earthquake distribution around Japan (1960-2014)



Sites of seismic intensity meters



Disaster information acquisition processing and analysis, providing to officials, decision makers and public

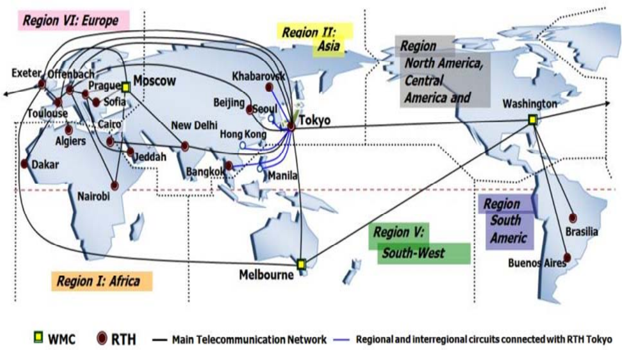
Telecommunications and Data Processing System

JMA operates two major computer systems; one is the Automated Data Editing and Switching System (ADESS) for the treatment of observational data and products, and the other is the Numerical Analysis and Prediction System (NAPS). ADESS is linked to individual JMA facilities for meteorological services as well as various related authorities (including both the central government and local governments) via exclusive landlines. To complement landline-based communication, JMA installed a communication channel through the Geostationary Meteorological Satellite (MTSAT-1R) for the delivery of earthquake reports and tsunami warnings due to the urgency and level of reliability required in disseminating such bulletins. NAPS is a super-computer system used for the computation of numerical weather predictions.

To cope with constantly increasing demand for computing performance and capacity, JMA updates NAPS with the latest high-performance computer every five years, and the most recent replacement was conducted in March 2006. ADESS and NAPS are collectively called the Computer System for Meteorological Services (COSMETS), and constitute a comprehensive system for data communication and processing.

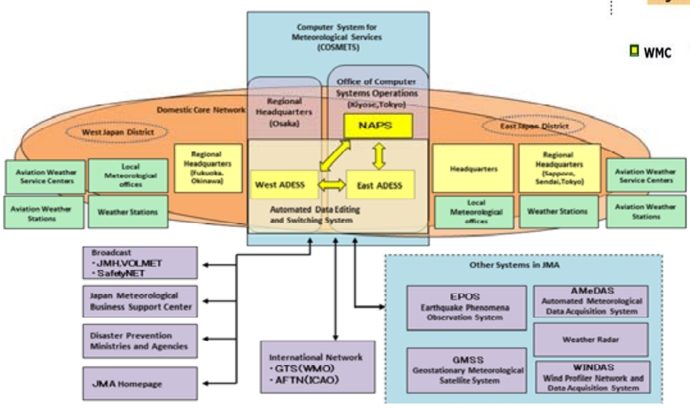
In addition to its role as described above, ADESS also exchanges observational data and weather-related products with National Meteorological and Hydrological Services (NMHSs) through the Global Telecommunication System (GTS), which is run under the WMO World Weather Watch (WWW) Programme. JMA serves as a Regional Telecommunication Hub (RTH) for the GTS Main Telecommunication Network, and is connected to World Meteorological Centres (WMCs), other RTHs and National Meteorological Centres (NMCs).

The Agency also operates a Global Information System Centre (GISC) and Data Collection or Production Centres (DCPCs) of the WMO Information System (WIS) for the collection and sharing of information for all WMO and related international programmes.



