IRIDeS has an exhibition space to introduce our research activities to the public. It is also equipped with the largest 3D screen among Japanese research institutes. Upon request, IRIDeS screens the 3D documentary film “The Great Tsunami in Japan: reflecting on the 2011 disaster” (90min25min, Japanese/English). The film was produced by NHK Media Technology and supervised by IRIDeS Director and Professor Fumihiko Imamura, to pass on memories and experiences of the Great East Japan Earthquake and Tsunami.

(Natsuko Chubachi, IRIDeS Public Relations Office)

In 2017, The Graduate School of Agricultural Science moved to the Aobayama New Campus. The Aobayama Commons opened with a library, cafeteria and campus store. The neighborhood of IRIDeS is becoming more and more lively!
Greetings

For a year now, IRIDeS has taken new initiatives: the implementation of a Project Area/Unit System and the hosting of the first "World Bosai Forum." Since the inception of IRIDeS, its researchers have performed academic research work on regional issues and aimed for the study of "practical disaster prevention" through research outcomes that give back to communities. The Project Area/Unit System promotes this objective.

Moreover, the World Bosai Forum held last fall invited people from all around the world to discuss their regional problems and take action. Many have high expectations from this—a forum that connects the Tohoku region to the world—and want us to develop it into a cornerstone for Sendai as an international city in the future.

This year, the results of the first World Bosai Forum will be tied to those of the 2018 International Disaster and Risk Conference which is to be held this summer in Davos, Switzerland. I strive to ensure the success of the second World Bosai Forum to be held in 2019 at Sendai.

For its various activities in academia, the arts, and society, IRIDeS has received the 67th Kahoku Culture Award that is given to individuals and organizations that contribute to the development of the Tohoku region. With the expectations inherent in this award, we continue to push forward in fulfilling the responsibilities that we so keenly feel.

July 2018 saw the 25th anniversary of the Hokkaido Southwest Offshore Earthquake that struck the island of Okushiri. One young researcher who experienced the earthquake as a junior high school student living on the island is now working at IRIDeS. I desire that the younger generation that lives through the Great East Japan Earthquake steps up to help Japan and the world with disaster risk reduction.

What is the World Bosai Forum?

In 2015, at the third IRIDeS World Conference on Disaster Risk Reduction held in Sendai, Japan, the "Sendai Framework for Disaster Risk Reduction 2015–2030" was adopted. Japan, who hosted this conference, is expected not only to develop domestic disaster risk reduction policies but also to strengthen cooperation with the international community, being a strong leader in the implementation of the Sendai Framework for Disaster Risk Reduction.

As part of this plan, the "World Bosai Forum/International Disaster Risk Conference in Sendai" will be held biennially from 2017 onward, in cooperation with the "International Disaster and Risk Conference IDRC Davos" held in Switzerland. Bosai is a traditional Japanese term, indicating a holistic approach to reduce human and economic losses from disasters, which represents activism in all disaster phases, including prevention, mitigation, response, and recovery. The World Bosai Forum invites experts from Japan, the international community, and local residents to discuss disaster risk reduction strategies devised by industry, government, academia, and the private sector. The purpose of the forum is to provide an opportunity for people from a wide variety of backgrounds to share the world's latest disaster risk reduction expertise, create specific disaster prevention solutions, and disseminate the lessons learned from the Great East Japan Earthquake to the rest of the world.

How Tohoku University and IRIDeS contributed

Tohoku University and IRIDeS shared responsibility for managing the World Bosai Forum and gave their full-fledged support to organizing the first event. The Director of IRIDeS, Professor Fumihiko Imamura, served as the World Bosai Forum Committee Chairperson, while the President of Tohoku University, Professor Susumu Satomi, served as the Committee President. The World Bosai Forum Secretariat was established within IRIDeS with an IRIDeS Professor Yuichi Ono as the Secretary-General, and they made diligent preparations in cooperation with various related agencies, including the City of Sendai.

The World Bosai Forum Committee "This committee was comprised of Tohoku University, City of Sendai, Miyagi Prefecture, Kahoku Shimpo Publishing Co., the Tohoku Economic Federation, Global Risk Forum GPF Davos, and the Sendai Chamber of Commerce and Industry."

