International Research Institute of Disaster Science
News Letter

IRIDeS quarterly

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Through learning, we find the power to persevere.

The International Research Institute of Disaster Science's mission upon the beginning of its second year.

3.11
Memorial Issue

Arata Hirakawa
Director of IRIDeS

It is the third month of the year, the beginning of a season of blooming flowers and new leaves. However, on March 11 two years ago, snow flurried over much of Tohoku. Despite the beauty of the season, we were suddenly struck by fear and anxiety at the time. Once again, I would like to express my sincere sympathy toward all who were affected by the disaster and those who are still adjusting to new environments. Founded on the determination and responsibility of researchers who work to reduce the risks incurred by unprecedented natural disasters, IRIDeS is a collective think-tank consisting of 7 broad divisions and 36 specific fields of engineering, humanities, and sciences, with the goal of providing a systematic and practical way of enhancing protection against disasters for present and future generations. Each IRIDeS staff member is reaching out the areas affected by the disaster to investigate the situation and to assist in the process of reconstruction. As such, it has been a busy yet productive year for all of us.

IRIDeS provides a systematic, "practical way of studying protection against disasters." By developing and deepening our specialized knowledge within each of our fields, our mission is to draft and to assess the effectiveness, practicality, and sustainability of redevelopment plans. In addition of being an expert in his or her field, each IRIDeS staff member is expected to broaden their knowledge outside their field of expertise, as we need to redevelopment in an intelligent, secure manner, not in haste. During reconstruction, broad, general knowledge is important, in order to see things from the big picture, and to encourage details in the reconstruction plan, so all the parts fit together into a coherent whole. Each of us constantly asks ourselves stoically, "how can I make my work more useful to society?"

In this issue of IRIDeS quarterly, we introduce this past year's activities and research topics. Our mission and responsibility is to pass on knowledge and wisdom to the next generation, as well as to implement effective disaster prevention & mitigation systems for today's and tomorrow's society.

The passage of time might cause our memories to fade away, but instead of focusing only on what we lost, we strive to utilize what we can learn from our experience to build a more resilient society in the future. Two years have passed since the Great East Japan Earthquake, and springtime is coming.

Restoring historical materials and documents. Over fifty thousand historical documents were recovered from the ruins of the disaster. During the past two years, only 1/5 of these materials have been restored and preserved, so there is still a long way to go. "The Miyagi Method" of document preservation was developed here and now is being introduced nationwide.

Founded on the determination and responsibility of researchers who work to reduce the risks incurred by unprecedented natural disasters, IRIDeS is a collective think-tank consisting of 7 divisions and 36 sub-fields of engineering, humanities, and sciences, with the goal of providing a systematic and practical way of enhancing protection against disasters for present and future generations.

Organization of International Research Institute of Disaster Science

IRIDeS was created to cultivate the new academic discipline of disaster mitigation based on lessons learned from the 2011 Tohoku earthquake and tsunami disaster. The institute has recruited world-class staff carrying out cutting-edge research with the aim of establishing resilient social and engineered systems for both prevention of, and for prompt and effective response to, natural disasters.

Hazard and Risk Evaluation Research Division

Professor Masato Motosaka

This division develops disaster prevention and mitigation technologies based on the synthesis of lessons learned from the 2011 Great East Japan Disaster and analysis of the disaster's generation mechanism. Through application of our research results to regions likely to be affected by a mega-disaster, this division aims to enhance preparedness, reduce risk, and speed recovery.

Human and Social Response Research Division

Professor Toshiaki Muramoto

This division studies historical disasters, in order to create a more resilient society in the present. Furthermore, we develop ways to protect regional culture and historical records from disasters, in order that this information may be preserved for future generations.

Regional and Urban Reconstruction Research Division

Professor Koichi Ishizaka

Focusing on "Reconstruction" of areas affected by disasters, this division develops survey and measurement technology to assess damage accurately and to decontaminate and reconstruct these areas into places where people may again live comfortably. Furthermore, the division develops technology for disaster prevention and mitigation, aiming for well-balanced, sustainable cities.

Disaster Science Division

Professor Hiromi Fujimoto

This division analyzes the mechanisms of generation of a wide-range of global natural hazards, such as great earthquakes and the resulting tsunamis, volcanic eruptions, climate change, and space hazards. Understanding these hazards better allows us to estimate short and middle-to-long term risks due to such events.

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Endowed Research Division

Professor Fumihiko Imamura

The endowed research division is sustained by a donation from private companies with the purpose of strengthening and diversifying education and research within the university and also to encourage putting research results to practical use. Currently, Tokio Marine & Nichido Fire Insurance Co. Ltd. funds the division's research on tsunami risk evaluation and assessment.

Disaster Medical Science Division

Professor Kiyoshi Ito

In cooperation with the Hazard & Risk Evaluation and Human & Social Support research divisions, this division aims to establish international standards for emergency medicine during major disasters. Such standards are needed for addressing infectious disease in affected areas, radioprotection from nuclear hazards, and for research on post-traumatic stress, in both the acute and chronic phases of a widespread major disaster.

Disaster Information Management and Public Collaboration Division

Professor Takeshi Sato

This division aims to enhance cooperation among government agencies and the public to provide practical support for reconstruction/revival and to prevent and reduce disaster risk. The division collects data on restoration/revival from both domestic and international sources focusing on the 2011 great Tohoku earthquake and tsunami. Major tasks set by the division are to design a new disaster-resilient society and to pass on lessons learned to future generations.

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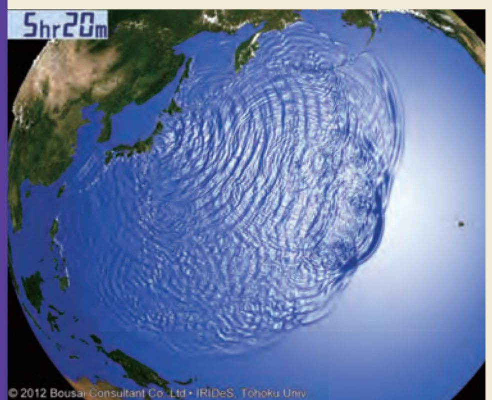
About the IRIDeS Logo

IRIDeS is the acronym for the International Research Institute of Disaster Science. Our logo was designed by inverting the Chinese character, 災, disaster, which represents "Turning a misfortune into a blessing." In short, IRIDeS hopes to use lessons learned from terrible disasters to create a more vibrant, resilient, and sustainable society. The logo also motifs a blooming flower of the Iris family, which symbolizes "Hope and Nobility."

Synthesizing the knowledge and experience of diverse experts

Researchers from IRIDeS

On March 11, 2011 at 14:46 pm, the earth trembled. An earthquake of magnitude 9.0 on the Richter Scale, the largest to have hit Japan in recorded history, struck Tohoku and the gigantic tsunami that followed swept away thousands of lives along our coasts, making us speechless and igniting our deepest emotions. Even cool-headed engineers and scientists were stirred to action by this event. What can we learn from this "3.11 event" and what needs to be done? For the first column in this series, we interviewed Professor Imamura, Japan's leading authority on Tsunami Engineering. (Interviewed Oct. 19, 2012)



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Simulating the mega tsunami flow (5 hour 20 min after the event) triggered by the 11 March 2011 Tohoku earthquake and tsunami (magnitude 9.0).

Moving forward with what we've learned Establishing academia of Tsunami Engineering that bridges scientific technology and human society

The day before the Great East Japan Earthquake, I was at the Japan Meteorological Agency in Tokyo for the Tsunami Disaster Symposium to make a keynote speech. I mentioned some problems concerning evacuation behavior of residents when attacked by the tsunami following the "2010 Chile Earthquake." Regardless of the warning alarm, only 10% of the residents of the area had evacuated. We exchanged ideas such as how to warn the residents of tsunami arrival. Looking back that occasion now, I think it was a very suggestive discussion.

The next day, I was still at Kasumigaseki in Tokyo for other business and encountered the earthquake. Tokyo also jolted severely. Furthermore, I found that the epicenter was off the coast of Miyagi Prefecture from the breaking news, which made me shivered: "the coming of a mega tsunami."

The "Tsunami Engineering Laboratory" is the only one organization in the world that studies tsunami disasters based on engineering approach. When an earthquake occurs, the possibility and scale of tsunami is immediately announced through the media. Such prompt "Tsunami Prediction" is a result of our study and this technology has been used in at-risk countries around the world.

A prediction technology employing computer analysis has made significant improvement in recent years. Besides the study of structures such as levees, in order to reduce damages actually, we need to raise people's awareness for risks that leads them to take evacuation actions. This is another aspect of tsunami engineering study.

As a specialist of this field, I have given suggestions to government authorities about disaster reduction systems and advice to citizens about disaster prevention through the media such as radio broadcast. What I strongly felt after "the 3.11," besides the feeling of emptiness, was a regret of not enough warning messages sent out to the public.

I am aware that the word "regret" expressed by specialists or researchers has a weighty meaning. However, what drives us to develop natural science at any eras is a feeling of great awe for nature which behaves beyond human understanding, and the attitudes of people reflecting own thoughts and behaviors.

The tsunami occurred this time in Japan where advanced information network runs through and thus large volumes of data were obtained. I feel that significant development in the tsunami research has been made as a result of precise data analyses contiributes to the hard work of researchers all over the world. I personally think, however, we have yet to grasp the essence: While the disaster (damage) occurred in human society, we need to evaluate information that we received, sent, and accumulated, such as on social media and car navigation, even though some may be unreliable and distort information. Collaborating with researchers from other fields, we are searching the possibility that such social information would complement numerical data.

As one of the victims going through the event, each IRIDeS member has high morale wanting to reflect his/her own intense experience on their research, thereby making use of the experience to mitigate and prevent disasters affecting society. Please take a closer look at our projects unequaled anywhere in the world.

