

The 'Beijing Understanding' 北京共识

Earthquakes, Tsunamis and Volcanoes in East Asia: International Collaboration and Regional Capacity Building for the Forecast, Preparedness, and Early Warning

Introduction

Proposed by H. E. Mr. Wen Jiabao, Premier of the People's Republic of China, during the 2011 Trilateral Summit, and endorsed by Japanese and Korean national leaders, the '**Seminar on East-Asia Earthquake Studies – Earthquakes, Tsunamis and Volcanoes in East Asia: International Collaboration and Regional Capacity Building for the Forecast, Preparedness and Early Warning**' was held in Beijing from October 19 to 21, 2011, organized jointly by CEA, JMA, and KMA. There are about 100 scientists and policy-makers from 18 countries attending this Seminar.

This report, formed by the discussion before, during, and after the Seminar, and reviewed and revised by the CEA, JMA, and KMA, respectively, is to be submitted to the 2012 Tri-Parties Meeting of CEA, JMA, and KMA, while open to international scientific communities and the public for comments and suggestions.

Great Earthquakes and Disasters: Lessons, Experiences, and Scientific Insights 共识之一：地震 1/3

Many Presentations (from China, Korea, Myanmar, Mongolia, Malaysia, Iran, Bangladesh and Russia) show that Asia is a great earthquake prone and high seismic risk region. Lessons and experiences from 2008 Wenchuan earthquake (M8.0), 2011 Tohoku earthquake (Mw9.0) also address the importance of earthquake disaster mitigation. Region Cooperation leading by China, Japan and Korea is needed.

Cooperation on short-term and long-term seismic hazard assessment is very important especially in the following aspects:

1. Regional database building (including research historical events more and re-evaluate Mw of historical events);
2. Data sharing and opening;
3. Tectonic survey and deep structure prospecting crossing political borders (including fault, deformation measured by GPS);
4. Enhance monitoring in ocean and mountain regions;
5. Research on methodology for seismicity modeling, seismic hazard assessment, and testing;
6. Case study for great earthquakes;
7. Application of the results of seismic hazard to engineering and decision-making for reducing earthquake disasters;
8. Training of young scientists.

The performance of EEW in the 2011 off the Pacific coast of Tohoku Earthquake(Mw9.0) shows current earthquake monitoring system can play important role in earthquake disaster mitigation and EEW is useful for disaster mitigation.

International cooperation on the capacity building of earthquake monitoring for public service is needed for:

1. Earthquake Early Warning System
2. Shaking map
3. Maps of the result of the rapid evaluation of the distribution of disasters
4. Warning of tsunamis and other secondary disasters

Tsunami Warning: Implementation and International Cooperation 共识之二：海啸 1/2

Tsunami is an event of small probability, but a kind of disaster hazard. Since tsunami usually follows earthquake, the tsunami generated areas could be closely to seismic zones around the coast of East-Asia. Most countries in this region had been affected, including China, India, Japan, Korea, Malaysia, Myanmar, Pakistan, Philippines and Thailand.

There were several fatal tsunamis in this region in recent years. The 2011 off the Pacific Coast of Tohoku Earthquake generated powerful tsunami waves which reached height of up to 40.5 meters. The 2004 Indian Ocean earthquake generated the tsunamis, which affected the coasts of most landmasses bordering the Indian Ocean. Both tsunamis caused huge disasters to human beings.

Those events have given the warnings for tsunami disaster mitigation. All the countries have expressed the high priority to tsunami counter measures.

The early warning system is an effective way to mitigate the disasters. A regional collaboration is urgently needed that covers all the affected countries. Investigation into past tsunamis through both historical record analysis and geological research is very useful to identify the potential tsunami sources.

Methodologies for tsunami hazard analysis and for building regional capacity can be suggested by all the concerned countries.

There is a need for engineering guidance in designing and building structures against tsunami waves as well as earthquake shaking.

Volcano Monitoring 共识之三：火山 1/2

current situation and recent development

There are many (over 300) active volcanoes in east Asia, disasters caused by eruptions of volcanoes bring more severe damage to society than many other natural hazards.

Accurate predictions of eruptions and potential hazards of volcanoes are very difficult, since they often have long and irregular recurrence intervals, and eruption types may change from time to time.

Volcano monitoring and volcanic warning system play the vital role in volcanic disaster mitigation.

Currently, only part of active volcanoes are under monitoring network, and

some large volcanoes with great potential eruption risk have been dormant for several hundreds years.

Comparative study on mechanism of volcanic eruption at volcanoes in east Asia region, such as Tianchi volcano (Baegdusan), Fuji volcano, Pinatubo volcano, Merapi volcano, and etc., will greatly help volcanologists for understanding of volcanism and potential hazard.

Promoting regional volcano monitoring data exchanging and sharing will enhance our understanding of eruption risk evaluation.

Development of volcano monitoring techniques as following for warning system is in great urgent:

1. Seismic observation
2. Continuous ground deformation observation by tiltmeters, GPS (real-time GNSS observation system), and Electronic Distance Measurement (EDM)
3. Gas analysis and acoustic observation as precursor of eruption
4. Remote sensing monitoring by infrared and INSAR
5. Electro-resistivity measurement
6. Comprehensive bore-hole observation (seismometer and etc.)

