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International Center for Urban Safety Engineering
Institute of Industrial Science, The University of Tokyo

IMPORTANCE OF BASIN-SCALE SEDIMENT CONTROL AS COUNTERMEASURES FOR GLOBAL WARMING

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What Hurricane Katrina left behind

Hurricane Katrina made landfall on the Mississippi Delta in August 29, 2005, and caused 108 billion USD in damage and more than 1,800 fatalities, resulting in one of the worst disasters in the history of the US. There are several possible main causes of such extraordinary damage. Some people say that the magnitude of the hurricane was most likely worsened by global warming, and others predict that a rise in atmospheric temperature will increase the number of extreme events such as huge hurricanes, and that Hurricane Katrina may be just one example of global warming's effects. There was, however, another cause that deserves special attention.

The U.S. Army Corps of Engineers is working to prevent flooding of the Mississippi River in diverse ways such as by constructing dams in the upper reaches and levees and floodways in the lower reaches. New Orleans, which was severely damaged by Hurricane Katrina, is located in a lowland area. The Army Corps of Engineers is making its best efforts to protect New Orleans from future floods.

Owing to these effective measures, the amount of sediment flowing into the lower reaches of the Mississippi River has been drastically reduced. At the downstream end of the Mississippi, a vast stretch of deltaic plain has been formed due to the deposition of sediment transported by the flow of the Mississippi. Deltas will naturally sink into the

Houses and cars devastated by water flow from levee breaks in the Ninth Ward of New Orleans. Hurricane Katrina broke levees and flooded much of New Orleans. (Photos taken by the author in November 2006.)

ocean under their own weight, and global warming and predicted increases in sea level worsen the situation. Although the deltaic plain used to grow and elongate offshore due to sufficient deltaic deposits, it is now retreating due to the decrease in sediment supply from upstream. New Orleans used to be protected from flooding by the well-developed deltaic land formed between the city and the ocean, but it has become vulnerable to hurricanes at present.

Basin-scale sediment control for long-term restoration of deltas

It has been said that nearly 6,000 square kilometers of wetlands have been lost underwater in the past 100 years. Some are afraid that a large part of the delta is still disappearing every year. In order to stop or reverse the loss, or even rebuild the delta, long-term restoration such as basin-scale sediment control is necessary.

The Mississippi Delta used to be formed by the repeated avulsion of channels and switching of delta lobes from one place to another. However, the Mississippi has been prevented from avulsions by levees built by the Army Corps of Engineers since the nineteenth century. One of the most effective sediment control strategies is artificial diversions of large amount of sediment-laden water from the Mississippi River to deposit sediment in near shore shallow waters, which are now dumped directly into the deep waters of the Gulf of Mexico. Several studies have been conducted on the feasibility and optimal methodology of artificial diversions. Kim et al. (2009) has proposed a numerical model describing the formation of deltas, and predicted that more than 1,000 square kilometers of delta can be recovered by appropriate diversions over a hundred years.

The scientific and engineering problems for large diversions have already been solved, and the biggest problem has been a social, political and economical issue. Particularly since the Deepwater Horizon oil spill in 2010, the need for basin-scale sediment control for the long-term restoration of the Mississippi Delta has been increasingly recognized by politicians from an environmental point of view. Artificial diversion of the Mississippi may be put into practice in near future.

As most of the major cities in Japan are located on river deltas, and they often suffer from typhoons, the problem of degradation of deltas is even more serious. However, a number of deltas are densely populated and intensively used for industry, so that basin-scale sediment control as seen in the Mississippi River cannot be directly applied to many rivers in Japan. We have to give a great deal of thought to countermeasures that effectively enable the protection of deltas in Japan. In addition, there is another sediment-induced problem which is of particular importance in Japan.