Dr. Fumihiko Imamura [Professor]

Deputy Director General, International Research Institute of Disaster Science at Tohoku University, Tsunami Engineering field Hazard and Risk Evaluation Research Division.

Dr. Imamura was born in Yamanashi Prefecture. He earned his Doctor of Engineering degree from the Department of Civil Engineering at Tohoku University in 1989. He was then appointed Assistant Professor at the Department of Civil and Environmental Engineering at Tohoku University, Associate Professor at the Asian Institute of Technology in Thailand, and Visiting Scholar at the Research Center for Disaster Reduction Systems, Kyoto University. Later, he served as a Director of the Disaster Control Research Center at Tohoku University. He was appointed to his current post in April 2012.

Special Topics 1

Research and Results 1

A massive earthquake, significantly greater than anticipated, struck the northeastern coast of Japan. Our goal is to elucidate the seismogenic mechanism through research on crustal movements.

Earthquake

The media described it as “unanticipated;” the 2011 Tohoku Earthquake was of a scale beyond the expectation of researchers and experts. Global positioning system/acoustic (GPS/A) seafloor positioning sites and ocean bottom pressure sensors had been set up on the seafloor in anticipation for an earthquake off Miyagi, and they provided valuable data on the 2011 Tohoku earthquake. The analyses of these data revealed an unseen scale of crustal motion beyond the conventional knowledge of geoscience, which was initially considered a “mystery”. Thanks to these seafloor geodetic data, the field of earthquake research has progressed tremendously.

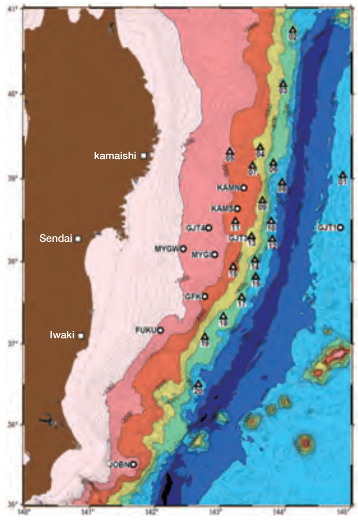
Slip area Coupling area GPS antenna

GPS signals do not reach the seafloor. Thus, a combination of GPS positioning and undersea acoustic measurements is used to identify the position of the seafloor indirectly, in a method called seafloor GPS. With kinematic GPS positioning of a buoy combined with GPS positioning of a fixed ground station, the location of the buoy can be identified to within 1 cm accuracy. Acoustic ranging then measures the distance between the buoy and acoustic transponders installed on the seafloor.

Off the Pacific coast of Miyagi Prefecture, subduction thrust earthquakes with magnitude around 7.5 occur at an interval of approximately 37 years. Many people may have heard the warning by the Headquarters for Earthquake Research Promotion (a special governmental organization): “the probability of the M~7.5 earthquake occurring within the next 30 years is 99%”. In anticipation for the earthquake, Tohoku University had been conducting observations on the oceanic crustal motion using GPS/A seafloor positioning. Based on the data obtained, it was found that the large slip area of the main shock of the 2011 Tohoku earthquake was concentrated off the coast of Miyagi Prefecture, and the slip was larger near the Japan Trench than near the coast. This phenomenon had never been expected. GPS/A seafloor positioning had largely been considered complementary to the terrestrial GPS observation network that continuously records high-precision, high-density, real time measurements. However, after this event, GPS/A seafloor positioning was found essential for investigating the distribution of seismic coupling on the plate boundary (especially near the Japan Trench) by measuring seafloor crustal movement in order to analyze megathrust earthquakes and massive tsunamis.

GPS/A seafloor positioning off the coast of Miyagi had been conducted both by Tohoku University and the Japan Coast Guard. However, there were no observation stations in the area with the largest slip during the 2011 Tohoku earthquake, highlighting the necessity to expand and upgrade the seafloor observation network. Entrusted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Tohoku University (in a joint project with Nagoya University) has recently deployed 20 observation stations in the vicinity of the Japan Trench, including deep water regions (6 km below sea level).

A major challenge in the collaboration among the universities and the Japan Coast Guard on the GPS/A seafloor positioning was the fact that each organization was using different echo-ranging systems. As such, it took time to calibrate the data acquired by these institutions. To avoid this process, a nationwide system of echo-ranging data acquisition was developed.



“○”indicates existing observation stations. “▲” indicates 20 newly installed observation stations. Standardizing data obtained by universities and the Japan Coast Guard increases the amount of data available to everyone; this nationwide system leads to better understanding of the detailed mechanism of subduction thrust earthquakes.

In order to reduce damage from natural disasters, it is necessary to first clarify their mechanisms. One of the keys to elucidating the mechanism of subduction thrust earthquakes is to measure seafloor movements.

Interview and figures provided by Hiromi Fujimoto
(Professor, Marine Geodesy Research Field, Disaster Science Division)

How long will aftershocks continue to occur?

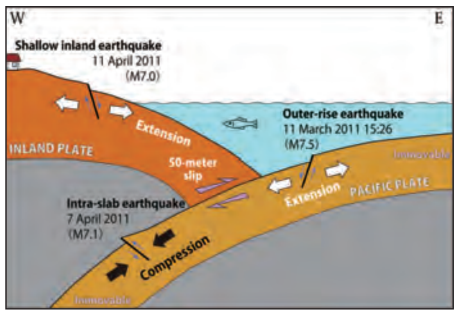
Widespread aftershocks as a result of stress transfer from one fault to another. Understanding their complicated behavior.

Ever since the 2011 Tohoku Earthquake, the earth has continued to rumble. Last December we had a magnitude 7.4 aftershock and this caused a tsunami of maximum height 1 m in Ishinomaki, Miyagi Prefecture. This was possibly an outer rise earthquake, as reported by the media. In general, a large earthquake is considered to be a phenomenon that releases strain accumulated in the nearby crust as a result of seismic movements. So, why does the risk of earthquake incidence increase?

An “aftershock” is an earthquake occurring along the fault (epicenter fault) that caused the main shock, in order to eliminate slip remaining after the main shock. The aftershock distribution within a day or so from the main shock is considered to indicate the scale of the source fault. Recent improvements in measurement accuracy have shown that a number of aftershocks occur at locations very far from the epicenter. Let me explain the mechanism more precisely:

“Coulomb failure stress” is used as an indicator to judge whether a fault is movable or immovable. Its value is the total of the shear stress (slipping) along the fault surface plus a coefficient of friction times the normal stress on the fault surface (negative if clamping, positive if unclamping). The Coulomb failure stress increases when the shear stress increases or the normal stress unclamps, which makes the fault move more easily. Although extensive research has been conducted, predicting actual seismic activity is still difficult because an enormous number of large and small faults exist within earth’s crust, and strengths and stress fields are complex.

The effect of the 2011 Tohoku Earthquake is considered to be diminishing, yet some areas do not show any apparent reduction in the frequency of aftershocks. A Japanese physicist and author, Terada Torahiko, wrote: “A natural disaster strikes when people forget the previous one.” We should make good use of our experience to prevent and mitigate disasters by never forgetting the 2011 Tohoku Earthquake.



Broadly-spread aftershocks greater than or equal to magnitude 7 were caused by the stress field flipped from the pre-Tohoku one.
The fault that caused the 2011 Tohoku Earthquake is estimated to be approximately 500 km long and 200 km wide, inducing horizontal land displacement of up to 50 m. The northeast Japan arc had previously been pushed toward the Pacific Plate and the land was gradually compressed from both the east and the west (The distance between the Oshika Peninsula on the Pacific side of Japan and Awashima Island in Niigata Prefecture on the Japan Sea side of the country had been shrinking at a rate of 3 cm/year.) The 2011 Tohoku Earthquake, however, reversed the direction of force applied to the terrestrial crust.

Interview and figure provided by Shinji Toda
(Professor, Natural Disaster Research field, Disaster Science Division)

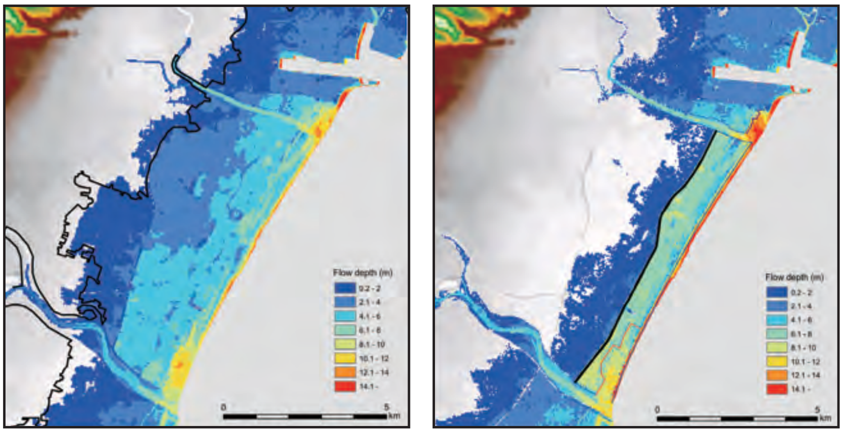
Special Topics 1

Research and Results 2

Elucidating the generation, behavior, and damage resulting from the tsunami, in order to make use of lessons learned from the mega earthquake by enhancing disaster preparedness and mitigation.

Tsunami

The massive tsunami caused by the Great East Japan Earthquake on March 11, 2011 left 18,579 people dead or missing in 12 cities and rural areas (Jan. 2013, Emergency Disaster Countermeasures Headquarters, National Police Agency of Japan).
The enormous impact of the mega tsunami described as occurring "once in a thousand years" dramatically changed people's thinking and attitude toward disaster preparedness.
We continue to devote our utmost effort to minimizing damage after an earthquake strikes.



