
ICUS/INCEDE NEWSLETTER

International Center for Urban Safety Engineering



**Institute of Industrial Science
The University of Tokyo**

*VOLUME 3 NUMBER 1
APRIL -JUNE 2003*

FLOOD DISASTER TRENDS IN ASIA IN THE LAST 30 YEARS

By

Dushmanta Dutta

Few years before, the Director General of the United Nations Environment Program said that war over water would be a distinct possibility in the 21st century. Similar view is reflected by many other experts from the United Nations and other international organizations highlighting the

seriousness of the problem of “water too little” in the 21st century. Another equally important and pressing water issue is “Water too much” - the floods, although that do not lead to a war but kill millions and cause big hindrance in socio-economic development. Floods are a constant threat to life and property. It has been

observed that more and more people have been affected by riverine floods in the recent years. From 1990 to 1996, there were six major floods throughout the world in which the number of fatalities exceeded 1,000 and 22 floods with losses exceeding US\$1 billion each. The majority of these recent



Devastating floods in Central Vietnam in November 1999

disastrous floods have occurred in Asia. The highest material losses were recorded in China during the 1996 and 1998 floods: about US\$30 and 26.5 billion respectively. Is the flood frequency increasing in Asia? If it is increasing, how rapid is the increment? Why are floods increasing? These are some of the important issues that need to be addressed to understand the gravity of the problem of floods in the 21st century. This article closely looks at the flood disaster trend in Asia in the past three decades and analyzes the major causes of the changing characteristics of flood disasters in Asian countries and their consequences.

Floods in Asia from global perspective

Out of over 7,000 natural disasters occurred around the world during the last 30 years, more than 74% were water related disasters including floods, drought and windstorms. Among these, floods are the most frequent natural disasters. Floods account for about 33% of all the natural disasters. In the past 30 years, floods have been the most catastrophic natural disaster affecting half of the total population affected by any natural disaster, i.e., on average about 80 million people per year and caused economic damage of over US\$11 million annually around the world. Annual statistics of natural disasters of the past 30 years show that number of floods and windstorms are rapidly increasing around the world compared to all other disasters. Floods have the highest increasing rate of occurrence. In the last 30 years annual flood frequency has doubled. There were on average about 50 flood events annually in 1970s, it became 100 in 1990s, and in the last three years it has increased to about 150 events per year. Windstorm has been following a similar trend as these two disasters are closely related. The same statistics show that except



An example of damage due to frequent flash floods in Japan

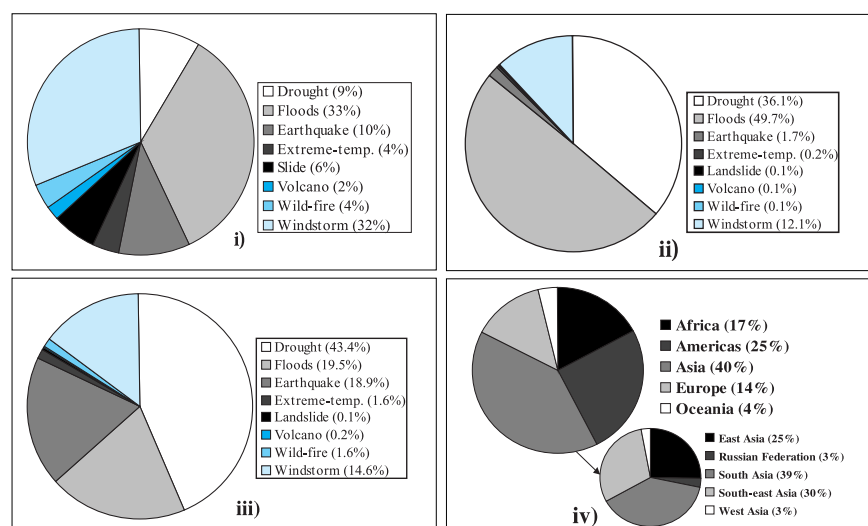
landslides, which have been increasing at a low rate, no other natural disasters exhibit any increasing trend unlike floods and windstorms in the past three decades.