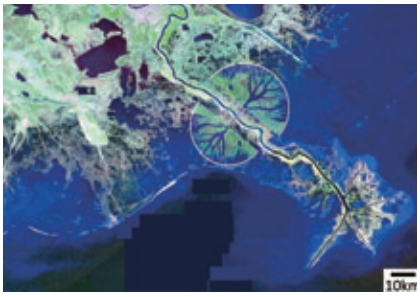


Image of the Mississippi Delta and new land created by two diversions as predicted by numerical simulation (Kim et al. 2009). Courtesy of Wonsuck Kim.

Recent sediment disasters in Japan and its vicinity

Heavy rainfall occurred in the upper reach of the Chubetsu River, a tributary of the Ishikari River in Hokkaido, on August 23 and 24, 2010. Rapid flow caused by the heavy rainfall gave rise to bank erosion and the resulting collapses

Collapses of a bridge and a road by rapid flow created by heavy rainfall along the Chubetsu River in August 2010. Courtesy of Hokkaido Development Bureau.

Distribution of rainfall per hour on August 24, 2010. The rain area illustrated in red is a line-shaped rain band which caused the heavy rainfall along the Chubetsu River.

of a bridge and a road. Four people were involved in the collapses and two lost their lives. It is suspected that the heavy rainfall was caused by "a line-shaped rain-band." The line-shaped rain-band stayed over the Chubetsu River basin for several hours, resulting in a large amount of precipitation. Record-high precipitations per hour were observed at eight observation points including 43 mm/h at Higashikawa, 54 mm/h at Ishikari and 42 mm/h at Sapporo.

Seoul, Korea, experienced extremely heavy rain in late July 2011. This was also caused by a stationary rain-band. Main streets in central Seoul were inundated and a large landslide took place at Mt. Umyeon in southern Seoul. This one hundred year flood and the resulting disasters caused a total of 53 dead or missing people. The rain-band causing this flood gave rise to a similar disaster in Japan a few days later – the Niigata and Fukushima heavy rains in July 2011. The upper reaches of Shinano River tributaries were severely damaged by overflow and bank erosion, and Aizu in Fukushima suffered from sediment-induced disasters. In total, six people died or went missing in this disaster.

Typhoons Talas and Roke made landfall on Japan soon afterward in the same year. At the beginning of September 2011, Typhoon Talas produced more than 2,000 mm rainfall within three days over the Kii peninsula. Rainfall of 2,000 mm is equivalent to the annual rainfall in Tokyo and twice the annual rainfall in Sapporo. Disasters caused by Typhoon Talas were characterized by a rash of landslides and the resulting formation of many natural dams. These landslides turned out to be deep-seated landslides, which include deep regolith, weathered rock or bedrock. The number of dead or missing persons was as high as 92. In late September, Typhoon Roke attacked the Tokai District and caused floods and sediment-induced disasters, and the number of dead or missing persons was 18.

Basin-scale sediment control in mountainous areas

As described above, sediment-induced disasters caused by heavy rainfall and typhoons in mountainous areas are serious problems in Japan. In most of Japan, it is predicted that global warming will increase rainfall by twenty percent and, as described before, this will raise the frequency of extreme events such as huge typhoons or deluges (Global Climate Prediction Information 6th Edition, JMA). The distribution of sediment along a river in an equilibrium state is basically determined by the average annual rainfall in that basin. In a basin with relatively small annual rainfall, a large amount of sediment is stored in the mountainous areas. Once rainfall increases, sediment stored in mountainous areas is destabilized and redistributed more uniformly over the whole basin. Therefore, a fast increase in rainfall due to global warming may activate sediment movement and cause an increase in sediment-induced disasters.

The areas most affected by this redistribution of sediment are valley floor plains and alluvial fans. Valley floor plains are the transport routes of sediment from mountains to lowlands, and alluvial fans are located at the outlets of sediment transport routes. In the examples

A rash of landslides and the resulting formation of natural dams at Nagatono and Akatani in the Kii mountain range due to a large amount of rainfall caused by Typhoon Talas.

of sediment-induced disasters described above, it is often observed that valley floor plains are severely damaged. Alluvial fans will also suffer from sediment-induced disasters by a further increase in rainfall. In order to mitigate damage, basin-scale sediment control is necessary. Unstable sediment should be tentatively stored in sediment reservoirs to prevent the rapid movement of sediment, but such stored sediment needs to be passed to lowlands in one way or another.