Left: Greatest inundation depth from tsunami simulation that reproduces the 3.11 event along the Sendai coast (tsunami inundation depth and area). This simulation has been verified with on-site investigation data and data from the Geospatial Information Authority of Japan (bold, solid black line).
Right: Greatest inundation depth including the effect of tsunami mitigation structures planned by Sendai City, such as a coastal levee (7.2 m) and a raised Shiogama-Watari prefectural road (6 m: Bold solid line). Thanks to the improvement of the levees and raised road, inundation area and depth are expected to decrease, especially to the west of the prefectural road. Still, it is impossible to fully prevent tsunami inundation, and tsunami waves reflected by the levee would deepen inundation on the east side of the road. Key factors to recovery are whether effective measures are devised for land use on the east side of the road, and whether living space and evacuation routes can be ensured for people living in that area. Prepared by Shunichi Koshimura.

Clarifying the mechanism of the tsunami's "Return Flow", destroyed coastal levees.

Coastal protection facilities like levees play an important role in creating a safe community. The Japanese government has established a guideline dictating the required minimum height of levees (method of setting design tsunami water level). According to this guideline, levees are to be designed tall enough to prevent overtopping due to tsunamis estimated to have a return period of over 100 years (tsunami prevention level), and strong enough to withstand a mega tsunami like the 3.11 event without incurring serious damage (tsunami mitigation level). In order to construct coastal levees tough enough to withstand the design event, it is necessary to clarify the mechanism of how coastal levees are destroyed by tsunami. Various records obtained after 3.11 have given us important clues about tsunami behavior and the mechanism responsible for failure of coastal levees.

Looking at the damaged levees, we found that not only surging waves carrying tremendous force, but also return flow (backwash), greatly contributed to the destruction of coastal levees. Areal images and photos show intense return flow issuing from the locations at which levees were breached. Return flow is concentrated into existing or historic channels, accelerating flow speed there, thus increasing coastal erosion and topographical deformation, and resulting in the destruction of levees.

Japan's longest canal, the "Teizan Canal", runs almost parallel to the coast of Sendai Bay, from the mouth of the Kitakami River to the mouth of the Abkuma River, passing through Matsushima Bay. The Teizan Canal was constructed by the order of Date Masamune, a feudal lord of the Sendai Domain. Its major purpose was navigation and shipping, but it also aimed to drain water from the coastal lowland, greatly contributing to the cultivation of new rice fields. To the north of the Abukuma River, the Teizan Canal (followed later by other canals) collected and mitigated overland flow, thereby reducing large-scale erosion. Our ancestors' civil engineering heritage is now drawing attention.

Evaluating towns' vulnerability to tsunami through numerical simulation.

Scientific data on tsunami damage can only be traced back 100 years, but ancient documents written by our ancestors tell us that a gigantic tsunami arrived at intervals of 500 years to 1000 years. Further, we are now investigating the distribution of crustal layers of "tsunami deposits" such as sea sand and seashells. This has revealed new evidence about tsunamis including the AD 869 Jogan Tsunami of about 1100 years ago that inundated the Sendai Plain (Miyagi Prefecture). It reached nearly 5 kilometers inland from the present coastline. With research and analysis of tsunami deposits and ancient documents combined with tsunami simulation, the generation mechanism, speed, destructive force, and extent of inundation of historical tsunamis can be estimated.

As for mega tsunamis with a return period of several hundred to a thousand years such as the 3.11 event, it is impossible to protect land areas only by using coastal levees and breakwaters. It is necessary to establish "multiple" preventive measures: fostering green zone and disaster-prevention forestry in the hinterland; constructing embankments that function as levees as well as transportation facilities such as main roads and railroads; and reorganizing the layout of residential areas. In order for a town to be rebuilt resilient to disaster, numerical tsunami simulations capable of verifying the effectiveness of such infrastructure at mitigating tsunami damage should be utilized at the stage of town planning (see the figures above).

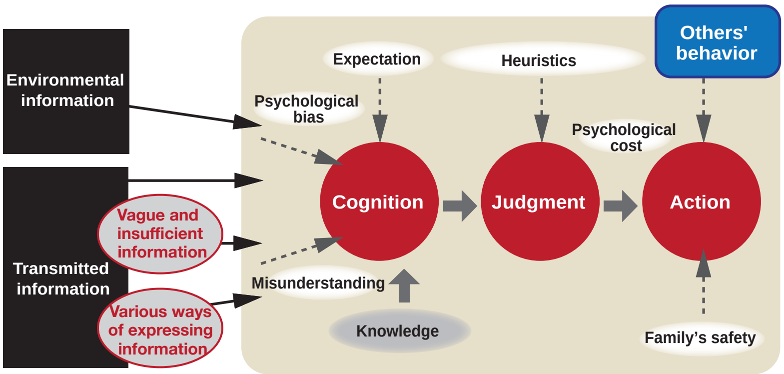
Based on lessons learned from the 3.11 Earthquake, high-risk areas need to implement various measures to create towns capable of withstanding a mega tsunami and thereby minimizing damages anticipated in the future. By actually taking the first step toward disaster mitigation, we can say that we have truly made use of the lessons learned from the 3.11 Earthquake.

Left: Yamamoto Coast before the 3.11 Earthquake (Photo provided by Tohoku Regional Bureau, Ministry of Land, Infrastructure, Transport and Tourism) and after the event (Photographed on March 19, 2011 by Kyodo News Service), showing the largest damage in the Sendai Bay area. The tsunami greatly eroded the backshore area, widely breaching the coastal levee.

Interviews, figures, and photos provided by
Akira Mano (Professor, Disaster Potential Study field, Hazard and Risk Evaluation Research Division)
Fumihiko Imamura (Professor, Tsunami Engineering field, Hazard and Risk Evaluation Research Division)
Shunichi Koshimura (Professor, Remote Sensing and Geoinformatics for Disaster Management field, Hazard and Risk Evaluation Research Division)

Why do people not evacuate? Searching for factors that govern how humans process information:

Evacuation and Information



Model of information processing at the time of a disaster. Human cognition is affected by a number of factors, so people often make an incorrect judgment without realizing it. Understanding this human tendency will help us educate people to make the correct decisions during a disaster.

In the event of a disaster, how do people take in "information," and what kind of decision do they make? The Central Disaster Management Council, Cabinet Office, Government of Japan (Technical Investigation on Countermeasures for Earthquakes and Tsunamis Based on the Lessons Learned from the "2011 off the Pacific coast of Tohoku Earthquake"), conducted a survey on the behaviors of people who had received information urging immediate evacuation to higher ground/places at the time of the Earthquake. The result showed that 60% of the people responded to the warning by evacuating immediately. The remainder did not take proper action.
The Disaster-Related Cognitive Science laboratory at IRIDeS conducts psychological classification and analysis of disaster victims' cognition, judgment, and behavior, investigates the factors that prevent people from evacuating promptly, and strives to determine how to more effectively provide information during emergencies.

Understanding the human cognitive response to information reception, to learn how to more effectively release information during disasters.

Why do people not evacuate, even when they know danger is imminent? According to surveys conducted after the 2003 Tokachi-oki Earthquake, the 2006 and 2007 Kuril Islands Earthquakes, and the 2010 Chile Earthquake, the most common answers by respondents were: "I thought the place was safe," "I didn't think that the tsunami would overtop the levee," and "I felt safe when I was informed about the tsunami heights in other areas." People overestimate the safety of their homes, are overconfident in their levees, and underestimate tsunami height, revealing the tendency of human cognition and judgment before disasaters.

The major factors that affect human information processing during a disaster are:
(1) Cognition: Even in an abnormal situation, people tend to consider the situation as normal, or selectively filter information that meets their own thoughts and expectations.
(2) Judgment: People make decisions intuitively by rule of thumb, rather than based on strict probability-based calculations. Also, we tend to judge things based on available information in our minds.
(3) Action: People tend to avoid physical and psychological stress, behave as others do (conforming behavior), and prioritize the confirmation of their families' safety over their own individual safety. This prevents people from evacuating.

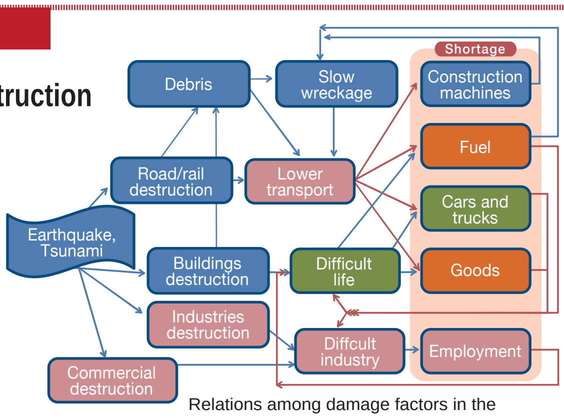
In order to link emergency information to an individual's decision to evacuate, it is necessary to understand the cognitive characteristics of humans as mentioned above, and to use effective phrases and expressions when issuing public warnings, thereby clearly conveying the urgency of the situation to the people in danger. In addition, it is important to pay attention to the quantity and quality of the broadcast information so that it can be properly conveyed to people who possess little knowledge about disaster. Furthermore, it is important to educate the at-risk populace about disaster before a disaster strikes.

The expertise with which information is broadcast during a disaster has a large effect on the degree of damage that follows. In addition to this, learning and preparedness of the at-risk population are necessary to reduce damage in the wake of disaster.

Interview and chart provided by
Toshiaki Muramoto (Professor, Disaster-Related Cognitive Science field, Human and Social Response Research Division)

Establishing a resilient transportation network

A transportation network for firm connection and prompt reconstruction 4 key points for avoiding traffic stoppage or local isolation



Relations among damage factors in the disaster area. These interdependent factors prevented prompt recovery and reconstruction.

The Great East Japan Earthquake strongly damaged public infrastructure such as roads, railways, and harbors, as well as electric power supply, communications, and broadcasting. In addition to this damage, devastated coastal areas faced the accumulation of an enormous amount of debris, making it difficult to grasp the full picture of the devastation. Furthermore, the lack of heavy construction equipment and fuel shortages delayed the removal of debris from the blocked roads, making it difficult to deliver relief goods from outside the disaster areas, and to fasten the recovery of people's lives and industries.