Floods occur in most of the countries around the world. Having the highest amount of average rainfall and volume of river water (13,500 km³/year), Asia is the most frequently affected continent by floods. During the past 30 years, total flood disasters occurred in Asia is the largest, 40% of the total events, compared to any other continents: America (25%), Africa (17%), Europe (14%) and Oceania (4%).

In terms of casualties, floods are the most devastating and widespread in Asia. 98% of the total population affected globally by floods are located in Asia.

Flood Trend in Asia

Almost all the Asian countries are affected by floods. The regional distribution of flood events in Asia shows that South Asia is the most frequently affected region by floods (about 39%), followed by South-east Asia (about 30%) and East Asia (about 25%). The West Asia region including Russian Federation is the least affected region (6%). The floods and windstorm in Asia in the past 30 years follow a similar



Global statistics of natural disasters in past 30 years: i) ratio of different natural disasters around the world, ii) percentage of affected people by natural disasters, iii) percentage of economic damage caused by natural disasters, and iv) continental level distribution of flood disasters and regional distribution in Asia

increasing trend as the global trend. The frequency of floods in Asia has doubled during the period of 1978-1999. The rate of increase of flood frequency is more prominent in the last 10 years, especially, the recent three years statistics show rapid increase of floods in Asia.

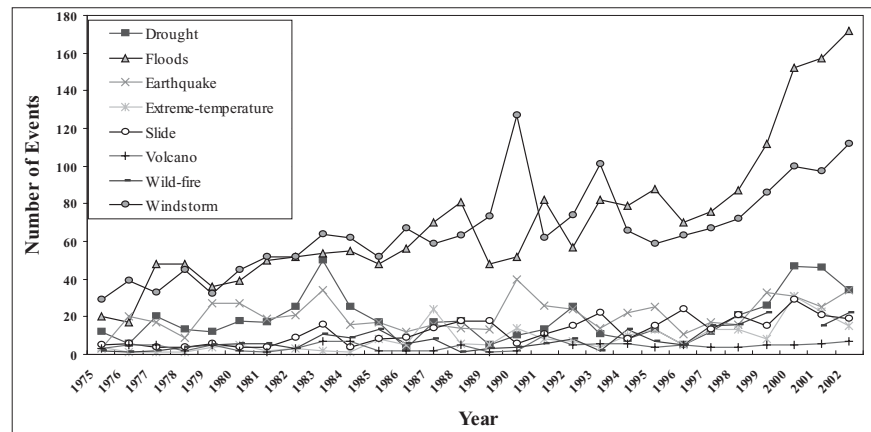
Among the Asian countries, China is the most frequently affected country by floods followed by India. The other eight of the top ten flood affected countries are Indonesia, Philippines, Bangladesh, Iran, Thailand, Sri Lanka, Vietnam and Pakistan in descending order. Except China and Iran, all these countries are located in South and South-east Asian Regions. The 5-year average flood statistics of last 30 years show that flood frequency is increasing in all these countries. China shows higher rate of increase of frequency than India in the last 10 years. Thailand also shows a higher rate of increase of flood frequency compared to its neighboring countries in the last 15 years. Among these 10 countries, the rate of increase of flood frequency was the lowest in Sri Lanka and the Philippines in the last 15 years.