The Chubetsu River and Typhoon Talas disasters may be the prologue to an increasing amount of sediment-induced disasters on account of global warming over the next few decades. Further studies on efficient and smart means for controlling basin-scale sediment need to be conducted before it is too late.

References

Kim, W., D. Mohrig, R. R. Twilley, C. Paola, and G. Parker (2009), Is it feasible to build new land in the Mississippi River delta?, *Eos Transactions*, 90(42), 373-374.

Symposiums marking the one-year anniversary of the 2011 Great East Japan Earthquake in Japan

By K. Meguro, H. Sawada, M. Ohara and M. Koshihara

One year has passed since that day on March 11, 2011, when the Great East Japan Earthquake occurred. During this period, many symposiums, seminars and meetings related to this disaster were held in Japan. This article provides an overview of the events which ICUS members participated in.

Prof. K. Meguro, director of ICUS, managed the symposium as one of the comittee members "Protecting life and the country from catastrophic disasters - originating from the 24 academic societies-" held by the Science Council of Japan. This symposium was held among 24 different academic groups for the social and industrial infrastructure of the country on 29 February, 2012. The purpose of the symposium was to review the nature of the traditional specialization, deeply exchange the fundamental relationships among the academic societies, and recommend basic policy on our country and the future direction of the academic groups.

The Japan Society of Civil Engineers (JSCE) also held the symposium "One year after the 2011 Great East Japan Earthquake -International Symposium on Engineering Lessons Learned from the Giant Earthquake-" with the cooperation of related domestic and international academic societies. Dr. Ohara participated in this symposium as a moderator. The purpose of this symposium was to discuss the fundamental problems and the future strategy of social safety against giant disasters. This symposium concluded with discussions on the importance of cooperation among all related fields – civil engineering, architectural, social science, and economics – to measure the concrete preparedness of the society and the progress of reconstruction in the Tohoku area.

Prof. Sawada managed the "Forum on the collection and use of information regarding to the environmental and disaster risk in wide area" held at The University of Tokyo on March 12, 2012.

Dr. Koshihara also managed some symposiums organized by the Architectural Institute of Japan (AIJ).

ICUS members intend to continue to contribute to the reconstruction from this disaster and provide a variety of information to the society.

Symposiums held marking one year after the 2011 Great East Japan Earthquake in Japan

Date	Title	Host/ Organizer
2012.1.18	2nd Symposium on "How we re-evaluate policies on Land and Infrastructure after the occurrence of a major disaster,"	Science Council of Japan
2012.2.11	The road to disaster mitigation and sustainable society considering lessons learned from the 2011 Great East Japan Earthquake	Science Council of Japan
2012.2.16-17	Japan-UNESCO/UNU Symposium on the Great East Japan Tsunami on 11 March 2011 and Tsunami Warning Systems: Policy Perspectives	United Nations University/ UNESCO
2012.2.21	Debriefing meeting of the results of investigations on safety issues of nuclear power plants by investigation committee	Japan Association for Earthquake Engineering (JAEE)
2012.2.29	Protecting life and the country from catastrophic disasters - originating from the 24 academic societies-	Science Council of Japan
2012.3.3-4	One Year after the 2011 Great East Japan Earthquake - International Symposium on Engineering Lessons Learned from the Giant Earthquake -	JAEE, AIJ, JSCE, The Japanese Geotechnical Society, The Japan Society of Mechanical Engineers, Seismological Society of Japan
2012.3.5-6	One year and the future since the occurrence of the 2011 Great East Japan Earthquake - Social safety and catastrophic disaster -	JSCE
2012.3.12	Forum on the collection and use of information regarding environmental and disaster risk over a wide area (21st Seiken forum)	Institute of Industrial Science, the University of Tokyo