Based on the experience from this event, future transportation networks need to be planned with the following in mind: (1) Transportation facilities need to be designed not only strong enough to withstand earthquake shaking and tsunami inundation, but transportation networks as a whole must be designed with enough redundancy to continue operating even after suffering localized damage. This is essential for smooth recovery from a disaster. (2) Technologies to quickly and remotely detect damage in transportation facilities must be developed. For example, wire and/or optical fiber embedded in pavement and railway tracks can be used to detect damage based on impedance changes. (3) An emergency traffic control system needs to be developed that uses data collected during a disaster to prioritize traffic flow for first responders and medical support services. (4) Redundant transportation networks should be funded and maintained for use during emergencies. For example, along with newly developed bullet train line, there are discussions as to whether to use or remove the conventional lines running parallel to the bullet train lines. After the 3.11 earthquake, the conventional lines were useful for shipping supplies to the disaster areas.

The Great East Japan Earthquake caused various and complex damage, prolonging the process of recovery. It is essential for us to understand what aspects of the transportation network worked, and what aspects failed, and to convey this knowledge to future generations.

Interview and chart provided by Makoto Okumura
(Professor, Affected Area Supportology field, Human and Social Response Research Division)

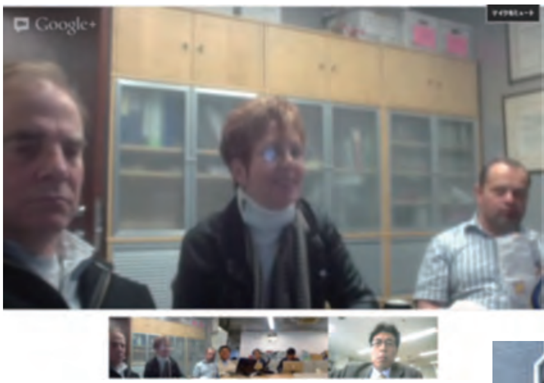
Structuring disaster medical treatment for flexibility and prompt response to the rapidly changing situation in a disaster area

Disaster Medicine

Our nation's disaster medicine practice has progressed dramatically since Hanshin-Awaji Earthquake in 1995. However, the Great East Japan Earthquake affected public health in a different manner than we had experienced in previous disasters. It is urgent to devise systematic and coordinated method for disaster medicine and public healthcare to overcome the difficulties of coming large area disasters.

On 3.11, we faced problems in the disaster areas that we had never experienced before.

After the earthquake, the death toll from the tsunami and from hypothermia (as victims spent hours outdoors in the cold while waiting rescue) was much higher than from building collapses.
Also, health providers have been facing new issues such as chronic disease as patients spend a prolonged time in evacuation shelters, mental instability and stress after having experienced the trauma of disaster, and potential health complications due to radiation. EMIS (Emergency Medical Information System), a system developed



The Division of Disaster Medical Science uses an online conference system as a convenient communication tool; on January 5, 2013, an online conference was made among three locations: Tohoku University's Department of Engineering, Senen Hospital in Tagajyo city, and Texas A&M University.

from the experiences and lessons leaned from the Hanshin-Awaji Earthquake should have functioned properly. However, a critical issue remained: the worse the damage to an area, the more difficult it was to hear victims crying out for help (refer to the article below).

Human society needs to respond to frequent disasters and all the damage they incur. The Division of International Cooperation for Disaster Medicine at IRIDeS has started consulting with cooperating organizations to standardize the educational curriculum of "Coordinators for Disaster Health Care and Medicine", with the focus of the program varying per prefecture. The goal of the coordinator is to systematize activities such as the collection and proliferation of information by trained expert coordinators during an emergency. Furthermore, we are providing an active type education to busy health professionals about how to deal with disaster situations, and standardizing the creation of BCP's (Business Continuity Plans) to encourage the smooth resumption of treatment and daily operation at hospitals in the disaster areas. These tasks are one of our main missions.

Tohoku University Medical Center held a major disaster prevention drill on November 9, 2012. The photograph shows injured patients awaiting triage. One year and 8 months have passed since the disaster, but still some staff recall the event clearly.

Disaster-proof society won't grow out of sturdy structures alone; this requires medical professionals and teams trained to adapt quickly and flexibly to the rapidly changing situations encountered in disaster areas. Providing the required support "on time and on site" to local medical providers will become a driving force for disaster recovery.

Interview and photos provided by
Shinichi Egawa (Professor, International Cooperation for Disaster Medicine field, Disaster Medical Science Division)

An information sharing system for health and medical care

Preparing and developing a disaster-proof information sharing network for gathering and distributing the information necessary to save lives

In the areas hit by the tsunami, the health and medical care systems were heavily damaged because facilities had been washed away or flooded. Tremendous efforts were made to keep medical care functioning despite the critical and chaotic situation. However, the sharing of information between local medical professionals and supporting teams from outside (both domestic and international) were insufficient.

Takeshi Sato, a professor at IRIDeS, worked with the Health and Welfare office of Miyagi prefecture a week after March 11, 2011. Prof. Sato organized the disaster health and medicine information sharing service at the emergency support center.

First, his team provided hardware, supported by an NGO and local private businesses. With this support, the team managed to supply 59 computers with built-in data communication terminals to requesting areas. Volunteers helped install and set up the computers at each site. This was followed by development of a mailing list system (started on March 24, 2011), after which sharing of information and problems among community members and supporters became possible. The team tried to match the needs of each disaster area with the available equipment. In addition to creating a mailing list, the team launched a website to share information covering various stories important to the local populace.

Development of a health and medical information sharing network for emergency situations will reduce the death tolls in future disasters. We are working to coordinate the logistical, technical, and financial support necessary to build such a network.

At the support center for disaster heath and medicine, various activities were enacted to support the disaster areas: providing information to assist medical relief activities, coordinating logistical support with the medical relief activity on site, supplying and distributing relief goods, and sending volunteers to assist in shelters and understand the needs of the victims and refugees.

Interview and photo provided by
Takeshi Sato (Professor, Disaster Reconstruction Design & Management field, Disaster Information Management and Public Collaboration Division)

Special Topics 1

Research and Results 5

Centering reconstruction planning on the natural environment that survived the disaster, with a link to the past based on memories of residents.

Reconstruction and Community Development

A shrine located on slightly elevated ground (Shimomasuda, Natori City, Miyagi Pre.) survived, while most of the houses and shrines along the coast near Sendai airport were washed away. This location of this shrine is elevated slightly above the surrounding area.

Field investigation of the special committee on the Great East Japan Earthquake of the Japan Society of Civil Engineers. From the presentation materials of Professor Eiichi Itoi (Tsukuba University).

There is a big difference in the extent of damage across only several meters difference in altitude. By combining relocation to slightly higher ground with other disaster prevention measures, disaster-resilient towns can be developed without the need to relocate to distant locales.

In traditional style, a shrine watches over the town's main road. Even though buildings have been destroyed, the town's framework remains as a foundation for linking the past to the future.

In recent years, many Japanese rural areas have been facing the serious problems of a shrinking and aging population and declining city centers. Disaster stricken areas aren't an exception to these issues, facing the same problems with the further challenges of reconstruction and developing disaster prevention/mitigation plans.

Since the giant tsunami struck such rural areas, these issues have become the main obstacles to reconstruction. If any realistic and specific plan of redevelopment had been presented in advance, it could have been a future model for newly developing areas by promoting "reorganizing society" into "compact cities." Because of the lack of any prescription for solving these problems, the affected areas inevitably rebuild haphazardly, without a clear vision for the future.

Also, the conflict between prioritizing safety and compact community development further complicates planning. For example, some residents desire well-built levees for protection from tsunamis and high tides in order to keep their communities safe. On the other hand, other residents oppose levee construction, as such structures block views of the sea and negatively affect tourism. At question is not just whether or not to build a levee, but an integrated development plan that balances safety and quality of life.

Reconstructing a community is a process of bridging the past with the future.

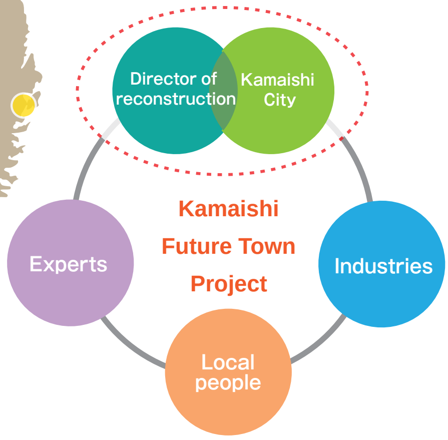
However, these obstacles can't stop us from rebuilding towns where the victims of the disaster can live and thrive. It's important to incorporate local history and culture into the community plan, as residents' memories of the place are what lead them to love the place and to work hard for its prosperity. Unfortunately, the giant tsunami destroyed many of the material objects their memories are centered around, but nature and its sights have survived: the color of the ocean viewed from a hilly road is the same as it was before the tsunami, a grove of trees and a shrine on a hilltop look just as they did years ago. Such sights and memories linked to them tie eras and generations of residents together, and bring people to love their land and to make it prosper. Retention of local history and culture is an essential theme for developing a community.

Combining social and economic functions on "slightly higher ground," a disaster-resilient compact city.

The redevelopment experience of the areas affected by the tsunami can provide several lessons for future community development plans nationwide. Many buildings and facilities located on slightly higher ground were undamaged by the tsunami. Wishing to develop safer communities, our ancestors thought about topography carefully and built their villages in areas they considered safe. As they did, we need to consider reorganizing towns to locations where residents can live in safety and prosperity, with a compact development style that is sustainable in light of the region's declining population.

Interview and photographs provided by
Katsuya Hirano (Associate Professor, Disaster Reconstruction Design & Management field, Disaster Information Management and Public Collaboration Division.)

