APRU-IRIDeS Multi-Hazards Program : 2013 Summer School

TOHOKU
UNIVERSITY

Report of the
APRU-IRIDeS Multi-Hazards Program
2013 Summer School

IRIDeS
International Research Institute of Disaster Science
災害科学国際研究所

APRU
Association of Pacific Rim Universities

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Report of the APRU-IRIDeS Multi-Hazards Program
2013 Summer School

23-25 July 2013

Tohoku University

Sendai, Japan

IRIDeS, Tohoku University
International and Regional Cooperation Office
6-6-40-102 Aoba, Aramaki, Aoba-ku, Sendai
980-8579 Japan
www. irides.tohoku.ac.jp/

The APRU Secretariat
NUS Shaw Foundation Alumni House, 2F
11 Kent Ridge Drive, Singapore 119244
www.apru.org

Edited by
Takako Izumi (International and Regional Cooperation Office, IRIDeS, Tohoku University)
Yuko Sato (International and Regional Cooperation Office, IRIDeS, Tohoku University)
Jeremy Piggot (Program Director for Research & Enterprise Partnership, the APRU secretariat, Singapore)

CONTENTS

APRU-IRIDeS
Multi-Hazards Program
"Lessons-Learnt from the Great East Japan Earthquake and Tsunami, and Future Disaster Risk Reduction"
23-25 July 2013

Background

The Association of Pacific Rim Universities (APRU) is a network of 42 premier research universities from 16 economies around the Pacific Rim. The Pacific Rim is the most dynamic and diverse region in the world. The world's three largest economies are located on the Rim along with a rich diversity of developing and developed nations from North America, Latin America, East and Southeast Asia, Russia, and Australasia. Responding to the increased economic integration of the region and the formation of APEC, APRU was established in 1997 by the presidents of Caltech, Berkeley, UCLA and the University of Southern California. APRU members together have around two million students, 120,000 faculty members and research capabilities related to the key challenges facing the region. APRU seeks to advance the aspirations of its members and contribute to global society by: 1. Shaping Asia-Pacific Higher Education and Research; 2. Creating Asia-Pacific Global Leaders; and 3. Partnering on Solutions to Asia-Pacific Challenges.

Having experienced the catastrophic disaster in 2011, Tohoku University established the International Research Institute of Disaster Science (IRIDeS) in April 2012. Together with collaborating organizations from many countries and with broad areas of specializations, based on the lesson from the 2011 Great East Japan Earthquake and Tsunami, IRIDeS aims to become a world center for the study of the disasters and disaster mitigation, leaning from and building upon past lessons in disaster management from Japan and around the world. In addition, IRIDeS intends to contribute to on-going recovery/reconstruction efforts in the affected areas, conducting action-oriented research, and pursuing effective disaster management to build sustainable and resilient societies.

IRIDeS together with the APRU launched the APRU-IRIDeS Multi-Hazards Program in April 2013 to mark the second anniversary of the Great East Japan Earthquake and Tsunami. The Program builds upon the strengths of eight APRU Multi-hazards symposia over the past decade in countries spanning the *Pacific Ring of Fire*. IRIDeS now provides secretariat services as the regional program hub harnessing the collective capabilities of APRU universities for cutting-edge research on disaster risk reduction (DRR) and recovery, shares strategies to cope with campus disaster risk management, and contributes to international policy making processes on DRR. In particular, the Program focuses on strategies to deal with low-frequency high-impact disasters and the role of universities in disaster management.

The key activities of the Multi-Hazards Program include:

- Organization of the annual summer school
- Survey the disaster preparedness of APRU universities, and promote 'best practices'
- Organization of the annual APRU Multi-Hazards Symposium
- Foster collaboration in disaster research and information/data sharing between APRU universities

- Contribute to international events on disaster risk reduction, such as the 2015 UN World Conference on Disaster Risk Reduction in Sendai, Japan

The 2013 summer school was organized on 23-25 July 2013 at Tohoku University as the first major activity under the Multi-Hazards Program. The summer school was attended by 31 participants from 9 countries, and it consisted of 17 students, 13 faculty members and 1 APRU secretariat staff. The agenda of the summer school and the participant list are attached in the ANNEX.

Prof. Susumu Satomi, President of Tohoku University and Dr Chris Tremewan, Secretary General, APRU at 8th APRU Multi-Hazards Symposium in Tohoku University

8th APRU Multi-Hazards Symposium in Tohoku University in September 2012

OPENING REMARKS

Prof. Susumu Satomi

President of Tohoku University

It is an honor for me to welcome you to Tohoku University for “APRU-IRIDeS Multi-Hazards Summer School Program”. I am pleased to meet all of you who gathered from various countries for this event.

The Tohoku region including Sendai City was severely struck by the Great East Japan Earthquake and Tsunami on March 11, 2011. It was the largest disaster event recorded in the Japanese history. All the Japanese citizens were devastated by the scale of the damages. Tohoku University aims to work for and with the communities and local governments in the reconstruction process. As one of the major universities in the affected areas, I believe that Tohoku University has an important role to play to contribute to the process. One of the objectives of this summer school is to share our experiences from the disaster. I hope these lectures will give you an idea on future disaster risk reduction.

The establishment of the International Research Institute of Disaster Science (IRIDeS) under Tohoku University is one of our commitments to share our knowledge and experiences globally. IRIDeS focuses on overcoming a low frequency great disaster and on putting our research results into practice. IRIDeS also launched the Multi-Hazards Program together with APRU in April this year. IRIDeS became the program hub and provides the secretariat service. This summer school is the first major event under the Multi-Hazards Program.

We are living in a disaster prone region. Due to urbanization, climate change, environmental and development issues, the disaster risks are getting increased. We have to tackle these issues in collaboration with various stakeholders. We must remember that universities and research institutes have a critical role to play in disaster risk reduction. As scientists, historians, economists, medical doctors, we all have different strengths to contribute to reduce disaster risks. I would like to emphasize that disaster risk reduction is not only the issue of science and technology. It also needs the aspects of history, environment, and social science. We believe that an innovative approach will be developed through such a collaborative environment.

As universities, we are also encouraged to strengthen the disaster preparedness capacity on campus. We have a responsibility to protect the lives of students and staff from next disasters. It will be a great contribution from all of you if you could share the ideas on this matter during the summer school.

I hope this program gives you an opportunity to exchange views and experiences among the participants. Especially for the students, this will be also a great opportunity to meet experts in disaster areas.

To conclude, I would like to thank the APRU secretariat for their kind support and cooperation. I wish you every success for this summer school program. Thank you.

Dr. Christopher Tremewan

Secretary General of APRU

Welcome to you all on behalf of APRU. It is a pleasure and privilege to welcome a diverse, talented and experienced group of participants from APRU universities and other partner institutions to this Summer School.

Following on from the APRU Multi-Hazard Research Symposium hosted here last year, this is the next major event in APRU's partnership with the International Research Institute of Disaster Science (IRIDeS) in Tohoku University.

We are very proud to be a member of that partnership. As you know, the Asia-Pacific region shares the Pacific Ring of Fire and has recently suffered from a series of disasters. These experiences have impelled us to consider more deeply the role of major research universities in responding to the needs of our societies under threat of natural hazards.

Through this Summer School, we are about to bring education and research arising from these experiences together in ways to benefit not only Japan but also the region. We look forward also to hearing your suggestions as to the most effective ways to do this in the future.

The region, of course, shares not only the uncertainties and risks of the Ring of Fire but also the challenges of a complex system effects from climate change, increasing extreme events, demographic shifts, rapid urbanization, fresh water supply, economic inequality and many other factors. Responding to uncertainties requires timely and well-focused research collaboration informed by local knowledge and global science. International cooperation has become more important as these challenges cross all national boundaries. It is crucial that we get to know each other and build long-lasting relationships of trust.

In APRU we are speaking about creating Knowledge Action Networks. This means we see that our task is to relate leading research to policy development and to local knowledge and needs by bringing researchers together with policy makers and community leaders.

APRU is a network of 42 research universities around the Pacific Rim, and adding up the capability of all these institutions, we are working with around 120,000 academics and two million students. We aim to mobilise this constituency around our strategic priority of 'Partnering on Solutions to Asia-Pacific Challenges'. This partnership with Tohoku University is one of the key activities under this priority.

On the final day of this event we are going on a field trip to see some of the physical effects and hear the human stories from the affected areas in the Tohoku region. This kind of experience always makes us realize that we deal with these issues not only from a scientific aspect but also in their human dimension. This also attests to the wisdom of this university including the social sciences as well as the physical sciences within IRIDeS.

Finally, I wish to express again my gratitude to President Satomi for hosting this event and for his support of the partnership with APRU. I also thank the organizing team who has constructed such an interesting program for the next few days. Thank you so much.

Prof. Fumihiko Imamura

Deputy Director, Prof. of Tsunami Engineering, IRIDeS, Tohoku University

It has been a year since the International Research Institute of Disaster Science (IRIDeS) was established in April 2012. It was just one year after the Great East Japan Earthquake and Tsunami occurred in 2011. We have started a new body of research, education and social contribution in Tohoku University. We have many lessons to share with you.

We are very fortunate to initiate the APRU-IRIDeS Multi-Hazards Program with APRU. This summer school is the first major activity under the Program. It is indeed our great pleasure to welcome you to Tohoku University for this summer school. As you know, the Great East Japan Earthquake and Tsunami caused tremendous damages though we in Japan have experienced a number of earthquakes and tsunamis as well as have developed various disaster risk reduction measures. We have never stopped fighting with such natural disasters in our history. Through these experiences, we have developed new technology and sciences to introduce a variety of risk assessment tools and educational materials. However, even these tools and materials are not yet sufficient to stop occurring natural disasters. We need to put more efforts to reduce risks, and it is why we are here to discuss what we should do more in case of natural disasters.

For this summer school programme, we have invited the speakers from Tohoku University as well as others universities. Today, we have 6 lectures. I will speak more about the roles and activities of IRIDeS and introduce our efforts and cooperation with local stakeholders in the recovery and reconstruction process from the 2011 Great East Japan Earthquake and Tsunami. The second speaker is Prof. Managi from the Graduate School of Environmental Studies and he will talk about the economic impact of the 2011 Earthquake and Tsunami. In this afternoon, it starts with Prof. Shuto who has very long experiences in the research on the tsunami in Japan and other countries. Then, it is followed by Prof. Motosaka who will speak about the earthquake engineering and the disaster preparedness experiences in Tohoku University. Also we have invited the city of Sendai who will introduce their activities in the reconstruction process and their commitment towards the 2015 UN World Conference on Disaster Risk Reduction in Sendai. The last lecture for today is Prof. Murao who speaks about the review of the Hyogo Framework for Action adopted in 2005. This is our important framework to mitigate disaster risks and strengthen our disaster risk reduction capacity. Tomorrow, we will have three more lectures, starting with Mr. Suzuki from Tagajo city. This is another affected area by the Disaster in 2011. Prof. Rundle from University of California, Davis, will give a lecture on the web-based approach to earthquakes. The last lecture in this summer school will be provided by Prof. Romero from University of Chile on his experiences and views on the Chile earthquake. I am very proud of a variety of these presentations and I hope you will learn a lot from their knowledge and experiences.

Again, thank you very much for your participation and enjoy the summer program.

PRESENTATIONS

Role of IRIDeS in Tohoku University / Damages due to the 2011 East Japan Earthquake and Tsunami, and the Lessons

Fumihiko Imamura

Deputy Director, Prof. of Tsunami Engineering, IRIDeS, Tohoku University

Having experienced the catastrophic disaster caused by the East Japan earthquake and tsunami in 2011, Tohoku University established the International Research Institute of Disaster Science (IRIDeS). Together with collaborating internal and inter-national organizations/universities from many countries and with broad areas of specializations and countries, the IRIDeS conducts the world-leading research on natural disaster science and disaster reduction/mitigation. One of significant activities of international collaboration is the APRU-IRIDeS Multi-hazards Program started in 2013 with the aims to build upon the strengths of eight APRU Multi-hazards symposia over the past decade in countries spanning the Pacific Ring of Fire and to harness the collective capabilities of APRU universities for cutting-edge research on disaster risk reduction (DRR) and recovery. And the program should share strategies to cope with campus disaster risk management, and contribute to international policy making processes on DRR.

