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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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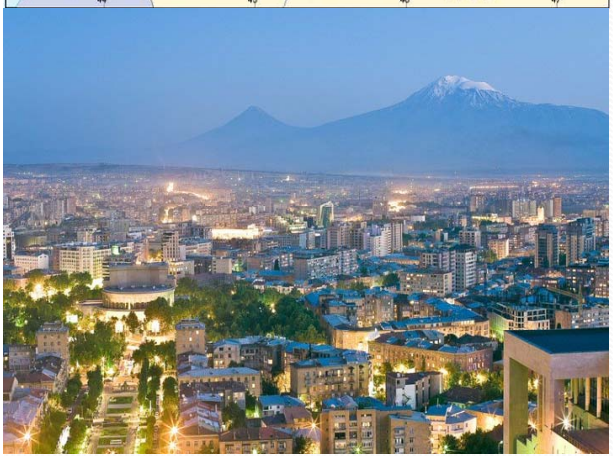


# General information Republic of Armenia

| | |
|---|---|
| Head of the State | President |
| Official language | Armenian |
| Capital | Yerevan |
| Administrative and territorial unit | Marz (11 Marzes in all including Yerevan) |
| National currency | Dram (international currency code - AMD) |
| Territory | 29.74 thousand square km |
| Neighbouring countries | north- Georgia<br>south- Iran<br>east- Azerbaijan<br>west- Turkey |
| Average elevation above sea level | 1800 m |
| The highest peak | Aragats mountain - 4090 m |
| The lowest altitude | Debed river canyon - 380 m |
| Population | 3,018,000 |
| Average temperature | in January - -6.8 ° C, in July - +20.8 ° C |
| Time zone | Greenwich mean time + 4 hours |


# General information Japan

| | |
|---|---|
| Official Name | Japan (Japanese: 日本 Nihon or Nippon; formally 日本国 Nippon-koku or Nihon-koku, literally the State of Japan) |
| Capital | Tokyo |
| Geographic coordinates: | 36 00 N, 138 00 E |
| Map references: | Asia |
| Area: | total: 377,835 sq km<br>land: 374,744 sq km<br>water: 3,091 sq 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<br>highest point: Mount Fuji 3,776 m |
| Natural resources: | Negligible mineral resources, fish |
| Environment - current issues: | Japan is one of the largest consumers of fish and tropical timber, contributing to the depletion of these resources in Asia and elsewhere |
| Population: | 127,220,000 |
| Geography | strategic location in northeast Asia |
| Time zone: | Greenwich mean time + 9 hours |

# DISASTER MANAGEMENT POLICY IN ARMENIA

**Natural Hazards in Armenia**

| | |
|---|---|
| **Earthquakes** | **94%** |
| **Mudslides<br>Landslides<br>rockfalls<br>Floods<br>Irradiation** | **6%** |

**Spitak Earthquake 1988**

**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)

25 000 victims
250 000 people were injured
12 500 people were hospitalized
514 000 homeless

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

| 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) | Hydrometeorology 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 | Southern Survey For Seismic Protection | Western Survey For Seismic Protection | Eastern Survey For Seismic Protection |


**Armenian NSSP was founded in 1991. The main objectives and the aims 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.

# Laws and regulations

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

| | |
|---|---|
| **Law of RA** | **The Law of the Republic of Armenia on Seismic Protection (2002)** |
| **Resolutions of Government** | **The Complex Program of Seismic Risk Reduction in the RA Territory (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)** |

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

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 11 regional (marz) level.

**Crisis Management Center in Yerevan**

## Crisis Management Centers in Marzes

## Disaster Education and Human Resource Development in Armenia

**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.

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.