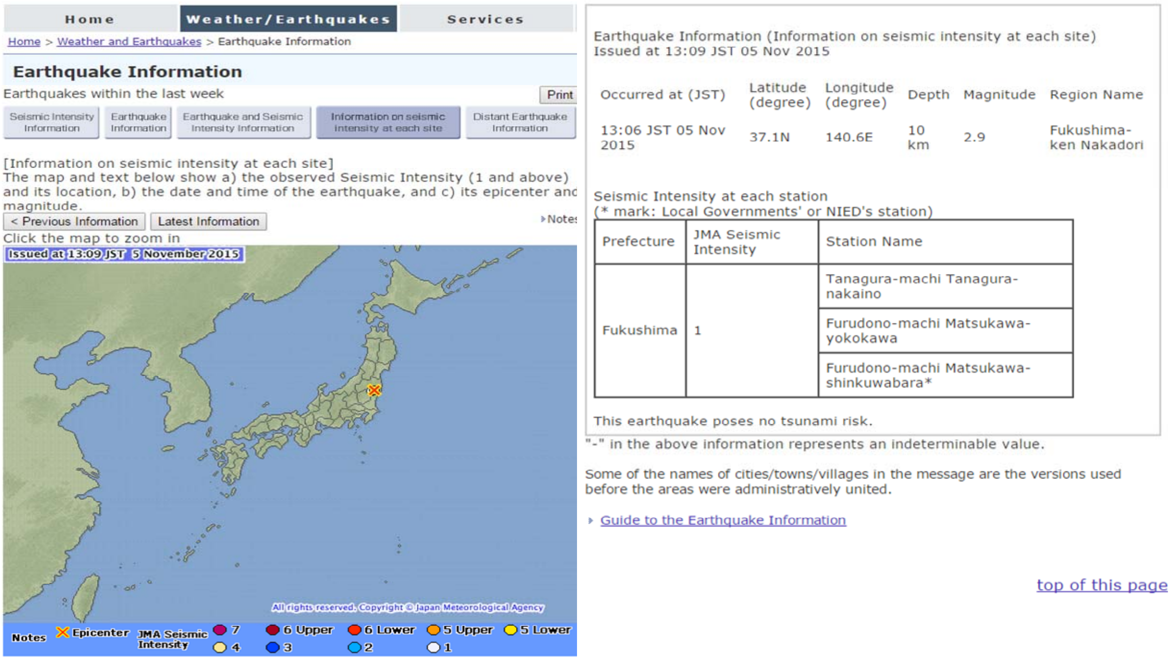
Schematic overview of Global Telecommunication System (GTS)

COSMETS and related systems



The data collected are input to the Earthquake Phenomena Observation System (EPOS) at the headquarters in Tokyo and the Osaka District Meteorological Observatory on a real-time basis. When an earthquake occurs, JMA immediately issues information on its hypocenter, magnitude and observed seismic intensity. If the seismic intensity is 3 or greater, the Agency issues a Seismic Intensity Information report within one and a half minutes. The information is provided to disaster prevention authorities via dedicated lines, and reaches the public through local governments and the media. This information also plays a vital role as a trigger for the initiation of rescue and relief operations related to earthquake disasters.

Earthquake information by Japan Meteorological Agency



Early Warning System

The Japan Meteorological Agency (JMA) provides residents in Japan with Earthquake Early Warnings. This is a new system that issues prompt alerts just as an earthquake starts, providing valuable seconds for people to protect themselves before strong tremors arrive.

On 1 October 2007, JMA launched the Earthquake Early Warning service for provision through a number of media outlets such as TV and radio.

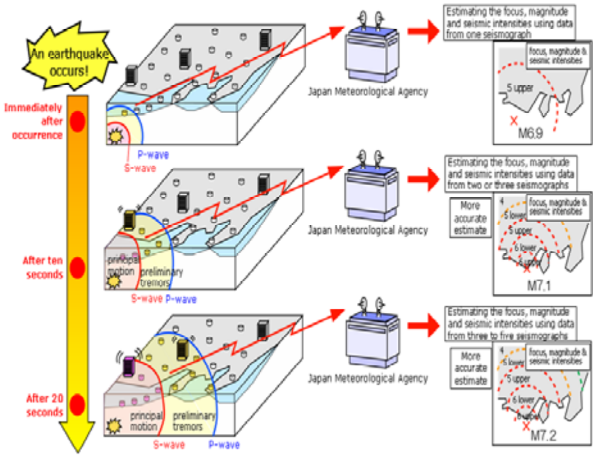
The Earthquake Early Warning system provides advance announcement of the estimated seismic intensities and expected arrival time of principal motion. These estimations are based on prompt analysis of the focus and magnitude of the earthquake using wave form data observed by seismographs near the epicenter.

