Information Transmitted by IRIDeS

The institute holds periodic meetings for the purpose of transmitting information and achieving cooperation and integration.

1 Expanded general meeting

●**IRIDeS Now**
Shares information inside IRIDeS.

●**Information on the IRIDeS Friday Forum**
Shares information on the content of research activities.

●**Great East Japan Earthquake Watcher**
Follows the various activities in disaster sites and inside and outside of Japan, and social movements.

2 IRIDeS Friday Forum

This forum is held on the evening of the 4th Friday of each month as a place for periodic announcements and discussions for the purpose of sharing information related to the research and other activities conducted at IRIDeS and to foster cooperation and integration in research. For details, see the website (http://irides.tohoku.ac.jp/event/irides-forum.html).

Information is also published on the IRIDeS website.

●**Activity announcements** http://www.irides.tohoku.ac.jp/topics/index.html
●**Future plans** http://shinrokuden.irides.tohoku.ac.jp/

**Evolving disaster prevention and reduction.
Creating a society prepared for
large-scale disasters.**

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

Name: IRIDeS
Symbolizes the Iris sanguinea, Iris laevigata, and Iris ensata, as well as hope and nobility
Meaning of the logo: Reverses the Chinese character for “disaster”, to symbolize the determination for overcoming disasters by promoting recovery and reconstruction, and creating a society that can intelligently handle disasters. The key color of the institute is the color of the Iris sanguinea, and comes from the logo of Tohoku University. This flower symbolizes hope and nobility.

IRIDeS Report 02

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International Research Institute of Disaster Science
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IRIDeS Report

Transmitting Practical Disaster Prevention Studies from Tohoku to the World

International Research Institute of Disaster Science

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

02
2014.03

Knowledge from Tohoku will save the world.

Close Up

1 "Keicho Period Oshu Earthquake Tsunami" Project
What are the messages from the damage caused by the earthquake 400 years ago?

2 Project "Power to Live" with Disasters
What is the power to live that humans can exert in disasters?

“The foundations for giving back our research to society are being put into place.”

Message from the first institute director (from April 2012 to March 2014)

Arata Hirakawa

The first director of IRIDeS
Professor in Preservation of Historical Materials
at the Human and Social Response Research Division

The Tohoku University International Research Institute of Disaster Science was founded with a strong determination to conduct research for society. The results of research into disasters must be returned to the people in the disaster stricken area, and by extension, the whole of humanity. We bear the responsibility for transmitting highly reliable research results to society.

Many visitors come every time we hold our Friday Forum, which was set up as a place to convey information to the citizens. Furthermore, with our links to the local community becoming stronger and stronger, we have been able to enter partnership agreements with seven local government bodies for the purpose of advising reconstruction plans with specialist knowledge. I believe that enabling third parties to more easily access the research results and information of our research institute has been a big achievement.

In the future, I believe we can utilize the framework we have built up over these two years to transmit our research results in a more concrete manner. I hope we can have industry, government, and academia working together to create a disaster research center for Japan and the entire world.

“We will accelerate linking with the local region and continue to dispatch information to the world.”

Fumihiko Imamura

The new director of IRIDeS

Professor in Tsunami Engineering Research field at the Hazard and Risk Evaluation Research Division

The “practical disaster prevention studies” promoted by the Tohoku University International Research Institute of Disaster Science is a field of study that will continue to expand according to society and lifestyles. To apply useful knowledge on disaster prevention and scientific knowledge to people’s daily lives, it is essential to link with local government and residents. Up until now, we have been building a framework for practical disaster prevention studies, including partnership agreements with local government, and systems for transmitting research information to citizens. It is now the crucial stage for reconstruction. I wish to cooperate with local government and the private sector to further promote our studies.

The World Conference on Disaster Risk Reduction is scheduled to be held in March, 2015. This conference will be an important opportunity to discuss world disaster prevention policies for coming 10 years, and also a good chance for us to internationally transmit the research results we have gained from the Great East Japan Earthquake. In addition, we plan on conducting non-verbal activities such as tours for visiting disaster areas. We will work together to prepare for this conference so that visitors will be able to take the results of our research back to their home countries in a concrete form.

Message from the new institute director (from April 2014)

A comprehensive disaster research institute

IRIDeS researches all facets of natural disasters, including their occurrence, damage caused, response, restoration/reconstruction, and future preparedness. It focuses on disaster site issues, propose solutions, and tries to assist in preventing or reducing the effect of disasters in society and people's actual lives.

1 Disaster Science Division

Disaster occurrence

This department researches the mechanisms, impact, and ability to forecast natural disasters, including earthquakes and tsunamis, volcanic eruptions and climate change, and threats from outer space.

2 Hazard and Risk Evaluation Research Division

Spread of destruction

This department aims to visualize the state of devastation caused by earthquakes or tsunamis using numeric simulations, etc., to reduce risks and assist early reconstruction.

3 Human and Social Response Research Division

Emergency response

This department researches the psychology and neuroscience behind how people react when a disaster occurs, and systems for reducing or preventing disasters that meet human characteristics.

4 Regional and Urban Restoration Research Division

Restoration/reconstruction

This department researches reconstruction plans for disaster-struck regions, technology for increased earthquake-resistance to ensure safety, and robotic technology that can assist disaster prevention.

5 Disaster Medical Science Division

Emergency medicine

This department creates the foundations of emergency medicine for disasters, and researches changes in the mind and body after a disaster, such as female-specific illnesses and infectious diseases, and mental health care.

6 Disaster Information Management and Public Collaboration Division

Future preparedness

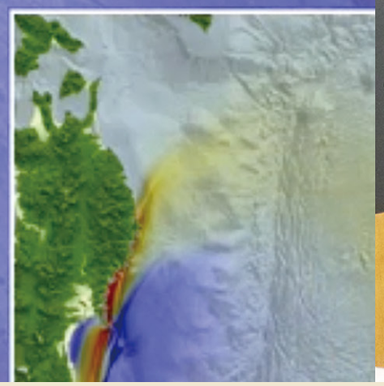
This department builds the “Michinoku Shinrokuden” disaster archive and collects a wide range of information such as records of the earthquake. This archive is for sharing both inside and outside of Japan, and for sharing with future generations.

7 Endowed Research Division (Tokyo Marine)

Education/research

This department has been established to enrich and invigorate education and research at the university using donations from the private sector, etc.

01



A simulation image of the tsunami propagation that occurred in the Keicho Period Oshu Earthquake, created by assistant professor Kentaro Imai. It is estimated that a large-scale tsunami pushed a wide area of the Sanriku coast.
*IRIDeS/BOUSAI Consultant Co., Ltd.

After taking photos of valuable old documents, interpretation is done by referring the background of the time they are written.

"Keicho Period Oshu Earthquake Tsunami" Project

About 400 years ago, it is said that the “Keicho Period Oshu Earthquake Tsunami” struck the pacific coast of the Tohoku region, which at the time included the Sendai domain. This event was viewed skeptically in the materials of old documents, and was underestimated as a past event of tsunami damage. However, after seeing the scope of the damage caused by the Great East Japan Earthquake, the validity of the event is being reassessed. Three professors started this project in order to get a more accurate picture of the tsunami damage caused by the event and give a warning so that people can prepare for tsunamis caused by earthquakes that may occur in the future.

Discovering the truth behind the large-scale tsunami that hit the Tohoku region 400 years ago

On the 11th of March, 2011, the Great East Japan Earthquake struck, and approximately 18,000 people lost their lives, mostly in Iwate, Miyagi, and Fukushima prefectures. The earthquake is generally said to be of a scale that occurs only once in a thousand years. This is because the fact that a huge tsunami hit the pacific coast of the Tohoku region after an earthquake in 869 in the Heian period has been confirmed in the tsunami deposits. However, there was actually another large tsunami after that, one which struck the pacific coast of the Tohoku region approximately 400 years ago in 1611, which was the start of the Edo period. This was the “Keicho Period Oshu Earthquake Tsunami”. Although it was more recent than the earthquake that occurred in the 869, we still do not know what kind of tsunami it was.

The professors of the Tohoku University International Research Institute of Disaster Science (hereinafter referred to as “IRIDeS”) who saw the damage caused to the coastal regions by the huge tsunami of the Great East Japan Earthquake, started this project to discover what the Keicho Period Oshu Earthquake Tsunami was actually like. The main members of this project are assistant professor in tsunami engineering Kentaro Imai, assistant professor in early modern Japanese history Yuichi Ebina, and assistant professor in geology Daisuke Sugawara.

The Keicho Period Oshu Earthquake Tsunami that is said to have killed about 1800 people in the Sendai domain and more than 3000 people and horses around Morioka domain, is normally called the “Keicho Period Sanriku Earthquake Tsunami”. However, these assistant professors insist on the term “Oshu” because it indicates more accurate range of disaster areas than the term “Sanriku”. Assistant professor Ebina explains that “Since the name ‘Sanriku’ is used, it is not widely known that the tsunami reached the Sendai plain, which may have been why the area was not warned. We aim to convey a more accurate picture of a tsunami that struck the regions in Oshu by using this term.”

Up until now, the estimated scope of the Keicho Period Oshu Earthquake was about magnitude 8.1, and the epicenter was thought to be to the East of the Japan trench. However, since such conditions could not explain a large-scale tsunami flooding the Sendai plain, this was considered a mystery amongst specialists.

This is why these three researchers from different fields decided to join forces to break down the boundaries between humanities and sciences to discover what actually happened in this earthquake and tsunami in the Edo period.

An attempt to presume the source of wave from old documents and tsunami deposits

Assistant professor Imai in charge of tsunami engineering presumed the source of wave from old documents and evidence found in tsunami deposits and created a tsunami simulation to find out what kind of earthquake caused the tsunami of the Keicho Period Oshu Earthquake Tsunami.

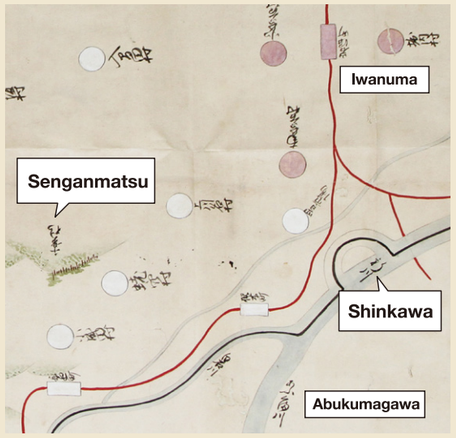
The reason why many earthquakes have historically struck off the pacific coast of the Tohoku region is because that is where the oceanic and landward plates are hitting alongside the Japan trench. The sinking oceanic plate pulls the landward plate, which causes distortion to build up. Sometimes the area where the plates are touching breaks, causing the plates to shift and an earthquake to occur.

In past research, the earthquake of the Keicho Period Oshu Earthquake Tsunami was estimated to be magnitude 8.1 with an epicenter inside a plate on the east side of the Japan trench off the Sanriku coast. However, although this model can explain the height and flood range of the tsunami that hit the Sanriku coast, it was not possible to depict a tsunami that reached the Sendai plain using a simulation.

Assistant professor Imai added information found in old documents and evidence found in tsunami deposits to attempt to presume new source of wave. As a result, he obtained two earthquake models which were “an inter-plate earthquake off the coast of Sendai bay and an inter-plate earthquake on the west side of the Japan trench” and “a plate-boundary earthquake off the coast of Sendai bay and an intra-plate earthquake on the east side of the Japan trench.”

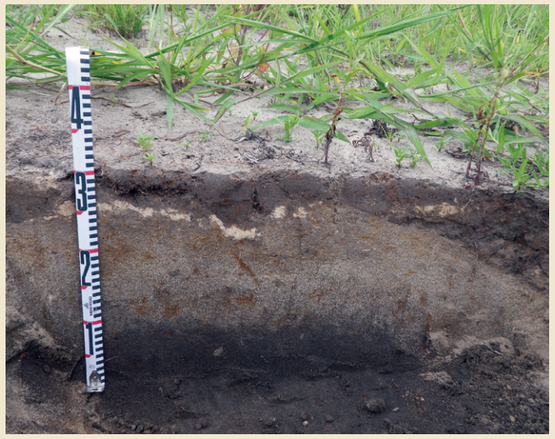
If earthquakes with different hypocenters occurred together, this would solve the question of why the previous theory of a single earthquake could not explain what happened. The estimated magnitude was increased to 8.5. It was found that multiple hypocenters linked to create a huge earthquake and the scale was found to be comparable to the main earthquake of the Great East Japan Earthquake.