## Disaster education at kindergartens and schools

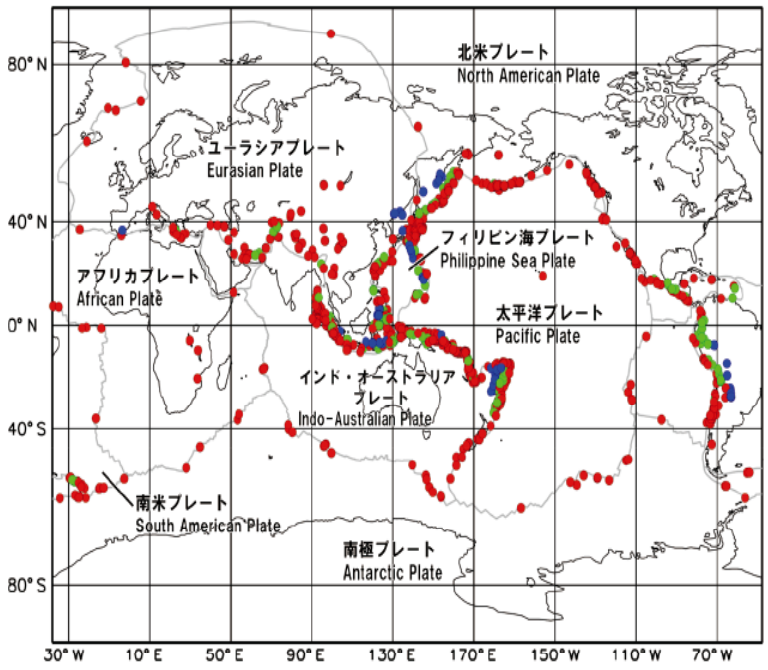



## Disaster education at companies and municipalities



# DISASTER MANAGEMENT POLICY IN JAPAN

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



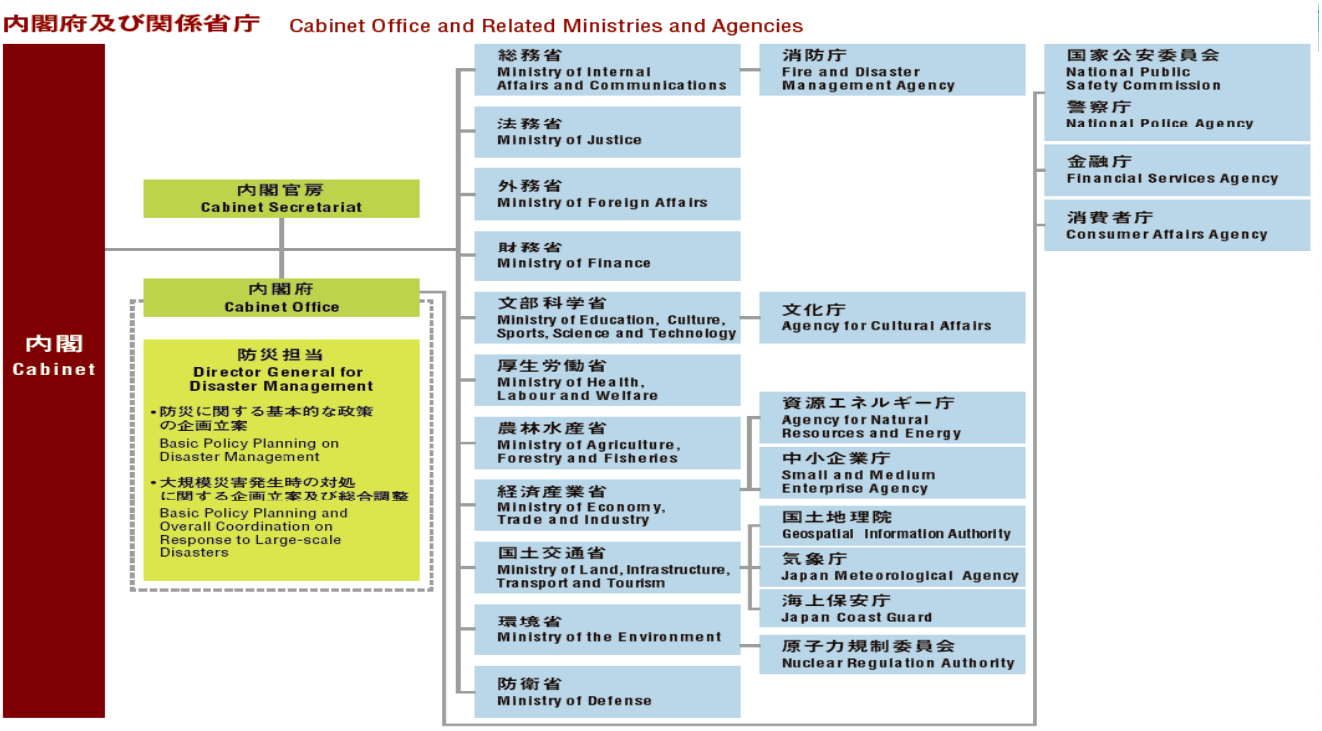

凡例 Legend
(2004 ~ 2013 年、マグニチュード 5.0 以上)
(2004 ~ 2013, Magnitude ≧ 5.0)