The first World Bosai Forum ended in a great success

The commemorative first World Bosai Forum was held at the Sendai International Center and the Tohoku University Centennial Hall (Kawauchi Hagi Hall) from November 25 to 28 in 2017. Forty-nine sessions and 27 mini-presentations were held, beginning with the "Pre-World Bosai Forum Festival" as a free event, open to the public, held the day before the main sessions started. In addition, there were 20 poster presentations and 12 exhibition booths. Further, while the forum was being held, there was also a field trip excursion to study the disaster areas.

In total, there were 547 registrants, who traveled to participate in the conference from 42 countries and regions. The forum was a great success, with the final number of participants totaling more than 10,000 people, including citizens and stakeholders attending the "Bosai Kokutai," and the "Bosai Industry Fair."
The activities of the first World Bosai Forum and achievements

One of the main characteristics of this World Bosai Forum was the participation of a diverse group of people hoping to gain an understanding of the practical side of disaster risk reduction rather than mere theory. In the section below, the various activities and achievements of the first World Bosai Forum are introduced.

The Pre-World Bosai Forum Festival

Approximately 700 people participated in the opening event “Pre-WBF Festival: Learning from the disaster, bridging to the future” held in partnership with Science Agora. During Part One, the younger generation from Iwate, Miyagi, and Fukushima Prefectures, having experienced disasters, announced various initiatives aimed at reconstruction and disaster risk reduction. Kataysa Oomishi, the mayor of Kuroshi in Kochi Prefecture, who has advanced their disaster risk reduction strategies preparing for a large Nankai trough earthquake, encouraged the younger generation saying, “Superficial things do not move people. An attitude that is seeking substance brings about the most sympathy and gets the support of others.”

Part Two focused on the cultural aspects of reconstruction and disaster risk reduction. There was a demonstration of the gallant traditional art form of the “Namiita Tiger dance,” performed by residents of Namiita, Kesennuma (a disaster area), as an expression of gratitude for all the support from within Japan, as well as around the world. The ensemble of the Sendai Philharmonic Orchestra and a concert by NHK Sendai Boys and Girls Choir impressed everyone with their performances such as “Azure” and “Flowers will Bloom” songs that were filled with hopes of reconstruction.

The World Bosai Survey

An A questionnaire survey related to the Sendai Framework for Disaster Risk Reduction was conducted to participants in the World Bosai Forum, entitled the “World Bosai Survey.” The results highlighted some very interesting trends. These included the following: while only 30 percent of the respondents had attended the 3rd UN World Conference on Disaster Risk Reduction, 70 percent of the respondents were aware of the Sendai Framework for Disaster Risk Reduction, and most respondents identified “earthquakes” as the disaster they felt their country was most at risk of experiencing in the future. This survey was conducted to inform global disaster risk reduction policies in the future. It might have been the first disaster risk reduction awareness survey that has ever been conducted on a global level.

The Summary of the Closing Ceremony

Fumihiko Imamura, the World Bosai Forum Committee Chairperson, presented the “Chair’s Summary” that compiled the results of the World Bosai Forum. The major talking points were organized into three areas: “science and technology,” “policies and finance,” and “society and culture.” In the areas of science and technology, major topics discussed were related to cutting-edge scientific technologies for disaster risk reduction, including tsunami simulations, drones, big data analytics, and the application of space technology. Meanwhile, in the areas of policies and finance, they discussed the importance of policies and financial supports that are necessary for disaster risk reduction. These were primarily themed around the recovery from the Great East Japan Earthquake, as well as around how to incorporate disaster risk reduction in the sustainable development strategies of developing nations. Finally, in the area of society and culture, topics were discussed such as: the various groups involved in disaster risk reduction activities, their situations, and challenges; the needs of those vulnerable to disasters; and local disaster risk reduction traditions.

Chairperson Fumihiko Imamura pointed out that the simultaneous functioning of these three areas is essential for disaster risk reduction. There is the saying “Disasters strike when they have been forgotten” as recognized by Toshihiko Terasa. Chairperson Imamura made a pun related to this saying and closed the Forum by stating “As far as we do not forget about disasters, we can handle them.”

Moving toward the next World Bosai Forum

During the first World Bosai Forum, diverse participants shared their cutting-edge disaster prevention technologies, science, and knowledge from around the globe, promoting the “Sendai Framework for Disaster Risk Reduction.” The Forum made a significance for the exchange of knowledge and culture between various countries, which is the main objective of the World Bosai Forum. The Forum was held to share the latest disaster prevention experiences, passing on the Great East Japan Earthquake experiences to the next generation and rest of the world. The lessons learned from the 2011 disaster should not just fade away.

