Lessons from the disaster and towards the resilient society

The approach by Industry-University cooperation from the 2011 Tohoku earthquake and tsunami

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The 2011 Tohoku earthquake and tsunami revealed that disaster risk in coastal area and recovery support is required to be highly improved. We have cooperated for ten years and collect data and research on disaster risk. Here, our mission is to return the knowledge we obtained through academic activity and insurance business to the society beyond the boundaries of industry and academia.

Improving prediction of next disaster

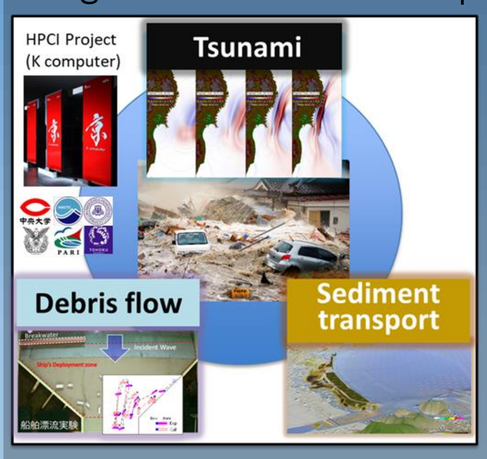

Black tsunami in Iwate pref. photo by Asahi shimbun


Tsunami, photo by Asahi shimbun, Japan


After the tsunami, photo by Asahi shimbun

Integrated Tsunami Simulation

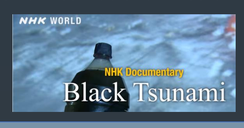
It is a great challenge for human societies to prepare for possible next disaster, especially earthquake related tsunami disasters including tsunamis, liquefaction, sediment transport (called “black tsunami”), drifted debris, fires, and so on. We have developed an advanced and practical computer simulation technology that can contribute to effective tsunami mitigation and evacuation planning strategy.




Analysis of Tsunami and Sediment Transport in Rikuzentakata City after the Great East Japan Earthquake


Analysis of Tsunami, Sediment Transport, and Drifting Debris in Kesennuma Bay after the Great East Japan Earthquake

Introduced in domestic and international media




Study: ‘Black tsunami’ from Nankai quake could exceed govt projection

Predicting the magnitude of hazards


Seawall destroyed by the tsunami


Overturned building at Onagawa area


On-demand lecture in an elementary school


Handkerchief for BOSAI education

Probabilistic Tsunami Hazard and risk assessment

“Hazard” means the threatening phenomena such as tsunamis. The magnitude of hazard has a great influence on the disaster risk. We proposed a method to quantify the risk by assuming tsunamis with different probability of occurrence (see Fig. a). We used the probabilistic tsunami hazard evaluation method to derive the tsunami hazard curve. In addition, tsunami inundation depth is evaluated probabilistically for a building located in Soma port, Fukushima Pref (Fig. b). By combining the information from the tsunami fragility functions, the tsunami risk curve is then derived (Fig. c). This method can be applied to other regions both domestically and internationally. Therefore, this method enables the comparison of tsunami risks among regions and promisingly to provide an indicator for decision making in practical scene, such as architecture, real estate, and insurance.