Iwate Prefecture Kamaishi City



Kamaishi future town project, experts and industries, incorporating local people's opinions to develop city planning. An architect who is selected by the committee will hold workshops and exchange opinions to build a partnership with locals.

January 25 and 26, 2013, "Building a Smart City, Kamaishi City's future industry and new sources of energy" (hosted by Tohoku University, the Embassy of the Netherlands, supporting the City of Kamaishi, Iwate prefecture). On the first day, a panel discussion was held with experts, researchers, and government officials from both Japan and the Netherlands. The second day, workshops were held by industries, local residents, and local high school students as well as Tohoku University students.

Visiting Unosumai district, northern part of Kamaishi city, where 583 people died or are missing due to the tsunami. Professor Onoda explaining the situation at the disaster site (right corner).

Communication between administration and residents to encourage cooperation for a prosperous future
Sharing a vision of the future to support the process of reconstruction

Prompt response and receptiveness to public opinion are key factors in reconstruction. However, these tasks are not easy to perform. Especially difficult is mapping out the future structure of the village in a way that blends the wishes of residents with the various aspects of technical feasibility.
Each stakeholder works independently, yet IRIDeS facilitates coordination among parties by providing clear explanations by expert city planners and architects to local governments and residents.

Making the reconstruction process transparent, and encouraging the involvement of society for their future. Introducing proposal-based projects.

Kamaishi City in Iwate prefecture was affected by the 3.11 tsunami as heavily as other parts of the Sanriku coast. The death toll (including missing people) reached 1.121 (announced on Sept. 2012 by the Fire and Disaster Management Agency). An area of 7 square kilometers, including the city center, was inundated. Some villages were isolated temporarily due to traffic routes being cut off.

IRIDeS Professor Yasuaki Onoda started a project supporting reconstruction of Kamaishi city in early April 2011, at the initial stage of reconstruction. His goal is to help rebuild the disaster area based on three pillars: local government, residents, and experts. By having experts discuss the reconstruction plan with residents, the team set three specific visions; securing experts' points of view, gathering public opinion, and bringing about hope for the future.

Regarding how to secure experts' points of view, Professor Toshihiko Koshimura (IRIDeS Disaster Potential study division) has contributed his extensive knowledge pertaining to prevention of tsunami disaster. Dr. Koshimura uses numerical simulation to understand the complex behavior of tsunami, in order develop plans for preventing tsunami disaster (please refer also to the article "Tsunami" on Page 5).
Furthermore, Professor Onoda coordinates the "Kamaishi future city project" for integrating society and ushering in the future. The project has announced open calls for competitions to design public housing for refugees from the disaster areas. Architect Toyoo Ito, Associate Professor Arata Endo (Tokyo Urban Tech) and Professor Onoda are the directors of the project. It is unique in that the residents get involved in the selection process. Furthermore, workshops are held with proposal authors to foster two-way communication with residents, so proposal authors can formulate their plans to reflect "local memories," the area's history and culture, and the ideas of individual residents. Thus far, in November 2012 in Tenjin district, and in January 2013 in Kojirahama district, such competitions have been held to select architects for public housing plan, so that reconstruction can commence.

Disaster-proof + Eco-friendly town Learning from countries with advanced technology and knowledge

Kamaishi city has been trying to develop a "Smart community master plan," aiming for building a disaster proof, energy efficient town. "Smart City" is a project based on utilizing advanced Information Technology to use energy efficiently in municipal operations. Renewable energy sources such as biomass (making use of plentiful forest resources) and solar can be assessed to find a perfect balance for the community. However, an obstacle is convincing existing energy suppliers to adopt renewable energy sources as an actual business.

In January 2013, five urban planning experts were invited to examine the consequences of the Smart City project. Tohoku University and the Embassy of the Netherlands hosted a panel discussion and workshop to share ideas and to examine the specific beneficial uses of the project in reconstruction. This venue gave locals an opportunity for active opinion sharing and cultural exchange, and all parties pledged for further support for the future.
During the initial stages of reconstruction, prompt and decisive action by the government is necessary, but those who are ultimately affected by reconstruction are the locals. To keep a reconstruction plan on track, it is important to share the vision for reconstruction among all stakeholders, connecting bureaucrats, locals, urban planners, and architects.

Interview, figure, and photos provided by
Yasuaki Onoda (Professor, Disaster Reconstruction Design and Management field, Disaster Information Management and Public Collaboration Division)

Miyagi Prefecture

Ishinomaki City

Moving forward to creating a safe and secure compact city.
IRIDeS staff working as a bridge between citizens' ideas and the municipality's business plan.

In the disaster areas on the Pacific coast of Tohoku, people are working toward the reconstruction of their towns while facing various challenges. One major problem is how to rebuild a town into a sustainable "compact city" or villages where, in the present situation, there is hardly any hope of population increase in the future. Here, "compact city" means an attractive place where people can communicate readily with each other, not just a place where houses and public facilities are gathered in the central part of the town. Usually, it would take a long time for an already-established city to evolve into a compact form. In the case of a city recovering from a devastating earthquake and tsunami, however, this process need not take so long.

Reconstruction work faces many challenges. Setting up a system for public and private sectors to work hand-in-hand.

Located at the mouth of the Kitakami River, Ishinomaki was a prosperous town as a central port for maritime shipping in the Edo era. In recent years, however, it has become a "typical backwater city" with a deteriorated downtown symbolized by the term "shuttered-store street," in addition to the problems of an aging and declining population (due to emigration to more prosperous suburban areas).

The massive tsunami that struck Ishinomaki left nearly 2,500 people dead or missing in the midtown area alone. Approximately 20,000 houses were completely destroyed. The tsunami not only destroyed the coastal area, but it ran up the Kitakami River and wrecked even urban areas far from the ocean. Progressing from recover to rebirth, Ishinomaki took a new step at aiming toward "a resilient, safe and secure compact city."

Image of a constructed walking path at Kawaminato where people enjoy the scenery, restaurants, and shops. "We learned the hard way that how fearful the force of water was! Therefore, in the first couple of months after the 3.11 event, many people of our committee made a firm decision that they would construct a safe and secure living place far from the Ocean. Gradually, however, we've come upon an idea that water is what characterizes Ishinomaki and is an important resource for the town, without which there would be no rebirth of the town. … It is important as well as necessary to accept the nature of water including its fearfulness, make good use of it, and live in harmony with it." (Suggestion by "Downtown Rebirth Committee," June 2011)

Unfortunately, it is not unusual that miscommunications occur between public and private sectors when a local township is planned and constructed. Government-led city planning is unlikely to reflect the ideas of the general public, while the general public, lacking in experience, cannot picture the future of its own town or give opinions effectively and independently. It is therefore necessary to set up a system to help public and private sectors to work together.

Citizens' power promotes the creation of a town where "hard" and "soft" aspects are organized harmoniously.

The Regional and Urban Reconstruction Research Division in IRIDeS works as a go-between for the "City Rebirth Committee" set up in the Ishinomaki City Hall and the "Compact City Ishinomaki Downtown Rebirth Committee" (Downtown Rebirth Committee) organized by its citizens. IRIDeS has provided support so that both these committees can share in the reconstruction process. One of the Division's tasks is to "interpret" technical terms into words easily understood by citizens so that smooth communication can be achieved. The city's basic policy is to actively acquire new resources such as new industries, experts, and volunteers from outside the city while reorganizing and developing the historical, geographical, and human resources that the city has owned as a base. It is this progressive sprit that Ishinomaki had during the Date Domain of the Edo era, when the city functioned as a logistics hub of Tohoku and large quantities of people and goods passed through. The Division also organized residents' workshops, put the design codes of "Ishinomaki Rebirth Guidelines and Rules" into shape, and gave suggestions to relevant organizations.

Workshop organized by the "Downtown Rebirth Committee" where Associate Professor Ubaura is a subcommittee chairperson. The workshop was held 11 times from Jan. to Apr., 2012.

Working on problems that existed even before the 3.11 Earthquake such as population decline, Ishinomaki is trying to reestablish itself as a sustainable urban community by establishing a "Basic Ishinomaki Reconstruction Plan" and promoting the integration of urban functions into its central district. Creating a compact city from the perspective of human aspects has only just begun. To begin with the "Downtown Rebirth Committee," the participation and empowerment of its people are anxiously awaited.

Interview, image, and photos provided by
Michio Ubaura (Associate Professor, Technology for Urban Resuscitation field, Regional and Urban Reconstruction Research Division)

COLUMN

Historical Document Rescue Team in action!

Within a month after the event, we started a historical document rescue operation. At the Kadonowaki area in Ishinomaki, there was a family that owned two houses, an earthen storehouse, a warehouse, and a board-wall storehouse, which were either destroyed or washed away. The earthen storehouse, seismically strengthened several years ago, however, miraculously survived although the 1st floor was inundated up to its ceiling. The total number of restored documents filled 60 cardboard boxes. Other rescued items include paper-made sliding doors with old documents placed underneath the door's surface paper, and more than 20 framed historical documents. Against the unprecedented earthquake and tsunami, these historical documents of the Edo area were safeguarded by the earthen storehouse, so the storehouse itself must be a symbolic figure of the memory of the 3.11 Earthquake. The photo at right shows the storehouse that endured the tsunami.

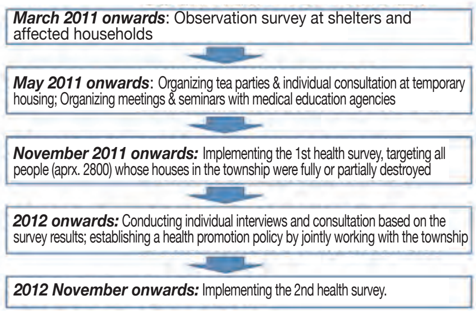
Miyagi Prefecture

Shichigahama Township

Health surveys in the devastated areas elucidated post-quake stress affecting people's physical and emotional health. Knowledge obtained from the survey results is used for betterment of post-quake health of victims.