The March 11, 2011 East Japan earthquake tsunami disaster devastated the Pacific coast of northeastern part of Japan. The large number of casualties more than 19,000 and several types of tsunami impact such as inundation in a large area, destructive force, and change of topography due to the erosion and deposition (Fig.1) are reported. The tsunami seems to have triggered nearly every imaginable kind of tsunami damage: destruction of coastal structures, tide/tsunami control forests, houses, buildings, and infrastructure due to flooding; topographical change due to erosion and sedimentation; rubble, offshore aquaculture rafts, and ships sent adrift; flammable materials spilled and on fire; damage to transportation networks such as roads and rail (including rolling stock); and even the impact on facilities such as nuclear and thermal power plants. We have been obtaining results of field surveys as well as analysis by a numerical simulation and satellite image analysis with ground truth data, to obtain the data of the tsunami and its disaster, and identify extent of tsunami inundation and damage, and lessons.

Based on the lessons from the 2011 East Japan earthquake and tsunami disaster (Fig.2), IRIDeS aims to become a world centre for the study of the disasters and disaster mitigation, learning from and building upon past lessons in disaster management from Japan and around the world. The 2011 East Japan Great East Japan earthquake and tsunami disaster, throughout the IRIDeS will contribute on-going recovery/reconstruction efforts in the affected areas, conducting action-oriented research, and pursuing of disaster reduction effective disaster management towards to build sustainable and resilient societies.

Although reconstruction plans have been drawn up for the areas affected by the disaster in 2012, many local issues remain unresolved; vigorous debate continues regarding specific issues (Fig.3) and about which projects should be implemented. Previous measures to address tsunami have been based on a comprehensive approach involving physical infrastructure to protect existing communities combined with evacuation systems and community-building efforts to address situations when such physical infrastructure is overcome. Although these three elements (physical infrastructure, intangible systems, and community building) remain unchanged, we hope the first step this time can be to reach consensus on an approach toward disaster mitigation (safety level) that can then be applied to a review of residential and other land use (building restrictions) that fosters the development of disaster-resilient communities.

Fig.1 Damage due to the 2011 tsunami, causing erosion and deposition on the coast in Sariku

Fig.2 Attack of the 2011 tsunami on the coast with the green belt which was constructed by Mr.Data 400 years ago based on the experience of the damage in the 1611 earthquake and tsunami

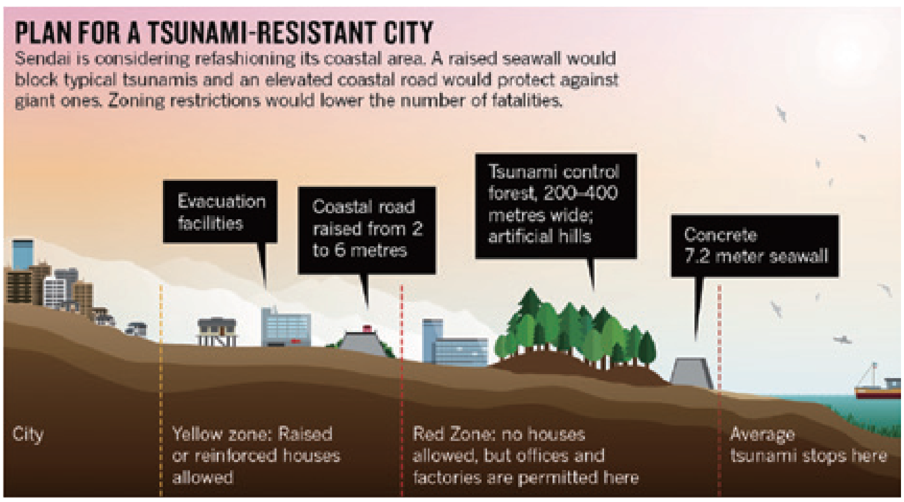


Fig.3 Idea of tsunami resistant city with multi-layer reduction system (Nature, 2012)

DISASTER

Shunsuke Managi
Associate Professor of Graduate School of Environmental Studies, Tohoku University

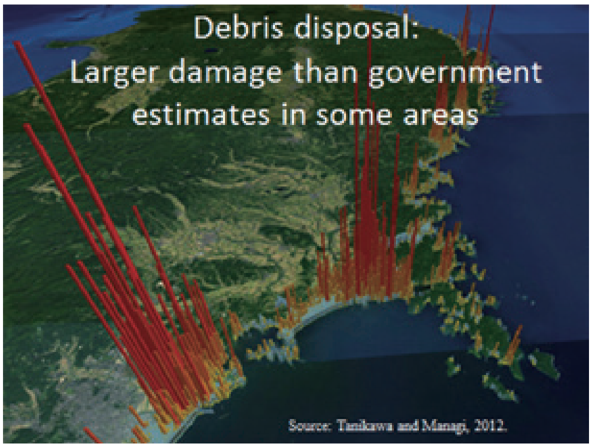
The Great East Japan Earthquake and Tsunami caused severe damages especially at the coastal area. Almost all the buildings were destroyed by the disaster, and the people were totally shocked by seeing the devastation through the tragic pictures and videos. On the other hand, there were also the areas that were less affected, and the impact by the disaster was not as severe as other areas badly affected. It has proved that the current standard of infrastructure and architecture in Japan is fairly strong and to be proud of.

Normally, the media shows especially the damages which are very striking and severe, and at a result, those information created the misunderstanding among the public concerning the situation of the affected areas. For example, the tsunami left a large quantity of debris, and soon a problem on where to dispose the debris arose. The initial information and message was that the quantity was too much to dispose only in the Tohoku region and the support from other areas was needed. Therefore, the government requested other prefectures and cities to help its disposal providing the subsidiary to those who accept the debris. A number of cities raised their hands to respond to the request. Based on our survey conducted one month after the disaster, it was found out that the quantity of debris was less than estimated by the government. It often happens that the actual situation is different from the one that has been already reported by media and governments. It is crucial to provide the right information to the right person, otherwise, it may lead to development of a wrong plan and strategy.

With regard to the nuclear power, a number of organizations and associations have been involved in the nuclear power issue, and the information provided by them are often confusing and missing the main points. What we have learned from the experiences of the nuclear disaster in Fukushima is that it is crucial to have a variety of energy sources. The public sentiment on the nuclear power is very complex. When the climate issue started attracting people's attentions, the government promoted the nuclear power energy. However, after the accident in Fukushima, the public' interest was moving from the climate change to a renewable energy. On the other hand, people hardly accept 20% rise of energy cost expected if all the nuclear power plants were stopped. In other Asian countries, the debates and discussions on the nuclear power have been very active, and their attentions to the future action and decision by the Japanese government are extremely high.

In order to accelerate the economic recovery in the local affected area, it is crucial to avoid the outflow of the population. From the survey result, it was found out that if people can expect high income and others will remain in the area, they are willing to continue staying the same area. The fishery is one of the most important industries in Tohoku and there is no recovery and re-establishment of Tohoku without the re-establishment of fishery. Even before the tsunami, the production of fishery itself has decreased in the last 20 years due to over fishery, and the income of fishermen is much lower than 20 years ago. Currently, this industry heavily depends on subsidiary from the government. It has heavily damaged by Fukushima's nuclear power plant accident and the prospect is very severe due to cesium and radiation problem. It is suggested to allocate more reconstruction budget for the reconstruction of fabrication facilities, not to reconstruct the ports as it used to be. If the subsidiary can be used more effectively, it will provide the job opportunities even in other industries which can generate the income.

It is important for us to learn from the history and experiences as many lessons learnt from disasters exist, to transmit and share the information to the public in easy-to-understand ways for the future.



Before 3.11

- Significant inefficiency on average and catch potential is huge.
- Close: 80% of region & 90% of managers
- Cost reduction: more than 400 billion yen (4 billion US dollar)
- 3 times income raise of revenue by Individual Transferable Quota (ITQ)

Source: Yagi and Managi, 2011.

Recovery

- Without re-establishment of fishery, no re-establishment of Tohoku
- For example, 65% (industry) budget used for fishery in 1st budget
- In total, 5-14 trillion yen needed as budget (0.10-0.20 trillion loss/year for fishery)
- 10 years (e.g, 5 years for Hanshin)

Create

- Start fishery when fabrication facilities exist
- Considering harmful rumor, back to the past would not be a solution

A Century against Floods, Storm Surges and Tsunamis in Japan

Nobuo Shuto
Professor Emeritus, Tohoku University

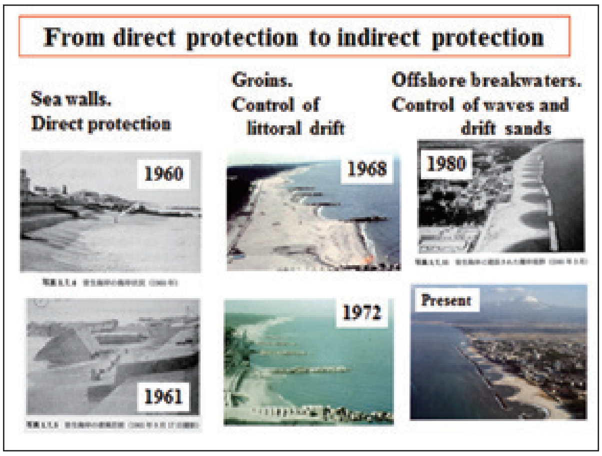
Japan has suffered from various types of natural hazards every year. Based on these experiences, various disaster countermeasures have been developed.

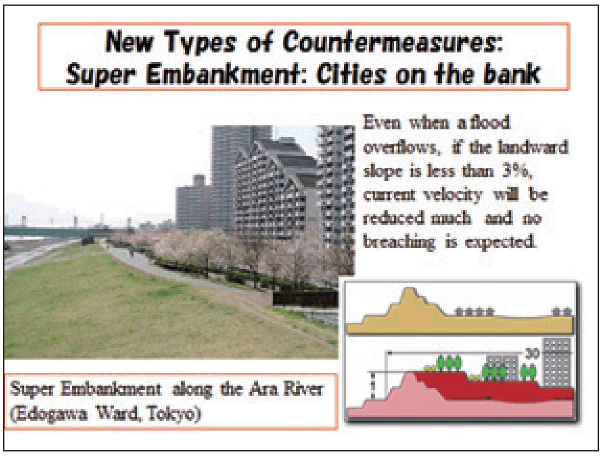
Flood countermeasures and reaction

To protect the Niigata Plain (rich paddy field) from floods of the Shinano River, The Okouzu Diversion Channel (watershed) was constructed in 1922. Then, the beach near the mouth of this new channel began to advance at a rate of 3 m per year. On the other hand, the beach around the river mouth began to recede. Several jetties and offshore breakwaters were built to protect the beach.

During 1950's, sabo works (erosion control work) began in the mountainous areas. Construction of multipurpose dams for water supply, electric power generation and flood control also progressed to decrease the sand supply to beaches. After several countermeasures were developed, a combination of offshore breakwaters and groins were identified as effective measures. In some cases, sand artificial nourishment is also added.

Rapid urbanization changes the state of run-off and flood. In addition, in many cities, the development of underground towns and subways developed a new type of flood disasters. In order to reduce these impacts, the use of artificial underground channels for flood control is progressing. In addition, the super embankment, which can be a new countermeasure to floods, allows floods to overflow the bank without erosion. If the landward slope is gentler than 3%, overflowing current velocity will be reduced much and no breaching is resulted. The wide levee areas can be used as the town itself.





Storm surges

In 1934 after the Typhoon Muroto hit the Osaka, the report prepared by JSCE (Japan Society of Civil Engineers) recommended three methods; 1) construction of defense structures, 2) regulation of ground height for buildings and 3) regulation of land-use.