The “Sendai Framework for Disaster Risk Reduction” has made SENDAI a disaster risk reduction keyword that is recognized worldwide. The World Bosai Forums of the future will aim to develop a safer society by joining forces with citizens and specialists from various fields and spreading BOsAI from SENDAI to the rest of the world.
Elucidating the Post-seismic Seafloor Deformation Following the 2011 Tohoku-oki Great Earthquake

Professor Motoyuki Kido of IRIDeS and his team are the first in the world to elucidate the complex movements of the seaﬂoor after the Tohoku-oki great earthquake. On March 11, 2011, along the Japan Trench—deep in the off-Miyagi Paciﬁc Ocean—fierce earthquakes began to occur, causing a huge earthquake with a magnitude of 9.0. This earthquake, and the resultant tsunami, caused severe destruction, particularly in the Tohoku region. Experts have named the “2011 Tohoku-oki earthquake” as a genuine natural phenomenon. “The Great East Japan Earthquake” is the name of the disaster that caused damage to people and society.

Due to major movements within the Earth, oceanic plates constantly sink into the Earth’s crust, causing earthquakes. The occurrence of the 2011 Tohoku-oki earthquake was also based on this principle: the rupture area of the fault was extremely large ever observed in Japan’s history.

The research team of IRIDeS, including Prof. Motoyuki Kido, and Prof. Ryota Hino of the Graduate School of Science, Tohoku University (IRIDeS concurrent faculty) used a special instrument to observe the huge movements at the time of the earthquake. In addition, over the course of four years from 2012 after the earthquake, they expanded the geodetic network and continued to investigate the seafloor crustal movement across the entire area of offshore Tohoku.

The equipment used by Prof. Kido and his team to measure the movements of the seaﬂoor is called a “seafloor precision transponder” (Figure 1). With one set containing three or more seafloor precision transponders, these sets were deployed in the seaﬂoor in advance, and sound waves were sent from a seaﬂoor vessel whose position was monitored by GPS. This time, the time for the response to come back from each transponder was measured, and by correcting for inﬂuences on the speed of the sound in the sea, due to seawater temperature change, the position of the transponder was determined. This measurement was concluded regularity to investigate the extent to which the transponder deployed into the seaﬂoor had moved since the previous investigation and to clarify the distance and direction of the crustal movement. Fundamentally, this was the principle involved for the continuous and accurate investigation of the position changes of the transponder, and although it seems simple, it involved water depths of 5000 m. At this depth, extremely sophisticated equipment is required to accurately grasp movements that occur in the order of centimeters.

The significance of the research of Professor Kido and the team

The achievement of Prof. Kido’s research team on this occasion was elucidating the “Post-seismic seaﬂoor movements following the 2011 Tohoku-oki Earthquake.” According to their research, at the time of this earthquake, a huge fault slip occurred off the coast of Miyagi Prefecture, which resulted in the plates continued to move to the west. In contrast, in the Fukushima offshore further south, the opposite movement to the east was observed (Figure 4). The fact that the crustal movements differ according to the region presents complex issues. The research team pointed out that while the cause of the off-Miyagi ﬂuctuations could be explained as “visco-elastic relaxation,” for the Fukushima-oki ﬂuctuations, the enduring area at the time of the giant earthquake is currently moving slowly, which can be considered as an “after-slip” occurring subsequent to the great earthquake.

Why is it important to determine what happens after a giant earthquake? This is “because it is important to understand not only the instant at which it occurred but also its continuous cycle.” The research team of IRIDeS, including Prof. Motoyuki Kido, and Prof. Ryota Hino of the Graduate School of Science, Tohoku University (IRIDeS concurrent faculty) used a special instrument to observe the huge movements at the time of the earthquake. In addition, over the course of four years from 2012 after the earthquake, they expanded the geodetic network and continued to investigate the seafloor crustal movement across the entire area of offshore Tohoku. That is to say, the team explored aftermath of the 2011 Tohoku earthquakes. Prof. Kido and his team were the first in the world to elucidate the complex movement of the seaﬂoor after the great earthquake. This was published as a paper in 2017, on a large and the world at the same time.