Development of Monitoring Systems

共识之四：监测系统1/3

Seismic monitoring systems have been experiencing rapid development in recent years. Many countries have built high quality digital seismograph stations.

With the development of seismology and information technology, the technology for seismic observation, such as the construction of digital seismic stations, automatic earthquake location and magnitude determination, data management and service, among others, have made significant progresses in many countries. It is important for Asian countries to enhance the cooperation in these fields.

Seismic observation data is the basis for Earth science research, preparedness and mitigation of earthquake disasters, and earthquake emergency response. Data quality control plays an essential role in seismic monitoring.

Although the data policies are different in different countries, it is necessary to promote the international exchange of earthquake data, and especially data products at different levels. It is suggested to build the Virtual East-Asia Seismological Network (VEASN) located on anyplace.

It appears that it is very important for scientists working in the field of seismic hazard and risk assessment to have an easy and uninterrupted access for international scientific community to majority of seismic recordings of all seismic events of the past. This would greatly assist our preparedness for future large and damaging earthquakes.

Recent Development of Science and Technology and Impacts on the Preparedness and Mitigation of Natural Disasters

共识之五：科技进步

What the 2008 devastating Wenchuan $M_s8.0$ earthquake in China and the big 2011 Tohoku $M_w9.0$ earthquake in east Japan, also including 2004 Sumatra-Andaman earthquake, indicates the urgent needs for the capacity building in reducing natural disasters. Earthquake, Tsunami and Volcano are commonly concerned in Asia.

Recent great earthquakes and Tsunami, including Wenchuan $M_s8.0$, Tohoku $M_w9.0$ and $M_w9.2$ Sumatra-Adaman earthquake, challenged the traditional concepts, methods, and results in earthquake science. However this challenge also provides the opportunity for scientific innovation.

Every step towards the development of science and technology of the forecast, preparedness, and early warning of earthquakes, tsunamis, and volcanoes can definitely contribute to the regional capacity building for the management and reduction of disasters.

Recent advances in science and technology have provided new opportunities for the new developments and breakthroughs in the forecast, preparedness, and early warning of earthquakes, tsunamis, and volcanoes, which helps to understand the preparation and occurrence of large earthquakes. These new developments include but not limit, active source monitoring, multi-scale physics of earthquakes, Ocean Bottom measurements, the broadband seismography observation and data analysis, GPS, time-lapse geophysics, combination of geodesy, seismology and geology.

Reduction of natural disasters needs the multi-national multi-disciplinary endeavor to understand the complex Earth system. It is time to speed up the international cooperation in study of earthquakes, tsunamis, and volcanoes to promote and solve scientific problem in field of forecast, preparedness, and early warning.

Participants suggest to set up appropriate international cooperation mechanism in East Asia, either official or civilian, to promote regional study of earthquakes, tsunamis, and volcanoes.

Large Earthquakes, tsunamis and volcanic eruptions are infrequent but strong impact to our society, which is over the boundaries of countries. So it is important to set up close collaboration among countries in Asia to conduct researches for disaster mitigation .

Science and technology for the public service of disaster mitigation include a series of innovation and application activities, from basic science research to development research, further to applied research and applications, with different technical readiness levels (TRLs). A regionalized mechanism is encouraged to systematically evaluate and enhance the TRLs of scientific products at different stages, so that the transition from pure science to public service could be facilitated well.

Attracting young generation scientists to the related research activities is the key for future development.

Science is a social activity based on the practices of theoretical formulation, numerical simulation, laboratory and field experiments, observation and

interpretation. Simple implementation of existing scientific knowledge does not necessarily work for the sustainable development. It is specially important for developing countries, although different countries have different levels of science capability. It is important for all countries to give more support to the basic science research activities.

Communicating with the Public

Public awareness education 共识之六：公众沟通 1/4

Knowledge management and packaging of information is critical for creating desired impact on the individual and community behavior based on disaster information shared.

Popularization of knowledge for earthquake prevention and disaster reduction includes education concerning earthquake phenomenon, earthquake generation and potential disaster. It also includes the current situation of earthquake forecast exploration and practice, fortification against earthquake for structure and building, emergency relief and rescue, interception of earthquake rumor, spreading knowledge regarding emergency evacuation and response for earthquake occurrence and self-rescue and mutual-rescue after destructive earthquakes.

An early warning system could be of little use if it were not able to get the community alert in the event of an upcoming disaster situation. Packaging of disaster information in various modes of communication such as personalized devices (such as mobile, telephone, email, etc.), mass media (radio, television, internet) and community media (loudspeaker, hooter, alarm, etc.) is necessary to ensure that desired objectives be met.

Lessons learnt from previous actions on the emergency response are crucial for making disaster emergency preparedness in the future. Sharing the information from the lessons of global disaster response could be improved by accumulating the experiences of the previous earthquake cases.

In this regard, an international cooperation project is suggested to establish a global case study sharing database of past earthquakes, tsunamis, volcanoes response experience, and their own manuals as well as common earthquake homepage among all countries, alerting sign-board for tourists as well as advertising brochure with various languages.