Causes of increasing floods in Asia

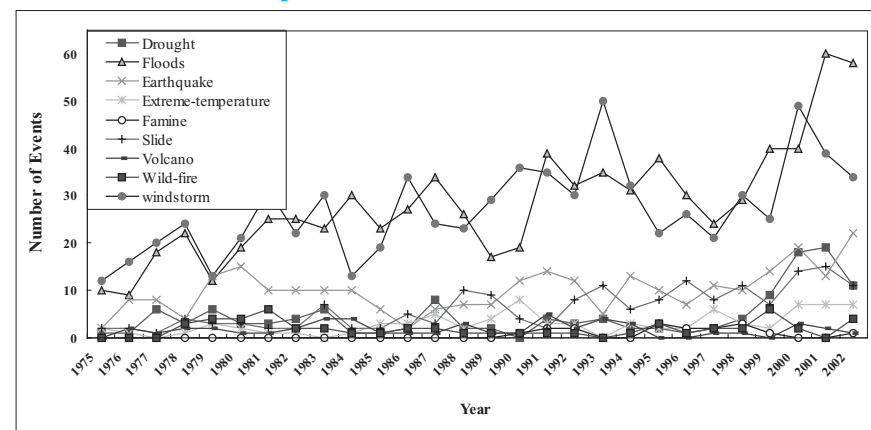
According to several research studies and observations, the causes of growing trends of floods in Asia can be attributed to mainly two factors: i) climate change and ii) landuse change and surface degradation.

Climate change and floods:

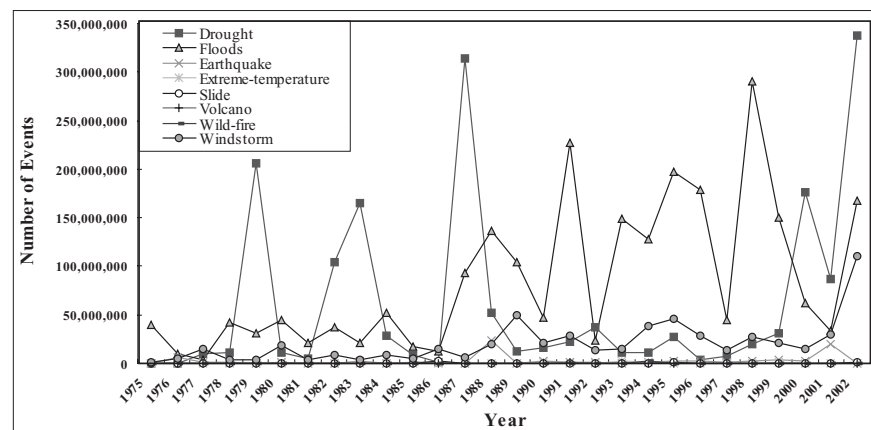
With the rapid increase of extreme climate events in the past few years, it is a common understanding that the major reason of increasing flood magnitude and frequency in most of the regions around the world is the climate change. The general direction of change in extreme water related events in Asia is broadly consistent with the climate scenarios presented by the



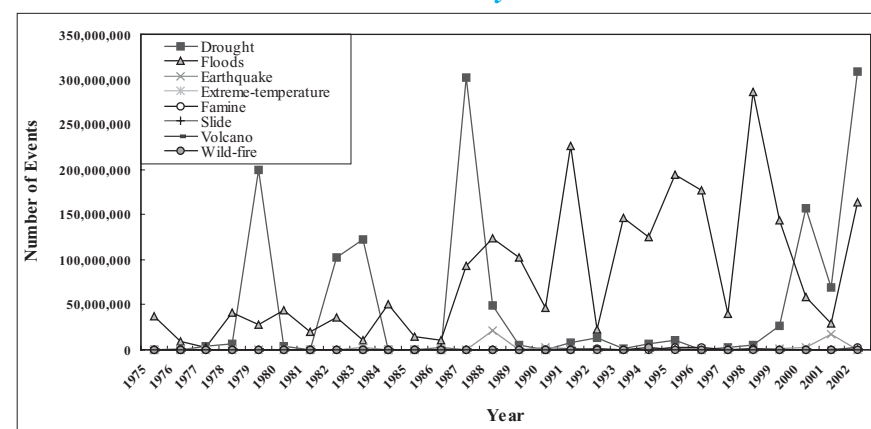
Worldwide trends of flood disasters in the last 28 years compared to other natural disasters