深さ Depth
- : 0 ~ 60km
- : 60 ~ 300km
- : 300 ~ 700km
- : プレート境界 Plate Boundaries

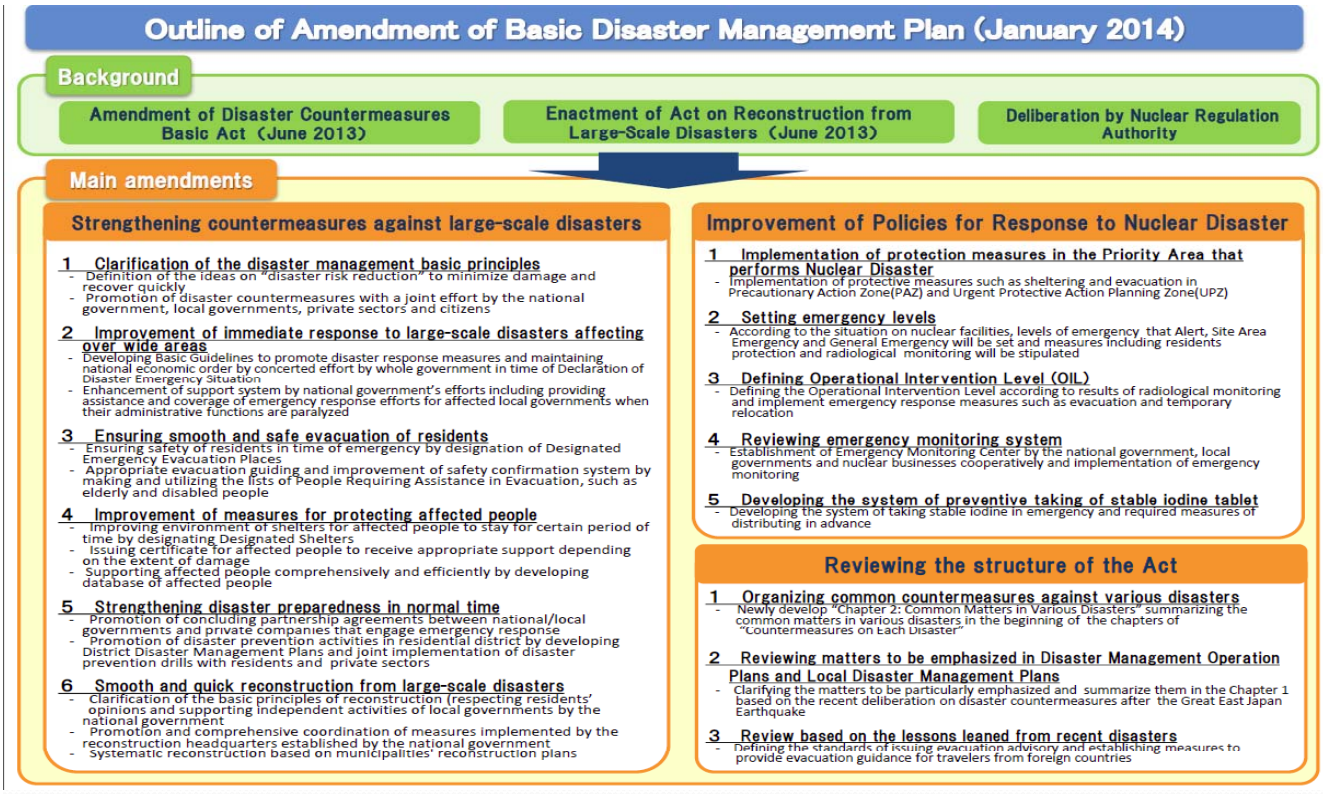
出典 : 防災白書 Source: White Paper on Disaster Management
注 :2004 年から 2013 年に発生したマグニチュード 5.0 以上の地震の震源を分析
Note: Analysis of magnitude 5.0 and greater earthquakes' epicenters from 2004 to 2013.

## 世界の災害に占める日本の災害の割合
## The Ratio of Natural Disasters in Japan to Those in the World

マグニチュード6.0以上の
地震回数 (2004年~2013年)
Number of earthquakes with magnitude of 6.0 or greater (2004-2013)




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.




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 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).

# Disaster Education and Human Resource Development in Japan

## Disaster Reduction Drills and Exercises

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,,.

### Disaster education at schools

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。

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 .

## Disaster education and trainings by University students

## 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**
- **Human Resources Development**
- **Building Communities Capabilities**

### Visiting Researcher ADRC 2015

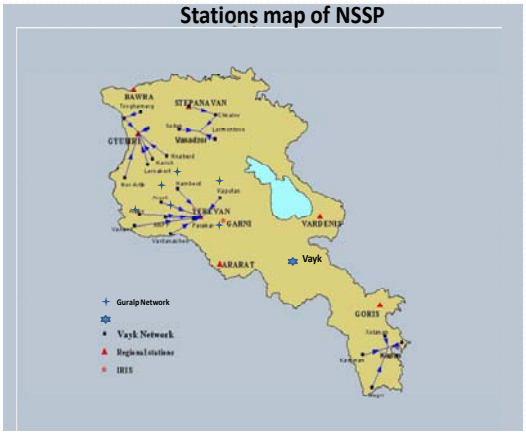
# Seismic monitoring, seismic hazard assesment and disaster information acquisition processing and analysis, providing to officials, decision makers and public in Armenia

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.