● Map of the Iwanuma area in the Edo period



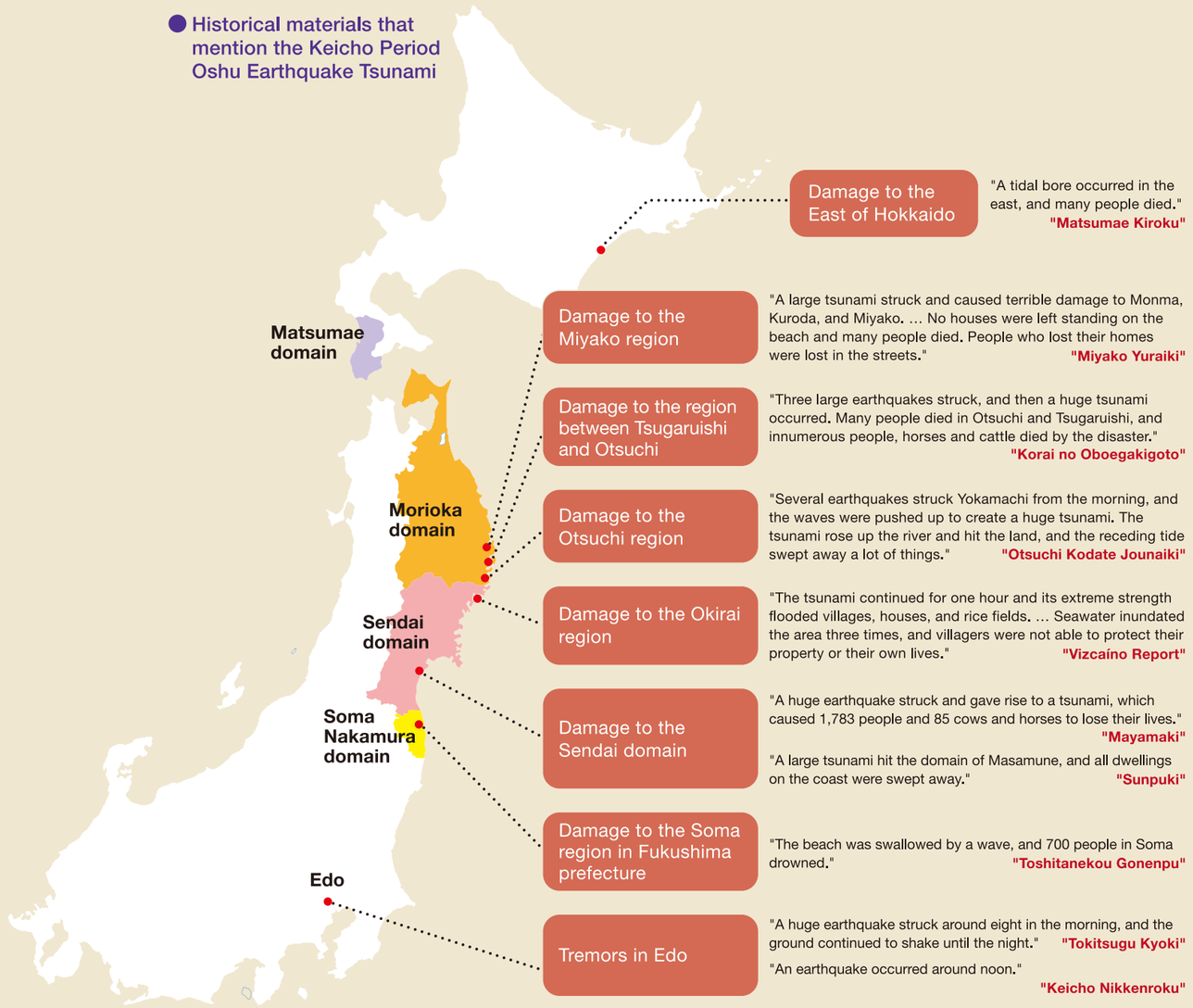
Senganmatsu is drawn in old maps in the same location it is today.
A record of people drifting to this place is found in “Sunpuki”.
*A part of Tamura Ukyonosuke chigyouchisakaime ezu
owned by SENDAI CITY MUSEUM

● Geological layers on the coast of the Tohoku region



Layers formed of coastal sand and pieces of seashells are tsunami deposits.
The scope to analyze can enable researchers to discover the scale of past tsunamis.

● Historical materials that mention the Keicho Period Oshu Earthquake Tsunami



Historical records need to be validated objectively and critically

“Why was the huge tsunami that hit the Sendai plain 400 years ago forgotten by the local people?” This was the question that spurred assistant professor Yuichi Ebina in charge of early modern Japanese history to start researching what really happened during the Keicho Period Oshu Earthquake Tsunami.

The “Sunpuki” was written by a retainer of Ieyasu Tokugawa, which describes the tsunami damage told by Masamune Date, and the “Vizcaíno Report” was written by the Spanish explorer Sebastián Vizcaíno who experienced a tsunami off the coast of Iwate prefecture. The reason why the Keicho Period Oshu Earthquake Tsunami was underestimated is because the reliability of so few historical records containing testimony of the people of the time was questioned.

The Sunpuki tells the “Senganmatsu legend”, which says that retainers of Masamune were hit by a large tsunami while they were out fishing, and ended up drifting to Mt. Sengan in Iwanuma city. Mt. Sengan is located approximately 8 km inland from the coastline, and is 186 m high. This story was considered to be a tale of fiction, but the believability of the story was verified after researching pictures and other materials.

The Vizcaíno Report contains records of tsunami damage over a wide region including Soma city in Fukushima prefecture and the Sanriku coast, which he was surveying. Since the report states that he received hospitality at Okirai village (currently Ofunato city), the record of his sightings was questioned. However, Mr. Ebina concluded that these statements were not contradictory due to the fact that tsunami damage is uneven in an intricate ria coast, and that people of power in the area had a habit of building their houses on elevated land.

Since historical records are sometimes written according to the whims of those in power at the time, it is essential to look at them objectively and critically amidst the historical backdrop. However, Mr. Ebina says that “We cannot reject historical materials simply because they are written a long time ago. If we match them with many other materials, we should be able to make more use of the information from our ancestors that experienced great disasters.”

The deposits left over from tsunamis shows the scope of damage

The geological strata of the Tohoku region coast include layers where coastal sand and fragments of seashells, etc. is mixed in with mud from marshes. These are tsunami deposits. It is the most reliable evidence of a tsunami striking, and the distributed range and thickness of these layers enables us to ascertain the scope and damage caused by tsunamis a long time ago.

Assistant professor Daisuke Sugawara in charge of geology is trying to gain a more accurate picture of the Keicho Period Oshu Earthquake Tsunami using tsunami deposits. He has been digging around the coast of Sendai city to collect innumerous geological stratum samples. However, most of the samples he found were from the Jogan period earthquake tsunami (in 869).

Why is it that evidence of a tsunami about 400 years ago could not be found, but deposits of a tsunami more than 1000 years ago could be? Mr. Sugawara believes it has a relationship with the past reconstruction and development in the disaster areas. He explains that “Reconstruction started immediately after the Keicho Period Oshu Earthquake Tsunami, and the coastal areas hit by the disaster quickly became settlements and cultivated land again. It seems that these construction processes removed the deposits.” On the other hand, with the Jogan period earthquake tsunami, it seems that the deposits remained as they were after the tsunami because large-scale reconstruction did not occur.”

What Mr. Sugawara is now particularly focused on is identifying the scope of the area that was hit by the Keicho Period Oshu Earthquake Tsunami. Discovering the northern limit and southern limit of the deposits will lead to an answer. The documented northern limit is around Miyako city, and the documented southern limit is around the Sendai plain. Deposit surveys in the north started from Onuma in Higashidori village in the Shimokita peninsula of Aomori prefecture, and those in the south started from Matsukawaura in Soma city. Deposits from the period were not found in either Onuma or Matsukawaura. He says “Sometimes we lament that we could not find anything. But we cannot give up.”

Understanding the interval between earthquakes so that the memories of disasters do not fade from memory

A new approach for linking sciences and the arts has enabled a clearer picture of what happened in the Keicho Period Oshu Earthquake Tsunami. Old documents and tsunami deposits are only single pieces of the whole story of a tsunami. The defining feature of this project is that three professionals in different fields succeeded in complementing each other's research.

The simulation calculations required for the tsunami model created by Mr. Imai requires various numeric values such as the height of the tsunami, however scientific observational data does not exist for the Edo period. That is why accounts of the tsunami and its scale recorded in old documents and the distribution of the sediment deposits transported by the tsunami become necessary.

Old documents have always been an important source of information in research into historical tsunamis, but researchers who specialize in the sciences do not have the specialized knowledge required to comprehend these old documents. This is where Mr. Ebina comes into play, with his ability to closely scrutinize the content of old documents to find out what is true and what is not. Sometimes it is possible to quantify the height of tsunamis by reading old documents and sometimes it is not. In areas where the watermark cannot be seen, it is necessary to check tsunami deposits. Definite evidence of Keicho period tsunami deposits has not yet been found outside of Sendai, but surveys are continuing in the coastal areas of Sanriku and Fukushima.

As a result of the collaboration between these three, the Keicho period Oshu earthquake was found to have a magnitude of 8.5, which is close to the magnitude 9.0 of the main earthquake of the Great East Japan Earthquake. The fact that multiple hypocenters linked to create a huge earthquake was also similar. Mr. Imai stresses "The tsunami of the earthquake is said to be a once in a thousand year event, but we discovered that a similar tsunami struck about 400 years ago. I believe that understanding the interval that these earthquakes will strike and the risks posed by tsunamis are important when considering future disaster prevention and reduction."

Mr. Imai was not the only one who is helped by Mr. Ebina in his research. Mr. Sugawara was also advised by Mr. Ebina when selecting sites to survey. He reflects that "It turns out that the geography is quite different now than what it was during the Edo period. For example, the coastline is more inland than it used to be, and the position of the rivers has changed. Information from old maps that I received from Mr. Ebina has helped my research."

The method that was adopted can also be applied to other earthquake tsunamis. Mr. Imai focuses on two other huge earthquakes that occurred off the coast of Hachinohe and off the coast of Boso in 1677, 66 years after the Keicho Period Oshu Earthquake Tsunami. Both areas are north and south of the hypocenters of the Keicho Period Oshu Earthquake Tsunami. Upon superimposing the Keicho Period Oshu Earthquake Tsunami with the Great East Japan Earthquake, he says "There may even now be a higher risk of an earthquake and tsunami after the disaster. I want to reassess the scale of these earthquakes and tsunamis."

It was found that the tsunami deposits of the Keicho Period Oshu Earthquake Tsunami were lost due to the subsequent reconstruction and cultivation, which made surveying difficult. However on the other hand, this means that reconstruction at that time must have gone well, which is surely a hopeful sign for us now.

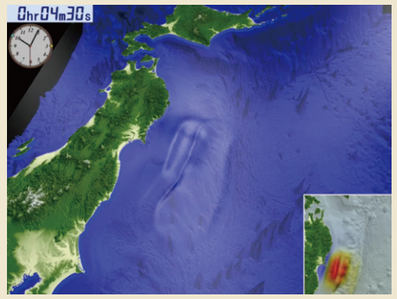
Mr. Ebina emphasizes that "How our ancestors overcame adversity to rebuild society is written down in old documents. I believe that learning from these people and conveying what happened is meaningful." Mr. Sugawara is also enthusiastic, stating "I want to increase surveys of tsunami deposits to accumulate data and discover tsunamis that are buried in history." Finding out about earthquakes and tsunamis that occurred in the past can help current day disaster reduction, prevention, and reconstruction. The research of these three professors has only just begun.

Discovering what really happened in the Keicho Period Oshu Earthquake Tsunami with efforts that transcend the border between sciences and the arts

● Geological surveys on the coast of the Tohoku region

Geological surveys are being conducted in areas where geological layers are not changed by humans (for example, intertidal flats, swamps, etc.)

● Simulation image of the tsunami propagation that occurred in the Keicho Period Oshu Earthquake



① **4 min 30 sec after the first earthquake**

Occurrence/propagation of the tsunami from the inter-plate earthquake in Sendai bay

② **30 min after the first earthquake**

The tsunami from the inter-plate earthquake in Sendai bay hits coastal areas

③ **10 min after the second earthquake**

5 hours after the first earthquake. Occurrence/propagation of a tsunami from the second earthquake that occurred near the trench axis off the Sanriku coast

④ **30 min after the second earthquake**

The tsunami from the earthquake that occurred near the trench axis off the Sanriku coast hits coastal areas

*IRIDeS/BOUSAI Consultant Co., Ltd.