Trends of flood disasters in Asia in the last 28 years compared to other natural disasters



Global trend of number of people affected by natural disasters in the last 28 years



Trend of number of people affected by natural disasters in the last 28 years in Asia

Intergovernmental Panel on Climate Change (IPCC). The observed increase in the incidence of great floods was found to be consistent with results obtained from the climate models, and the model results suggest that the trend will continue. Although only a few studies have assessed the effects of climate change on flooding frequencies, there are a number of possible reasons why, in a warmer climate, the frequency of floods increase in any particular region. Out of that the most related issues to Asia that have been observed are:

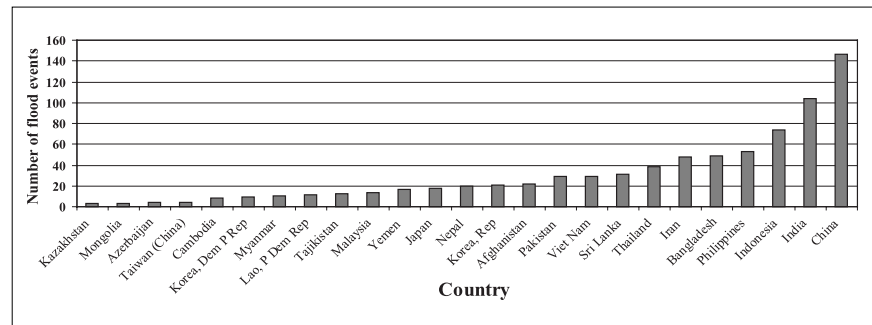
- i) *an increased frequency of extreme precipitation events*
- ii) *increased magnitudes of precipitation events of high intensity*

In 1997, some studies showed that flood discharges in the major river basins in India and Bangladesh (Ganges, Brahmaputra and Meghna) were estimated to increase by 6-19%. The statistics of the flood records of the past few years also indicated the effects of climate change in the flood frequency in Asia. The average annual flood events in the past three years are 1.5 times of that of 1990s and 3 times of 1970s.

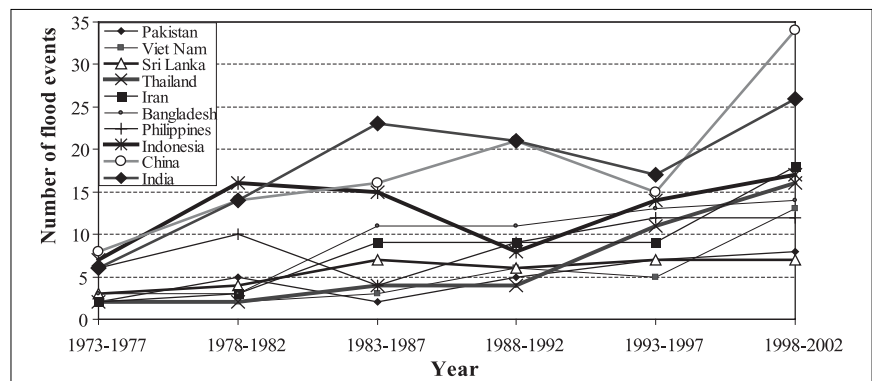
Landuse changes and floods:

The effect of climate change alone is not triggering the high rate of increase of flood frequency in Asia. It can be observed from the time series of flood data that they are not exactly in tune with climate-change-related prognoses, but they reflect complex responses that may be due to other non-climatic factors such as deforestation and urbanization.