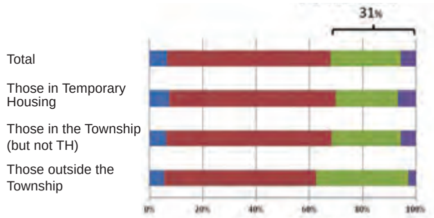
Disaster strikes without any warning. It threatens one's life, claims the lives of precious family and friends, and shakes the foundation of one's livelihood such as property and job. It is known that traumatic stress severely affects people physically and mentally, and is often a direct or indirect cause of disease.
The importance of mental health care was suggested after the Great Hanshin Earthquake, and relevant knowledge has since been accumulated. Immediately after the 3.11 Earthquake, health and welfare professionals and teams visited the disaster-stricken areas to help people with disaster-related psychological problems.

Shichigahama Township & Tohoku University joint project for promotion of post-quake health

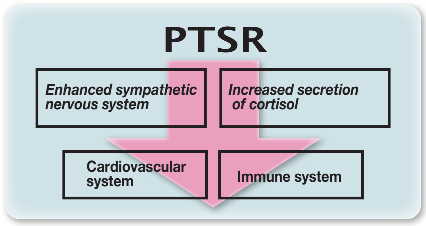


Based on the results of the health surveys, in collaboration with Shichigahama Township, we increased the opportunity for people suffering from post-quake health problems to obtain consultation. In addition, we continue to provide information to help people recover from post-disaster physical and mental damage.

Disaster Impact Measurement Result:
Nearly **30%** of people exhibit more than a certain level of post-quake impact on health. This is especially apparent among those residing outside the township.



People possibly having post-quake mental and bodily influences above a certain level



Encouraging people affected by the disaster to help them rise from the ruins. Health Enhancement Project under collaboration with the local government.

In collaboration with Shichigahama Township in Miyagi Prefecture, Tohoku University set up the "Shichigahama Health Enhancement Project," in order to provide consultation to individuals, organize tea parties in temporary housing, and run health seminars. In addition, the Project conducted a questionnaire survey on the general health and living conditions of people whose houses were completely or partially destroyed. The obtained results have been used to provide people with more detailed support for health enhancement, and were also published in the township report to inform the residents about post-quake health effects. More detailed data were obtained through an interview survey targeting those who agreed to be interviewed.

Here, we summarize the survey results of 1,892 people who agreed to collaborate with our data analysis. The questionnaire was conducted in November 2011. Of the respondents, 48% live in temporary housing in Shichgama Township, 34% in their own repaired or reconstructed house or in a relative's house, and 18% in neighboring areas. Among them, males accounted for 48% and females 52%. The present analysis results use data from adults only.

Anxieties, insomnia, and disorders… Understanding the physical and mental changes caused by the disaster, in order to use analysis data to promote healing.

After experiencing a severe earthquake, some people recall painful memories unexpectedly in their ordinary life, become nervous due to even small things, have nightmares, or wake up during sleep. This is called Post-Traumatic Stress Reaction (PTSR). Most of these symptoms diminish with time, but such symptoms may continue in same cases. The present survey showed that these impacts still persist in nearly 30% of the respondents. (See the graph above.) Also, sleep disorders such as insomnia were found in nearly 40% of them. This is about 10% greater than the result of a nationwide survey using the same questionnaire.
It is known that stress affects the sympathetic nervous system, cortisol (a hormone), and immune cell functions, closely related to mental condition. It is also known that immune cells exist in saliva and blood, and the study of immune cells at the molecular level will elucidate the physical and mental effects of stress more precisely. Our research of molecular immunology will continue along with health surveys and interview surveys (See the chart above).

There are some people who hesitate to consult even with a person close to them or to get medical help, even though they have health problems. This tendency is often observed in disasters. In order to lead such people to seek proper medical support, it is necessary to continue health surveys, investigate the mechanisms of how disaster affect people's body and mind, and use the results to suggest ways to provide support and medical care. We will continue our investigation and support with the collaboration of Shichigahama Township and the affected people.

Interview, charts, and photo provided by
Hiroaki Tomita (Professor, Disaster Psychiatry field, Disaster Medical Science Division)

COLUMN

Historical Document Rescue Team in action!

Two months after the earthquake, a person who lived near the Sendai coast asked us about an emergency measure for his historical documents damaged by seawater. We found that his A-4 size, black-lacquered letter box was filled with some 30 historical documents and scrolls. We learned that his ancestor was a martial arts instructor hired by Date Masamune, and the land on which he was living was granted by Date. The documents inside the box proved what he told us. Until the 3.11 event, the box had been placed in a tokonoma, a sacred alcove in a Japanese house. "It could have been washed away by the tsunami, but, miraculously, it remained there as if it had a will of its own," he said. We should carefully listen to what the documents say to us. The photo at right shows the historical documents brought to us.

Miyagi Prefecture
Osaki City

Integrating disaster prevention with characteristics of the region. Understanding and overcoming local vulnerabilities.

The Great East Japan Earthquake brought serious damage not only to coastal areas, but also inland. Osaki City, located in northwestern Miyagi prefecture, experienced an upper 6 quake on the seven-point Japanese shake scale, leaving 15 dead and over 200 injured. Also, due to severe foundation damage, around 2,700 houses were left either completely or partially uninhabitable.

"Symposium on Osaki City's recovery and reconstruction" was held on July 9, 2011 at Furukawa Health &Welfare Plaza in Osaki City. Professor Motosaka is the second from the left. He gave a keynote speech, "Developing a disaster-proof community". The symposium fostered exchange of various opinions on reconstruction, employment, industrial development renewable energy with the locals.

After beginning post-disaster reconstruction planning, Osaki City organized roundtable meetings on the reconstruction process. Professor Masato Motosaka served as chairman of these meetings. He was appointed to the committee as an academic specialist of earthquake disaster science due to his contribution to Miyagi Prefecture's earthquake damage prediction project of as a member of the disaster prevention committee, and also due to his experiences of collaboration with local schools and communities in Osaki City through a disaster prevention project run by the Ministry of Education, Culture, Sports, Science, and Technology (MEXT).

Osaki City formed in 2006 via the merging of 6 towns and one city. Consisting of diverse locales with different histories, cultures, and economies, the newly formed city has been facing some problems. Professor Motosaka took on the responsibility of integrating the opinions and requests of experts from various fields and 25 different community organizations, forging an agreement, providing updated knowledge of disaster science and technology, and advising on methods of disaster prevention. Professor Motosaka emphasized that the basic tenet of disaster–prevention should be "understanding and overcoming local vulnerabilities." Local characteristics must be integrated into disaster planning, and local businesses and government must cooperate for an effective strategy.

Currently, as a disaster reconstruction plan, Osaki City aims for "The birth of an affluent society in Osaki City through cooperation and collaboration" while developing governmental enterprise in each stage, from restoration, to regeneration, to growth within approximately seven years by 2017, thereby completing the reconstruction of the whole city.

Interview and photography provided by Masato Motosaka
(Professor, Earthquake Engineering field, Hazard and Risk Evaluation Research Division)

Miyagi Prefecture
Ishinomaki City
Fukushima Prefecture
Fukushima City
Iitate Village

Scientific approach to reducing anxiety toward the invisible radiation. Implementing educational activities, providing factual knowledge, and planning radiation countermeasures.

TEPCO's (Tokyo Electric Power Company) Fukushima Daiichi nuclear plant incident made the consequences of the Great East Japan Earthquake even worse. Soil contamination from the radiation, fear of being radiated, and fears of agricultural, forest, and fishery product contamination, are all difficult issues that need to be considered and solved immediately. It is important to decontaminate the disaster area, compensate residents for violation of their trust, and to bring safe goods to market using scientific knowledge and factual data.

Tohoku University established the "Research Center for Remediation Engineering of Living Environment Contaminated with Radioisotopes" to develop techniques to restore people's livelihoods in areas that had once been contaminated by radiation. These techniques include: 1. Countermeasures against internal radiation exposure ① Inspecting food for contamination ② Development of methods to grow agricultural products without irradiation. 2. Countermeasures against external radiation exposure ① removing soil contaminated by radiation ② developing advanced technology to remove radiation from the contaminated soil ③ long term measurement of radiation concentration in air (over both land and water).

Notably, the City of Fukushima, in addition to inspecting contamination of locally grown food products, also inspects food that people bring in from other areas. The team organizes lectures and workshops to teach locals factual scientific information about radiation and radioactive substances. This prevents proliferation of misinformation that could slow down the process of reconstruction. In addition, the team works on various projects to support the reconstruction process.

In the past, measuring the concentration of a radioactive substance on products required the preparation of samples by chopping up the products into pieces. However, the Research Center for Remediation Engineering of Living Environment Contaminated with Radioisotopes has developed new machine that doesn't require a such a sample to detect radiation; this shortens the time required for preparation. Professor Ishii, on the right, is in charge of the "06 project to develop countermeasures against radioactive substance contamination" at Tohoku University's organization for Disaster Recovery.

Interview and photo provided by Keizo Ishii
(Professor, Radiational Decontamination Science field, Regional and Urban Reconstruction Research Division)

COLUMN

Historical Document Rescue Team in action!

A family in Osaki city owns a warehouse estimated to be 200 years old. In addition to locals, 19 volunteers came from Iwadeyama (Osaki city), and far away (Nagoya, Hyogo, etc.) to help rescue historical materials. While transporting the documents outside, we discovered a plate indicating that the warehouse was built in 1897. The house was damaged by the April 7, 2011 aftershock after withstanding several big earthquakes in the past. In addition to securing a stable environment for preservation of these rescued materials, continuous maintenance is required to preserve old architecture. The photograph shows the family's rescued historical documents.