Collaborative survey on disaster information in a rural mountainous area of Thailand

By A. Kawasaki

Rapid economic growth in Asia – which includes not only high population concentration and over-development in urban areas but also large-scale land development in mountainous areas, such as conversion from forests to commercial rubber tree and cassava plantation – is increasing the risk of disasters such as floods and landslides by increasing the population in disaster-prone areas where people have not yet settled. For example, people in the northeastern part of Thailand have been affected by floods, storms, landslides and drought, resulting in delayed economic development and social problems such as a lower educational level relative to the rest of the country.

In order to address these issues, junior researchers from ICUS, the Asian Institute of Technology (AIT), Chiang Mai University, and the Loei Fund for Nature Conservation and Sustainable Development Foundation are collaborating to develop a disaster information dissemination system for improving local communitys' disaster response ability in rural and agricultural mountainous areas where support from the national and local governments cannot be expected.

Loei Province, Thailand

Consultation workshop with local community in Nam Moon Tum village

Questionnaire survey in Non Rhattana village

In order to design and develop such a system, localization based on current local conditions and needs should be carefully evaluated and considered. To clarify the current problems and needs at the local community level, we conducted a joint field investigation in Loei Province in March 2012. First, we interviewed provincial and district officials in charge of disaster management in the region to clarify the flow of disaster information from the national government to the local community. We then organized consultation workshops in two villages in order to understand the current means of disaster information collection and what systems are desireable in the future. In addition, their general concerns in daily life and literacy were examined through a questionnaire survey in three villages with around 300 responses.

Our initial findings are as follows: 1) independent disaster information collection and distribution systems at the district level need to be developed because currently disaster-related information sent from the central government is often useless in terms of the timing (too slow) and detail (the information is too rough for the local level); 2) as a result, local governments and communities judge the possibility of flooding based on information sent from forest rangers in upstream mountains and visual checks of the water level and velocity of neighboring streams by local leaders and residents themselves because no scientific data or analysis are available; 3) there is a large gap among local people's consciousness against disasters and response depending on their previous disaster experience; 4) although about 70% of families have more than one mobile phone, they wish to obtain disaster information through community speakers or television because mobile phones are not available in most houses and farms due to poor mobile reception.

With further deep analysis, we hope to propose a disaster dissemination system in the study area with technological strategies for implementation which can be applicable in other mountainous areas in Asia.

* This project was funded by the FY2011 Special Project Formation Investigation of SATREPS (Science and Technology Research Partnership for Sustainable Development), Japan Science and Technology Agency .

Professor Meguro's visits to Nepal

By R. Guragain, Deputy Executive Director, National Society for Earthquake Technology-Nepal (NSET), Community Earthquake Learning Centre (CELC)

Professor Kimiro Meguro, Director of ICUS, visited Nepal from the 19 to 26 of January 2012, to supervise and provide guidance to the research of a JSPS/RONPAKU fellow based in Kathmandu. During his visit, Prof. Meguro also met with key persons Nepalese research institutions, ministries and organizations related to disaster management, signed a Memorandum of Understanding with the National Society for Earthquake Technology (NSET), Nepal, and conducted a seminar to leaders and representatives of relevant departments and organizations in Nepal.

Prof. Meguro met government officials from the various ministries involved in disaster management to discuss building code implementation and the retrofit of government schools, as well as helding meetings with the Chief Representative of the Japan International Cooperation Agency (JICA) and his Excellency the Ambassador of Japan to Nepal.

As a part of the ICUS objectives to expand its international network of organizations working in the urban safety engineering field, Prof. Meguro signed an MOU with NSET-Nepal, a society focusing on the advancement of the science and practice of earthquake engineering and technology in mitigating earthquake risk and enhancing seismic safety in Nepal.