Under the pressure of high population growth and economic development, a great change in landuse pattern has taken place in most of the Asian countries in the last few decades. One of the major changes is the deforestation caused



Flood events in different Asian countries in last 28 years



Flood trend in most frequently flood affected 10 countries in Asia

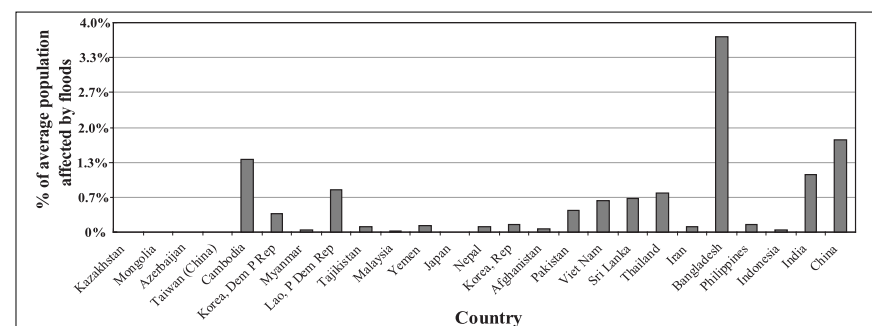
by conversion of forest to agricultural or inhabitable land. Thailand is a good example of that. Between 1976 and 1989, Thailand lost 28 percent of its forest cover. A recent study at the University of Tokyo has showed that deforestation has greatly influenced the changes in rainfall patterns in Thailand. Additionally, deforestation also causes the increase of surface runoff and thereby increases the flash floods. In several Asian countries, where deforestation is very prominent, increase of flash floods can be witnessed in the past few decades.

The tremendous economic development and migration of population to urban centers in most

of the Asian countries in the past few decades have caused rapid urbanization. Urban growth in most of the Asian countries in the last three decades is more than 4%. Nepal shows the highest growth rate (7.5%) followed by Bangladesh (5.9%). The urbanization has not only led to reduction of pervious areas but also change in catchment use of manipulation of water within the channel (e.g., dams, abstractions, canalization). These factors have directly contributed to increase of urban floods.

Impacts of increased flood frequency in Asia

Economic losses and human casualties from flood events have



Percentage of total population affected by floods annually in different Asian countries in last 28 years

increased five folds between the 1970s and 1990s in Asia. These losses largely reflect an increase in the vulnerability of our society as a whole to extreme events. Although part of the observed upward trend in losses can be linked to socio-economic factors, such as economic developments, population growth, etc., increased flood frequency attribute more to the observed growth in human casualties and economic losses in the past three decades. Although it is difficult to quantify the effects, the increasing flood frequency certainly seem to have adversely affected many Asian countries. In the recent years, floods have had increasingly detrimental and disruptive effects on various aspects of socio-economic conditions in Asia including: human health (through diseases such as diarrhea in flooded areas); buildings and infrastructure; settlements; coastal areas; financial services (including insurance and

reinsurance); transport; water supply; agriculture and ecosystems.

Conclusions

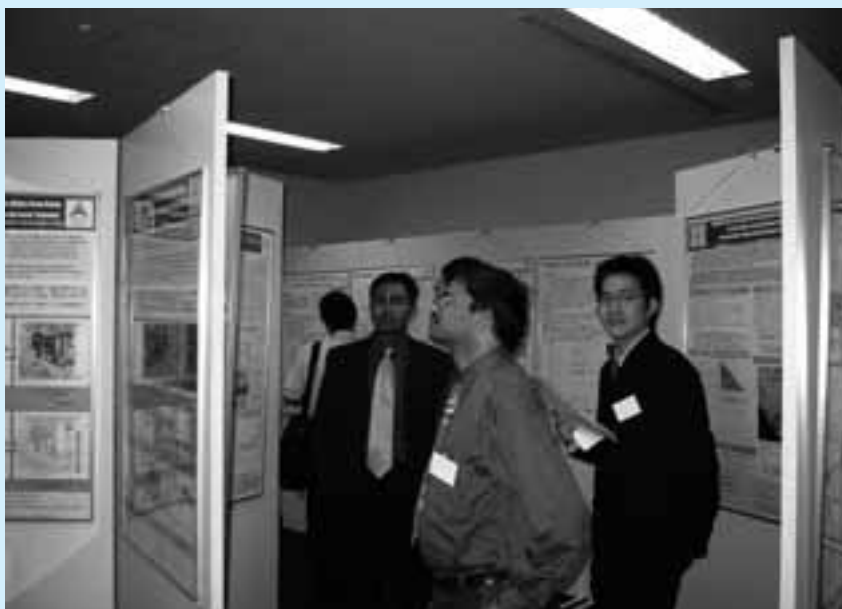
The statistics of the flood events of the past 30 years in Asia clearly show an increasing trend of flood disasters in most of the Asian countries. Combined effects of climatic changes, landuse changes and urbanization are considered to be the main reasons of this increasing trend. Due to several devastating flood disasters and droughts in different parts of the world in the past few years, extreme weather and climate events have received greater attention. A recent study of 2002 that analyzed the outputs of 19 climate models predicts that very wet summers in the Asian monsoon region will probably rise up to five folds increasing the risk of flooding. This is a very serious concern for Asian countries. Proper consideration of long-term climate change scenarios in flood risk management strategies is utmost