Seafloor survey for which advanced technology is required

How is it possible to investigate deep seafloor movements? For land positioning surveys, measurements over ground were performed in the past, however, in recent years, with the development of global positioning systems (GPS) using artificial satellites, this investigation can be conducted in an exact, simple, and economic way using radio waves. Changes over time, in a particular point location, can be continuously monitored, making it possible to accurately ascertain the extent of crustal movements over a specific period. In contrast, radio waves do not reach points under the sea, a GPS cannot be used on sea floor. The area around the Japan Trench is far from the land and located at a depth of 5000 m or more from the surface of the water. It has been extremely difficult to gauge, over many years, the detailed movements of a deep seaﬂoor that is inaccessible to humans. However, to elucidate the mechanism of an earthquake occurring beneath the seabed, it was essential not only to make observations from land that is far away but also to collect data from positions close to the seabed. Prof. Kido and the team had already realized the importance of this and were tackling this issue since the early years of the 21st Century. In cooperation with the Japan Coast Guard, they developed and deployed a seafloor geodetic observation system, particularly focusing on the off-Miyagi earthquakes that occurred periodically. Therefore, the system was in use for geodetic ﬂuctuations already in 2010, just before the Tohoku-oki Eq. occurred.

To accurately grasp movements in the earth’s crust after an earthquake, it is vital to understand how strain is released or how strain is further accumulated within the plates; this is extremely important. When considering the magnitude of an earthquake, it is not scientifically possible, at present, to accurately predict the date of an occurrence or the magnitude of an earthquake. Nevertheless, this type of elucidation of ﬂuctuations in crustal movements may be important reference material for evaluating the risk of earthquakes and setting up a disaster risk reduction plan.


**Note on Terms:**
- **Seafloor precision transponder:** A device used to measure the precise movements of the seaﬂoor after an earthquake. It sends sound waves to the transponder from a vessel (vessel position measured by GPS) and measures the time it takes for the response to come back. This helps in understanding the movement of the seaﬂoor.
- **Slow-slip events:** These are intermittent and slow ruptures, emitting no seismic waves, and are often referred to as “slow motion earthquakes.” They can lead to a trigger for giant earthquakes.
- **Post-seismic seaﬂoor movements:** These are the movements of the seaﬂoor after a large earthquake, including the time it takes for the seaﬂoor to come back to its normal state.
Introduction
In the fiscal year 2017, Prof. Shunichi Koshimura's research team started a large-scale, five-year study to combine a wide-area-damage-grasping technology and disaster medical science. The purpose of this study was to establish a mechanism to grasp the states of human and property damage from tsunamis that affect a wide area immediately and then estimate the healthcare and relief needs for better response. There will be an overwhelming shortage of medical resources when a large-scale disaster occurs. The study aims to create a system to assist the health responders including Disaster Medical Assistance Team (DMAT) as quick as possible to coordinate the whole health sector to save as many lives as possible.

Research origin
Immediately following the Great East Japan Earthquake in 2011, Prof. Koshimura, as a researcher, had a bitter experience of not being able to obtain disaster information and confirm the situation of the disaster area because the communications network was cut off. This became his research impetus, which led to developments to grasp the extent of the damage and to obtain a general picture of the disaster area within a short period of time using computer simulation techniques and remote-sensing technology that employs satellites and unmanned aircrafts. For instance, a real-time simulation technology, led by Prof. Koshimura, goes into operation immediately following a tsunami. This system has been adopted by the Japanese Cabinet Office allowing the government to estimate the damage within 30 minutes.

However, as Prof. Koshimura pursued these studies, he felt that “while it is important to forecast and grasp the damage, it is not enough to save people’s lives. The current studies designed to grasp the extent of the damage are quite ‘passive’ in dealing with natural disasters, and I want to expand my research so it can save people.”

When Prof. Koshimura was considering what kind of research would be able to save people’s lives, Prof. Shinichi Egawa and Assist. Prof. Hironori Sasaki in IRDE6’s Disaster Medical Science Division gave him an opportunity to get the detailed understanding of the activities of DMAT. DMAT consists of members including doctors, nurses, and operation coordinators who receive training so that they will be able to enter the disaster area, save the lives of victims, and take actions to reduce the number of preventable disaster deaths as much as possible. Assist. Prof. Sasaki has a DMAT certification, and during the 2016 Kumamoto earthquake, he conducted medical activities in the disaster areas.