Assistant professor

Kentaro Imai

Born in Tokyo. Completed his doctor's course at the Graduate School of Engineering and Resource Science at Akita University. Worked as a special researcher at the Earthquake Research Institute of Tokyo University, an assistant professor at the Graduate School of Engineering of the Tohoku University Disaster Control Research Center, and then as an assistant professor at the Tohoku University International Research Institute of Disaster Science from 2012. He specializes in tsunami engineering.

Assistant professor

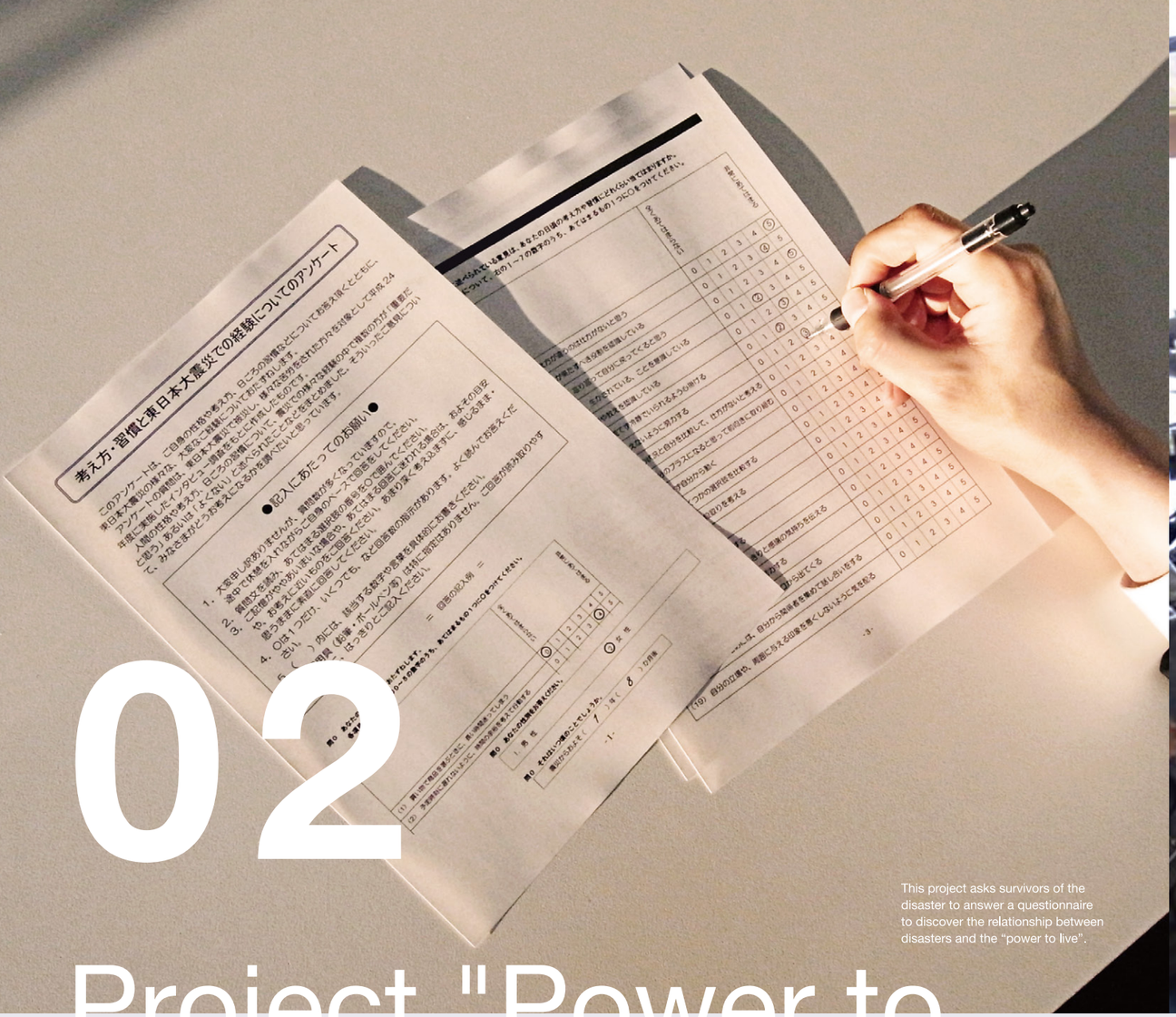
Yuichi Ebina

Born in Aomori prefecture. Completed his doctor's course at the Graduate School of International Cultural Studies at Tohoku University. Worked as an education research assistant at the Center for Northeast Asian Studies at Tohoku University, and then as an assistant professor at the Tohoku University International Research Institute of Disaster Science from 2012. He specializes in early modern Japanese history and domain administration history.

Assistant professor

Daisuke Sugawara

Born in Iwate prefecture. Completed his doctor's course at the Graduate School of Science at Tohoku University. Worked as a COE research fellow at the Graduate School of Science at Tohoku University, as a researcher linking industry, academia, and government at the School of Engineering at Tohoku University, and then as an assistant professor at the Tohoku University International Research Institute of Disaster Science from 2012. He specializes in geology.



This project asks survivors of the disaster to answer a questionnaire to discover the relationship between disasters and the “power to live”.

Conducting interviews for the project. Questionnaire data is added to the survey results to analyze the “power to live” that can be exerted in a disaster.

02

Project "Power to Live" with Disasters

When an event such as the Great East Japan Earthquake occurs, some people are able to use their instincts to stay alive, by making flexible decisions to save themselves and the people around them. On the other hand, due to standard human psychology, some people think that everything is alright even when an unexpected danger is nigh, and these people lost their lives because they were unable to take the appropriate actions.
What is the difference between these kinds of people? This project researches this “power to live” that enables humans to avert crises and overcome difficulties.
It performs analysis in various specialized fields to discover what the source of this power is and how it can be exerted. It aims to define the “power to live” in an easy to understand manner, so it can be made useful when taking actions in an emergency and for reconstruction.

What is the latent “power to live” that humans can utilize in emergencies and adversities such as earthquakes?

When the huge tsunami caused by the Great East Japan Earthquake was looming, there were people who were able to make flexible decisions to save themselves and the people around them. When there were electricity and water shortages immediately after the disaster and communications were cut, some people gathered nearby people together, and other people scrambled to secure supplies. Where does this “power to live” that enables humans to avert crises and overcome difficulties come from, and how can it be applied to human actions?

In the Project “Power to Live” of the Tohoku University International Research Institute of Disaster Science, cognitive psychology professor Toshiaki Muramoto and neuroscience associate professor Motoaki Sugiura and other members analyze testimony from the people that experienced the disaster to research this “power to live” that was exerted by people in the area struck by the disaster.

The research started from interviews. 78 people who were living or working in 15 coastal cities and towns in Miyagi prefecture when the disaster struck were interviewed.

The interviews start from giving a self-introduction, where the subjects were when the earthquake struck, and the damage they received by the tremors and tsunami. They are then asked about what has been difficult, what gave them trouble, and what continues to give them trouble, from the time that the disaster occurred until the time of the interview. Finally, they are asked about what measures they take to improve or resolve these matters, and the reasons for doing so.

The interviewees are asked to relate at least one experience they had during three defined periods, which are in the week immediately after the disaster occurred, the emergency period from one week to half a year after the disaster, and the recovery/reconstruction period from that time until the present day. The survey results are categorized as experiences/countermeasures and reasons for countermeasures.

This survey is done along with the project assembly (refer to the chart on page 13). The project now is at the stage where professor Muramoto, associate professor Sugiura, and assistant professor in disaster social information studies Shosuke Sato analyze the results from different viewpoints, including survey analysis by questionnaire.

Some factors which consist the “power to live” in the time of disaster are found in the results of the survey.

Visualizing brain function to analyze actions in emergencies and adversities

Mr. Sugiura seeks to find out how the "power to live" and human minds work based on the method called "functional brain" which shows which parts of the brain perform which functions.

Human actions are basically determined by a combination of the functions of various parts of the brain. For example, let us say you hear your name called by someone you know. Your brain recognizes the face and voice it knows and starts transmitting and processing information. It then thinks about what action to take after connecting memories and past feelings with the person.

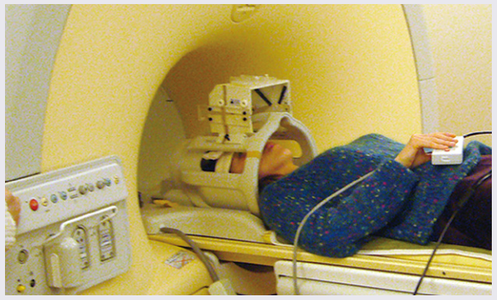
Finding out which parts of the brain information comes from and where it is processed may lead us to unexpected way to control your own thoughts and feelings. For example, actions and emotions that have a positive image such as living positively and not brooding on things may be actually achieved in the brain by a process that may have a negative image, such as the suppression of emotions. If this is true, researchers can conduct research and development into methods for achieving the power to live positively from a new perspective. Mr. Sugiura believes that a hint for discovering this lies in the frontal lobe. He enthusiastically states "Research on the power to live is taking on currently unknown areas head-on."

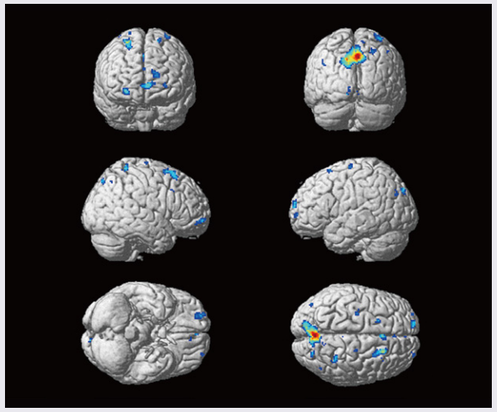
Before conducting functional brain mapping relating to the "power to live", the project conducted interviews and questionnaire surveys of people affected by the Great East Japan Earthquake who live in the coastal areas of Miyagi prefecture in order to figure out what the "power to live" is. Mr. Sugiura explains that "We have discovered, for instance, that the attitude of 'preparing' in daily life is very important in the time of disaster as well as the act of 'preparing' for disaster is. People who work on maintaining good health and relieving stress, etc. have overall good results in the time of disaster and reconstruction. People who are able to control themselves on a daily basis have the ability to adapt when situations and environments change." On the other hand, he has the vague impression that in extraordinary situations, brain functions that differ from those required by general society may function at an advantage.

The research will soon move on to drawing a map of the "power to live" in the brain. An MRI (magnetic resonance imaging) device will be used to measure the blood flow of the brain and capture images of the areas that are highly active when the "power to live" is being exerted. This will seek to clarify the combinations of the parts of the mind that achieve the "power to live" The test subjects will act out situations where the "power to live" will be exerted in a virtual world in MRI scans, to check their brains using the machines. First, who can move fast, and who cannot. Then, who can respond correctly, and who cannot. The research will analyze how their brain activity differs. The scenarios in the virtual world will reflect how the "power to live" is tried out based on the results of the interview.

If a map of the brain can be drawn, it may be possible to encourage the power to live to come out in a manner that takes into account the weak areas of each person's functional brain.

MRI scans to measure brain activity and brain function mapping





Our minds are comprised of complicated combinations of brain functions, which form our emotions, etc. Researchers seek to figure out the relationship between brain activity and our minds by discovering which combinations of brain functions are found in what areas of the brain.

Analyzing the "cognitive biases" of humans to guide them to make accurate decisions during an emergency

Immediately after the Great East Japan Earthquake occurred, there were many people that failed to escape because they did not react to the words "A tsunami is coming. Evacuate immediately". Why did so many people not act immediately? The key to solving this mystery lies in cognitive psychology, which is the specialty of Mr. Muramoto.

Normally when humans catch external information, they understand, evaluate, and make decisions. They take the course of action that they think is best for themselves. However, sometimes preconceptions hinder this process, which can lead to wrong decisions. It is thought that thoughts such as "The tsunami will not reach here." and "I can go home to get something." lead to many people losing their lives.