important to cope with the increasing flood frequency. Population in Asia is expected to grow by more than 25% in the next 20 years exceeding 4.9 billion by 2025, and urban growth is going to continue in a similar rate as the past decade in most of the developing countries in Asia. Unless appropriate countermeasures are taken to establish better preparedness and prevention of flood disasters, uncontrolled development in developing countries will certainly result in increased flood damage due to the greater concentration of population, most notably the poor, in disaster-prone areas. This will make it difficult to break the vicious cycle of poverty in Asia.

The author gratefully acknowledges the usefulness of the International Disaster Database of Centre for Research on the Epidemiology of Disasters in preparing this article.

ICUS participated in IIS Open House

This year, ICUS participated in the Open House of the Institute of Industrial Science (IIS) with the theme "Towards safety and security of Mega Cities" which was held during June 5-6, 2003. The Open House is an important annual event of IIS held for two days in the first week of June every year to demonstrate the research and development activities of the different laboratories and departments of the institute to the public. Open House saw a large increase in the number of visitors this year, with the total number exceeding 5,100, compared to the past few years. A new trend of young participants from junior high or high school could be observed. It was overwhelming to see the interest of these young people in the new scientific and technological developments in this frontier institute of Japan.



A snapshot from the ICUS booths on the 2nd day of the Open House

The three research divisions of ICUS prepared their own sub-themes for the Open House under the banner of the main theme and displayed their past and present research activities. ICUS also arranged a video display of its

international activities carried out in the last two years. About 200 persons visited ICUS booth in two days. They showed deep interests in ICUS activities in urban safety and security of mega cities.

New Developments in ICUS Staff

Farewell to Dr. Ochi

After serving ICUS as a Research Associate for a period of two years from April 2001 to March 2003, Dr. Shiro Ochi has moved to Kinki University, Nara, Japan to join its Faculty of Agriculture as an Associate Professor. During this period, Dr. Ochi played a very important role at ICUS and strongly contributed to the various activities of the center including its collaborative research project in Thailand. Dr. Ochi is going to continue his research activities in the fields of GIS, remote sensing and environmental monitoring in the Kinki University. We wish him all the best and great success in his new career in Nara. The new contact address of Dr. Ochi is: Faculty of Agriculture, Kinki University, 3327-204 Nakamachi, Nara-City, Nara 631-8505, Japan.

Congratulations to Dr. Dutta

ICUS staff Dr. Dushmanta Dutta was promoted to Associate Professor from June 1, 2003. At ICUS, Dr. Dutta has been involved in academic and research activities in the fields of hydrology and water resources engineering. For the last few years, he has been mainly focusing on physically based modeling for urban flood risk management and water resources analysis. Dr. Dutta is currently acting as a team leader of a

collaborative research project of ICUS in Thailand on urban flood risk mapping. We extend our hearty congratulations to Dr. Dutta.