The Osaka area was hit again by the Typhoon Jane in 1950. Probability analysis was introduced for the first time and resulted in that occurrence probability of the Typhoon Muroto of 1934 was 1 on 813 years. Seawalls along canals were recommended to protect the Osaka city, and these walls could prevent the Second Muroto Typhoon in 1961.The Coast Law was also enacted in 1956. Based on this law, the Technical Standard for Coastal Protection Facilities was made in 1958. Sea dikes with three armored surfaces became the national standard.

In 1959, the Ise Bay Typhoon hit and gave a severe damage to the city of Nagoya. In order to protect Nagoya Port, storm-surge breakwaters and seawalls were constructed, however, it was found out that the storm-surge breakwaters are not effective for storm-surge but for high wind waves that hit with storm-surge. The City of Nagoya also introduced a municipal ordinance, land use regulation. It divides the areas into 5 regions, and each region, depending on its surrounded condition and environment, has a special regulation such as no wooden houses are allowed or every house should have a shelter higher than 3.5 m.

Tsunamis

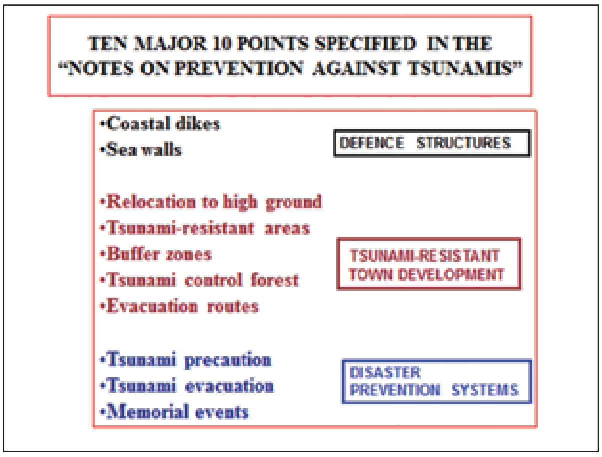
After a giant tsunami hit the Sanriku District on June 15 (May 5, in lunar calendar) in 1896, the citizens were relocated to the higher ground. However, according to Tanakadate & Yamaguchi (1938), many of relocated families returned to the original low land. The reasons are: 1) Beaches were too far for fishermen, 2) Drinking waters was insufficient in high ground, 3) People were strongly attached to their ancestral lands, and 4) Tsunamis are comparatively infrequent, and so on.

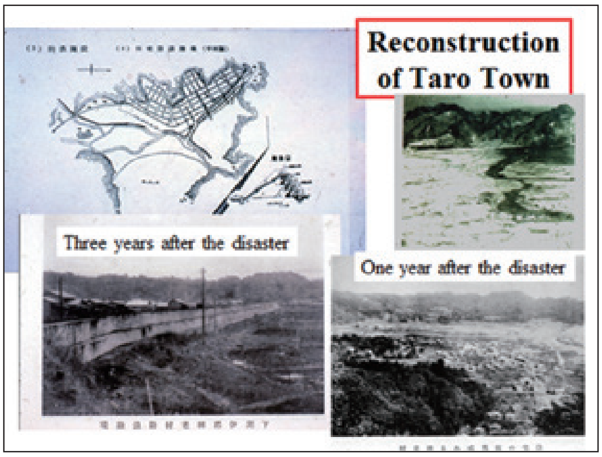
After the same area was struck by another tsunami on March 3 in 1933, an idea of the Comprehensive Tsunami Defense Countermeasures were identified: 1) (Defense structures): Coastal dikes, Sea walls, 2) (Tsunami-resistant town development): Relocation to high ground, Tsunami-resistant areas, Buffer zones, Tsunami control forests, Evacuation routes, and 3) (Disaster prevention systems): Tsunami precaution, Tsunami evacuation, and Memorial events

In Miyagi Prefecture, a very strict land-use regulation with legal penalty for violation was introduced. After this tsunami, an effort began to establish tsunami forecasting. In 1941, a tsunami warning system for the Sanriku District started.

After the Chilean Tsunami in 1960, the economic development accelerated building concrete structures. The first tsunami breakwaters in the world were completed in 1968. Many coastal dikes and seawalls as well as tsunami gates were constructed along the coast and rivers. In case of the 1968 Tokachi-oki earthquake tsunami, all the structures worked perfectly to prevent the tsunami. Thereafter it became a common belief that any tsunami could be prevented by structures.

In 1993, a tsunami hit the western shore of Hokkaido. After this experience, tsunami related government agencies agreed to develop the comprehensive measures to mitigate tsunami damages: the data from the largest tsunami in the past that has sufficient number of accurate run-up data and the data from the tsunami generated by the largest earthquake such as the recent seismology. The larger one of the two is the design tsunami. Another comprehensive countermeasure is a combination of three means. Major items are as follows: 1) Defense structures: Sea walls, coastal dikes, tsunami breakwaters, tsunami gate, 2) Tsunami-resistant town development: Residence on high ground, tsunami resistant buildings, tsunami control forests, and 3) Disaster prevention





systems: Forecasting and warning, Evacuation drills, Public education.

In 2004, a committee under the central government provided a manual for preparation of hazard maps against tsunamis and storm surges. Prof. Katada, Gunma University, introduced a new method, dynamic hazard map, to make residents understand the importance of early evacuation.

In 2011, May 11, the Great East Japan Earthquake Tsunami devastated the Tohoku region. The highest run-up was over 40 m, and nearly 22,000 lives were lost. The tsunami hit the Coast of the Fukushima Prefecture with run-up height higher than double the estimated one for defense plan. The Nuclear Power Plants, Fukushima No.1, TEPCO situated on the ground over 10 m high, but was hit by the tsunami 13 m high. Immerged and then electric system rupture led to the serious accident of the plants. Hazard maps prepared by local governments had a negative effect at many places. Many of them who learned they live outside the estimated inundation areas did not try to evacuate and lost their lives. On the other hand, even though their schools were situated just outside of the estimated inundation areas, the students kept the Katada's three rules: Assumed is only assumed, do your best under a given condition and be a leader of evacuation and saved their lives.

Conclusions

Structures that can mitigate damages to some extent do not work if they are not well maintained for a long term. At the same time, high and strong structures may act to deteriorate human's concern of the nature. We, human beings easily forget even our own bitter experiences. In addition, once human activity changes the natural condition, a new type of disaster appears with different magnitude. The power of nature often exceeds our level of knowledge and learning, and we should live with the nature. This is the way to mitigate natural disasters in the future generation.

Experience of the 2011 Tohoku Earthquake
～ For stronger campus against earthquakes ～

Masato Motosaka

Professor of International Research Institute of Disaster Science, Tohoku University

1. Introduction

The 2011 Tohoku earthquake with the magnitude of 9.0 brought huge damage due to not only Tsunami but also ground vibration. Many ground motion records were obtained by the huge earthquake, which characterized as long duration and different ground motion amplification due to geological structure. Tohoku University's campuses were suffered from the earthquake damage not only research buildings but also research equipments, especially at campuses at Aobayama hill in Sendai city.

This lecture starts from general description of the Tohoku earthquake, followed by, earthquake preparedness at the university, damage feature during the earthquake and the recognized problems. Then emergency response and recovery activities are introduced. Toward reconstruction and resilient campus making specific points are explained. Finally general lessons from the earthquake are additionally addressed.

2. Earthquake preparedness

Tohoku University established a project, "Tohoku University earthquake countermeasure Base Project", against the expected Miyagi-ken Oki earthquake in 2007 head by the author. The project tackled with the following subjects as the project reports in 2008. 1) Earthquake circumstance and ground motion prediction 2) Present-state survey of facilities at each campus from hardware aspect , It is noted that the seismic retrofit ratio of university facilities were 88.5% before the Tohoku earthquake. 3) Present-state survey of Earthquake counter measures at the university, 4) Investigation of earthquake counter measure at other universities, 5) Earthquake damage simulation at the university for the predicted earthquakes, 6) Strengthening of future earthquake counter measures planning and promotion organization, 7) Focused earthquake counter measures in f yr. 2008. "EEW system installation considering retrofit status of university facilities" and "Practical evacuation training for the expected earthquake"

It is noted that earthquake preparedness against the earthquake had been done in division level. The following preparedness was done in case of 'School of Engineering'. 1) Formulation of various manuals and planning, 2) Execution of disaster prevention training, evacuation drill, 3) Preparation of emergency stocks, 4) Installation of Earthquake Early Warning System, 5) Inspection of earthquake counter measures at each office, laboratory

3. Damage feature at Tohoku University and recognized problems

Even if the preparedness, huge amount of facilities' damage was occurred The estimated total loss is \ 66,000,000,000 ($ 660,000,000). The recognized problems due to the earthquake are summarized as follows. 1) Stop of education and research; recovery as soon as possible is needed from BCP view point, 2) Repeated aftershocks cause psychological problem, 3) Building damage on Aobayama campus due to resonance to the amplified ground motion (ref. to Fig.1), and also failure of life lines and land failures due to long duration ground motion, 4) Topple of fixed equipments; anchoring of heavy equipment (ref. to Fig.2)

Fig.1 Damaged and demolished building. (a) Overview, (b) collapsed corner column, (c) Damage feature of top floor's room, (d) Crack at 3rd floor level by partial uplifting

Fig.2 Damaged experimental equipments (Chemical Department)

4. Emergency response and recovery activity

As for response policy just after the earthquake, actual situation of School of Engineering is explained as follows. Students were recommended to go back to their home town, off-limit to the buildings to promote the recovery work. Lectures were cancelled by the last decade of April Graduation ceremony was also cancelled. Communication to students and safety confirmation were continuously performed using Information transmission HP, Safety Confirmation System of Tohoku Univ. at first conveniently then information transmission network of each laboratory and telephone. The safety confirmation was continued until March 30. Recovery of laboratory was done as the following steps; Off limit of buildings, rapid inspection of buildings, tidying up for electricity and water supply. Then, recovery of lifelines, repair of buildings and tidying up laboratory's inside. It is noted that recovery of electricity takes 24 days, water supply takes 33 days and gas takes 44days.

5. Towards reconstruction and resilient campus making against earthquakes

Not to cause the same kind of damage, the following earthquake countermeasures were adopted. 1) Adoption of base-isolated building (ref .to Fig.3), 2) ductile life line countermeasure, 3) land slid countermeasures, and 4) equipments' countermeasures not to topple down or installation of base-isolation devise (ref. to Fig.4).

Through the experience of the Tohoku earthquake, is was found that the prepared countermeasures are worked well as for confirmation of evacuation route by disaster training, and Earthquake Early Warning System makes it possible to gain available time for evacuation. Promotion of the system installation and training would be recommended. Preparedness of the emergency articles were well prepared due to office inspection. But Practical training considering injured persons would be needed and it would be needed to reconsider the evacuation response procedure and notification and so on.