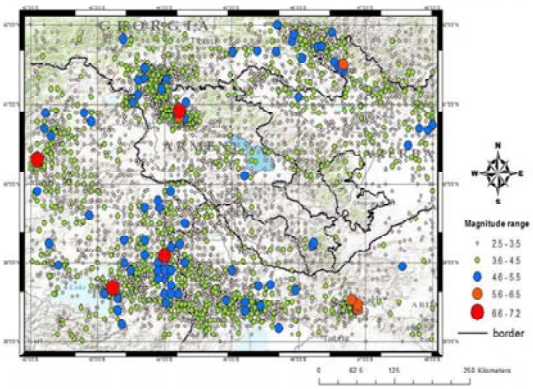
We base some of our researches on the fact that the preparation of earthquakes with various magnitudes is accompanied by the appearance of precursors in various physical fields. We deal with medium-tem, short term and operative probably- seismogenic anomalies as well as co-seismic and post-seismic effects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

There are four types of seismic network in Armenia:
- Guralp Network
- Vayk Network
- Regional Network
- Global Seismograph Network Station (IRIS)

**Stations map of NSSP**




**Map of the epicenters of earthquakes with magnitude M≥2.5 for time period 1962-2015**



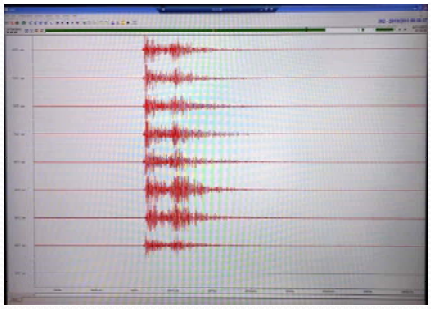

**GURALP STATION**

**VAYK STATION**

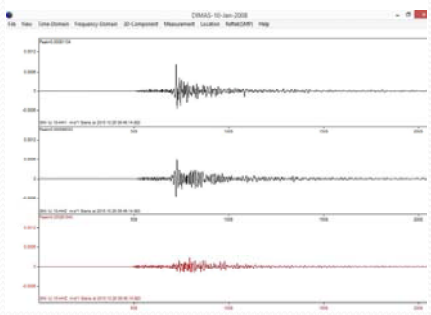
**NEW BUILDING OF NSSP IRIS STATION**

**Seismic record of Guralp station**

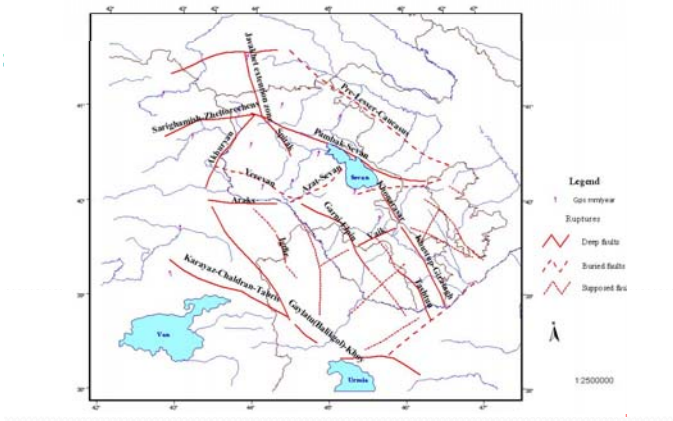
**Seismic record of Vayk station**

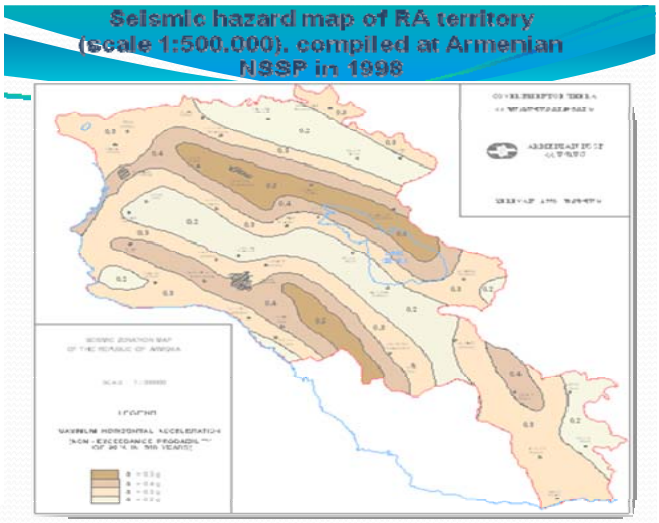


**Seismic record of IRIS station**



## MAP OF FAULTS



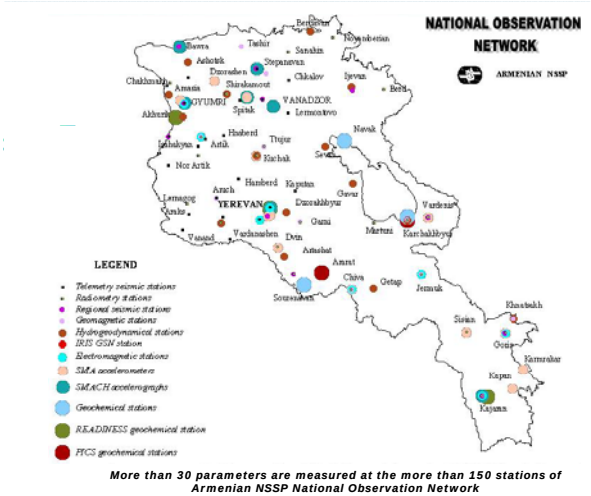

**Current seismic hazard assessment includes:**
Definition of probabilities of current anomalies seismic realization based on testing of strong regional earthquakes (M≥6.0) and local notable earthquakes (M≥3.7) and monitoring time period.