There has been no collaboration between tsunami engineering and medical science in the past. However, Prof. Koshimura believed that such collaboration could make it possible to conduct a study that reduces the number of preventable disaster deaths. So, he proposed a joint research project to researchers in disaster medical science. His association with IRDE6, an interdisciplinary disaster research institute, helped him come up with this idea. He won the support of researchers in disaster medical science and started a research team consisting of 12 people, both within and outside IRDE6 in a wide variety of fields, such as a DMAT supervisor, researchers in disaster science and spatial information engineering, disaster medical care, medicine, and public health science.

The aims of this study are as follows. (1) After a disaster occurs, the damage will be promptly assessed. The extent of damage suffered by people and medical institutions will be estimated based on this physical damage to the disaster area. (2) Then, an estimate will be made regarding the number of casualties, the number of hospital tasks that are needed, the number of people needing transport, and the medical resources required. (3) DMAT members dispatched to the forefront of the disaster area will be provided with information obtained through the wide-area-damage-grasping technology so that their medical care activities will be supported. (4) At the same time, a simulation will be conducted to analyze how the DMAT should allocate its limited medical and human resources and how it should operate to save as many lives as possible. Then, the system that allows DMAT to operate most efficiently will be suggested. (5) Forecasts and support information will be updated in real times as the situation changes, such as the state of the damage and the supply of materiais. (Figure 1)

Characteristics
The aims of this study are as follows. (1) After a disaster occurs, the damage will be promptly assessed. The extent of damage suffered by people and medical institutions will be estimated based on this physical damage to the disaster area. (2) Then, an estimate will be made regarding the number of casualties, the number of hospital tasks that are needed, the number of people needing transport, and the medical resources required. (3) DMAT members dispatched to the forefront of the disaster area will be provided with information obtained through the wide-area-damage-grasping technology so that their medical care activities will be supported. (4) At the same time, a simulation will be conducted to analyze how the DMAT should allocate its limited medical and human resources and how it should operate to save as many lives as possible. Then, the system that allows DMAT to operate most efficiently will be suggested. (5) Forecasts and support information will be updated in real times as the situation changes, such as the state of the damage and the supply of materiais. (Figure 1)

One of the notable features of this study is that DMAT members who work on the front lines of disaster medical care have been taking part in the project since the research phases. They will incorporate on-site activities into the study and determine whether their study is workable.

DMAT has made important progress after the Great Hanshin-Awaji Earthquake in 1995, in which many preventable deaths took place because prompt medical care could not be provided in the disaster areas. As mentioned above, the impetus for Prof. Koshimura’s wide-area-damage-grasping technology was the 2011 Great East Japan Earthquake. In Japan, a nation with many natural disasters, efforts are underway to learn from the past disasters and create solutions for future disasters.
Assistant Prof. Okada and his team tackled a number of questions: “Is this really an active fault? If so, how far does the fault continue?” Initially, Okada’s team conducted a seismic reflection survey, in which sound waves were transmitted underground and their reflections were used to determine the structure of the geology through which they traveled. The team moved gradually in an eastward direction across Sendai Plain during their investigation. They found that the underground geological features had undergone deformations, and these deformations were not limited to the immediate Miedashima area; the deformations extended into the region fairly far to the south. Strata that were initially horizontal had repeatedly been pushed upwards. In other words, these deformations are believed to be the evidence of an active fault. To analyze the underground density structure, the team also conducted a gravity survey using minute differences from gravity intrinsic to the surface of the earth. The results supported those of the seismic reflection survey and suggested that the area is indeed home to an active blind fault (Figs. 1 and 2). It was also confirmed that the north end of this active blind fault disappears in the northeast of the Miedashima Hills. Assist. Prof. Okada’s team presented this study at the Japanese Society for Active Fault Studies 2014 Fall Congress (J. Seismol. Soc. Japan 27, 70-77, 2017).

This study aimed to confirm the presence of this previously undiscovered active fault in Sendai Plain and to clarify its position and features; however, the times during which this fault had experienced movement were not examined. The fact that this fault could ultimately lead to earthquakes is a concern for the future, but Assist. Prof. Okada says, “Looking at the region of this active fault, there does not appear to be any large gaps in the strata. It does not appear as a clear geomorphological feature at the surface; so it can be considered to be low activity and does not present a great risk.” If it were connected to the Nagashima fault to the north, it would have the potential to cause a large earthquake. However, this study has also confirmed that this newly discovered active fault breaks off to the north; therefore, it is viewed as separate from the Nagashima fault.