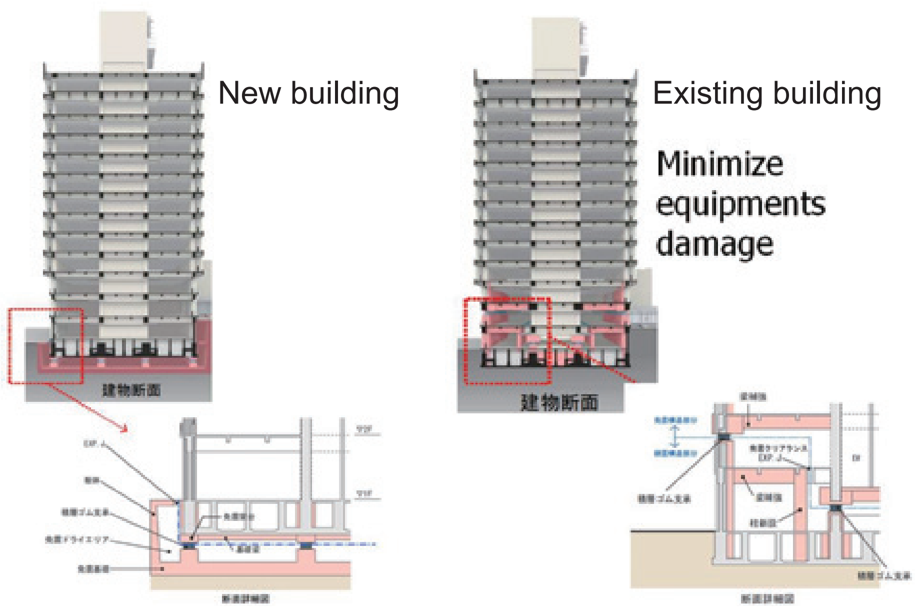


Fig.3 Adoption of Base-isolated building

Fig.4 Fix to strong support frame-not to be extracted from the wall

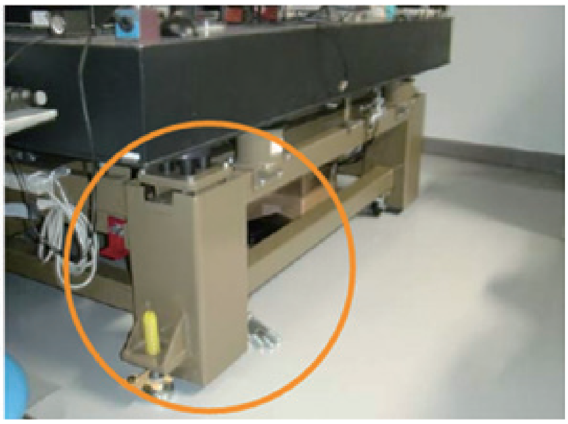


Fig.5 Installation of base-isolation device

6. Lessons from the 2011 Tohoku earthquake

Regarding hardware, the following lessons were addressed. 1) As for seismic strength of building structure, new building code and promotion of seismic retrofit was effective to reduce the damage. These are mainly structural element of the building. Seismic performance of non-structural element and equipments are not sufficient considering total balance of the building. 2) As for utilization of disaster prevention system, earthquake and tsunami warning systems would be widely promoted together with disaster prevention education to promote the new technology. Safety confirmation System combined with EEW would be promoted. The useful securing of communication tools (satellite phone) would be efficiently used.

Regarding software, the following lessons were addressed. 1) Problems of refuge plan and evacuation drill, 2) Evacuation drill for not only earthquake but also tsunami, 3) Evacuation drill as collaboration of school and community, 4) Promotion of installation of Earthquake and Tsunami warning system and evacuation drill using these systems

Through experience of the 2011 Tohoku earthquake, the author emphasized that holistic and well-balanced earthquake counter measures are necessity in recent too much sectionalized society and that collaboration beyond each academic field become important to lead synergic combination. Collaboration of Local governments' collaboration and international collaboration are also important.

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Building a Disaster Resistant City based on the Lessons Learned from the Great East Japan Earthquake and Tsunami

Hiroshi Ishikawa
Senior Director, World Conference on Disaster Risk Reduction Preparation Department, Sendai City

The Great East Japan Earthquake Tsunami devastated the Tohoku region. Sendai City is the largest city in the Tohoku region with a population of over one million. In Japan, over 15,000 lives were lost in the unprecedented magnitude 9.0 earthquake and ensuing tsunami. Over 800 precious lives were lost in our city alone. The economic damage in Sendai City is roughly 15.7 billion US dollars. It was the most complex and extensive damage that we had ever had.

Through the lessons learn from the Disaster, we believe that the following three initiatives are necessary to build a disaster-resistant city.

1) It is important to adopt the concept of "disaster risk reduction." There is a limitation to mitigate the damages and impact caused by tsunami only by infrastructures and physical preventative measures such as breakwaters against the unanticipated huge tsunami and earthquakes.
2) It is crucial to understand the "vulnerability of the city." Disruptions of lifeline utilities including electricity, water, gas and telecommunications caused tremendous confusion and problems. Due to energy shortage, all urban functions were declined and recovery work was hindered. Transportation was interrupted and communications were shut down.
3) Self-help, cooperation, and mutual support are considered as a basis of assistance. It is not ideal to rely on public assistance and administration. The local bonds greatly contributed to the rescue of those who required special care and to management of disaster refuge areas. The cooperation with other municipalities is also a key.

These are three initiatives toward becoming a disaster-resilient city:

1) Development of a disaster-resistant city (development of equipment and facilities and systems)

This approach calls for a multi-faceted protection system which combines improving tsunami counter measures and reinforcing existing infrastructure, making revisions to refuge area administration policies and information provision systems, and finally increased cooperation with other cities over a wide area.

- Recognizing the disaster risk in communities and the importance of investment in disaster reduction
- Building a disaster-resistant urban infrastructure (utility lifelines, public buildings, etc)
- Taking comprehensive countermeasures against tsunami based on multiple defenses
- Improving response capabilities for disasters (review of ecacuation centers, countermeasures for persons unable to return home, provisi of information, BCP formulation etc)
- Establishing systems for wide-ranging cooperation, mutual support, etc.

2) Development of self-reliant communities based on mutual support

The government must promote cooperation and face-to-face relationships between the community, schools, public interest groups, and businesses before a disaster strikes in addition to pursuing higher levels of disaster preparedness in the community.

- Promoting support activities in local communities (Countermeasures for those who need support, promotion of participation by women and children in disaster reduction activities)
- Developing local human resources responsible for reconstruction and disaster reduction (Collaboration with local communities, schools, public entities, companies, etc)

3) Development of strong disaster-prevention awareness in citizens

It is important to strengthen the disaster-response capability of each citizen through evacuation drills and disaster education.

- Holding disaster reduction seminars for citizens
- Developing local leaders for disaster reduction and supporting their activities
- Improving new disaster reduction education

Sendai City has been recognized by the United Nations International Strategy for Disaster Reduction (UNISDR) as a role model in the 2010-2015 World Disaster Reduction Campaign "Making Cities Resilient: My City is Getting Ready". In addition, the 3rd UN World Conference on Disaster Reduction is held in Sendai City in 2015. It is a role of Sendai City to introduce the recovery process, activities to build disaster-resistant communities and our reconstruction projects in collaboration with various sectors.

Hyogo Framework for Action 2005-2015 Review from a viewpoint

Osamu Murao
Professor of International Research Institute of Disaster Science (IRIDeS), Tohoku University

The presentation by Prof. Murao at the Multi-Hazards Summer School consisted of the following five topics: (1) Meaning of Protection of Cities in the History, (2) Disasters in Japan and Background of Hyogo Framework for Action (HFA), (3) Disaster Management and Disaster Life Cycle, (4) Outline of Hyogo Framework for Action 2005-2015, and (5) A Brief Review of HFA in Japan.

The presentation started with a question, "what is a city?" and referred various risk surrounding a city and how cities in the world had overcome the threat of disasters and enemies (Fig.1 and Fig.2).

Japanese society has made efforts to reduce disaster damage through devastating experiences in its history as a disaster-prone country in the world. The second topic focused on the remarkable disasters in Japan and chronological improvements of disaster management (Fig.3 and Fig.4), followed by the HFA background including International Decade for Natural Disaster Reduction (IDNDR), World Conference on Natural Disaster Reduction 1994 in Yokohama, and World Conference on Disaster Reduction 2005 in Kobe.

Showing "Disaster Life Cycle," an idea to deal with disaster management, for the third topic, it presented the Five Priorities for Action in HFA associated with it in the fourth (Fig.5).

Finally, the significance of continuous effort (Fig.6) and recent Japanese disaster management activities developed in this century were introduced, such as increasing tsunami evacuation towers (Fig.7) and Disaster Risk Reduction Education Model Projects for Elementary Schools (Fig.8).

Prof. Murao mentioned that the next World Conference on Disaster Reduction will be held in Sendai in 2015, and that IRIDeS will contribute it as an academic organization in the venue.

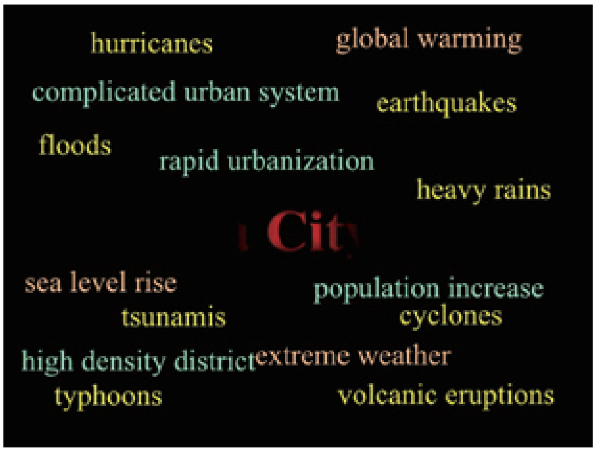


Fig.1: A City surrounded by various risks

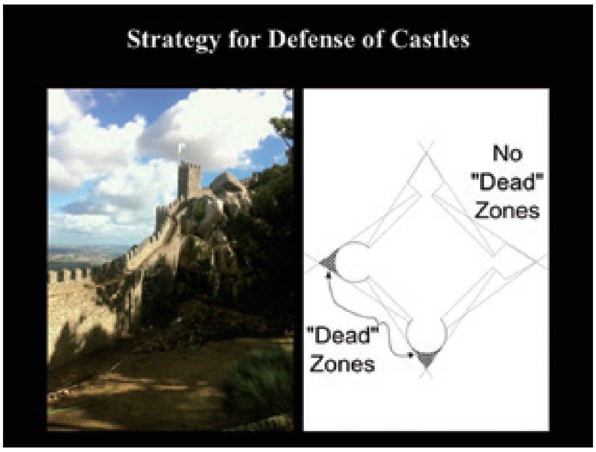


Fig.2: Architectural design for defense

Fig.3: Timeline of critical disaster events in Japan

Fig.4: Shirahige Disaster Prevention Base

Fig.5: HFA Priority 1 on the Disaster Life Cycle

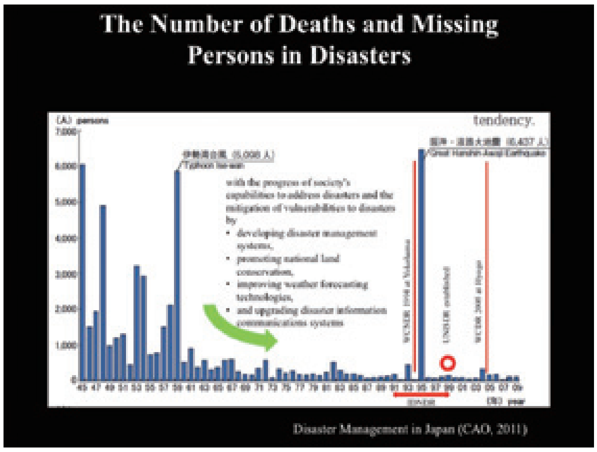


Fig.6: Japanese efforts to disaster reduction

Fig.7: Tsunami evacuation tower

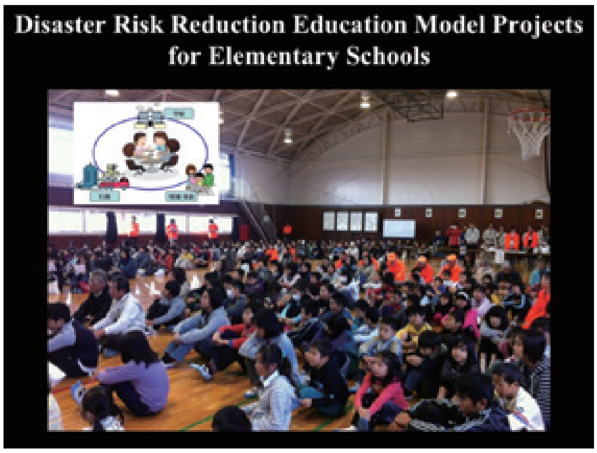


Fig.8: Disaster Reduction Education Model Proj.