History analysis using “SeisHelp” (Monitored the time series, the anomalies are selected visually).

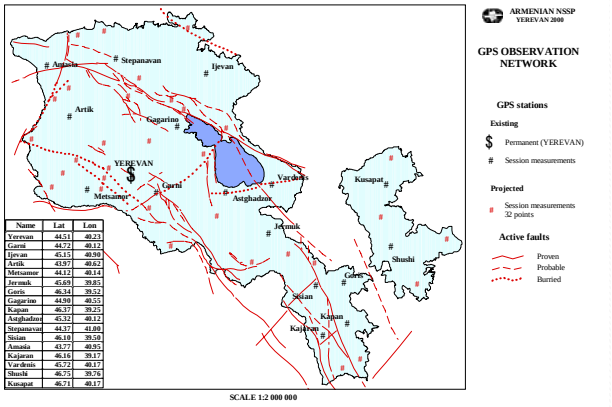
For seismogene anomalies using “Dynamic Fields”, probability evaluation of the site, time and magnitude of expected earthquake using “Expert” programs.

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.




*More than 30 parameters are measured at the more than 150 stations of Armenian NSSP National Observation Network*




SCALE 1:2 000 000

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.

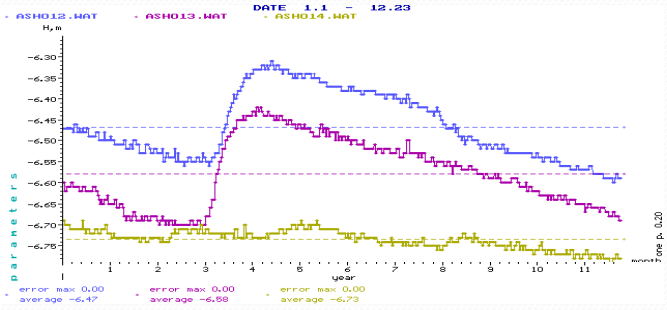
## Anomalous concentration as an earthquake-precursor

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

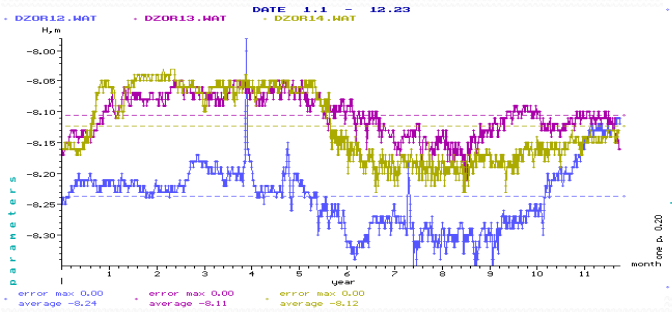
Based on the retrospective analysis of practically all seismic events which had occurred 1983-2015 in Armenia and adjacent territories are systematically tested and based the Catalogue of precursory anomalies. It was supplemented few times, and the anomalies included were critically over estimated and 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.