This series of studies by Assist. Prof. Okada and his team revealed another aspect of the active fault system in Sendai Plain. Assist. Prof. Okada explains: “While we have located the northern end of this fault, we do not yet know how far it extends to the south. That is a topic for future research.”

The Nigata-Rifu active fault zone lies at the boundary between the plains and hills of the Sendai region, directly below a densely populated area of Sendai City. No significant seismic activity along this active fault zone has been recorded in history. However, M 5.0 to 7.5 earthquakes can occur in the Nigata-Rifu active fault; therefore, residents in this region need to be prepared for a major future earthquake.

The presence of the Nigata-Rifu active fault is evident; however, there are faults that also diverge underground and are therefore difficult to discern (active blind faults). The Nagashima fault, which extends over 8 km underground to the east of the Nigata-Rifu active fault, is one of such active blind faults. Recently, Assist. Prof. Shinmu Okada of IRIDeS Disaster Science Division and his research team discovered the presence of a previously unknown active blind fault in this region.

The area of Miedashima in the city of Natto, located in the southern reaches of Sendai Plain, is built on a clay region that follows a scarpy and is about 2.5 km long. It has been previously speculated that this scarpy might represent the partial exposure of an active fault; however, no scientific evidence to support this speculation had previously been produced. If it were a true active fault, the fault would be longer than the 2.5 km-long scarpy, with the rest of its length hidden beneath the surface.

Approximately 2,000 active faults are found in Japan. Each active fault may move only once in thousands or tens of thousands of years to cause inland earthquakes. However, longer active faults comprise large active fault planes and store huge amounts of accumulated energy and consequently tend to cause major earthquakes during fault movements.

Seaweed beds are regions in shallow water where seaweed grows. Eelgrass (Zostera marina) is one of the species in these beds that purifies water and provides a habitat in which fry can grow and thrive. Seaweed species such as brown seaweed (Undaria pinnatifida) and kelp (Laminariales) are an essential part of the Japanese diet and are also a food source for abalone and sea urchins. Seaweed beds also harbor a wide variety of sea life. Although most people do not see them on a daily basis because they are under the water surface, seaweed species are extremely important to humans from the perspectives of ecosystems, aquaculture, and economics.

Seaweed beds along Japan’s northwestern coastline were devastated by the 2011 Great East Japan Earthquake and Tsunami. The loss of eelgrass from Shizugawa Bay in the town of Minami Sanriku in Miyagi Prefecture was particularly severe. However, to date, there have been few efforts to elucidate the scientific mechanism by which tsunamis cause damage to seaweed beds.

Therefore, Assist. Prof. Kei Yamashita (who specializes in tsunami engineering) and others at IRIDeS have commenced research to clarify the damage that tsunamis cause to eelgrass beds, specifically in the Shizugawa Bay of Miyagi Prefecture. Using expertise they gained from their prior research regarding tsunami-induced sediment transport, they first deduced that the sediment transport and flow velocity associated with tsunamis were likely to be important factors in the damage to the eelgrass beds. They also hypothesized that the tsunami causes damage by several mechanisms: eelgrass is uprooted due to the erosion of seaweed sediment and deposition of sand, brown seaweed is torn off from rocks in the strong currents, and brown seaweed is damaged by sediment deposited by the currents flowing over the rocks. Then, they evaluated the state of damage to the seaweed beds and assessed whether it matched the state of damage that was predicted by a simulation of the sediment transport associated with a tsunami. For example, several places where sand erosion was predicted were consistent with the places in which eelgrass damage was observed.

Then, Assist. Prof. Yamashita delved further into this matter in collaboration with A. Suppasri, K. Fukui, K. Yamashita, N. Leelawat, O. Hirayama, and F. Imamura. The researchers decided to conduct a study to quantitatively verify the relationship between the force of a tsunami and the level of damage to the eelgrass beds. Specifically, they investigated the correlation between the flow velocity caused by a tsunami and the damage to the eelgrass beds in Lake Hamana, a lake in the city of Inamuragasaki in Shizuoka Prefecture. The results of this investigation were recently published. For example, they found that when the tsunami flow velocity was 1 m/s, approximately half of the eelgrass was damaged, but when the flow velocity increased to 3 m/s, 90% of eelgrass was lost. In the future, they plan on incorporating sediment transport into their investigation.