Towards Disaster Risk Reduction City

Manabu Suzuki

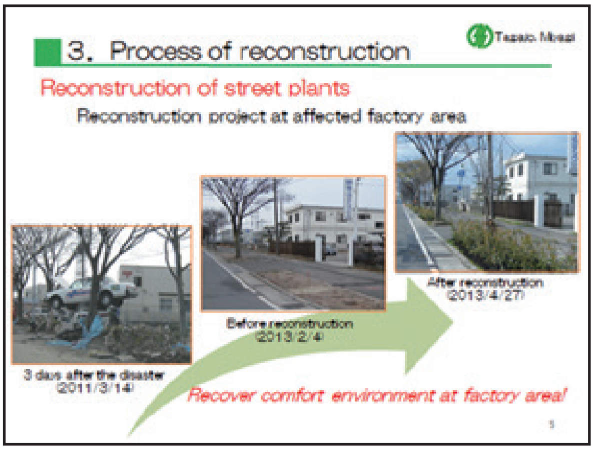
Chief, Bureau of Reconstruction Promotion, Office of Mayor, Tagajo City

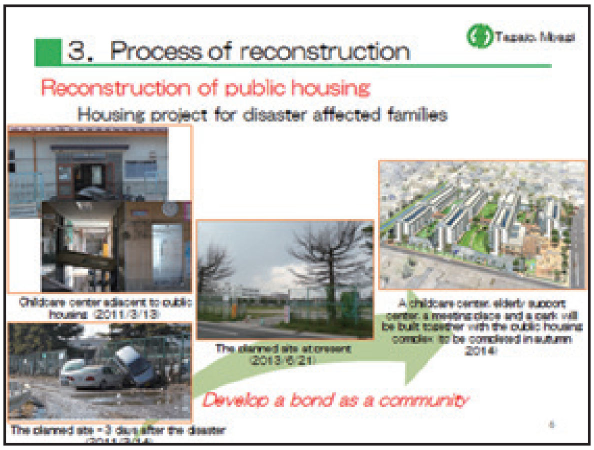
Tagajo city is located in the east of Miyagi prefecture which is 12 km away from the city center of Sendai. The population is 62,513 as of May in 2013. Total 188 lives were lost, and 11,000 houses and buildings were damaged at the Great East Japan Earthquake and Tsunami on 11 March 2011. After the earthquake, the large-scale tsunami warning and evacuation announcement were issued, then immediately, the headquarters for disaster control was established. Within 1 hour after the tremor, the tsunami (the highest 4.6m) came to the city, and one third of the city was inundated by the water.

A fire broke out at the LPG (Liquefied petroleum gas) complex. The situation was very serious, and no one was able to go closer to the area. Under the snow falls, the self-defense force and the fire department started the evacuation support. More than 10,000 people evacuated by themselves and stayed at the various evacuation centers. The life and the situation in the centers were very severe and challenging. The information became intricate and chaos. Most of the factories and offices were totally destroyed. The next day, when I saw the area submerged by the tsunami water and the area burned out by fire, I had a feeling of sadness and anger, but I did not know to whom I should direct the feeling. I was just stunned with anxiousness without hope.

Though Tagajo had tremendous damage by the disaster, all the citizens had a very strong will for reconstruction. The city itself is very small and there is no other land that we can move in and no land at the higher place, therefore, we had no choice to start the reconstruction on the spot. We set the 3 major goals, namely, 1) Reconstruction of citizens' lives and of industry, 2) Securing safety and security, 3) Sharing the experiences from the Earthquake and Tsunami.

There are 2 on-going reconstruction projects that made a progress. One of them is the reconstruction for the street plants near the factory areas. By replanting all these trees, we hope this areas will be reconstructed towards the comfortable factory areas. The second project is to develop the disaster public housing complex. Tagajo city plans to establish 532 houses in 4 areas. In the Sakuragi-area, the construction work has been already initiated and will be completed in autumn 2014. The childcare center will be also attached to the public housing complex. We hope it will become a place for children to play and for elderly people to meet and for everyone to develop a strong bond. Also we build the complex that can be a place to evacuate in case of emergencies.





We are willing to adopt the concept of disaster risk reduction (DRR) which can minimize the damage. One of the DRR measures is multiple-defenses. We plan to build sea-walls against the great tsunami in order to weaken the impact of tsunami. Also, we strengthen the capacity of communication and early warning of tsunami such as DRR radio, area-mail. In order to evacuate as quickly as possible, the evacuation road to higher places and evacuation tower and buildings plan to be constructed. Developing these multiple DRR measures is one of the most effective DRR measures.

Secondly, we try to collect and accumulate the DRR technologies. One of them is the research and development of a plant factory that produces lettuce with LED artificial lights. In the factory, 500 lettuces are produced per day and sold at the markets. Because of this innovation, it will become possible to produce crops sustainably in case of emergencies due to extreme weather and air pollution. Securing food is one of the priorities under the emergencies.

The third one is to promote DRR education. As local governments, it is our important role to develop infrastructures with multiple-defense, however, it is equally important to have the preparedness by education strengthening the capacity of survival, self-help and protection. For disaster education, a DRR handbook was developed together with the International Research Institute of Disaster Science (IRIDeS), Tohoku University that includes the important information at the disaster response and recovery. It will be distributed to all families, and we hope it will encourage the discussions on the preparedness among the family members. In addition, the schools plan to start the classes using the handbook. In order to promote the DRR education domestically and internationally, we established the archives that include records, images, and disaster experiences. It aims to reflect the voices of citizens and groups, and share the information on the HP.

We made tremendous loss due to the tsunami. However, we gained lots of experiences, wisdom, surviving skills as well as incredible support from all over the world. We also had strong determination to start the DRR measures and we plan to change our way of thinking from negative to positive in the process of reconstruction. With our current various DRR efforts, we aim to build a resilient city.

A Web-Based Approach to Global Earthquake Forecasting
Online Tools for Global Disaster Risk Management

John B. Rundle

Distinguished Professor and Senior Advisor to APRU MH Program
Departments of Physics and geology, University of California Davis

Great natural disasters are increasing in their impacts primarily because of the movement of growing populations into at-risk regions. In addition, the rising expense of coping with these problems is falling more and more on the public rather than on governments, which are often overwhelmed by the expense and complexity of the problem. The most obvious case of this is Haiti, whose recovery from the 12 January 2010 M7.0 Port-au-Prince earthquake remains problematic. Another example is the second M6.3 Christchurch, NZ earthquake which caused more than $30 billion USD in damages. It has been estimated that it may take 50 to 100 years to fully recover (see, e.g., http://en.wikipedia.org/wiki/2011_Christchurch_earthquake).

The World Wide Web offers many new and unique opportunities to address problems and challenges associated with great natural disasters. These examples of complex natural dynamics often occur as cascading events, such as the failure of the Fukushima reactors following the March 11, 2011 M9.1 Tohoku earthquake. Great destructive events typically involve four phases: Anticipation, Mitigation, Response and Recovery.

The Four Phases of a Disaster

Disaster Phase	Typical Time Scales	Solutions
Anticipation	Months to Decades	Science: Forecasting and Planning
Mitigation	Months to Years	Engineering: Structures and Lifelines
Response	Seconds to Weeks	Social, IT, Medical: Emergency Responders
Recovery	Weeks to Years	Economics, Engineering: Finance and Reconstruction

Figure 1

Each of these phases has time scales associated with them, and each requires distinct approaches and technologies to address them. The Anticipation phase involves forecasting the disaster over a variety of time periods. Intermediate term earthquake forecasting involves time scales of months to decades. Real-time early warning for earthquakes is a special case of Anticipation, but has time scales of only seconds. Real-time warning for hurricane and typhoon landfalls is another special case with time scales of hours. Mitigation occurs over days to years, Response over time scales of hours to weeks, and Recovery over time scales of weeks to years. Solutions associated with these phases utilize special knowledge from a variety of fields in physical science, engineering, social and medical science, and economics and finance.

Modern information technologies have the potential to unify many of these tasks within a common organizational framework. Forecasts are computed using automated computational approaches via data mining and simulations, and are disseminated using IT portal technologies. Planning involves communication and scenario analysis, which can use approaches as diverse as spreadsheet analysis and video gaming. Response involves real-world practice and simulation using first responders and their equipment. And Recovery involves novel financial approaches, financial analyses and market-based approaches. These issues are summarized in the table shown in Figure 1.

Overshadowing all of these areas is the availability of modern IT, and in particular, social networking technologies. These played an important role in responding to the disaster of the March 11, 2011 Tohoku earthquake (e.g., http://arxiv.org/abs/1109.1618). Other technologies such as Facebook, Google+, and Instagram illustrate the potential for IT to contribute to solutions in the unfolding cascading processes of major disasters. Yet most of these technologies, designed for the public, are often not well suited to the distinct needs of the disaster management communities.

Challenges in Web-Based Forecasting

Data & Models	Information Delivery	Meaning
Acquiring & validating data	Automation	What is probability?
Model building	Web-based integration	Visual presentation
Efficient algorithms	UI	GIS
Validating/verifying models	Tools	Correlations
Error reporting, correction, model steering	Collaboration/social networks	Expert guidance/blogs

Figure 2

In the lecture, I discussed new approaches to these problems. These approaches, grounded in a variety of modern IT, involve the computation and global dissemination of data from data-driven forecasts, data-mining, and simulation methods. Development and use of portal technologies, collaboration and social interaction websites, will be critical. Computational methodologies are only useful in a modern context if they are implemented with accessible User Interfaces (UIs). Here we discuss the development and use of these methods as exemplified by four websites: www.quakesim.org , www.e-decider.org , www.openhazards.com , and http://social.openhazards.com . Of course, these approaches involve a variety of challenges, which are summarized in Figure/Table 2.

The website www.openhazards.com was organized and initiated to fill the widespread need for global earthquake forecasting, and its communication to the global public. It has since expanded to include other types of disasters, as well as the need for disaster education. Given the fact that governments are finding disaster assistance to be beyond their financial means, it will fall increasingly on the global public to address their own risk management needs. Personal risk management will only be possible if the public has the tools and information to make informed decisions.

The forecast we originally developed for the Open Hazards site relies on data-driven approaches derived from online earthquake catalogs. We developed a method to use space-time patterns of small earthquakes to forecast large events. Until recently, methods proposed have been based on rates of small events, either anomalous activation or anomalous quiescence. Our method is based on the proposition that the Gutenberg-Richter magnitude-frequency distribution is a stable statistical distribution over time. The largest events must eventually "fill in" the distribution being formed by the smaller events.

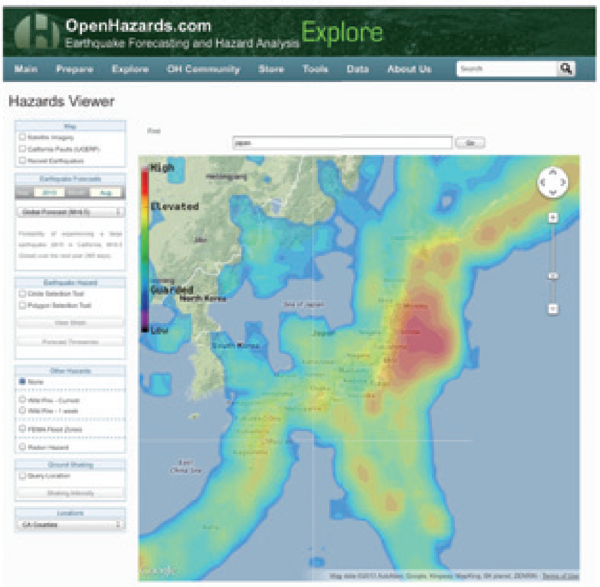


Figure 3

We showed that large event probabilities can be computed via automated methods and back-tested to optimize the few parameters in the model. To illustrate the method, we computed probabilities for large earthquakes M>6 in California and M>7 in Japan from 1980 until the present. An example of the application ("app") that we developed and made operational on the openhazards site is shown in Figure 3.