Welcome to Dr. Endo and Ms. Yoshimura

We are glad to introduce our new colleagues Dr. Takahiro Endo and Ms. Miho Yoshimura, who joined ICUS as Research Associates from April 1 and June 1, 2003 respectively.

Dr. Endo received his D. Eng. degree from the Department of Civil Engineering of the University of Tokyo in March 2003. His research interests are environmental monitoring and modeling with remote sensing. Presently, he is involved in developing detection method for concrete degradation, and estimation of terrestrial ecosystem parameters such as biochemical content and carbon dioxide absorption of vegetation using advanced hyperspectral remote sensing.

Ms. Yoshimura received her M. Eng. degree from the Department of Civil Engineering of the University of Tokyo in March 2001. Prior to joining ICUS, she worked a Research Associate with Prof. Meguro of ICUS. Her research interests include retrofitting promotion system for low earthquake-resistant structures in earthquake prone countries.

We welcome Dr. Endo and Ms. Yoshimura and wish them great success.

New Assistant for ICUS Intl. Symposium

ICUS welcomes Ms. Shravani Hazarika, who joined ICUS from June 2003 to assist in the activities of the 2nd International Symposium of ICUS on "New Technologies for Urban Safety of Mega Cities in Asia". She can be contacted for any matters related to this symposium by e-mail (icus@iis.u-tokyo.ac.jp).



Dr. T. Endo, Ms. M. Yoshimura and Ms. S. Hazarika

ICUS ACTIVITY RECORDS

* Prof. Y. Yasuoka visited AIT, Thailand during May 28-31 to

attend a meeting on MODIS Satellite Receiving Station.

* Dr. D. Dutta visited AIT from June 8-17 to start his term as a Visiting Faculty from ICUS.

Registration for ICUS International Symposium on October 30-31, 2003

The activities of ICUS 2nd International Symposium in Tokyo on "New Technologies for Urban Safety of Mega Cities in Asia" are progressing very well. The deadline for submission of abstract was over at the end of June. We

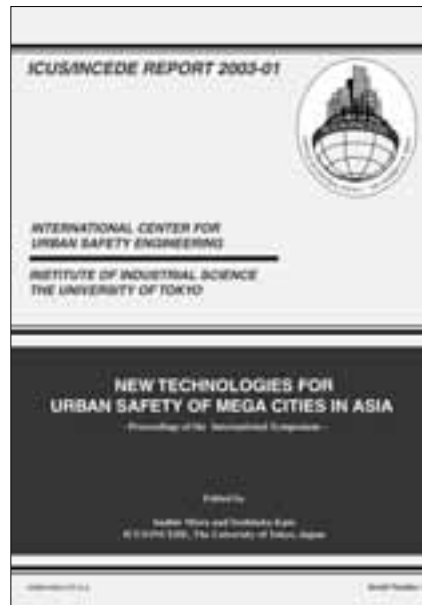
have got a very good response from many professionals around Asia and Europe. Please note that the deadline for submission of full paper and advanced registration is August 31, 2003. The registration form is available at the Symposium Website

(<http://icus.iis.u-tokyo.ac.jp/icus03>). You may also contact the Symposium Secretariat by e-mail (icus@iis.u-tokyo.ac.jp) for a copy of the registration form. We welcome any interested person to attend the symposium.

ICUS Publishes Two Technical Reports

ICUS has recently published two reports of the ICUS/INCEDE Technical Report series.