Up until now, research has been conducted on seaweed beds in the field of ecology, or on the mechanism by which typhoons damage seaweed beds. Few studies, however, have shown the correlation between tsunamis and seaweed beds. The researchers hope that by scientifically elucidating the details of the mechanism by which tsunamis destroy seaweed beds, they may be able to identify the locations of seaweed beds that are less prone to tsunami damage. Assist. Prof. Yamashita aims to provide the necessary knowledge to prevent future seaweed damage to protect the livelihood of people in coastal areas. He also hopes to expand the scope of his research to be able to predict which areas will be at risk for damage from a tsunami caused by a potential earthquake in the future.
How to Utilize Uncertain Scientific Information to Mitigate Disaster:
Exploration of “The Study Group for Countermeasures on the Forecast of Nankai Trough Earthquakes”

The “Nankai Trough” is a groove in the deep-ocean formed by plate subduction, which extends from off the coast of Shizuoka to off the coast of Miyazaki. In the vicinity of the area, large earthquakes have occurred quite frequently. Historically, there were cases in which Tohoku and Nankai earthquakes occurred consecutively, resulting in great disasters, such as the Amei Earthquakes (1856) and Showa Earthquakes (1944 and 1946). In Japan, following the Great East Japan Earthquakes, re-evaluation of earthquakes long-term evaluation has taken place. In 2012, the Cabinet Office announced a new estimation based on experts’ opinions: if a gigantic earthquake would occur around the Nankai Trough in the future, it is possible that, in the worst case scenario, the earthquake could be maximum M9 class and the number of deaths could reach as large as 220,000 or even more.

In IRiDS, young researchers volunteered to create a study group on the Nankai Trough earthquake and have been organizing monthly meetings by inviting experts of various fields to study and discuss pertinent issues. The central theme, above all, is how we can utilize uncertain information to mitigate disasters. We cannot predict earthquakes in our current knowledge. However, seafloor observation networks have rapidly improved in recent years and have made it possible to capture oceanic plate movements and other phenomena, slow slips for example, that possibly trigger large earthquakes. Currently, in the Nankai Trough area, “the world’s best observation network” that can acquire real-time data is in place.

Excursion around Iwaiizumi, Disaster Area in 2016 Typhoon No.10

On August 30, 2016, Typhoon No. 10 struck Iwaiizumi-cho in Iwate Prefecture, causing major destruction due to the heavy rain and flooding of the Omoto River. Just a little more than a year since the typhoon, on October 21, 2017, IRiDS researchers, including Assoc. Prof. of History Yatsuki Ebina and Assoc. Prof. Shoji Moriguchi who specializes in landslides, visited the site, with local disaster expert Tsunemasa Momba and Yumiko Waeilsho of local radio station FM Iwate’s Iwaiizumi bureau, who was responsible for reporting on Typhoon No. 10, and others.

Associate Professors Ebina and Moriguchi considered the information obtained from an analysis on river flooding (provided by Shuichi Kuno, Assoc. Prof. at Toyama Prefectural University) and an old map of Iwaiizumi and compared them to the shape of the local terrain and the testimonials of locals. The results suggested that the Omoto River flooded as a result of the massive rain concentrated in a short period of time and drifted that acted as a dam and that previously, the river flowed to a road in which overflooding water ran. Assoc. Prof. Ebina pointed out, “Further detailed analysis must be done to arrive at a conclusion, but this is perhaps an example of how the remains of old land use have an impact in a disaster, even after land use has changed due to human action.”

Moreover, IRiDS researchers, Waeiilsho, and Momba exchanged opinions on current disaster reporting and issues with disaster prevention countermeasures. With regard to a landslide countermeasures booklet created by disaster prevention expert Momba based on individual investigative visits, Assoc. Prof. Moriguchi stated, “This has a lot of information, such as where dangers lurk in our homes and what escape routes to use in times of disaster, which will help us understand disasters as personal events. It is very advanced and will be a fantastic reference on disaster risk reduction in the future.” This collaboration between IRiDS arts and sciences partnership researchers, media personalities who know their community, and a disaster prevention expert provided an opportunity for a number of discoveries and useful findings.