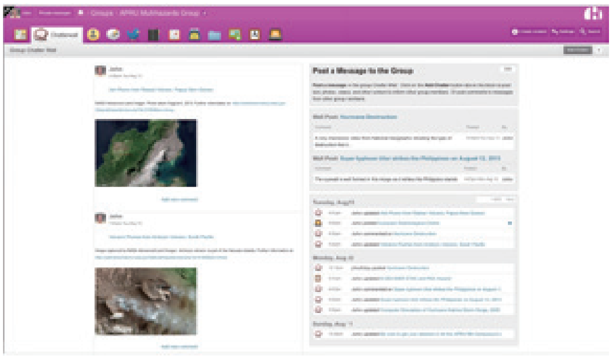


Figure 4

Finally, I touched on the need for new modes of collaboration through social networking that are needed for initiatives such as the APRU Multihazards program. I discussed the development and use of social.openhazards.com, a collaboration network built on Drupal 6 and Open Atrium technology.

A variety of further developments enhance the site beyond its basic functions, including an advanced search, and features such as an Imageboard (an image gallery), a Chatter Wall (streaming group conversation messages), and an AppFrames feature (allows the user to create apps by linking to external web sites through iFrames). A screenshot of this site is shown in Figure 4. All of these web sites are fully operational, and the interested user can only see their full functionality by visiting them and exploring their various capabilities.

Geographical and socio-political vulnerabilities and resiliencies in Chilean recent "natural" disasters[1]

Hugo Romero

Professor, Department of Geography and Research Centre of Vulnerabilities and Socionatural Disasters (CIVDES) of University of Chile

Chile is a Latin American country that together with several North, Central and South American nations, conforms the Eastern border of the Pacific Ocean Rim, sharing with western Pacific countries the occurrence of all natural hazards such as earthquakes, tsunamis, droughts, floods, volcanic eruptions and landslides. Between 2009 and 2013, a large earthquake and tsunami affected the Chilean central section (February 10th, 2011), killing more than 500 persons and producing economic losses equivalents to a one eighth of its Gross Domestic Product (GDP). In 2009 and 2013, respectively, Chaitén and Copahue volcanos –located in Southern Chile- have erupted, and their populations have been evacuated (or have resisted to be evacuated). Since 2010 and due a pervasive La Niña phenomena, relevant droughts have affected, specially energy, agricultural and urban water uses in Central Chile, and, on the contrary, have caused serious floods and landslides at the northern Andes highlands, and around Santiago, the seven million inhabitants country´s capital city, which water sources have collapsed several days during the last summer as a consequence of mountainous storms. Same natural hazards have affected the Latin American countries, being necessary to increase the exchange of scientific information, prevention strategies and risk reduction practices with the West Pacific region.

According to Rubin and Rossing (2011), regressions predicting mortality for floods and storms in the region, between 1980 and 2000, are positively correlated with exposure and socioeconomic disparities (measured using the Gini coefficient), and inversely, with GDP/capita. It means that to interpret correctly the occurrence of "natural disasters" in Latin America is very relevant to take into consideration not only natural hazards but also socioeconomic vulnerabilities of local populations. In the case of Chile, exposure is mainly related with the lack of land use planning and enforcement, and, as a consequence, the installation of especially, poorer people, in hazardous sites like river and streams beds, foothills, dangerous costal zones, and lava and volcanic ashes flow areas. Urban master plans have allowed the allocation of residential areas trying to solve social urgencies instead to protect the population in terms of natural hazards. A lack of environmental justice could be observed everywhere, since social groups that receive less income are located, either at the countryside or in the cities, at hazardouscapes. Such is the case of Talcahuano, one of the most devastated cities by the 27th February 2011 tsunami. Thousand families were living in areas that scientific information has demonstrated that were previously flooded by tsunami waves and floods or affected by landslides and water logging. In 2013, in terms of socioeconomic disparities and them, sensibility, 63. 5% of the Chilean national population belonged to the lower middle and poorer social classes, and only 5,4% is a part of the richest group. In the case of Talcahuano, poorer people occupy near 150 Has of land which has been in previous events completely inundated, while, only 20 Has of land locate dwellers that belong to the most affluent urban population.

Social vulnerability is mainly related with exposure, sensibility and resilience of local populations. All of these components depend, in turn, from socioeconomic and institutional levels of development of countries and

[1] Abstract of lecture offered as part of the Summer School of the International Research Institute of Disaster Sciences (IRIDes) of Tohoku University, Japan, on July 24th, 2013. Research supported by the Millenium Initiative of Scientific Research from the Chilean Minister of Economy, Support and Tourism.

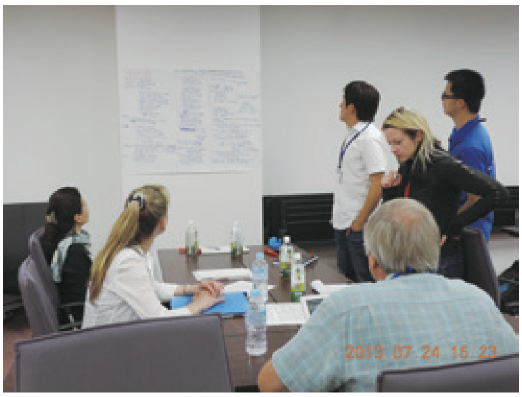
regions. Natural hazards cannot be analysed separately of social vulnerabilities. It seems to be more appropriated to define socionatural disasters instead of purely natural ones, at least in Latin America, where social disparities are one of the most outstanding social features.

Reduction of disaster risks, preparedness of the society, urban design and land use planning, material prevention, and, especially the strength of social capital, are challenges that should be part of a general process of a more even and equalitarian socioeconomic development. Social injustices and uneven development mean remarkable vulnerabilities that must be urgently reduced in Latin America. If social reforms are not implemented, socionatural disasters will continue growing their number, magnitude and socioeconomic damages. Many times, disasters could be used like large opportunities to recover previously socioeconomic deprivation zones, correct economic disparities and recognize the role of grassroots organizations. Top-down procedures that have operated in all the Chilean cases must be replaced by bottom-up practices, allowing a democratic participation and decision making processes adopted by local communities, along the whole steps of preparation, coping and recovering.

In the case of Chile, the last earthquake and tsunami meant the collapse of its centralized and hierarchical institutionality. Lack of electricity produced a complete fail of communication systems and erroneous messages from the authorities in terms of warning and evacuation of population. Such failures are not only responsible of many loss of lives, but also of a relevant crisis of credibility affecting the most important services from the State (the Chilean Emergency office depending of the Interior Minister; the Oceanic and Hydrographic Office, depending from the Navy and having responsibility in the functioning of the tsunami warning system). Political and juridical responsibilities are still expecting a final decision from the justice, but it is clear than in Chile, the topic has not been necessarily deeply discussed in academic and institutional terms.

However, on the other hand, several social surveys practiced at local scale have recognized the role of institutions like families, neighbourhood, churches, voluntary fire companies and representatives of the police at neighbourhood scale, in the performance of successful practices to increase community resilience. Much more social sciences researches are needed to systematize qualitative and quantitative analyses that facilitate the construction and strength of social networks and capital at community level like main components of local resilience.

GROUP WORK DISCUSSIONS



“Campus Safety” Group Work Session, 24 July 2013

A “Campus Safety” group work session was conducted on 24 July to discuss the following specific questions. Participants of the Summer School where divided up into four groups and provided the following questions to discuss:

1) Does your university have an experience being hit by disaster? If yes, what kind and scale of damages were caused?
2) What were the issues and challenges under the emergency and recovery phases? What were missing to minimize the damages?
3) How can the capacity of disaster risk reduction (DRR) and preparedness capacities on your campus be strengthened?
4) Please develop a checklist to ensure the DRR capacities and measures of universities.
5) How can APRU contribute to strengthening this capacity?

Universities should be responsible for the safety and protection of students, staff and visitors on campus. In this discussion, the focus was on natural disasters. It is extremely important for universities to have a preparedness and response plan that provides the idea and guide on how to prepare for and respond to emergencies. A variety of initiatives by universities have been taken on campus safety, i.e., developing a guidebook for emergency, setting up a communications solution to quickly disseminate an urgent message and alert through multiple communications mediums, and establishing an emergency management office to coordinate university’s emergency response and continuity plan and to conduct comprehensive risk assessment as well as training, planning, mitigation and response.

The discussions and international campaigns to advocate the need of a preparedness plan at schools have been very active to make schools safer from disasters. However, the discussion on how to ensure the safety of university campuses is minimal. In this context, APRU as a network of universities and research institutes in the Pacific Rim, where disaster risks are generally high, would like to promote the importance of “campus safety” and encourage the member universities to develop a comparative assessment of DRR and preparedness on campus.

Summary of Discussions:

Each group developed a list of issues and challenges in the disaster preparedness on campuses. Some groups raised concerns of the existing mechanisms and systems of disaster preparedness on their campuses. Even if a system and plan existed, not many staff and students were familiar with it, or how the system would work in case of real emergencies. There was a general consensus that universities should ensure all staff and students are aware of the disaster management systems and procedures and with regular practice drills. At the same time, universities need to consider “what the most effective and efficient drill is” to make it both practical and realistic. In addition, the following needs should be emphasized:

- ✓ Strengthening the communication system that could be used during emergencies
- ✓ Vulnerability and risk assessment (old buildings, chemical hazards, natural gas lines, etc) before disasters occur,
- ✓ Post-event data collection (oral history, documents, analytical measurements, etc) to use them as data and materials for future research and to pass the lessons from disasters to future generations to learn from

It was also highlighted that universities can play an important role in their wider communities post-disaster through harnessing the knowledge and skills of students and faculty members, especially in the fields of structural assessment, medical assistance, and psychological support as well as response coordination of student and staff volunteers.

All the groups recommended that APRU could be a platform to share experiences and knowledge on DRR between the member universities around the Pacific Rim. Furthermore, the development of a checklist/guidelines and the provision of mutual support for continuity of study and disaster research were recommended. The APRU-IRIDeS Multi-Hazards Program endeavors to explore an effective system of data sharing including disaster management manuals and disaster archives (interview records with community members etc) and promote best-practice "campus safety" that all universities may utilize and contribute to.

Group work discussions

GROUP 1

Q1. Participating Universities

Tohoku University (EQ, Snow storm, Typhoon)
Stanford University (flood, EQ)
University of Malaya (Fire)
University of Melbourne (Heat, Fire, Hail storm)
University of the Philippines (Typhoon, Volcanic Eruption, Earthquake)
Columbia University(Flood, Hurricane, Snow)

Q2. Issues and Challenges

- Insufficient Building strength
- Inadequate communication of plans
- Lack of awareness and anticipation
- Insufficient level of trust in the system, complacency and unreliability
- Failure of the backup equipment
- Bureaucratic red tape

Q3. What should be in place? (HFA)

1. Governance / DM institutional arrangement
2. Risk Identification, analysis, estimation, and communication
3. Knowledge management and Education
4. Underlying risks and risk reduction/mitigation
5. Preparedness/ emergency response

Q5. How APRU contribute for capacity building?