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.

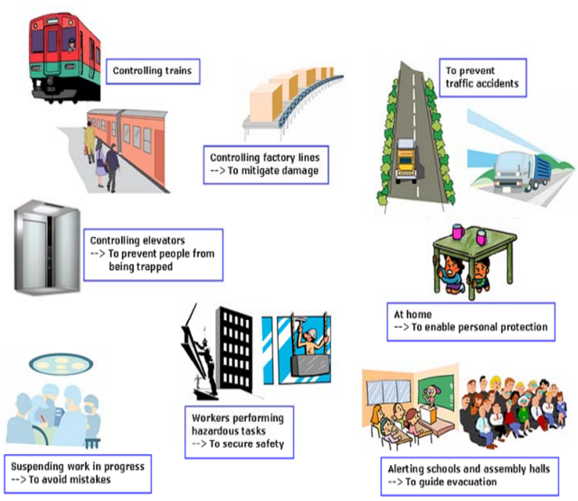
The period between the Earthquake Early Warning and the arrival of strong tremors is very short, i.e. a matter of seconds (or between several seconds and a few tens of seconds). As a result, areas that are close to the focus of the earthquake may not receive the Earthquake Early Warning transmission before strong tremors hit.

There are limits to the accuracy of the Earthquake Early Warning, such as the estimated seismic intensity. This is because the system is necessarily dependent on very short-term data.

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



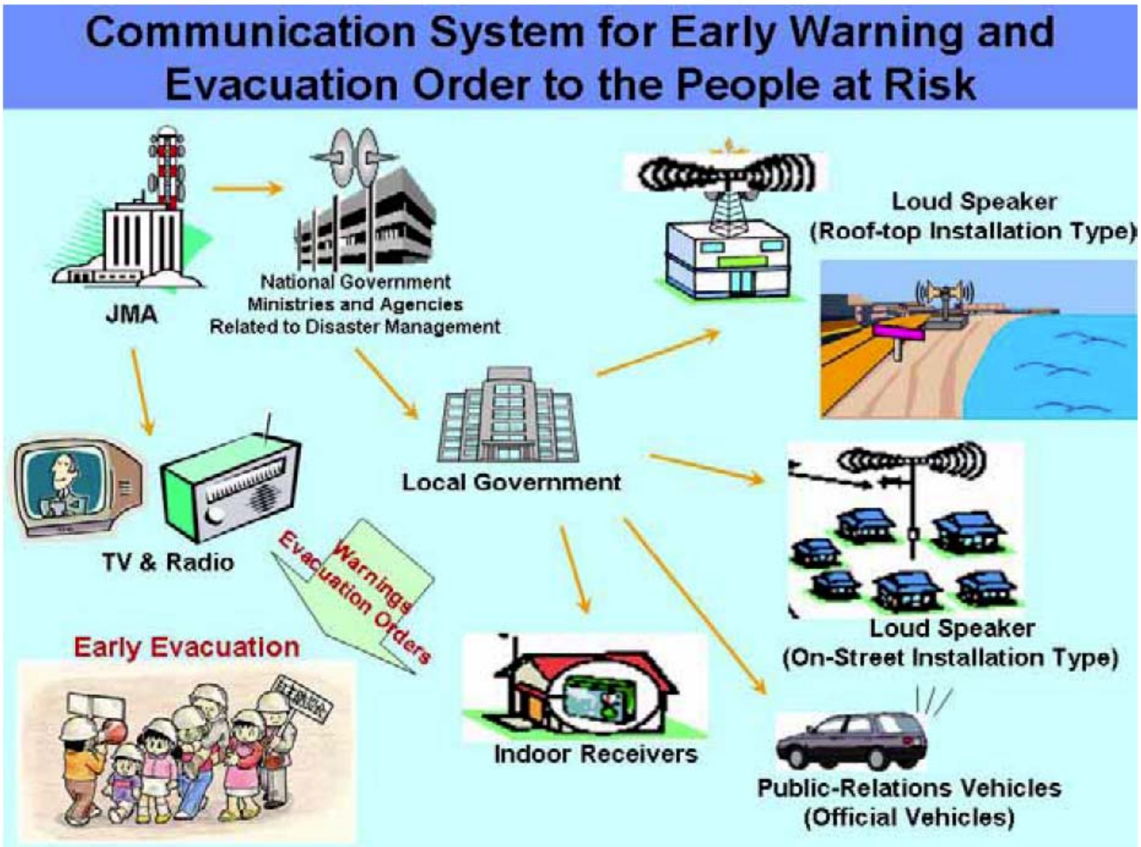
Examples of Response to an Earthquake Early Warning