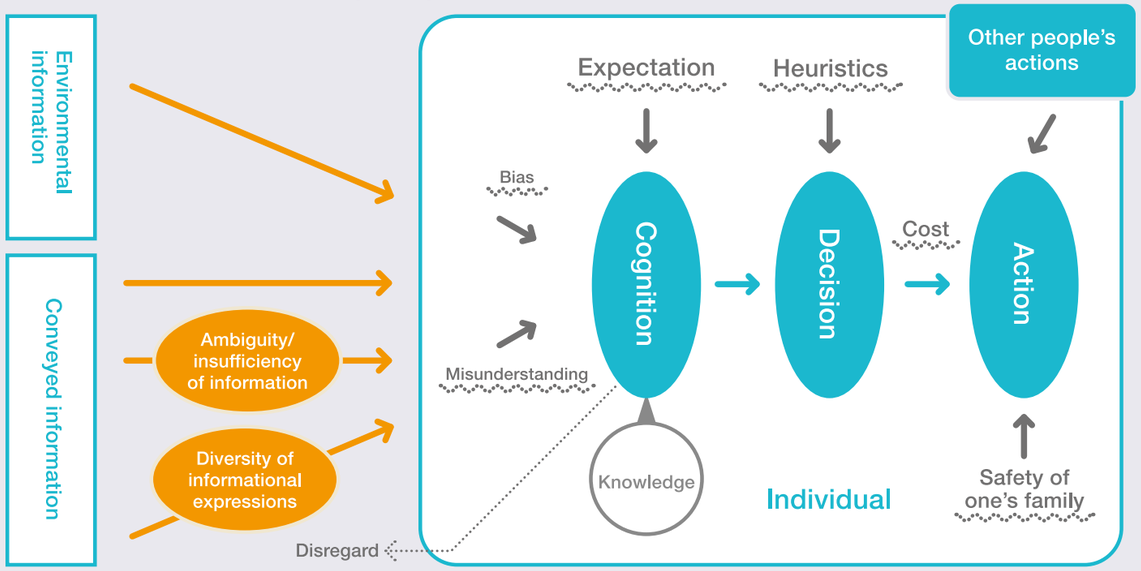
Mr. Muramoto analyzed the factors that lead to wrong decisions based on the results of questionnaires from the disaster and past disaster areas. This has leaded him to "cognitive biases", which are something that everyone is familiar with in everyday life.

A typical example of this is the psychology of people recognizing something as "a thing that normally occurs." This is called the "normalcy bias", and is a state of mind that seeks to keep the mind stable by considering an emergency to be "within the scope of everyday life".

Mr. Muramoto explains "By researching the mechanisms behind 'cognitive biases' and generating various approaches for the act of evacuation, etc., I believe that we can increase the power to live".

Mr. Muramoto feels particularly strong about disaster prevention education. He was lecturing to students and citizens about once a month from 2004 to get people to think about the connection between human cognition, decision making, and disaster prevention. However, after many people lost their lives in the disaster, he was troubled by a feeling of helplessness. He says "However, if I stop still there will be no progress. I face my research into the power to live because I believe that cognitive psychology will definitely be of help to later generations".

Model for information processing during a disaster



Column　How do humans process information in an emergency?

When a disaster strikes, human cognition can be biased due to the information from the environment around them and information that is conveyed from various routes. The ambiguity and insufficiency of conveyed information and the diversity of informational expressions can also cause things to be misunderstood. The expectations of the receiver can influence information cognition, causing information to be skewed to fit expectations or information that does not fit expectations to be ignored. Knowledge is at the basis of this cognition, and a lack of knowledge means that correct cognition cannot be performed. Furthermore, when someone decides whether they are in a dangerous situation, prominent information and easily available information is prioritized, which can cause risk to be underestimated.

Even if a risk is correctly evaluated, it does not guarantee that the person will immediately evacuate. Feelings such as "I cannot be bothered" and "That sounds like a lot of trouble" can prevent actions from being taken due to their perceived cost. People may also be influenced by the actions of others and not evacuate because they conform with the people around them, or be worried about the safety of their family and put actions for their family ahead of their own evacuation.

Researching the source of the “power to live" by analyzing interviews of disaster survivors

After the Project “Power to Live” interviewed survivors of the Great East Japan Earthquake, it organized examples of dealing with difficulties into 15 categories. These included “voluntary unpaid work”, “fulfilling a role or mission using technical or specialized skills”, “surviving after evacuating or experiencing the disaster”, “succeeding in evacuating from the tsunami”, and “exerting leadership to bring together organizations or groups”.

The reasons for being able to overcome difficulties were also organized into 24 categories, which included “human relations/spirit”, “optimism”, “upbringing/environment”, “assistance”, and “experience”. The project members believe that these reasons that were given can capture the “power to live” during an emergency.

Being able to evacuate from the tsunami after the earthquake occurred depended on “instincts”, “experience”, and “preparations/knowledge”. Being able to recover oneself and live a positive life during the emergency period depended on “being optimistic”, “seeing one’s self objectively”, and “having hobbies”. Rebuilding during the recovery/reconstruction period depended on “determination” and “gumption”. Also, regardless of the period, “liking people” and “liking one’s job” helped people be involved in volunteer activities and resume their jobs. Common elements that helped exert leadership, technical skills, and specialized skills included “caring about others”, “experience”, and "having a sense of responsibility”.

The project tested these results by conducting and analyzing a social survey using questionnaires and performing a medical survey using magnetic resonance imaging (MRI). It then moved on to practical research including training and simulations, aiming to contribute to disaster prevention and reduction for citizens and the local region.

The minds and brains of humans are two sides of the same coin. The research fields of psychology and neuroscience can also be considered similar, although the former researches human responses and the latter researches brain activity. Having both of these fields come together is highly significant for disaster prevention and reduction. This is because the human minds and brain functions that influence actions taken to save human lives are formidable adversaries that cannot be easily controlled, as proven by the Great East Japan Earthquake.

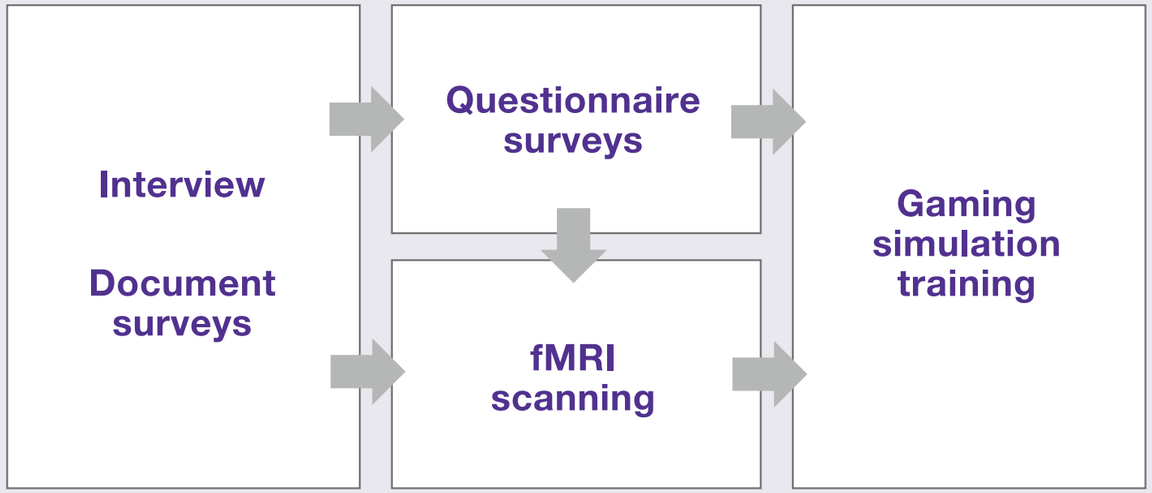
The disaster has led to natural disaster prevention measures being taught all over the nation, including regions where there is fear of a huge earthquake occurring in the Nankai trough. However, even if detailed evacuation plans are crafted and evacuation roads that lead to evacuation sites in elevated areas are constructed, these preparations will not come into play unless people feel that they want to act when a disaster occurs. In order to overcome this obstacle, the researchers are considering various ideas for the end of the project.

Associate professor Sugiura works from the viewpoint of neuroscience to discover the processes and transmission of information that occurs in the brain during difficulties and the functions that prompt actions. He says that “I want to be able to reply with, for example, eight important things when I am asked what the power to live is”. He continues his research to show how to convey information that people can easily take to heart and the appropriate timing for doing so depending on characteristics of brain functions.

Professor Muramoto works from the viewpoint of cognitive psychology to utilize the results of researching the power to live to investigate how to create teaching materials that can be enjoyed like a game and develop evacuation plans and disaster prevention programs that adapt to the structure of an organization, such as the age and gender of its members. He says “I consider various methods, including education for children, training for adults, and preparations that can be made in the region. If I find an approach that helps in a certain situation, I want to convey this to future generations.”

Linking research with the power to enable people to act in emergencies in addition with elaborate disaster prevention and evacuation plans

● Project assembly



Professor
Toshiaki Muramoto

Born in Toyama prefecture. Withdrew from his doctorate at the Graduate School of Letters / Faculty of Letters at Hokkaido University after earning the required credit. Worked as an associate professor at the Graduate School of Information Sciences at Tohoku University, and then as a professor at the Tohoku University International Research Institute of Disaster Science from 2012. Specializes in cognitive psychology.

Associate professor
Motoaki Sugiura

Born in Tokyo. Completed his doctor's course at the Tohoku University School of Medicine. Worked as a researcher at the Jülich Research Centre in Germany, as an assistant professor at the Miyagi University of Education, as an associate professor at the National Institute for Physiological Sciences, as an associate professor at the Institute of Development, Aging, and Cancer at Tohoku University from February 2008, and then concurrently as an associate professor at the Tohoku University International Research Institute of Disaster Science from 2012. He specializes in functional brain mapping.

● Eight factors of “power to live” that can be exerted in a disaster

General name	Description	Situation
Power to gather people	The power to take the initiative to contact people and organizations to get things done.	People with this power were able to gather people together to evacuate from the tsunami, manage evacuation sites, and help regional reconstruction.
Power to tackle problems	The power to think about things logically to tackle problems.	People with this power were able to avoid or tackle problems that occur in their life after evacuation, etc.
Power to care about others	The power to be glad about the happiness of others and be able to help them out.	People with this power were able to help people in trouble to assist the region and conversely had many opportunities to receive help themselves.
Power to stick to one’s beliefs	The power to properly convey your wants and desires to people.	People with this power were able to convey their desires and help they require to people when they face difficulties.
Power to stay calm	The power to stay calm and positive no matter what happens.	People with this power were able to calmly evacuate after the earthquake and positively face their life after evacuation and the troubles of reconstruction.
Power to live properly	The power to properly perform the actions expected in daily life.	People with this power were able to overcome various troubles in their life after evacuation by themselves. They are also ready to deal with the next disaster that might occur.
Realizing the meaning of life	Realizing the meaning of life that transcends the concept of loss and gain.	People with this realization were able to positively overcome the various troubles in their life after evacuation. They are also ready to deal with the next disaster that might occur.
Power to live life to the fullest	The power to live life with a healthy body and mind, and have aspirations.	People with this power were able to use their high sense of awareness to overcome the difficulties of evacuating the tsunami after the earthquake, their life after evacuation, and the troubles of reconstruction.

Professor

Shinji Toda

Natural Disaster Research
Disaster Science Division

“Figuring out the mechanism behind earthquakes and conveying it to people is the role of geophysicists.”

Mr. Toda is a professor of Natural Disaster Research at the Disaster Science Division of IRIDeS. He was born in 1966 and specializes in earthquake geology. After completing his master's program at the graduate school of science at Tohoku University, he worked at the Central Research Institute of Electric Power Industry, Earthquake Research Institute at the University of Tokyo, Active Fault Research Center, and Disaster Prevention Research Institute Kyoto University, before assuming his current post.

After the Great East Japan Earthquake, we finally realized that the ground that we are standing on is not stable. Why does that ground shake? When does it happen? Professor Toda works hard everyday to survey and research the aftershocks that frequently occur after a disaster to assist future earthquake predictions.

An abnormally large earthquake that nobody predicted

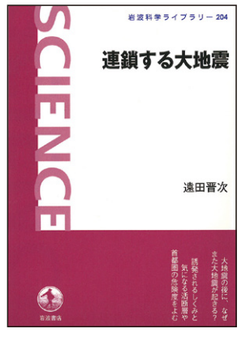
When the Great East Japan Earthquake occurred, Professor Toda was in New Zealand. When he saw “Magnitude 8.9 off the coast of Miyagi prefecture” (later corrected to magnitude 9) on the TV, he shouted “There’s no way a magnitude 9 earthquake could hit Japan! The caption must be wrong!”