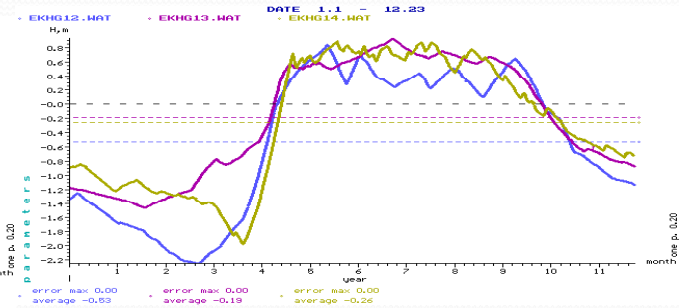
The examples, in particular, the imposing of precursory anomalies of different order, as well as the presence of pre-, co-, post-seismic periods in observed.

**Examples of analyzing the data as anomalous of some stations**

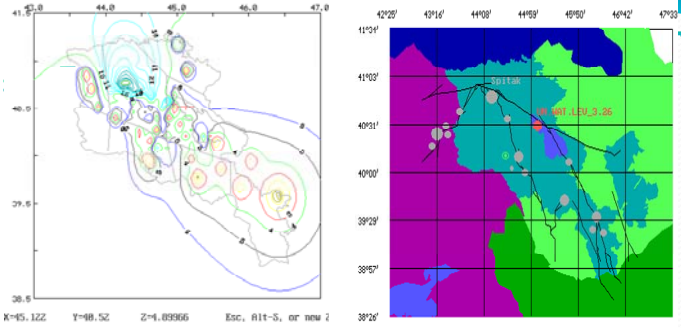



Udergraound water level changes
Ashotcq (1), Zoraxbyur (2) , Eghegnazor (3) hydrogeodynamical stations




**Seismic hazard assessment using software EXPERT for hydrodynamic parameters**



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

## 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.

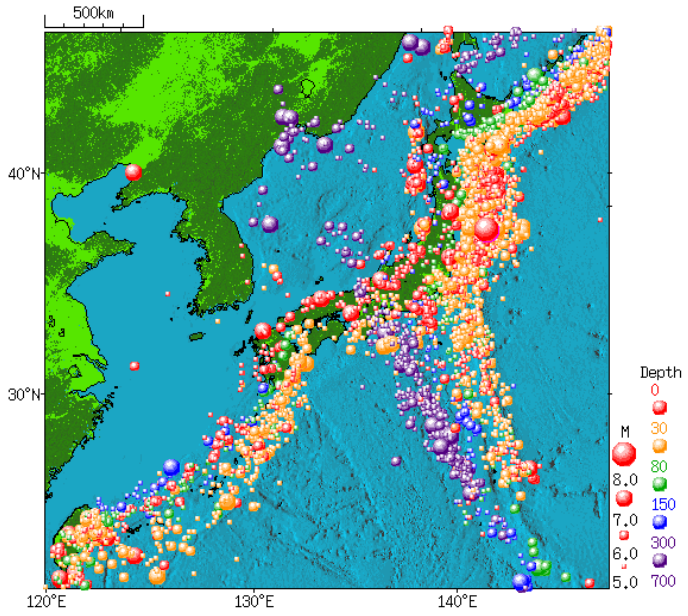
Using software Expert implemented every day current seismic hazard assessment.

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

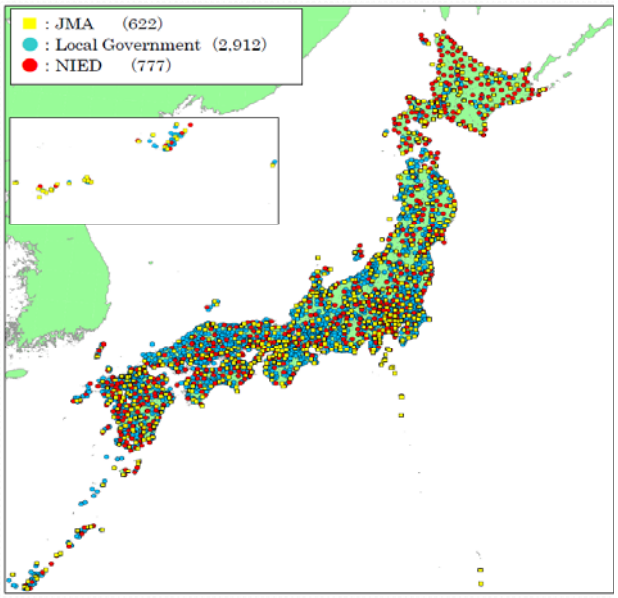
# Seismic monitoring, seismic hazard assesment and disaster information acquisition processing and analysis, providing to officials, decision makers and public (Early Warning System) in Japan