On the 26th of January, a seminar on "Earthquake Risk Management in Developing Countries," organized by NSET, ICUS and World Seismic Safety Initiative (WSSI), was given by Prof. Meguro to representatives from the relevant departments of the Government of Nepal, professional organizations, banking/insurance companies, UNDP, engineering universities, and civil societies. He highlighted the importance of appropriate technology use in disaster risk management, with regard to local availability, economic limitations and cultural acceptability, discussing the possibility of promoting low cost retrofitting techniques through providing the public with micro-insurance and double incentive systems.

Group photograph of seminar participants

During his visit, Prof. Meguro appeared on national television to discuss issues of disaster management, and engaged with one of the few municipalities in Nepal that is implementing the building code at the municipal level to discuss the challenges they faced.

Through his visit to Nepal, Professor Meguro furthered ICUS's key objective of promoting advanced research and expanding the ICUS international network of organizations working in the field of urban safety engineering and information collection and dissemination.

Theses of recent ICUS laboratory graduates

Meguro Laboratory

- Development of Local Government Support System for Concluding Mutual-Support Contracts Based on the Analysis of the Supporting Activities Conducted in the 2011 Great East Japan Earthquake Disaster
- A Study towards the Formation of Disaster Management Planning Process with Past Disaster Lessons -The Case of the Revision Process of "Standing Orders on Disaster" in Bangladesh-.
- Study on Application of the Methods of Project Management to Procedures of Preparing Temporary Housings.
- Proposal of Financial Models Contributing to Seismic Risk Control and Risk Financing of Local Industries.

Ohara Laboratory

- Study on Human Evacuation Plan during Large-scale Flood in Metropolitan Area and Development of Flood Disaster Risk Viewer -Case Study in Koto Delta Area-.
- Study on Effective Use of Early Earthquake Warning in Manufacturing Industries.

Kuwano Laboratory

- Evaluation of Stress Distribution in Model Ground usig Bender Element Method.

Sawada and Takeuchi Laboratory

- Multi-sensor Remote Sensing Techniques to Manage Cambodian Forests for Implementation of REDD+ policies.
- Tsunami-Inundated Area Estimation

Using Remote Sensing Data.

- Development of a wavelet filter for numerical elevation model.

Nagai Laboratory

- A Study of the Acquisition of Resource Necessary for a Life and the Social Network in a Japanese Mountainous Village.
- A Shear performance of HPFRCC Beam That Mixed with Coarse Aggregate and Steel Fiber.
- A study on achorage performance and simulation of failure behavior of beam-column joint by three-dimensional discrete analysis.
- Particle size effect on Press-in pile and the measurement of ground deformation with inclinometers on sites.

Tanaka Laboratory

- Multi-Objective Assessment and Optimization of Highway Monitoring System.
- Maximum Entropy Model for Trip-Chain Estimation and Allocation Method of Charging Stations for Electric Vehicles using Network Traffic Simulators.
- The Effect of Coordination on the Drivers Behavior in Signal Change Intervals.

Koshihara Laboratory

- Theoretic analysis of the timber circulation system based on sustainability

Kato Laboratory

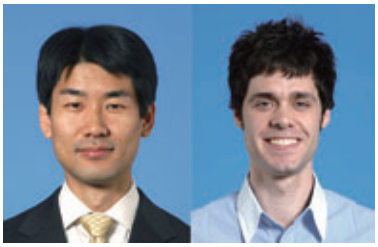
- A Study on Feasibility of Infra-Free Village as Post-Disaster Reconstruction.
- A Practical Study on Promotion Method of Community-based Disaster Mitigation and Preparedness Activities for building-up specific activities according to characteristics of each district.

Farewell to Prof. S. Tanaka and Dr. M. Henry

By K. Meguro

From April 2012, Lecturer Dr. Shinji Tanaka retired from ICUS to join the Institute of Urban Innovation, Yokohama National University.