“At the time, almost no geophysicists thought that an earthquake of this level could strike Japan. The giant earthquake that occurred at 14:46 shook the very principles of researchers.” Professor Toda says “We have a large cross to bear.” due to them being unable to predict the disaster. This is how much of an abnormality the Great East Japan Earthquake was.

On the other hand, researchers were able to figure out new things precisely because such a large earthquake occurred. Professor Toda conducted detailed research into the frequency of aftershocks after the Great East Japan Earthquake and the patterns behind the other large-scale earthquakes that occurred as a result, and succeeded in discovering several new mechanisms. “After the disaster, aftershocks occurred that were of a type that had not been researched much before. Research into how these earthquakes occurred after the disaster may help in predicting the next earthquake.”

The role of science is to figure out how phenomena occur. By figuring out the mechanisms behind earthquakes, we can discover what is happening below our feet and predict what might occur in the future. “We cannot avoid natural disasters. However, if we can discover how disasters are dangerous and warn about how often they may occur, the people in charge of construction and development can minimize risks. I believe that my role is to steadily research these phenomena and let people know about the risks.”

The Great East Japan Earthquake was an unexpected event for scientists and for all of us. Let us take a look at how abnormal an earthquake it was and what new things have been discovered.



“Iwanami Kagaku Library: Rensa Suru Daijishin”
Published by Professor Toda in February, 2013
(Iwanami Shoten, Publishers)

The faults shifted greatly within a compact epicenter

Earthquakes occur when two plates that are calmly together shift because they cannot withstand the stress. The Great East Japan Earthquake occurred where a plate on landward side meets an oceanic plate. Earthquakes often occur where plates overlap. In the north eastern waters of Japan, earthquakes occur off the coast of Miyagi Prefecture about once every 40 years. “It was predicted that there was a 99% chance of an earthquake occurring off the coast of Miyagi Prefecture within 30 years. We forecast that there would be an earthquake, but we did not expect one of this magnitude.”

Before the disaster occurred, seismologists forecast the scale of earthquakes that could occur along the Japan trench off the Tohoku Pacific coast into several seismic sources (hereinafter, simply“epicenters”) along the Japan trench off the Tohoku Pacific coast. Seven epicenters were defined off the north east coast based on a survey of the 1978 earthquake that occurred off the coast of Miyagi prefecture. It was predicted that these seven epicenters would not link and earthquakes up to magnitude 6 or 7 could occur. However, during this disaster, six of these epicenters linked and caused an earthquake of magnitude 9.

The epicenter of the Great East Japan Earthquake reached approximately 500 km to the north and south and 200 km to the east and west. This made the area five times larger than was expected up until then.

However, Professor Toda says that a range of 500 km to the north and south and 200 km to the east and west is small for a magnitude 9 earthquake. For example, the magnitude 9.1 earthquake that occurred in Sumatra in 2004 had an epicenter that extended 1000 km to the north and south. “It is not an exaggeration to say that Japan does not have an epicenter of 1000 km. Therefore, we believed that an earthquake of magnitude 9 could not occur.”

If that is the case, then how could an earthquake of magnitude 9 occur off the north east coast? The reason is the amount that the fault slipped. “The fault slipped by about 20 m in the Sumatran earthquake, but 50 m in the Great East Japan Earthquake. This disaster was the first time we realized that a magnitude 9 earthquake could occur with a relatively short fault if the fault slips a large amount.

The cause of frequent aftershocks is due to sudden extension of the Japanese archipelago

Another abnormality was the frequency of aftershocks after the disaster occurred. 740 earthquakes of magnitude 5 or higher occurred in the year before 2012. “Since the epicenter of the Great East Japan Earthquake was 500 km long, it affected a wide area. If we include small earthquakes, they have been increasing all the way down to Lake Biwa.”

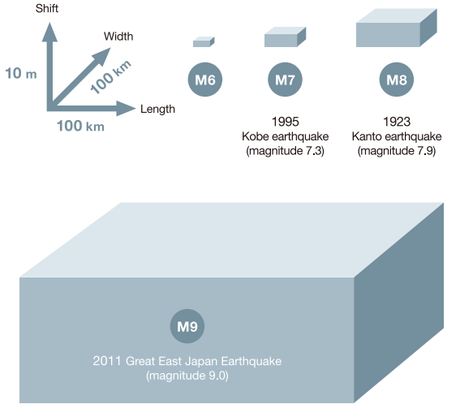
Why are the number of aftershocks increasing? The reason is because the Japanese archipelago has been distorted after the Great East Japan Earthquake.

The Japanese archipelago is situated on the Eurasian plate. Before the disaster, the Eurasian plate was being pushed by the Pacific plate, which was causing the Japanese archipelago to slowly contract. However, due to the Great East Japan Earthquake, the Pacific Ocean side of landward plate moved to east, the opposite direction from before, which caused the Japanese archipelago to be strongly pulled to the Pacific Ocean side. Furthermore, rather than the entire archipelago being pulled in an even manner, areas closer to the epicenter were pulled more than those that were further away. For example, the Oshika Peninsula in Miyagi Prefecture moved 5.3 m east-southeast, but Sado island in Niigata Prefecture only moved 0.5 m. “The unprecedented tectonic activity occurred in the mere three minutes that it took for the earthquake to subside. What is more, the ground in the Tohoku region is continuing to move.”

When the ground continues to move in the same direction after a large earthquake, it is called an “afterslip”. Professor Toda explains that the Tohoku region is still experiencing an afterslip. “In the year and four months after the disaster, the Oshika Peninsula has moved a further 67 cm in the direction it moved during the earthquake. An afterslip occurs without the help of a large earthquake, and energy equivalent to a magnitude 8.6 earthquake has already been emitted. However, the fact that this afterslip is occurring means that the plate movements have not returned to the way they were before the disaster occurred. The ground of the Tohoku region is still unstable.”

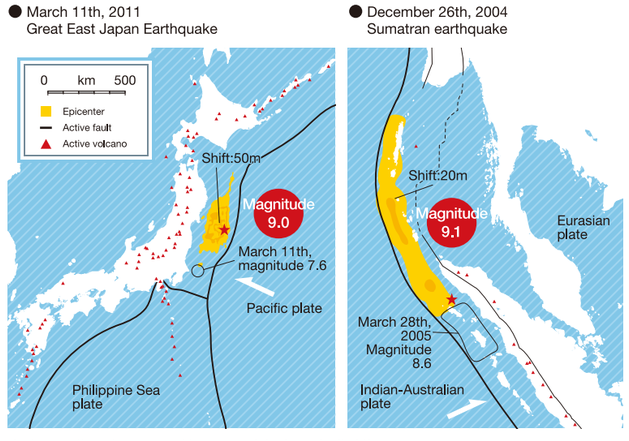
What was abnormal about the Great East Japan Earthquake?

● Concept of magnitude



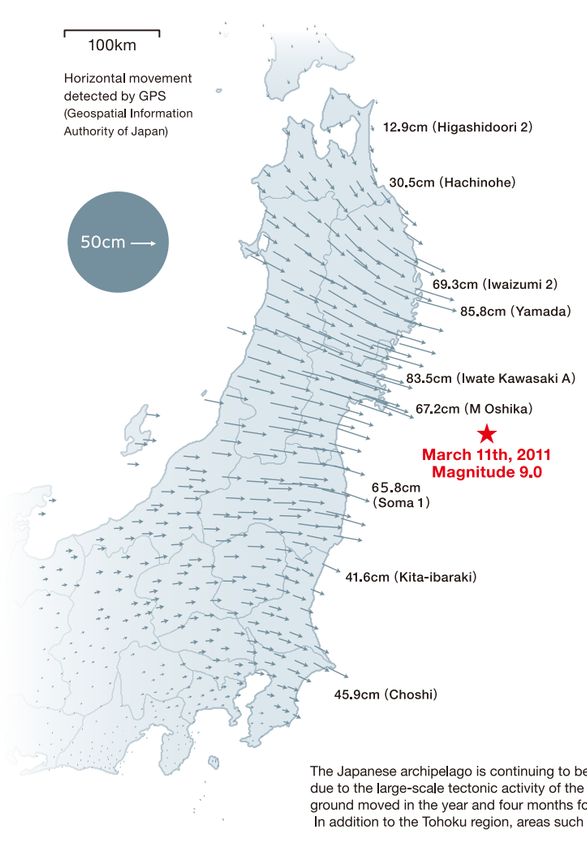
This is a visual depiction of the size of the earthquake. The energy release by the Great East Japan Earthquake was 1400 times larger than that of the 1995 Kobe earthquake.

● Epicenters of the Great East Japan Earthquake and the Sumatran earthquake



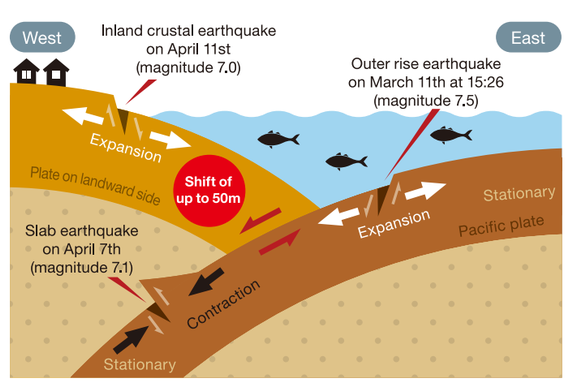
A giant earthquake occurred because of the large fault shift, despite the narrowness of the epicenter

● Ground that moved with the afterslip



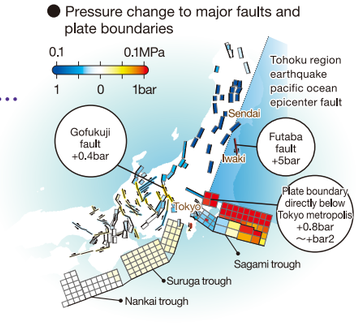
The Japanese archipelago is continuing to be pulled towards the Pacific Ocean side due to the large-scale tectonic activity of the disaster. This diagram indicates how much the ground moved in the year and four months following the earthquake using arrows. In addition to the Tohoku region, areas such as Choshi have moved a large amount.

● Plate movement and large aftershocks



The Great East Japan Earthquake occurred because the plates shifted.
Most of the aftershocks occur not only where the shifted plates meet but also at the active faults which are cracks inside of the plates.

● Pressure change to major faults and plate boundaries



Column 01　What are active faults?

Japan used to be part of a continent. It broke away from the continent, was bent into an “L” shape, and was then hit by the Izu islands coming from the south. Japan is an archipelago that has seen various geological events occurring over a long period of time. The archipelago can be said to be covered in wounds. Those wounds are the faults and the freshest wounds are active faults. It is said that there are more than 2000 active faults in Japan. In addition to the faults that have been discovered, there are also faults that have not been exposed because they are hidden by sediment. Although it sounds like it is dangerous to live near an active fault, the reality is that in Japan it is difficult to live somewhere that is not close to a fault.

The stress of tectonic activity excites inland active faults

The ground of the Japanese archipelago has moved greatly due to the large-scale tectonic activity caused by the earthquake and the subsequent afterslip. Professor Toda describes the Japanese archipelago as “a rice cake that has been baked until it is crispy on the outside.” The outside of freshly baked rice cake is stiff but the inside is runny and stretches when a slight amount of force is applied. “If the surface of the rice cake equates to the crust of Japan, the cracks you see in the surface of the crispy rice cake are the active faults found over Japan. When a rice cake is stretched, the cracks in its surface widen. In much the same way, since the ground of the Japanese archipelago has been stretched, stress has been applied to the active faults over the country, which has caused earthquakes to increase. That is one of the defining feature of these aftershocks.”

13 hours after the giant earthquake, a magnitude 6.9 epicentral earthquake occurred in the north of Nagano prefecture. 14 hours later, a magnitude 6.4 earthquake occurred off the coast of Akita prefecture. In April, 2011 a magnitude 7 earthquake occurred in the fault at Iwaki city. These aftershocks that occurred in areas far away from the epicenter of the Great East Japan Earthquake are thought to have occurred because the Japanese archipelago was pulled.

“Up until now, it was thought that it becomes less likely for an earthquake to occur in the area after a giant earthquake has occurred. This is because we thought that the giant earthquake would relieve the distortion of the surrounding area. However, this is not what happened with this earthquake. Since the balance of forces acting on the Japanese archipelago was altered, distortion arose under the inland surface.”

Furthermore, most of the regions where aftershocks are frequently occurring were not found to be very seismically active. Since different forces than usual were exerted, aftershocks occurred in unexpected areas.