What comprise the ability to survive? Analysis of human behavior during the disaster from a cognitive-science perspective

Project leader

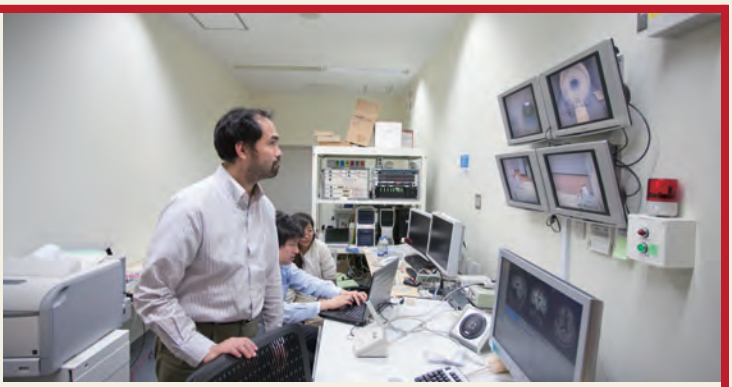
Motoaki Sugiura (Disaster Related Cognitive Science Lab., Human and Social Response Research Div.)

Internal collaborators

Toshiaki Muramoto, Shosuke Sato, Fumihiko Imamura, Rui Nouchi

External collaborators

Tsuneyuki Abe (Graduate School/Faculty of Arts and Letters at Tohoku University), Akio Honda (Tohoku Fukushi University), Masahiro Iwasaki (Japan Science and Technology Agency)



fMRI is one of the methods to visualize hemodynamics. It measures which parts of the brain are functioning with millimeter resolution. The system can scan the entire brain approximately every 2 seconds.

Dividing ridge of survivors and non-survivors. Searching for the reason in brain function

What is the relationship between brain and mind? The latest neuroscience research gives us clues.

The word "Neuroscience" has become common within the last several years. However, despite the popularity of this word, poor results and lack of scientific evidence inhibit our understanding of the phenomenon. Still, I am pleased to know that people are now interested and curious about the brain.

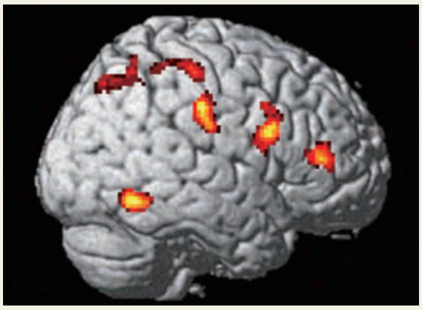
The role of the brain is to facilitate neurological functions such as emotions and thoughts. Life requires a link between brain and mind. Studying the brain's function by investigating how it works also helps us understand this link. Perhaps, this research stimulates the curiosity of many people.

Because of recent technological progress in measuring brain activity, the field of neuroscience has lately achieved remarkable progress as well. My research mainly focuses on " How humans acknowledge self (self-perception)" as well as investigates the relationship between brain and mind by employing functional magnetic resonance imaging (fMRI) to image brain function.

Interdisciplinary research seeking to identify the source of the ability to survive

During and after the Great East Japan Earthquake, individuals experienced and overcame harsh difficulties. It is human nature and ability to fight for life, especially in the face of immense danger.

We consider that individual difference in brain



Imaging the unique brain function when one recognizes his own face. The right side of the cerebral hemisphere is shown, indicating active areas.

functioning is related to the sensitivity in perception and decision regarding risk, that is, recognition of hazard and evacuation behavior. Also, I am interested in how the brain's social functions, such as consideration of others, communication, and leadership, is connection with the ability to survive.

We interviewed people who were affected by the disaster to investigate how they survived one difficulty after another. Then, developed a method to evaluate their responses quantitatively. Of course, brain function is very complicated and unique. However, we are clarifying the relationship between how the brain digests information and how it recognizes behavioral patterns. This is an interdisciplinary research project, encompassing psychology, cognitive science, and neuroscience.

In terms of disaster prevention/mitigation, multiple research groups will participate. I will try my best to analyze the brain function from the point of view of cognitive science. As one of the research team, I will integrate individual views to shape my research.

Interviewed on October, 23 2012

Project Report

Research Forefront

Motoaki Sugiura

Associate Professor at Tohoku University

Department of Functional Brain Imaging at the Institute of Development, Aging and Cancer, Disaster-Related Cognitive Science field (concurrent), Human and Social Response Research Division

Born in Tokyo, Dr. Sugiura received MD and Ph.D. degrees in medicine from the graduate school of medicine at Tohoku University, worked as an assistant professor at New Industry Creation Hatchery Center at Tohoku University, then the Jülich Research Center as a visiting fellow (Post-doctoral fellowship for research abroad from the Japan Society for the Promotion of Science), Then served as an associate professor of the Miyagi University of Education and National Institute for Physiological Science. Appointed to his current post in 2008, From 2012, Dr. Sugiura is an associate professor in the Disaster-Related Cognitive Science field, Human and Social Response Research division at IRIDeS, specializing in functional neuroimaging.

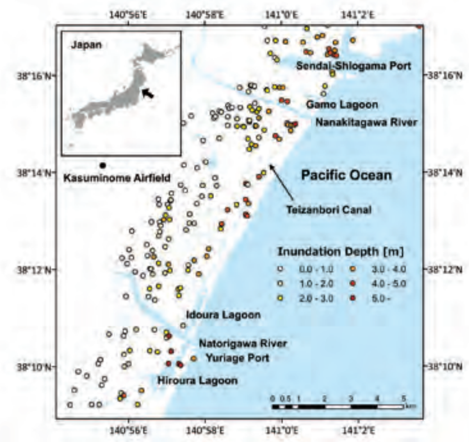
News from Research Results

Topics

01

International scope of IRIDeS articles! The Coastal Engineering Journal cited IRIDeS researchers' articles as ranking at the top of its most-read list!

Coastal Engineering Journal (CEJ)*1, published by World Scientific Publishing Co. (headquartered in Singapore) covers the research fields of coast, port & harbor, and ocean engineering. CEJ released a special issue (Vol. 54) in March 2012, featuring 12 articles as special reports about the 2011 Great East Japan Earthquake.
Articles in CEJ are published online, and the list of the most read 20 articles (based on the number of full-text downloads) is updated every day. As of November 19, 2012, six articles written or co-authored by IRIDeS researchers ranked among the top 20 articles, including the 3rd most-read article "IMPACT OF THE 2011 TOHOKU EARTHQUAKE AND TSUNAMI ON BEACH MORPHOLOGY ALONG THE NORTHERN SENDAI COAST" by Associate Professor Keiko Udo, et al. Also, two articles written by IRIDeS tsunami researchers are on the most-read article list of the Journal of Earthquake and Tsunami. Continuous downloading of these articles ever since their online publication indicates that our researches are receiving worldwide attention.



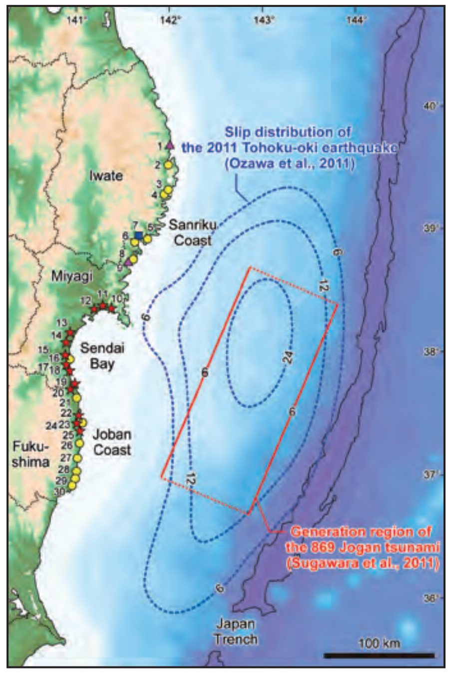
The article "IMPACT OF THE 2011 TOHOKU EARTHQUAKE AND TSUNAMI ON BEACH MORPHOLOGY ALONG THE NORTHERN SENDAI COAST" reports the results of analysis of beach erosion along 15 km of the Northern Sendai Coast. Refer to the full text at: http://www.worldscientific.com/doi/pdf/10.1142/S057856341250009X

* Most-read article site:
http://www.worldscientific.com/action/showMostReadArticles?journalCode=cej
*1, The CEJ committee conducts review and editing.

02

Spreading knowledge of tsunami globally Eleven research papers were published in the 2011 Tohoku-oki Tsunami special issue of the Journal of Sedimentary Geology

Elsevier (a world-leading provider of scientific, technical and medical information that publishes various journals based in Amsterdam, The Netherlands) published a special issue entitled "The 2011 Tohoku-oki Tsunami" as the 282nd issue of Sedimentary Geology.
Four papers in this issue were authored by Associate Professor Kazuhisa Goto and Assistant Professor Daisuke Sugawara (Science and technology for low-frequency Risk evaluation field, Hazard and Risk Evaluation Research division), and seven papers were authored by collaborating researchers in Japan and overseas.
Mainly, the contents of the papers are based on field investigations and numerical analysis of the tsunami sediment deposits on the Sendai plain. The paper cited in the preface (Goto et al., 2012) discusses what further research on tsunami sediment deposits is necessary in order to make reliable tsunami risk assessments, and also discusses ways to overcome obstacles to this research.
Furthermore, as the subject of a paper assessing the magnitude of the 869 Jogan tsunami, which became widely known after the 3.11 event, Sugawara et al. (2012) explains what has been learned from sediment deposits on the Sendai plain up to the present time (the map on the right). Via numerical modeling of the 2011 Tohoku-oki tsunami offshore and on the Sendai Plain, Sugawara and Goto (2012) explained the sedimentary processes associated with sand and boulder deposits observed to be formed on Sabusawa Island (Goto et al., 2012).