The JMA has therefore built an online system that links relevant ministries and agencies, local government bodies, and media organizations.

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 (70% of municipalities have developed such systems as of March 2005). Tsunami and severe weather warnings are also conveyed by the JMA to media organizations, and are promptly distributed to the general public via TV and radio broadcasts.

An earthquake early warning (EEW) announces the estimated arrival time of the S-wave of the earthquake and seismic intensity in each region. 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).



Conclusion

Extensive damage by a large earthquake is still inevitable, and a lot of lives will be saved if the earthquake is foreseen a day or even one hour before. This is why earthquake prediction is always ranked at the top of urgent problems in all of the world. However, till the world hasn't succeeded in predicting the earthquakes.

Plate tectonics theory which brought the earth sciences a revolution in the latter half of the twentieth century clarified that Earth has an approximately 100 km thick rigid surface layer which is divided into about 10 plates that are moving with such speeds. The earthquakes of the world occur chiefly in the boundary zones of the plates. About 10% of the earthquakes of the world occur in the Japanese area because of the Pacific Plate and the Philippine Sea Plate surge to Japan and subduct under the Japanese Islands.

Many scientists doubt that reliable and accurate earthquake predictions are even possible. It is important the short-term prediction which requires catching short-term precursory phenomena. The problem are both in Japan and in Armenia, that the seismic observation is not enough for this purpose because seismographs in principle provide only information on the earthquake that has already occurred. It is therefore necessary and important:

1. To adopt a new strategy of encouraging observations of anomalous changes in non-seismic phenomena, including not only crustal deformation but also underground water, gaseous release such as radon and carbon dioxide, and terrestrial magnetism and earth currents etc.
2. To increase amounts of data, new theories, and powerful computer programs, and scientists are using those to explore ways that earthquakes might be predicted in the future.

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:

1. 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
2. Incorporate systems for sharing warning information among relevant organizations and disseminating it to residents.
3. 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:

1. **Information Sharing Among Relevant Organizations**
   The development of a quick and accurate communications system is essential to the effective use of early warning information.
2. **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.
3. **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.
4. **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.

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 such as Daichi, 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. The first step in this process is the Sentinel Asia Project

References

- Disaster Management in Japan, March 2015
- Japan's Natural Disaster Early Warning System and international Efforts March 2006
- http://www.adrc.asia/
- http://mtaes.am/en/
- http://www.spyur.am/en/armenia
- http://www.gov.am/en/structure/
- http://www.jma-net.go.jp/shimonoseki/ws/ws.htm
- http://www.jma.go.jp/en/quake/
- http://www.jma.go.jp/jma/en/Activities/earthquake.html
- http://www.jma.go.jp/jma/en/Activities/eew.html
- http://www.jma.go.jp/jma/en/Activities/telecommunications.html
- http://www.jma.go.jp/jma/en/Activities/pws.html
- http://www.jma.go.jp/jma/en/Activities/intcorp.html
- http://www.jma.go.jp/jma/en/Activities/eew2.html
- http://www.kyoshin.bosai.go.jp/kyoshin/docs/overview_kyoshin_index_en.html
- http://www.seis.bosai.go.jp/seis-portal/
- http://www.data.jma.go.jp/svd/eqev/data/bulletin/catalog/appendix/appendix_e.html