Distortion building up due to afterslips

We also have to pay more attention to the afterslip, which is continuing even now. Afterslips are occurring in the areas surrounding those that shifted due to the actual earthquake. Some areas have continued to move more than when the earthquake occurred, such as Choshi, which has been pulled approximately 46 cm towards the Pacific Ocean. “It is possible that distortion has built up in the surrounding areas due to the Great East Japan Earthquake.” Professor Toda believes that another large earthquake might occur due to this distortion.

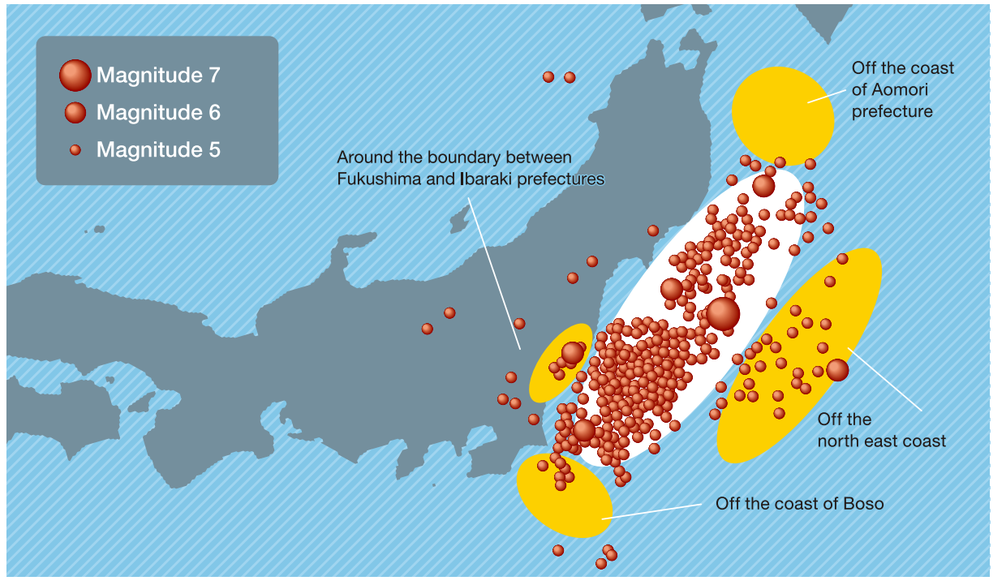
“The Kanto Plain and off the coast of Kushiro in Hokkaido are predicted to have a high danger of being hit by an earthquake in the future.” Several large earthquakes have been recorded in the Kanto region, including the Great Kanto Earthquake. The Kanto Plain is located where the Philippine Sea plate and the Pacific plate slide under the Eurasian plate. There are only ten or so areas on Earth where three plates come together. “Even more worryingly, there are recent theories about there being the fourth plate. We cannot even imagine what kind of stress would build up in an area influenced by four plates.”

Professor Toda also says that we need to be careful about the area around Kushiro in Hokkaido. “Upon analyzing the amount of earthquakes and movement of the ground, several research groups have reported that distortion has built up to an extent equivalent to that before the Great East Japan Earthquake occurred. It is possible that an extremely large earthquake may occur if all this distortion is released at the same time.”

Professor Toda says that “The influence of the disaster may continue for up to some decades in the future.” Preparing for earthquakes in the future is essential.

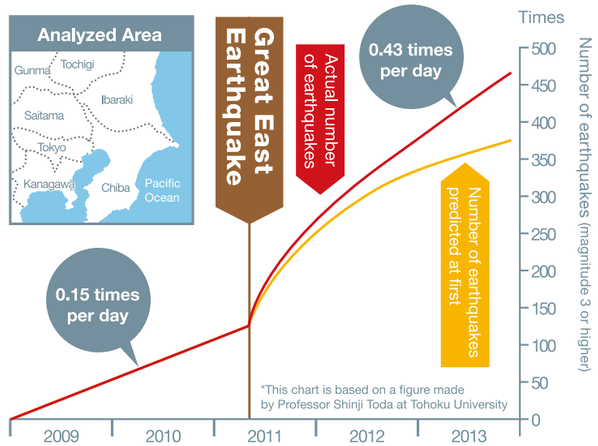
The possibility of a giant earthquake hitting somewhere like the Kanto plain or off the coast of Kushiro

● Earthquakes after the disaster and areas of concern in the future



Although aftershocks are centered off the north east coast, there is concern of a large earthquake occurring in the Kanto region or off the coast of Aomori.

● Number of earthquakes after the disaster



An analysis of aftershocks in the Kanto region. They have increased suddenly after the disaster and have not dropped since.

● Survey of the fault which appears in the earthquake of April 11, 2011.

Seeking multidisciplinary collaborations

IRIDeS conducts research in the humanities and the sciences, and also fields that cover both. The institute is already proceeding with some projects. Professor Toda is looking for ways of linking with researchers in history and engineering. “If we link with architectural engineering, the information gained from our geological surveys of active faults can be used in the building designs and embankment planning conducted in disaster-stricken areas. By notifying engineers of what dangers are found in an area based on geological surveys, we can implement urban development that includes the construction of particularly strong buildings, for instance.”

Professor Toda has recently been concerned about construction on soil mounds and reclaimed land in disaster sites. “I am worried that the collapse may occur if an earthquake occurs in the future. I believe that plans which take into account a large earthquake caused by active faults are necessary in some areas."

Linking with historical science is also being considered for researching past earthquakes for the purpose of future predictions. “In geological surveys, we look at the condition of faults to determine the decade when an earthquake occurred, but decades-long discrepancies can arise. However, historical records can allow us to know when earthquakes occurred in greater detail, up to the month, day, and time. Although we must continue conducting geological surveys, using the detailed information offered by historical records will be extremely useful in analyzing the patterns of earthquakes.”

The Great East Japan Earthquake occurred in a so-called blind spot, which researchers could not see. “I believe that in the future we must conduct our research by confronting the reality that we have blind spots, that there are things that we do not know. I hope we can recognize that things we do not know are still unknown, and gradually figure out these mysteries.” Let us hope that the challenges taken on by Professor Toda will lead to a society where we can live secure lives.

Column 02　Faults and distortion seen with GPS

How is movement in the ground, such as faults and distortion, analyzed?

GNSS-based control stations which are high-precision GPS placed by Geospatial Information Authority of Japan are playing a part in this research. After the Kobe Earthquake, the control stations have been installed at approximately 20 km intervals over the country.

The control stations continuously transmit their own location. The reason researchers are able to discover how the archipelago was stretched and continues to move due to the Great East Japan Earthquake is thanks to the control stations.

Movement of faults which caused the large earthquake was also presumed based on the data measured by the control centers. By comparing past data with recent data, the position and shift of faults are assumed to simulate earthquakes better. The GPS system that you find in car navigation systems and mobile phones is also being utilized in earthquake research.

Professor

Yuichi Ono

International Regional Cooperation Office
Disaster Information Management and Public Collaboration Division

Mr. Ono is a professor at the International Regional Cooperation Office at the Disaster Information Management and Public Collaboration Division of IRIDeS. He was born in 1967. After completing his master's program at the Graduate School of Education at Utsunomiya University, he received his doctorate in geology at Kent State University in Ohio in the United States, and then worked at the World Meteorological Organization, the United Nations Office for Disaster Risk Reduction, and the Economic and Social Commission for Asia and the Pacific, before assuming his current post.

"Using 'United Nations World Conference on Disaster Risk Reduction' to connect the world, Sendai, and disaster-stricken areas."

Professor

Osamu Murao

International Strategy for Disaster Mitigation
Regional and Urban Reconstruction Research Division

Mr. Murao is a professor of International Strategy for Disaster Mitigation at the Regional and Urban Reconstruction Research Division of IRIDeS. He was born in 1965. After the latter doctor's program at the Faculty of Engineering in Yokohama National University, he worked as an assistant at the Laboratory of Urban Safety Planning, the Institute of Industrial Science at the University of Tokyo, as an associate professor at the Graduate School of Systems and Information Engineering of Tsukuba University, and as a Fulbright researcher (at Harvard University and the University of Hawaii), before assuming his current post.

"I want to make this an opportunity for transmitting the knowledge of IRIDeS to the world"

IRIDeS is currently preparing for "The 3rd United Nations World Conference on Disaster Risk Reduction", which is to be held in Sendai in March, 2015. What will IRIDeS be asked to do, and what information can they transmit, in this conference being held in Sendai after the first two times in Yokohama and Kobe? Professors Murao and Ono were interviewed to find out what preparations they are making.

A mission to transmit knowledge gained from the disaster to the world

The United Nations World Conference on Disaster Risk Reduction (hereinafter referred to as the "WCDRR") is a conference with the goal of sustainable national and regional development, where people will discuss how the countries of the world should partake in activities for preventing and reducing disasters. In May last year, it was decided that the third conference will be held in Sendai in March 2015, and preparations are currently being made.

The first WCDRR was held in Yokohama in 1994, and the second was held in Kobe in 2005. A 10 year plan of action was announced in each conference, the second being the HFA (Hyogo Framework for Action 2005-2015), which was adopted ten years after the 1995 Kobe earthquake, and immediately after the Indian Ocean Earthquake and Tsunami that occurred on December 26th, 2004. The HFA is a policy regarding how the world's nations should work towards reducing disasters, what systems governments should adopt regarding disasters, and how to build frameworks for disaster-reduction systems. It includes five main goals of action.

To prepare for the 3rd WCDRR to be held in Sendai, the Tohoku University International Research Institute of Disaster Science (hereinafter referred to as "IRIDeS") published the "HFA IRIDeS Review Preliminary Report", which was mainly directed by Professor Murao. He stated "The purpose of this review was to analyze how the disaster management systems in Japan have changed in the past ten years and what problems are remaining based on the policies of the HFA, as a university situated in the disaster-stricken area." In 2014, the latest review is scheduled to be completed for the Asia Ministerial Conference on Disaster Risk Reduction in June."Due to the Great East Japan Earthquake, the researchers at IRIDeS have generated a large amount of research. We have a responsibility to transmit that knowledge to the world."

● HFA IRIDeS Review Preliminary Report

This review analyzes the five goals of the HFA from a unique perspective. It highlights good practices and problems, and recommendations that can be taken in the future.

Previous United Nations World Conferences on Disaster Risk Reduction

1st United Nations World Conferences on Disaster Risk Reduction

Held in May, 1994 in Yokohama, Kanagawa prefecture
Adopted "Yokohama Strategy and Plan of Action for a Safer World" comprised of two basic concepts and six plans of action

2nd United Nations World Conferences on Disaster Risk Reduction

Held in January, 2005 in Kobe, Hyogo prefecture
Adopted the "Hyogo Declaration" that included the "Hyogo Framework for Action 2005-2015", comprised of five plans of action

3rd United Nations World Conferences on Disaster Risk Reduction

Scheduled to be held in March, 2015 in Sendai, Miyagi prefecture
The keypoint is to set monitoring method for operating states and concrete numeric targets and goals in addition to setting a new action policy

IRIDeS will lead the implementation of a disaster-reduction system

IRIDeS is starting to implement actions for the WCDRR. First of all, the institute will promote the result of disaster research to be utilized in the policies of each nation in the Asian Ministerial Conference to be held in Thailand in June, 2014 by insisting the importance of collecting statistical data related to disasters occurred in Asia and the system which can enable the result of disaster research to be included in the policies. Professor Murao says that "The construction of such a system is also important for analyzing how much the frameworks adopted in the WCDRR have actually helped in preventing disasters. IRIDeS must set a leading example about how such a framework can be utilized."

Japan is one of the countries leading the world in research into disaster prevention and reduction. In the peaceful Edo period, principles regarding disaster prevention were born in Edo, due to the numerous fires that broke out. After this, the Japanese people have realized the importance of disaster prevention and reduction first-hand, by experiencing many disasters such as the 1923 Great Kanto Earthquake "If we take a look at the world, there are still many countries that require efforts to be made for disaster prevention. I believe that we must let the whole world know about the knowledge of Japan and IRIDeS."

An opportunity to strongly connect the world, Sendai, and disaster-stricken areas.