The result of sediment deposit surveys due to the Jogan tsunami in A.D. 896, during the early Heian period. ★ on the coast areas where Jogan tsunami sediment deposits have been found, ■ areas where sediment deposits due to the Jogan tsunami have not been found, ●unclear whether the deposit is from the Jogan Tsunami,▲ sediment deposit due to the 2011 tsunami. Red square dots off shore indicate the estimated epicenter of the Jogan Tsunami, and the blue dashed line indicates the slip area of the 2011 earthquake off the Pacific Coast of Tohoku, estimated from the GPS observation.(Modified after Sugawara et. al 2012).

03

Paper on modeling of urban flooding in Jakarta, Indonesia published in Journal of Disaster Research

The Journal of Disaster Research (JDR) has published a paper with co-authors including IRIDeS Hazard and Risk Evaluation Research Division faculty members Akira Mano and Keiko Udo. The paper describes development and application of a model to simulate river floods in urban Jakarta. The model combines a 1-dimensional component for channel flow and a 2-dimensional component for overland flow, along with a method to represent the effects of dense urban construction, so that the model simulates flood behavior in good agreement with observations.

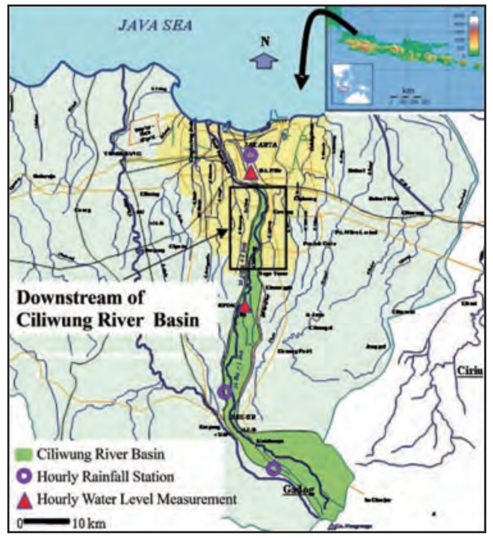
On January 15, 2013, heavy monsoon rains resulted in severe flooding near the Ciliwung River, which as of January 24 had resulted in 10 deaths, 20,000 refugees, and terrible economic damage. To reduce the extent of such damage and to develop effective flood countermeasures, modeling of the flood itself is essential. The model described in this paper will allow quantitative assessment of the effectiveness of proposed flood countermeasures, and will also allow prediction of how changes in land use (urbanization) and climate change will affect flooding in the city. Further improvement of this model and proliferation of its application will help resolve urban flooding problems around the world.

IRIDeS dispatched a fact-finding mission to Jakarta and visited the Pintu Air Manggarai Gate, which connects the West Drainage Canal to the Ciliwung River. The investigation team collected data on the flood event and discussed possible future flood countermeasures with local authorities.

Dr. Farid explains the 2013 flood mechanism to Dr. Bricker, the IRIDeS mission leader. Routing of the flood to the West Drainage Canal via this gate enhanced the capacity of the drainage system.

Citation: M. Farid, A. Mano, and K. Udo (2012). "Urban Flood Inundation Model for High Density Building Area", Journal of Disaster Research, Vol.7, No.5, 2012.
Link to paper:
http://www.fujipress.jp/finder/xslt.php?mode=present&inputfile=DSSTR000700050004.xml

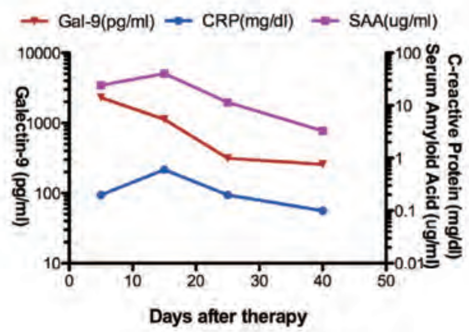
A large flood occurred in Jakarta on 15-18 January 2013. The estimated flooded area was 41 km² with the flood depth ranging from 0.2 to 3.5 m. This event causes massive economic losses (preliminary statement from the Governor said around $1-2 billion).



04

New Possibility for Regulating Immunological Infectious Diseases: Discovery of the ThGal-9 Cell Regulating Immunological Inflammatory Diseases

Our research group, including Professor Toshio Hattori et al. of the Disaster-related Infectious Disease field, Disaster Medical Science Division, discovered a new cell, galectin-9 carrying protein (ThGal-9), that regulates immunological inflammatory diseases. The group showed that the stimulation of the cell allows control of other cells that regulate immune responses. Further, they revealed that ThGal-9, along with Gal-9, produces the interleukin IL-10 protein that suppresses immune responses, suggesting that the administration of Gal-9 makes possible regulation of immunological infectious diseases*1. The research was conducted with collaboration by Professor Emeritus Mitsuomi Hirashima and Assistant Professor Toshiro Miki of Kagawa University.
It is known that the Gal-9 level increases due to such diseases as HIV and dengue (transmitted by mosquitoes), suggesting that ThGal-9 can be used as a clinical marker for early detection of infectious diseases after disasters (figure)*2.



Inflammatory marker of acute HIV patients

*1. S. Oomizu, et. al., Cell Surface Galectin-9 Expressing Th Cells Regulate Th17 and Foxp3+ Treg Development by Galectin-9 Secretion. Plos One. Published online on 7 November 2012
*2. H. Saitoh, et. al., Rapid Decrease of Plasma Galectin-9 Levels in Patients with Acute HIV Infection after Therapy. Tohoku J. Exp. Med. 228(2):157-61, 2012.

IRIDeS information

Guests from 12 countries visited areas in the process of rebuilding from the 3.11 tsunami

APRU (Association of Pacific Rim Universities) Research Symposium

September 20-22, 2012
Sakura Hall, Katahira Campus, Tohoku University
Field trip to Ishinomaki and Onagawa

Founded in 1997, APRU (Association of Pacific Rim Universities) is an international alliance of 37 world-class universities from 16 Pacific Rim countries. APRU plays an important role by fostering cooperation among the member universities to promote the betterment of society along the Pacific Rim.
APRU holds student conferences, summer camps and Internet conferences throughout the year, and sponsors a research symposium held by different universities every year. Tohoku University hosted the Symposium on Multi-hazards around the Pacific Rim, inviting 92 faculty and students from 12 countries, mainly from Asia, this year.
The symposium opened with a keynote speech by Mr. Jin Sato, the mayor of Minamisanriku Town, followed by invited guest lectures, panel discussions and presentations, which covered a total of 56 topics from 11 different fields including the mechanism of disaster, climate change, social vulnerability, disaster related medical treatment and public health.

During the field trip on the symposium's final day, the group visited Ishinomaki and Onagawa, where scars left by the catastrophic disaster still remained. Participants commented, " It was a harsh reality. I am glad that I got to meet the local fisherman who survived the tsunami." "Debris was neatly organized for cleanup, and temporary housing was well organized and clean. I could clearly see the cooperative and resilient element of Japanese culture."

As storytellers of the event, passing down our memories and records to future generations

Symposium on Great East Japan Earthquake Archives:

On January 11, 2013, "Symposium on Great East Japan Earthquake Archives - To pass down the memories and records of the past and present, to future generations" was held at Sendai International Center (Organized by the Ministry of Internal Affairs and Communications, Tohoku University IRIDeS, and Tohoku University Library; and Supported by National Diet Library).

Around 200 attendance shows that people's great interests in inheriting disaster records.

The presentations of the first part of the symposium were about activities of collecting records after the Great Hanshin-Awaji Earthquake. The second part was about the present situation of archival activities, archive examples of each area, and relevant problems relating to the Great East Japan Earthquake. The third part was discussions where all the panelists expressed their opinions. The materials used at the symposium are available at the URL below:

Michinoku-Shinrokuden: Tohoku University Archive Project:
http://shinrokuden.irides.tohoku.ac.jp/symposium/sympo20130111

Improving disaster resiliency in areas at high risks

IRIDeS hosts an international workshop of the United Nations Centre for Regional Development (UNCRD)

IRIDeS hosted a seminar titled "International Workshop on Disaster Risk Reduction and Resilience Building of Urban Communities." This was a part of the 5-day-long seminar organized by UNCRD during 10-14 December 2012 in Nagoya and Sendai. The objectives of the workshop were to strengthen disaster mitigation and risk reduction in urban and rural areas with high disaster risks. Twelve participants from all over the worlds visited IRIDeS on December 13, 2012. At the seminar, Prof. Fumihiko Imamura (Deputy Director of IRIDeS) made a keynote speech, followed by lectures of other IRIDeS members concerning obtained knowledge as well as dilemmas and problems in reconstruction planning, regional tsunami risk evaluation, and a digital archive project. Most of the participants were government officials and NGOs from developing nations, and they were especially interested in the recovery and reconstruction process after the large-scale disasters in Tohoku. The participants also joined a field trip to Minami-sanriku, Miyagi Prefecture, to listen to emergency response by survivors and observe ongoing recovery and reconstruction processes. Prof. Yuichi Ono (International and Regional Cooperation Office, Disaster Information Management and Public Collaboration Division) accompanied the trip.

Rethinking disaster medicine based actual disaster experience

Team-building workshop to prepare for the next disaster

The workshop's duration was short, but it was an intense and active group activity.

On December 5, 2012, as a special lecture for the Introduction to Disaster Medicine class at Tohoku University School of Medicine, a "team building workshop to prepare for the next disaster" was held. Open to all departments, 19 participants, including master's degree students, clinical doctors and nurses, non-student nurses, and health science students attended.
Participants worked in groups, collecting individual experience, clinical skills and knowledge gained from the disaster medicine class to construct a product within the workshop. During the Q&A session, there were some questions based on the experience of the disaster, such as how to deal with medical experts' mental conditions, as they are also affected by the disaster while having to support the community. One of the participants, who worked as a counselor, responded with a remarkable answer. The workshop was a great opportunity to rethink disaster medicine education and to motivate change in our own actions.

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