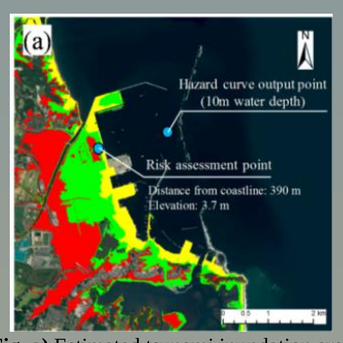


Fig. a) Estimated tsunami inundation area by recurrence period

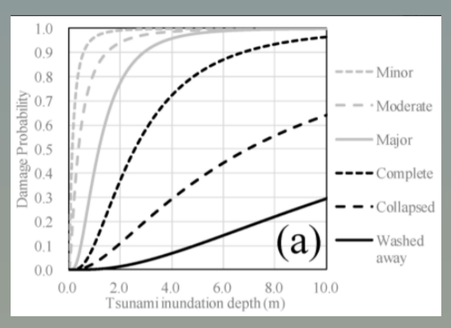


Fig. b) Tsunami fragility functions and building structure

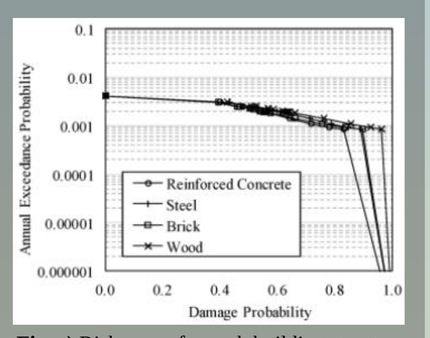
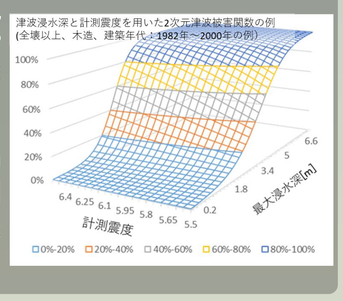


Fig. c) Risk curve for each building structure

Developing tsunami fragility functions of building considering the effect of building age and earthquake ground motion

We found that the tsunami damage of buildings differs depending on the building age, and also showed that the effect of earthquake ground motion before the tsunami disaster on the tsunami damage differs depending on the building age.



Exploring Ecological-based Disaster Risk Reduction

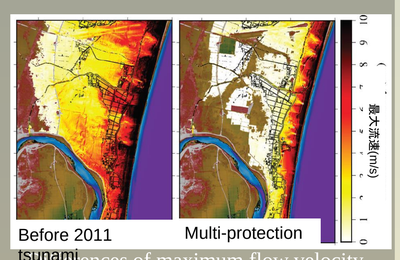

Sandy beach vegetation on the land-side of the seawall at Arahama area (2020)


Blooming coastal flower (*Calystegia soldanella*) on the seawall at Arahama (2019)

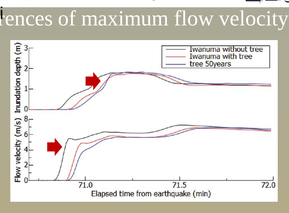
Effects of coastal forests to reduce tsunami damage

Unexpectedly, the coastal road which embankment structure showed the function of tsunami run-up and debris inflow prevention, and serving as an evacuation site. From this lesson, the concept of “multiple protection”, which considers natural landforms, levees, and coastal forests as disaster prevention infrastructure has been spotlighted. We verified the effect of coastal forests by numerical analysis.

As a result, in the 2011 tsunami, the coastal forest contributed to delaying the tsunami run-up by up to 3 minutes. In the future, we will also focus on ecological value and clarify the effect of ecological resilience to social recovery.



Differences of maximum flow velocity



Temporal change of tsunami inundation depth and flow velocity

How should we act in disaster? Challenge to disaster education

Activity of “YUI” project

We need to learn and pass on the lessons from the disaster. At the same time, we need to prepare to respond the next disaster.
Before the 2011 tsunami, there is no opportunity to learn about disasters scientifically. In this project, we have been conducting on-demand lectures, which focused on “active-learning method”.


要請を受け，ハワイの小学校でも出前授業を展開

Launch 2013: exploring the educational methods

Using hazard maps and floor plans of houses, children worked in groups to confirm the safety of their homes and evacuation routes.

-2016: “May the disaster awareness be with you”

We created a handkerchief that contains the minimum information about disaster, based on the concept that people should be able to carry disaster awareness with them at all times.


▲the design of handkerchief


Expanded overseas, such as Hawaii, Thailand, Indonesia, and Philippines

The handkerchief has been translated to several language and developed as a new style of disaster prevention education integrated into our daily life.

-2020: Disaster mitigation stamp rally

Breaking away from listening-only lectures, we have created a stamp-rally for disaster prevention and mitigation. In process of selecting stamps, children can simulate the experience under the disaster. Therefore, children can learn about emergency preparedness in a game-like manner. This stamp-rally has made it easier to provide disaster prevention education in more areas.

▲images of stamp rally

Stamp rally activity

Children complete the stamp rally with discussion


Presenting the results of stamp rally works


Cultivating understanding by feed back time

A series of education programs began in disaster-stricken area, and is now spreading to areas other areas and overseas.

Learning from the disaster experience, and create a resilience society in the future

The research we have conducted for ten years after 2011 tsunami may not solve all of our immediate problems.
However, we believe that collecting, presenting, and sharing objective data and evidence will surely help us to decide the long-term direction of our future society.
We will continue to contribute, not only in industry and academia, but also in relation to everyone who lives in society together.