Professor Ono was working at the United Nations for over ten years until last year. "The WCDRR is a place for nations to negotiate. The role of Tohoku University is to provide indirect support. We are currently considering how this support role can be used to convey our knowledge effectively." Professor Ono set action goals for Tohoku University regarding the conference. The first of those goals is to promote the inclusion of the knowledge of IRIDeS in the final document of the third WCDRR. The next goal is to assist the act of connecting the world with disaster-stricken areas. The final goal is to create a framework that will enable the world to cooperate with Sendai even after the conference is over. "At the conference, each nation will give a statement on disaster prevention in the main room. The final document, a subsequent document from HFA, will be created based on those speeches and the documents published by the various institutes, to formulate an action framework like the HFA. It would be an honor if knowledge published by IRIDeS was to be included in the final document." Another thing that Professor Ono wants to focus efforts on is acting as a go-between for the conference and the disaster-stricken areas. "It is significant that the conference will be held in Sendai because of the reconstruction going on in the disaster-stricken areas. If the people in those areas simply think 'some big-shots just came to United Nations Conference, did something, and left' then we cannot say that the conference was a success. I think the key to this conference will be how much the people in the disaster-stricken areas feel they have a sense of unity with the conference." The people of the world are also very interested in the reconstruction process. Professor Ono hopes that he can contribute to create programs with students' help that enable people to stay in the disaster-stricken areas, before, after, and during the conference. "At the end of the day, I hope that we can provide assistance so that cities, towns, and villages that have been struck by a disaster can build friendly relationships with the nations of the world, like Minamisanriku and Chile have done."

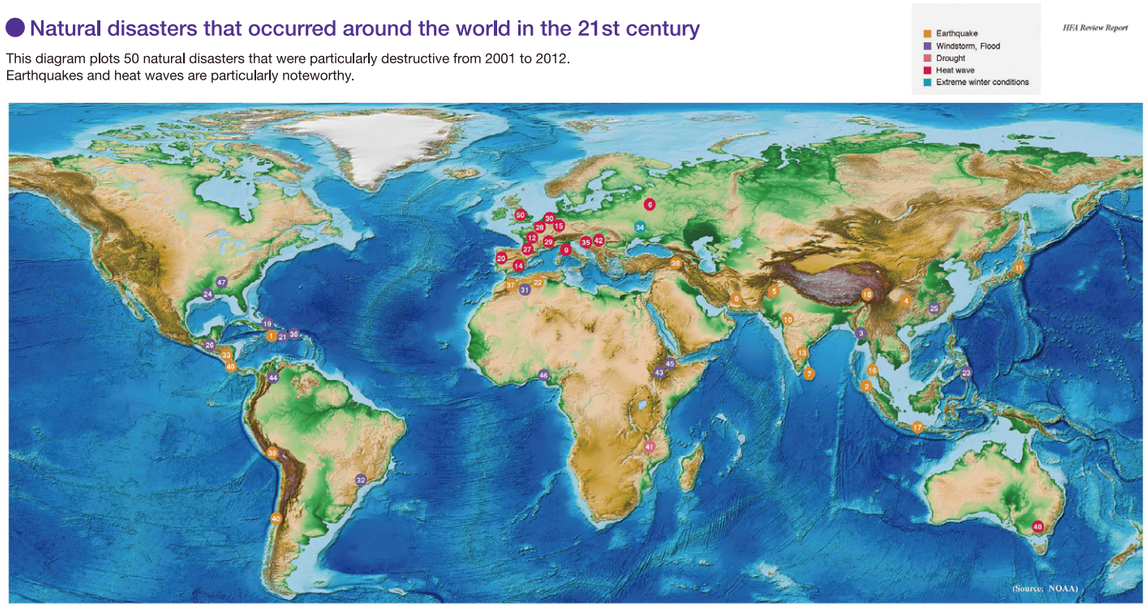
Professor Ono also wonders whether he could create a framework that would enable the people of the world to periodically gather in Sendai after the conference is over. "The areas struck by the disaster are heading towards recovery day by day. I believe it would be good to periodically hold international symposiums in Sendai after the conference so that the world's researchers, corporations, and government officials can keep an eye on the progress that is made." In accordance with this idea, Tohoku University is planning a "Tohoku Forum for Creativity, World Disaster Risk Reduction and Recovery Forum" (tentative title) to be held on the 9th and 10th of March, 2015 as a pre-event of WCDRR. This "Tohoku Forum for Creativity" is held by Tohoku University to provide an opportunity for researchers on the world's front line to intercommunicate. "If we could create a framework that makes industry, government, and academia come back to Sendai so that the city would become a central place for disaster risk reduction, well, what more could we ask for?" The WCDRR is an important opportunity because the eyes of the world will be focused on Sendai. Efforts will continue to make the conference more profitable for those involved.

What is the role of IRIDeS at the United Nations World Conference on Disaster Risk Reduction?

From the "HFA IRIDeS Review" document

● Natural disasters that occurred around the world in the 21st century

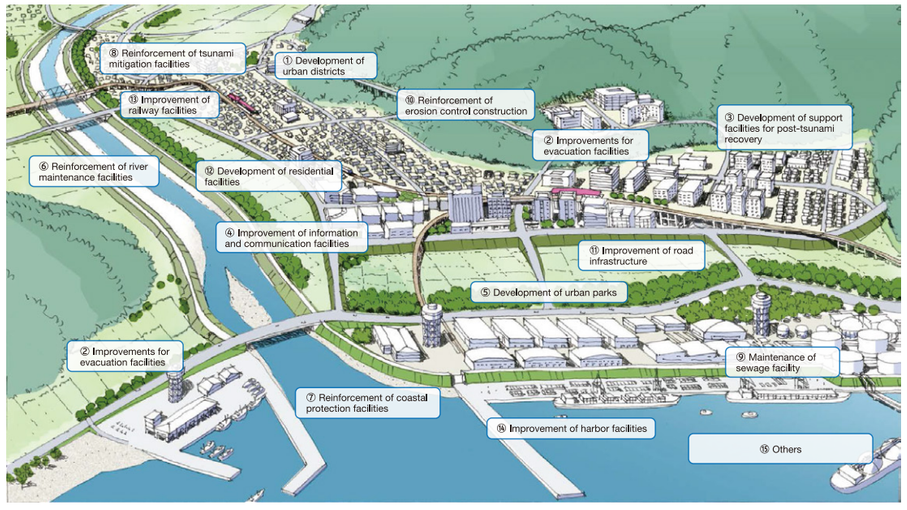
This diagram plots 50 natural disasters that were particularly destructive from 2001 to 2012.
Earthquakes and heat waves are particularly noteworthy.



No.	Month/Year	Disaster Type	Country	Killed	Total Affected	Estimated Damage (US$ Million)
1	January 2010	Earthquake	Haiti	222,570	3,700,000	8,000
2	December 2004	Earthquake	Indonesia	165,708	532,898	4,452
3	May 2008	Storm	Myanmar	138,366	2,420,000	4,000
4	May 2008	Earthquake	China	87,476	45,976,596	85,000
5	October 2005	Earthquake	Pakistan	73,338	5,128,309	5,200
6	June-August 2010	Heat wave	Russia	55,736		400
7	December 2004	Earthquake	Sri Lanka	35,399	1,019,306	1,317
8	December 2003	Earthquake	Iran	26,796	267,628	500
9	July-August 2003	Heat wave	Italy	20,089		4,400
10	January 2001	Earthquake	India	20,005	6,321,812	2,623
11	March 2011	Earthquake	Japan	19,846	368,820	210,000
12	August 2003	Heat wave	France	19,490		4,400
13	December 2004	Earthquake	India	16,389	654,512	1,023
14	August 2003	Heat wave	Spain	15,090		880
15	August 2003	Heat wave	Germany	9,355		1,650
16	December 2004	Earthquake	Thailand	8,345	67,007	1,000
17	May 2006	Earthquake	Indonesia	5,778	3,177,923	3,100
18	April 2010	Earthquake	China	2,968	112,000	500
19	September 2004	Storm	Haiti	2,754	315,594	50
20	August 2003	Heat wave	Portugal	2,696		
21	May-June 2004	Flood	Haiti	2,665	31,283	
22	May 2003	Earthquake	Algeria	2,266	210,261	5,000
23	December 2012	Storm	Philippines	1,901	6,246,664	1,060
24	August-September 2005	Storm	United States	1,833	500,000	125,000
25	May-August 2010	Flood	China	1,691	134,000,000	18,000
26	October 2005	Storm	Guatemala	1,513	475,314	988
27	July 2006	Heat wave	France	1,388		
28	August 2003	Heat wave	Belgium	1,175		
29	July 2003	Heat wave	Switzerland	1,039		280
30	July 2006	Heat wave	Netherlands	1,000		
31	November 2001	Flood	Algeria	921	45,423	300
32	January 2001	Earthquake	El Salvador	844	1,334,529	1,500
34	January-February 2008	Extreme winter Conditions	Ukraine	801	59,600	
35	July 2003	Heat wave	Croatia	788		
36	May-June 2004	Flood	Dominica	688	10,002	
37	February 2004	Earthquake	Morocco	628	13,465	400
38	October 2011	Earthquake	Turkey	604	32,938	1,500
39	August 2007	Earthquake	Peru	593	658,331	600
40	February 2010	Earthquake	Chile	562	2,671,556	30,000
41	February 2002	Drought	Malawi	500	2,829,435	
42	July 2007	Heat wave	Hungary	500		
43	August 2006	Flood	Ethiopia	498	10,096	3
44	April 2010-March 2011	Flood	Colombia	418	2,791,999	1,000
45	August-September 2006	Flood	Ethiopia	364	8,000	
46	July-October 2012	Flood	Nigeria	363	7,000,887	500
47	April 2011	Storm	United States	354	17,200	11,000
48	January-February 2009	Heat wave	Australia	347	2,000	
49	February 2001	Earthquake	El Salvador	315	256,021	349
50	July 2003	Heat wave	United Kingdom	301		

Data Source: EM-DAT: The OFDA/CRED International Disaster Database, Centre for Research on the Epidemiology of Disasters (CRED)

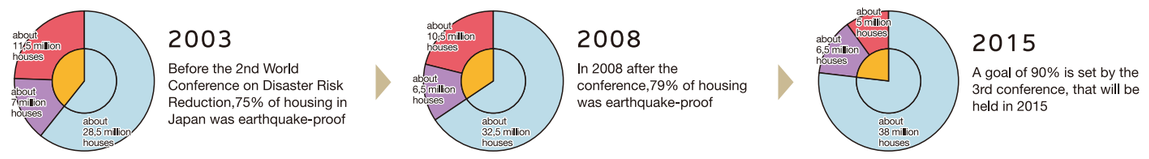
● Town reconstruction plans that recognize disaster prevention and reduction



This diagram indicates how coastal areas hit by the tsunami caused by the Great East Japan Earthquake will be reconstructed. Multiple protection measures and collective relocation are frameworks built by Japan.

● Earthquake-proof housing in Japan

Earthquake-proof houses After 1982 / Before 1981 / Non-earthquake-proof houses / Earthquake-proof houses

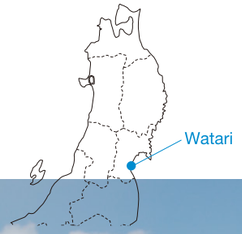


2003
Before the 2nd World Conference on Disaster Risk Reduction,75% of housing in Japan was earthquake-proof

2008
In 2008 after the conference,79% of housing was earthquake-proof

2015
A goal of 90% is set by the 3rd conference, that will be held in 2015

IRIDeS — Miyagi prefecture Watari



(Left) Employee dispatched from Nakano ward in Tokyo

Masaya Nakata

(Right) Watari safety measures team member

Yu Hirama

Signing ceremony for the Watari partnership agreement in 2013

Meeting between Watari and IRIDeS on the day before the disaster drill

Traffic jam caused in the disaster drill

“The great advantage of IRIDeS is to provide one-stop solutions to various issues related to disaster prevention”

Major example of links between Watari and IRIDeS

- **Data analysis for disaster drills**
- **Disaster partnership agreement with Watari**
- **Assisting the review of the disaster prevention plan of Watari, etc.**

For queries related to the case examples/collaborations, please contact IRIDeS at contact@irides.tohoku.ac.jp

Recognizing the importance of vehicle evacuation by analyzing training data

On June 25th, 2013, Watari and the Tohoku University International Research Institute of Disaster Science (hereinafter referred to as “IRIDeS”) entered a partnership agreement. This partnership was made possible because of the desire of Watari to create a town that is resistant against all types of natural disasters including earthquakes and tsunamis matched with the philosophy of IRIDeS, which is to link with regional society to conduct research. Mr. Hirama stated “Our town is now formulating a new disaster prevention plan in response to the Great East Japan Earthquake. It is extremely beneficial to be able to receive advice based on specialized knowledge.”