- Knowledge and experience sharing among the member universities
- Development of a standard/generic checklist
- Resource sharing amongst the members

GROUP 2

Underlying Principles

- University is not isolated from surrounding community and region
- Each university is in a specific hazard, cultural, political, financial condition that will influence its disaster response.
- We have modified checklist concept: our checklist intended to provide a framework to develop disaster response plans

Q1: University Disaster Experience

- Study of best practices already available from university planning and experiences
- Examples to illustrate

Q 2: Issues & Challenges in 4 categories

a) Planning and prevention
b) Response
c) Information
d) Communication

a) Planning & Prevention

- How to maintain essential services
- University link to government disaster response organization
- System to gather information for university decision-making
- Identify vulnerabilities (old buildings, chemical hazards, natural gas lines, etc.)
- Plans for using available resources (food, water, medical, gas, electricity)
- Develop capacity for local safety officer

b) Response

- Initiate local safety officer response
- Community Assistance
  - Structural assessment
  - Medical assistance
  - Psychological support
- Preservation of real-time information for later analysis
- Post-event data collection (oral history, documents, analytical measurements, etc.)

c) Information

- Audience – who is target for information
  - Students, staff, faculty
  - Families of students, staff, faculty
  - General community
- Central warning system for university students, staff (central=credible)
- Systematic introduction of disaster awareness
- Maintain memory and sense of self responsibility

d) Communication

- One center for communication
- Process for correcting misinformation from media
- University communication system independent of regional system (e.g. cell) (internet most reliable)
- Control media access to university (for safety and consistency)
- University press office must understand issues and have their own campus sources of information
- Press office must have credibility to outside world (built up over time)

Q 5: Suggestions for APRU Coordination

- Grand plan for a shared, Pacific Rim data base recording all types of post-event data (oral history, images, documents, social media, analytical data, etc.)
- Create an APRU Hub for the interface between policy makers and disaster data analysis

GROUP 3

Question 1: Experience of the university hit by disasters

- No major disasters at University of Washington
- One fire at NUS
- Kyoto U. – No major disasters.
- IRIDeS – Earthquake 2011. Not too much structural damage at Tohoku U.
- Indonesia – no particular experience.
- Sri Lanka – tsunami 2004, but no damage to the university. Lost 3 students. Mainly floods are the predominant form of disaster.
- UC Davis – Rupture of Berryessa dam
- Fudan University (Shanghai) – No serious earthquakes of faults in that area. Affected by Typhoons during summer vacation. Do not generally affect students.
- Melbourne U. – Australia has many disasters, but university not generally affected

Question 1 – cont.

- Kyoto U. - monthly training for landslide, fire, earthquake
- Sri Lanka – not prepared for tsunami. Some storm surge experience however.
- Tohoku U. – Evacuation drill every 6 months. Helmet is handed to every student or employee with name and blood type.
- Tohoku U. – Drills for fire. No earthquake drills (apparently).
- Teheran U. – twice a year – drills. Didn't take it too seriously. (How does one change the mentality of not taking the risk seriously?)
- Kyoto U. – bio-monthly drills for fire
- Discussion about Taipei 101 and damping mechanisms

Question 2, 3 challenges and strengthen DRR

- Relationship between building damage and casualties.
- Tohoku: Building is safe – concern is about safety of people. Every month earthquake early warning is tested, speakers, elevators, etc. Direct people to do the planned actions such as evacuation procedures.
- Question is whether people should stay in the building or evacuate outside.

Question 3 - challenges

- How are the plans formulated? Turnover at universities is high, so lack of continuity
- At NUS, required to take a course on fire safety. 45 minute online course.
- More drills would be worthwhile? But people tend to ignore frequent emails for participation.
- Problem of how to take seriously low probability, high impact events.
- As academics we should be setting an example

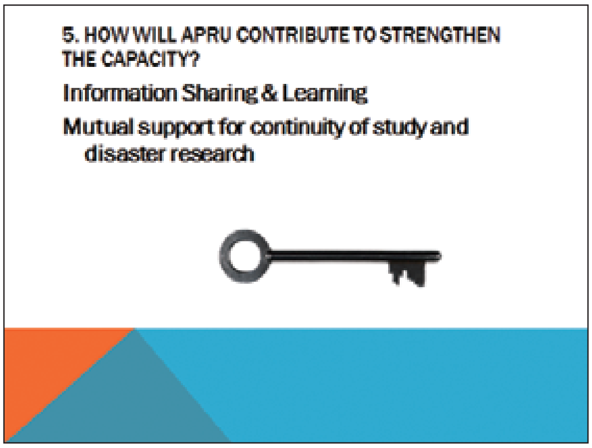
Checklist

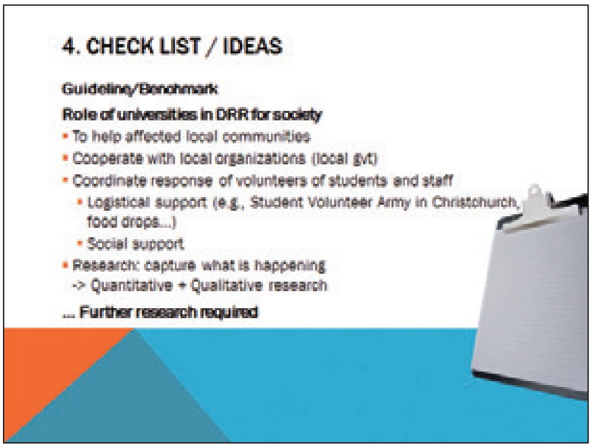
1. More drills at higher frequency
2. Inspection of structures
3. Inspection of non-structural damage potential (bookcases falling on you, etc.)
4. Fire safety inspection and design
5. Training (compulsory?)
6. Having a fire marshall or "disaster marshall"
7. Campaigns
8. Helpful signage and placards
9. Department meetings to keep people engaged

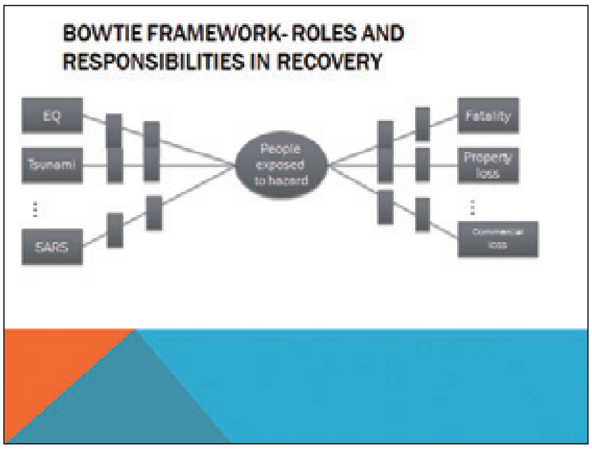
Question 5 - APRU

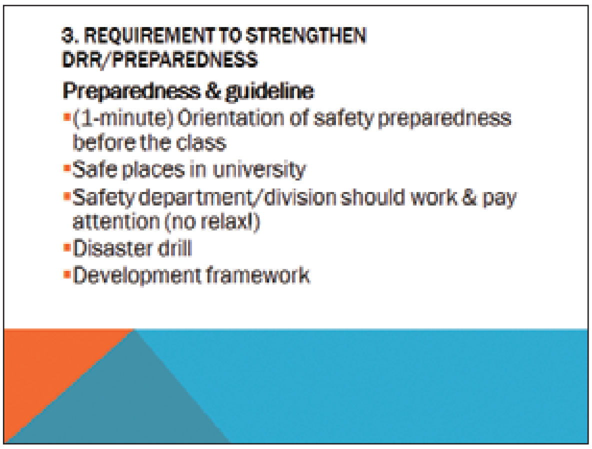
- Compile a list of researchers within the Universities?
- Self-sustaining networking mechanism
- APRU could be some kind of channel to share experience of DRR
- Research should be translated into products, can APRU help with that?

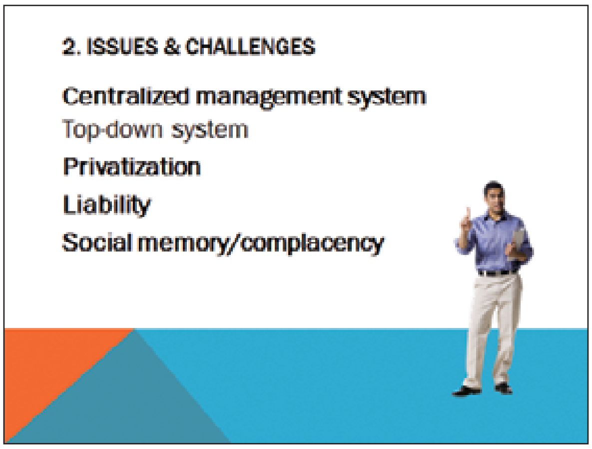
GROUP 4


5. HOW WILL APRU CONTRIBUTE TO STRENGTHEN THE CAPACITY?
Information Sharing & Learning
Mutual support for continuity of study and disaster research


4. CHECK LIST / IDEAS
Guideline/Benchmark
Role of universities in DRR for society
To help affected local communities
Cooperate with local organizations (local gvt)
Coordinate response of volunteers of students and staff
Logistical support (e.g., Student Volunteer Army in Christchurch, food drops...)
Social support
Research: capture what is happening
-> Quantitative + Qualitative research
... Further research required


BOWTIE FRAMEWORK- ROLES AND RESPONSIBILITIES IN RECOVERY
EQ
Tsunami
SARS
People exposed to hazard
Fatality
Property loss
Commercial loss


3. REQUIREMENT TO STRENGTHEN DRR/PREPAREDNESS
Preparedness & guideline
(1-minute) Orientation of safety preparedness before the class
Safe places in university
Safety department/division should work & pay attention (no relax!)
Disaster drill
Development framework


2. ISSUES & CHALLENGES
Centralized management system
Top-down system
Privatization
Liability
Social memory/complacency


1.EXPERIENCES OF DISASTER IN OUR UNIVERSITIES
SARS (Asia)
Haze (Singapore)
Earthquake (New Zealand, Japan, Chile)
Flood (Thailand)
Typhoon/Hurricane/Cyclone

FIELD TRIP

Field trip to the affected areas on 25 July 2013

After the 2-day seminar, the participants joined the field trip to the areas affected by the Great East Japan Earthquake and Tsunami. The places include Onagawa town, Ishinomaki city, Arahama town, Yuriage town and the Thousand Year Hope Hill.

Tarnya Kruger
PhD Candidate, Department of Resource Management and Geography,
University of Melbourne

In July 2013, I was fortunate to be one of five PhD students from the University of Melbourne, funded to attend the APRU Summer School at the University of Tohoku, Sendai in Japan. Like the other four students, this was my first visit to Japan and while I only spent one week in the country, the trip was really worthwhile. The opportunity to experience another culture is always most rewarding, and we found friendly and helpful people from Tokyo to Sendai. Travelling on the world famous bullet train to Sendai was also a highlight. The gathering at Tohoku University of approximately 30 participants was most useful in getting to know each other, rather than at a large conference, where it can be overwhelming. The wonderful food, the dinner and the Bento Boxes for lunch were also a great treat.

The two days of presentations provided an opportunity to learn much about the natural hazards of earthquake and tsunami, specific to Japan. This gave us insight into the history, where over the centuries Japanese communities have endeavored to live with, cope and minimize the impacts of large scale disasters that occur every couple of decades. The most recent is the Great East Japan Earthquake in 2011.

In contrast these hazards are not problematic for Australia, rather bushfires, floods and cyclones are our concern. However, there are many parallels in preparing and recovering from any natural hazard. I was most interested in the historical preparatory approaches begun in the 1600s, which seemed to use nature to work with nature, such as the creation of coastal forests and canals. This coastal strip aimed to safely separate the sea from people. Whilst much of the forest was destroyed in 2011, the landscaping is as an important community education marker, signalling the ever-present threat of tsunami, where social memory can fade and complacency takes hold. The new construction of the ‘Thousand Years of Hope Hill’ which we visited during the field trip was really interesting, reflecting the partnering of government, scientific research and communities in the recovery process. The hills or mounds act as protection against tsunamis and with new ideas about trees and landscaping provide an aesthetic and practical safe guard and a memorial for communities and visitors now and in the future, about the earthquake of 2011.

It is clear that with forecasts of increased intensity and frequency of disastrous events due to climate change, an interdisciplinary approach to natural hazards is essential. It will be critical that we share knowledge across countries, universities and research disciplines. The APRU network provides an excellent platform for working together and the summer school is a step in encouraging and fostering interdisciplinary research and learning. Our group from the University of Melbourne really valued the opportunity to attend Tohoku University and we are most grateful.