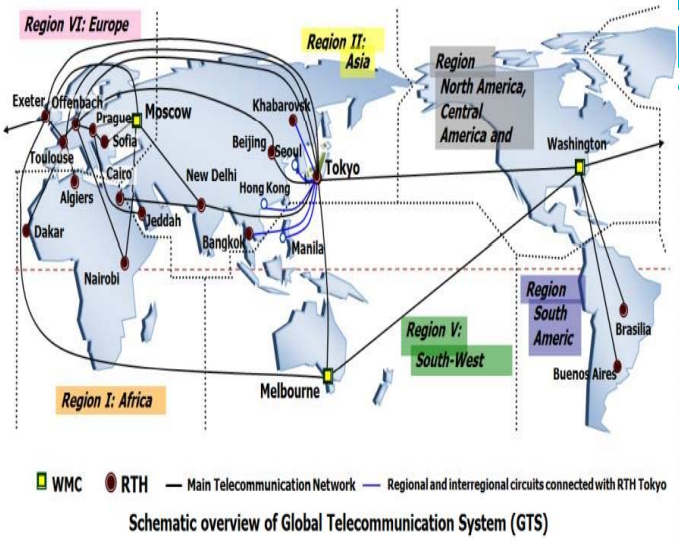
To monitor earthquakes, JMA operates an earthquake observation network comprised of about 200 seismographs and 600 seismic intensity meters. It also collects data from over 3,600 seismic intensity meters managed by local governments and the National Research Institute for Earth Science and Disaster Prevention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

**Earthquake distribution around Japan (1960-2014)**



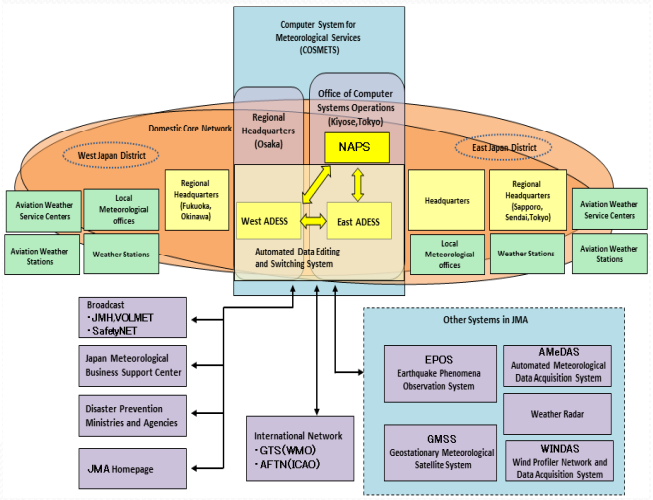

**Sites of seismic intensity meters**



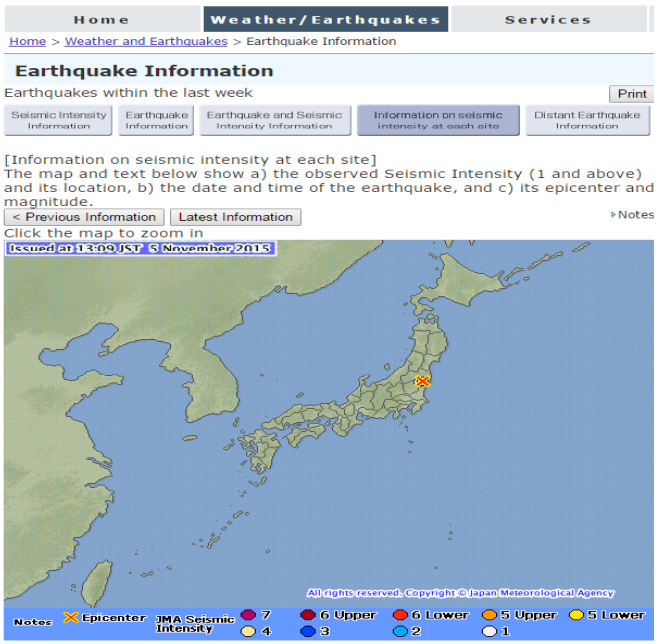

Schematic overview of Global Telecommunication System (GTS)

## COSMETS and related systems




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.

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.




Earthquake Information (Information on seismic intensity at each site)
Issued at 13:09 JST 05 Nov 2015

| Occurred at (JST) | Latitude (degree) | Longitude (degree) | Depth | Magnitude | Region Name |
|---|---|---|---|---|---|
| 13:06 JST 05 Nov 2015 | 37.1N | 140.6E | 10 km | 2.9 | Fukushima-ken Nakadori |

Seismic Intensity at each station
(* mark: Local Governments' or NIED's station)

| Prefecture | JMA Seismic Intensity | Station Name |
|---|---|---|
| Fukushima | 1 | Tanagura-machi Tanagura-nakaino |
| | | Furudono-machi Matsukawa-yokokawa |
| | | Furudono-machi Matsukawa-shinkuwabara* |

This earthquake poses no tsunami risk.