The first time that IRIDeS participated in an activity in Watari was their disaster drill conducted on J 9th, 2013. This was about two weeks before both parties entered their partnership agreement. “The defining feature of this disaster drill was that we asked our residents to evacuate by car. About 1,400 residents participated in more than 600 cars.” Due to the flat land between Watari and the sea, about half of the town was flooded due to the tsunami that occurred due to the Great East Japan Earthquake. Some areas about 5 km inland were even flooded. “We conducted drills using cars before the earthquake, but never at this scale. We needed strong evidence for including vehicle evacuation in future disaster prevention plans.” IRIDeS analyzed the evacuation patterns of residents using vehicle evacuation questionnaires and GPS data. It was found that national highway intersections and the roads near evacuation sites become particularly congested, and this information was conveyed to Watari. “We discovered specific issues such as needing to improve vehicle guidance, and were able to recognize the importance of vehicle evacuation and related issues. I believe we will be able to explain this to our residents with more confidence than before.”

In addition to disaster drills, the town is planning to enhance its other intangible disaster prevention efforts, such as publicity activities and disaster prevention education. “I feel that our partnership agreement has made it a lot easier for us to ask for advice. It is handy to be able to get the opinion of a third party on things such as the location and design of evacuation signs and the content of disaster prevention education.” Mr. Sai said that he hopes that Watari and IRIDeS can utilize each other’s knowledge and technology to create more effective plans for disaster prevention.

Tohoku University International Research Institute of Disaster Science “Michinoku/Ima wo tsutaetai”

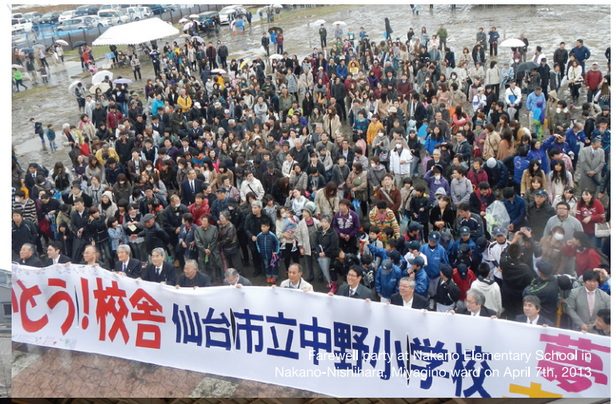
(Left) Officer in charge of Miyagino ward

Yuko Sone

(Right) Officer in charge of Wakabayashi ward

Keiji Sometani

In Wakabayashi ward on April 5th, 2013



At “Welcoming” at Nakano Elementary School in Nakano-Nishihara, Miyagino ward on April 7th, 2013

Meeting about evacuation sites at the citizen center in Saiwai-cho, Miyagino ward on September 4th, 2013

In Wakabayashi ward on April 7th, 2013

“Passing on earthquake experience and training to our children, and the next generation.”

These two are in charge of collecting information on Sendai city for “Michinoku Ima wo tsutaetai”. Mr. Sometani, who lives in Okino in Wakabayashi ward, used to work as the head of the Rokugo Civic Center, and knows the local area and people very well. After the earthquake occurred, he spent some time walking around to photograph the damage to the region. “After the disaster, I spent each day looking for some way that I could help. I joined the team because I wanted to think together with others about how we can reconstruct our town.”

Ms. Sone, who is in charge of Miyagino ward, felt the same way. Since an earthquake of this magnitude is said to happen once in a thousand years, it will certainly be remembered by generations to come. “Our generation that experienced the earthquake has an obligation to leave a record of the disaster and the lessons we have learned. That is why I thought we must properly convey these things to the children of the next generation. Since other volunteer activities require a lot of physical strength, this ‘Michinoku Ima wo tsutaetai’ is where I could help out, being a woman.”

Collecting information involves interviewing all kinds of people, from local acquaintances, people living in temporary housing, and people walking in the park or on the street. Some people that they talk to say things that they would rather not hear. “It can be difficult to interview people about things that they do not want to remember, and this makes it hard for both parties.” However, hearing what people really think is an important task. People’s emotions also need to be recorded, as they change with the passing of time.

Three years on from the disaster, a reconstruction plan is being implemented to start building a new town that considers how to prevent and reduce disasters. However, the reconstruction cannot allow the memory of the disaster to fade away. We cannot forget the reality that there are still many people living in the disaster-struck region that cannot see the light of hope. “We want to keep a proper record of what occurred in the disaster for the future. That is our mission.” A record of the disaster, the town heading for a brighter future, and the thoughts of the people living there will certainly be handed down to the next generation.

Michinoku/Ima wo tsutaetai

This team works to collect various kinds of regional information to keep and convey, including records and evidence of the areas struck by the Great East Japan Earthquake, current lives of residents, and their thoughts and hopes for the future. It is currently active in 15 cities and towns on the coast of Miyagi prefecture.
The team is made up of residents from the various regions, which are openly recruited. The activities of the team are part of the “Michinoku Shinrokuden” archive project of IRIDeS.

- Michinoku Shinrokuden http://shinrokuden.irides.tohoku.ac.jp/

みちのく・いまをつたえ隊

みちのく震録伝

Find us on Facebook.

- Michinoku Ima wo tsutaetai
  https://www.facebook.com/imawo.tsutaetai
- Michinoku Shinrokuden Earthquake Archive
  https://www.facebook.com/MichinokuShinrokuden

The Great East Japan Earthquake in Figures

Status of Destruction

Intensity on Japanese scale — max. 7

Moment magnitude — 9.0

Number of dead — 15,884 people

Number of missing — 2,636 people

Number of wounded — 6,147 people

Number evacuated — 470,000 people
(approximately, as of March 14, 2011)

Area flooded — 561 km²
(90% the size of the 23 wards of Tokyo, or 2.5 times the size of Osaka city)

Damage to buildings

Completely destroyed — 127,290 buildings

Half destroyed — 272,788 buildings

Partially destroyed — 747,989 buildings

Damage to roads — 4,198 locations

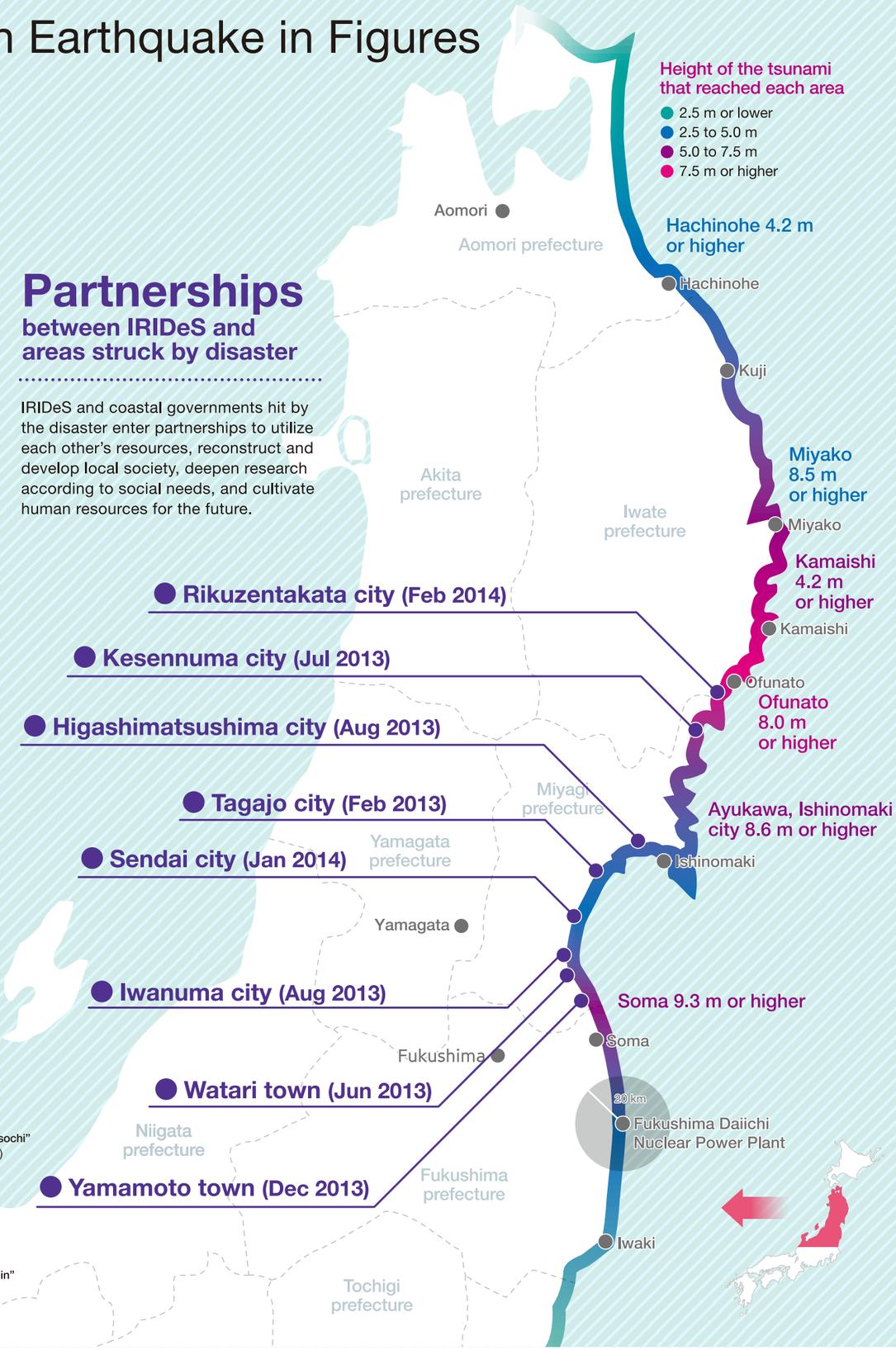
Disaster waste produced (including tsunami deposits) — 2,981 million tons

Total damage — 16,900 billion yen

<Reference>
"Heisei 23 nen (2011) Tohoku chihou taiheiyouoki jishin no higaijoukyou to keisatsu sochi" (Emergency disaster security headquarters, National Police Agency, February 10, 2014)
"White Paper on Disaster Management 2012" (Cabinet Office, Government of Japan)
"Higashi nihon daishinsai ni okeru higaigaku no suikei ni tsuite" (Cabinet Office, Government of Japan, June 24, 2011)
"Higashi nihon daishinsai ni kakaru saigai haikibutsu no shori koutei hyou" (Ministry of the Environment, May 7, 2013)
"Tsunami ni yoru shinsui hani no menseki (gairyakuchi) ni tsuite (5th report)" (Geospatial Information Authority of Japan, April 18, 2011)
"Saigaiji jishin/tsunami sokuhou heisei 23 nen (2011) tohoku chihou taiheiyouoki jishin" (Japan Meteorological Agency)

Partnerships
between IRIDeS and areas struck by disaster

IRIDeS and coastal governments hit by the disaster enter partnerships to utilize each other's resources, reconstruct and develop local society, deepen research according to social needs, and cultivate human resources for the future.



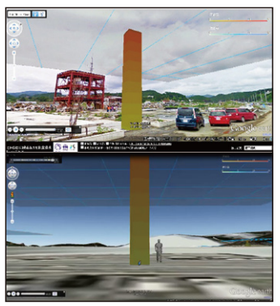
IRIDeS Archive Project

Michinoku Shinrokuden
● http://shinrokuden.irides.tohoku.ac.jp/

"Michinoku Shinrokuden" is an archive project that has IRIDeS linking with industry, government, and academic institutions to collect memories, records, case studies, and knowledge relating to the Great East Japan Earthquake to share both inside and outside Japan, and with future generations. This project can be utilized in countermeasures for future earthquakes feared to occur in the Tokai, Tonankai, and Nankai regions.

March 11th tsunami flooding as seen by human eyes
● http://michinoku.irides.tohoku.ac.jp/ttjt/ttjt_view.html

This site displays the water-mark of the tsunami that occurred in the Great East Japan Earthquake in Google Earth as a polygon bar, to enable a birds-eye view of the height of tsunami to be easily visualized. It enables people to experience the height of the tsunami and how terrible it really was.



Scenery changing due to reconstruction efforts
● http://michinoku.irides.tohoku.ac.jp/photovr/map.html

"Michinoku Shinrokuden" continues to collect photos of disaster sites captured in the same place but at different times. The project also has a website that enables these photos to be viewed while comparing them. On the site, balloons on the map can be clicked to move a time slider that enables changing scenery to be viewed.