Liao Kuei-Hsien, Ph.D.
Assistant Professor, Department of Architecture, School of Design and Environment, National University of Singapore

The 2011 Tohoku earthquake and tsunami of Japan has once again demonstrated the uncontrollable power of nature. While I've seen numerous reports, images, and videos that document the aftermaths of the catastrophe, while most of the debris have been cleared, seeing the impacted area in person was still a powerful reminder of nature's mighty force of nature and human vulnerability. From Onagawa to Ishinomaki to Arahama to Yuriage, I saw one terrain after another being taken over by wildly growing vegetation. It was difficult to imagine that these places use to be lively towns, full of man-made structures and human activities. The visit to Yuriage was especially memorable. As I climbed to the top of a small hill and saw an expanse of "green field" that used to be a town. The green field was seemingly endless, and just down the hill a man was gardening in a lot, probably where his house used to stand. The man seemed small and humble against a backdrop of the disappeared town of Yuriage.

I don't know much of the recovery plans of the visited towns, but my understanding is that these areas are not going to be rebuilt for fear for future tsunamis. This is logical, as any defense structure has limited capacity and we never know what nature would bring in the future—the best strategy is to avoid the exposure of hazards. However, it is simply impossible to avoid all hazards, particularly in the modern era where even humans are producing hazards. One could relocate to another area to avoid one type of hazard only to be exposed to another. I do not believe there is any right way for recovery. My lesson, after seeing the impacted area after two years of the catastrophe, is that we need to learn to be more humble.

Raouffard Mohhammad Mahdi
Master course student, Graduate School of Engineering, Department of Architecture and Architectural Engineering, Kyoto University

The field trip to Tsunami hit area in Sendai was a perfect accomplishment on the 2-day intensive seminar of APRU-IRIDeS Summer School 2013. I had heard a lot about the scale of the disaster, attended many presentations, and watched tens of video footages on YouTube but never truly had realized how frightening a big Tsunami could be. We went to different places that were heavily damaged by the Tsunami and could see the process of reconstruction and recovery of each area. Also talking to local people and reviewing what happened to them during the Tsunami and after that was a great lesson from this trip for me. The most impressive thing that I saw there was the nice harmony between nature, local people and the authorities. Throughout the long history of Japan, Japanese people have learnt how to turn a disaster to a fortune. Everybody tries to forget the bitterness and sadness of the disaster and look forward to a safer and brighter city and future.

Bruce K. Nelson
Professor, Dept. Earth & Space Sciences, Associate Dean for Research, College of the Environment, University of Washington

I am very pleased that I was able to join the July 25, 2013 full-day fieldtrip to review the tsunami damage and recovery efforts in the Miyagi Prefecture as part of the Multi-Hazards Program summer school at Tohoku University. In response to your request for some comments on my experience on the fieldtrip, I would like to emphasize three observations that lead to a suggestion for future workshops:

1. The fieldtrip was immensely important to the success of the summer school.
2. The fieldtrip is a critical venue for discussion and exchange of ideas among participants
3. Without seeing the real effects and scale of the tsunami devastation in person, even as scientists familiar with the phenomenon, we cannot fully comprehend the scale of the event.

The fieldtrip was very well executed both in terms of logistics and content. I greatly appreciated the efforts of the leaders and organizers. As for most fieldtrips, the critical aspect was that we could have long, detailed conversations about many issues in a way that is not possible during the sessions at the university. That opportunity is invaluable. Equally critical was the opportunity to get to know our colleagues. This is so useful in a conference of this size. Several questions and issues arose during the fieldtrip that we could then discuss with local experts leading the fieldtrip. Many of these were subjects we could not address from within the confines of a conference room. The fieldtrip was an essential part of the success of the workshop. A full day is essential.

Discussions occurred on the fieldtrip that did not occur during the seminars for two reasons. First, we were able to see the scale and on-the-ground effects of the tsunami that led to a different set of questions and discussions. No amount of photographs or video can provide the intellectual stimulation that comes from visiting the sites, and being able to observe details and complexities. Second, many discussions require time to develop and mature. This time is not available during 10 minute question and answer periods following powerpoint presentations, but is available during a fieldtrip. These longer discussions also resulted in developing some understanding of people from very different specializations. *This is a critical observation: for researchers from very different specializations to effectively communicate, it requires extended conversation to learn different vocabulary, assumptions and perspectives of other disciplines. This time is only available during the fieldtrip.* The variety of disciplines present at the workshop was one of the great strengths of the experience.

Finally, the tsunami destruction was an enormous humanitarian disaster. It is critical for academics to have at least some personal, first-hand exposure to the effects by visiting the devastated sites. Descriptions, photos and videos cannot substitute for personal visit. It is critical that academics conduct not only the intellectual and scientific analysis of the disaster, but that they also have some more personal sense of the impacts on lives, families and society. This is a real-world grounding that I believe is an important foundation to academic analysis.

My observations result in a suggestion I offer for future summer schools/workshops: the fieldtrip is so central to developing communication among participants and to raising important issues for discussion, that the fieldtrip should be in the middle of the conference, not at the end. Some introductory presentations and discussion at the university is important to set the context, so it should not be the first event of the workshop, but it should not be the last event either. The opportunity for the fieldtrip experience to inform subsequent discussion at the workshop would greatly enhance the overall experience.

ACKNOWLEDGEMENT

The first summer school was attended by 31 participants from 9 countries. The organizer would like to extend a sincere appreciation to the participants and speakers that deeply contributed to the organization of this event. At the same time, IRIDeS received the tremendous support from the IPPO IPPO NIPPON project, the APRU Secretariat based in Singapore as well as Tohoku University. The organizer is also grateful for valuable suggestions and advices given by the faculty members of IRIDeS on the program development and planning.

This is a kick-start event of the APRU-IRIDeS Multi-Hazards Program, and IRIDeS together with the APRU secretariat will continue making the efforts to develop the Program and work together with the member universities to strengthen the roles of universities in disaster risk reduction. IRIDeS looks forward to further collaboration with the APRU institutes in the future activities.

Lastly but not least, great appreciation goes to the International Exchange Division of Tohoku University, the staff of the administrative office and the international and regional cooperation office of IRIDeS for their considerable support, suggestions and hard works to make this event happen.

ANNEX Ⅰ: APRU-IRIDeS Summer School Program

23-24 July: Seminar at the WPI-AIMR 2F, Katahira Campus, Tohoku University
25 July: Field trip to Onagawa town, Ishinomak city, Arahama town, Yurigage town and the Thousand Year Hope Hill

7月23日

09：00 － 09：25	Opening ceremony
09：25 － 09：40	Introduction of participants
09：40 － 10：40	"Introduction of IRIDeS and its roles" (Prof. Fumihiko Imamura, IRIDeS, Tohoku University)
10：40 － 11：00	Coffee break
11：00 － 12：00	"Disaster" (Associate Prof. Shunsuke Managi, Graduate School of Environmental Studies, Tohoku University)
12：00 － 13：00	Lunch
13：00 － 14：00	"A Century Against Floods, Storm Surges and Tsunamis in Japan" (Professor Emeritus, Nobuo Shuto, Tohoku University)
14：00 － 15：00	"Experience of the 2011 Tohoku Earthquake –For stronger campus against earthquakes-" (Prof. Masato Motosaka, IRIDeS, Tohoku University)
15：00 － 15：20	Coffee break
15：20 － 16：00	"Building a disaster-resistant city based on the lessons learned from the Great East Japan Earthquake" (Mr. Hiroshi Ishikawa, City of Sendai)
16：00 － 17：00	"Hyogo Framework for Action 2005-2015: Review from a View Point" (Prof. Osamu Murao, IRIDeS, Tohoku University)

7月24日

09：00 — 10：00 “Towards disaster risk reduction city” (Mr. Manabu Suzuki, City of Tagajo)

10：00 — 11：00 “A Web-Based Approach to Global Earthquake Forecasting” (Distinguished Prof. John Rundle, Department of Geology, University of California, Davis)

11：00 — 11：20 Coffee break

11：20 — 12：20 “Geographical and Sociopolitical Vulnerabilities and Resilience in Chilean Recent “Natural” Disasters” (Prof. Hugo Romero, Department of Geography, University of Chile)

12：20 — 13：30 Lunch

13：30 — 15：00 Group work (Roles of universities in DRR)

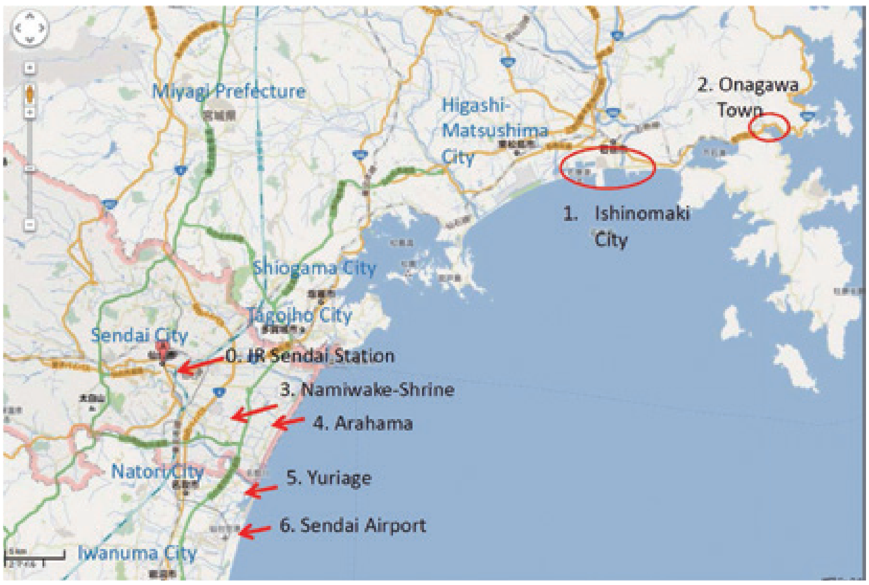
15：00 — 15：20 Coffee break

15：20 — 16：50 Group presentation and discussions

16：50 — 17：00 Closing

7月25日：Field trip

Onagawa town, Ishinomaki city, Arahama town, Yuriage town and the Thousand Year Hope Hill



ANNEX Ⅱ : List of Participants

	Name	Status	University	Country based
1	Colette Mortreux	PhD student	University of Melbourne	Australia
2	Connie Kellett	PhD student	University of Melbourne	Australia
3	Jorge León	PhD student	University of Melbourne	Australia
4	Sam Amirebrahimi	PhD student	University of Melbourne	Australia
5	Tarnya Kruger	PhD student	University of Melbourne	Australia
6	Yi Wen Tremewan	Under graduate	University of Melbourne	Australia
7	Hugo Romero	Professor	University of Chile	Chile
8	Ni Hao	PhD student	Zhejiang University	China
9	Zhang Hanbo	MA student	Fudan University	China
10	Raouffard M. Mahdi	MA student	Kyoto University	Japan
11	Naoki Tagami	MA student	Tokyo University	Japan
12	Naoki Tagami	MA student	Tokyo University	Japan
13	Shunsuke Honma	MA student	Tokyo University	Japan
14	Yuichi Otsuka	Under graduate	Tokyo University	Japan
15	Anawat Suppasri	Associate Professor	IRIDeS	Japan
16	Ingrid Charvet	PhD student	IRIDeS	Japan
17	Jeremy Bricker	Associate Professor	IRIDeS	Japan
18	Naho Ikeda	Assistant Professor	IRIDeS	Japan
19	Natt Leelawat	PhD student	IRIDeS	Japan
20	Prasanthi Ranasinghe	PhD student	IRIDeS	Japan
21	Takako Izumi	Associate Professor	IRIDeS	Japan
22	Yuichi Ono	Professor	IRIDeS	Japan
23	Tin Tin Su	Associate Professor	University of Malaya	Malaysia
24	Cynthia Zayas	Professor	University of Philippines	Philippines
25	Larisa G. Moskovchenko	Associate Professor	Far Eastern University	Russia
26	Liao Kuei-Hsien	Assistant Professor	National University of Singapore	Singapore
27	Goh Yang Miang	Assistant Professor	National University of Singapore	Singapore
28	Jeremy Piggott	Program Director	APRU secretariat	Singapore
29	Bruce Nelson	Professor	University of Washington	USA
30	John Rundle	Professor	University of California, Davis	USA
31	Masahiko Haraguchi	PhD student	Columbia University	USA