"-" in the above information represents an indeterminable value.

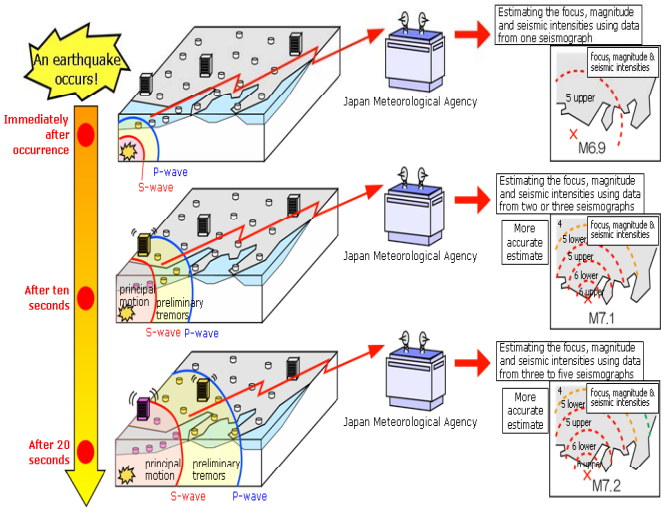
Some of the names of cities/towns/villages in the message are the versions used before the areas were administratively united.

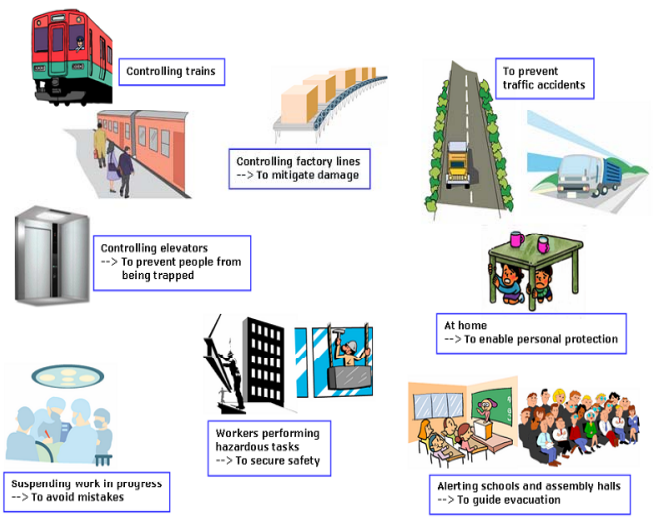
Guide to the Earthquake Information

top of this page

**Earthquake information by Japan Meteorological Agency**

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.



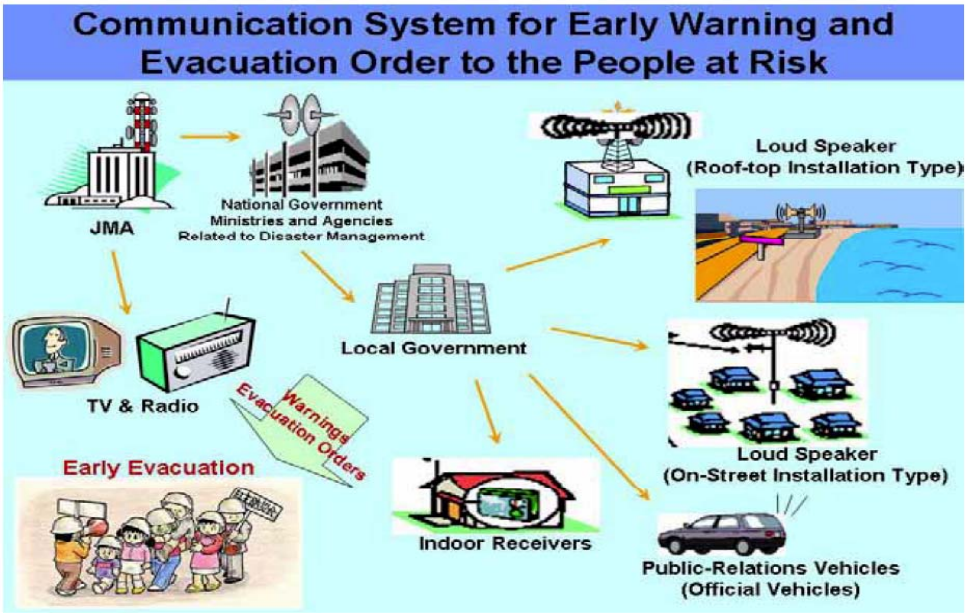

**The Earthquake Early Warning system provides advance announcement of the estimated seismic intensities and expected arrival time of principal motion**

**Examples of Response to an Earthquake Early Warning**

The 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.




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 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.

**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.

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