Dr. S. Tanaka joined ICUS as a lecturer in March 2007. Over his five years in ICUS, Dr. S. Tanaka and his laboratory conducted research works on road traffic phenomena and problems including traffic congestion as well as environmental problems as a part of ICUS's Environmental Informatics Division.



Prof. S. Tanaka, Dr. M. Henry

Dr. Michael Henry retired from ICUS to join the Division of Field Engineering for the Environment, Faculty of Engineering, Hokkaido University as an Assistant Professor from 16th February 2012.

Dr. M. Henry joined ICUS as a project researcher in April 2010. During his stay, he continued his research on the regional context of sustainable concrete considering social perspectives in Asian countries as a part of ICUS's Sustainable Engineering Division.

ICUS would like to thank them for their great contributions during their stay and wish them all the best at their new positions. We are looking forward to collaborating with them again in the future.

ICUS Activities January – March

- Prof. K. Meguro visited Nepal from Jan. 19 to 26 to sign a MOU with the National Society for Earthquake Technology Nepal. He also visited Jakarta and Padang, Indonesia, from Feb. 18 to 22 for project on development of seismic retrofitting technology in Indonesia with Dr. M. Numada.
- Prof. H. Sawada visited Macedonia from Feb. 25 to Mar. 7 for a project on the development of integrated system for prevention and early warning of forest fires.
- Prof. T. Kato visited Beijing, China, from Mar. 28 to Apr. 2 for a meeting about a project on human resource development for urban disaster mitigation planning organized by JICA.
- Dr. S. Tanaka attended Transpartation Research Board (TRB) conference and workshop from Jan. 23 to 27 in Washington, D.C., USA.
- Prof. A. Kawasaki was at AIT in Bangkok, Thailand, from Jan. 12 to Jan. 20, from Jan. 30 to Feb. 28, and again from Mar. 5 to Mar. 29 for operating the RNUS office and conducting lectures. He also traveled to Loei, Thailand from Mar. 14 to 18 for a collaborative survey on disaster information in a rural mountainous area of Thailand with Dr. S. Kondo.

Editor's note...

The Great East Japan Earthquake and Tsunami disaster and the Thai Flood, both in 2011, greatly affected not only these nations but also other countries through economic damage to the global supply chain. In recent era of rapid globalization, a large disaster in one nation is often not just a problem for that country. Response to a great disaster, just as with global warming, is an agenda which can't be handled by one country alone.

For tackling these global disaster and environmental challenges as an academic institute, ICUS has been promoting scientific collaborations beyond the borders of Japan, particularly in Asia. Some examples are introduced in this newsletter, such as a joint survey by junior researchers from ICUS and Thailand and Prof. Meguro's meeting with researchers and governmental officials in Nepal. At our annual event, the "10th International Symposium on New Technologies for Urban Safety of Mega Cities in Asia (USMCA 2012)" in Ulaanbaatar, Mongolia, a special session on "urban flood risk management in a changing climate" will be jointly organized through collaboration with the United Nations University Institute for Sustainability and Peace (UNU-ISP).

Network formation is one of ICUS's main missions. In addition to strengthening the human networks and research bases accumulated from ICUS and INCEDE's activities since 1991, we would like to explore new frameworks for research collaboration with both domestic and overseas partners. I hope you join ICUS's activities and seek an opportunity for collaboration with us or other colleagues in our network for building a foundation for tackling global disasters and environmental challenges.

By. A. Kawasaki

USMCA2012 (Ulaanbaatar, Mongolia)

We would like to call for participation in USMCA2012 (to be held from Oct. 10 to 12, 2012, in Ulaanbaatar, Mongolia). Further information is available at the USMCA2012 official website:

http://www.usmca2012.mn/

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The International Center for Urban Safety Engineering (ICUS) is a research center located at the Institute of Industrial Science, The University of Tokyo.

The purpose of ICUS is to identify, investigate, and resolve issues towards the realization of sustainable urban systems for the prosperity and safety of society considering challenging socio-economic problems.