With our current knowledge on earthquake physics, it is difficult to know if abnormal signals captured in the observation data indicate an impending earthquake. But we may know, albeit with a large uncertainty, if the probability of an earthquake has increased or not. Can this type of information be utilized for disaster mitigation by allowing precautionary measures? Discussions have been going on among researchers, whose backgrounds are in different disciplines such as sciences, engineering, psychology, and volcanology, local government officials who have been taking part in disaster risk reduction plans in the Nankai Trough area, and journalists who have been involved in disaster reporting. Yo Fukunishi, an associate professor of the Disaster Science Division in IRiDS and the head of the study group organizers, states that “by confirming seminars and discussions for more than a year, we have been able to consider the problem from various aspects. We hope to continue working deeper on this theme through multidisciplinary discussions.”

Researchers can well analyze the past and present if data are available, but they cannot accurately predict the future. Yet, can we utilize available scientific information to build a better future, to mitigate the risk of Nankai Trough earthquakes? The researchers’ pursuit continues.

“World Tsunami Museum Conference” Held in Ishigaki


The island of Ishigaki is thought to have been struck by tsunamis numerous times in the past, with historical records showing major damage from the Meiwa Tsunami of 1771. In addition, it is well-known that tsunamis have carried many large “tsunami boulders” inland on the island.

At the World Tsunami Museum Conference, representatives of museums for tsunami or disaster prevention, such as Wabakama Prefectural’s “Inamura-no-Hi no Yakuza,” gathered from places such as Indonesia, Thailand, Sri Lanka, Portugal, and Turkey to share museum activities and issues. Prof. Shuichi Kawaiisho and Assoc. Prof. Kaeshi Goto of IRiDS lectured the group on tsunami boulders from the perspectives of folklore and geology. In addition, the gathering screened the 3D documentary “Tsunami 3.11 Meets a no Kirika” (The Great Tsunami of 3/11: Memories for the Future) (produced by NHK MediTek Technology, supervised by Prof. Furumichi Inamura, director at the IRiDS), which provides a record of the Great East Japan Earthquake and subsequent rebuilding. While increasing their understanding of tsunami, conference attendees shared the current state of tsunami museums around the world as well as the issues they face, ensuring that for those working in tsunami museums and in disaster prevention, the conference was a valuable opportunity to reaffirm the importance of global partnerships.
The Great East Japan Earthquake:

1. Taro District, Miyako City, Iwate Prefecture

- This photo was taken just about one month after the earthquake. Surrounded by double seawalls known as the “Great Wall,” in 2003 the town of Taro at that time had declared that it was “tsunami proof...” (photo taken April 8, 2011)

- The landslide seawall that had been submerged was raised ten meters above sea level. (the eight meter white portion was then added). The mountains in the background were leveled and construction for relocation to a higher location began. (photo taken April 23, 2014)

- While many homes and stores had lined the center of the Taro area, it has now become a baseball field, with the shouts of junior high school students echoing around the town. (photo taken June 19, 2016)

- This is the Taro-Sanno district, relocated to a higher land area. The Taro police box of the Miyako police department, fire station, nursery school, and health clinic have also been relocated here. (photo taken September 15, 2017)

2. Rikuzentakata City, Iwate Prefecture

- The center of Rikuzentakata City: devastated by a 15 meter high tsunami. More than 1,000 people lost their lives in the disaster. (photo taken April 10, 2011)

- Even with more than two years having passed since the disaster, many volunteers were still coming from across the country to help clean up the debris. (photo taken August 3, 2013)

- The city center: where the post-disaster reconstruction is progressing. The straight line extending from the mountain is a giant conveyor belt to carry gravel to raise the land of the city center. (photo taken April 28, 2014)

- The “Miyako Takata” commercial complex opened its doors in the center of town. It features six supermarkets, restaurants, and others. A municipal library also opened in July. (photo taken September 17, 2017)

3. Shishiori District, Kesennuma City, Miyagi Prefecture

- This ship, the 18th Kyotoku-maru, used for large scale net fishing, was swept away more than 700 meters from the port as far as JR Shishiori Station. (photo taken April 30, 2011)

- This ship, the 18th Kyotoku-maru, used for large scale net fishing, was swept away more than 700 meters from the port as far as JR Shishiori Station. (photo taken August 3, 2013)

- The Shishiori district was swept up in flames on the night of the disaster, now construction of permanent houses has finally begun (September 17, 2017)

- These disaster recovery public housing units are under construction and enmeshed in blue netting. (photo taken April 23, 2016)

- The Shishiori district was swept up in flames on the night of the disaster, now construction of permanent houses has finally begun (September 17, 2017)