The first report is ICUS/INCEDE Report 2003-01. It contains the proceedings of the International Symposium on the New Technologies for the Urban Safety of Mega Cities in Asia, which was held in Bangkok, Thailand on October 28, 2002. It was jointly organized by ICUS and the Asian Institute of Technology (AIT), Thailand. The symposium was very successful in bringing together a large number of participants from different disciplines including policy makers, planners, engineers and architects to create greater awareness towards the issues related to urban safety. This report contains a total of 14 technical papers presented in the symposium by the participants from different countries covering a wide range of issues in the areas of new technologies for urban safety. The report is jointly edited



Cover pages of Report 2003-01 and Committee Report 2002-01

by Prof. Sudhir Misra and Dr. Yoshitaka Kato of ICUS.

The second report is ICUS/INCEDE Committee Report 2002-01. It contains the technical papers and research activity reports of the Research Committee-39 that was initiated by ICUS a year ago as a part of its collaborative research activities with private sectors in

areas of urban safety. The report contains a great deal of information about the on-going activities of this Research Committee. This report is available only in Japanese.

Those who are interested to receive a copy of these reports, please contact ICUS by e-mail (icus@iis.u-tokyo.ac.jp) or fax (+81-3-5452-6476).

Visitors to ICUS

During the period of April-June, 2003, ICUS received the following visitors.

-Dr. Somnuk Tangtermsirikul, Associate Professor, Sirindhorn International

Institute of Technology, Thammasat University, Thailand (April 14).

- Dr. Cintia Marquetti, Geological Mining Survey of Argentina, Argentina (May 22).

- Dr. Kenichi Kurihara, Japan Mining Engineering Center for International Cooperation,

Japan (May 22).

Dr. Masaharu Toyama, Japan Mining Engineering Center for International Cooperation, Japan (May 22).

- Dr. Yoshii Kakimoto, Japan International Cooperation Center, Japan (May 22).

Dr. Dutta joins SCE, AIT as a Visiting Faculty

From the beginning of June 2003, Dr. Dushmanta Dutta of ICUS has joined the School of Civil Engineering (SCE) of AIT as a Visiting Associate Professor from the University of Tokyo. At AIT, Dr. Dutta will coordinate the activities of the ICUS Regional Network Office for Urban Safety (RNUS), which was established at SCE in October 2002 to work in areas of mutual interests of AIT and ICUS. RNUS focuses on

collaborative research activities with different organizations in Asian countries in the fields of urban safety engineering with advanced technology tools such as numerical models, remote sensing, geographical information system, global positioning system, etc., for devising appropriate methodologies for management and maintenance of urban buildings, infrastructures, mitigation of urban disasters and environmental problems for

sustainable development of Asian cities with adequate safety and security.

In addition to the activities of RNUS, Dr. Dutta will be involved in research and academic activities at the Water Engineering and Management program of SCE, AIT. He can be reached at AIT by telephone (+66-2-524-5794) or fax (+66-2-524-5565) or e-mail (ddutta@ait.ac.th).

Editor's Note

In the past few decades, various problems associated with water are increasing rapidly. The seriousness of water related problems was brought to the attention of the whole world by the 3rd World Water Forum held in Japan at the beginning of this year. The main article of this issue of the ICUS Newsletter shows that water related extreme events are on rise around the world and this trend is going to continue due to change in climatic conditions. Asia is going to be most severely affected by water related disasters due to the combined effects of its high rate of population growth and urbanization with climatic changes. The article shows that flood frequency is increasing in most of the Asian countries in the last three decades.

To cope with the increasing problems of floods in Asia, large scale and long term mitigation measures are required. Flood problems have to be addressed together with other water issues in basin scale not as a standalone issue confined within the floodplain. It requires adaptation of integrated river basin management policies incorporating various issues of water. Transbasin water sharing is another important aspect to be focused into for mitigating the problems of "water too much and too little". However, such measures need long-term planning and high cost. Emphasis should also be given to short term measures for reduction of devastating consequences of major floods by taking proactive strategies of proper guidelines for floodplains, hazard and risk mapping, early warning and real-time risk management.

From the beginning of June 2003, I have joined AIT as a visiting faculty from ICUS. At AIT, I am going to be involved in coordinating the activities of the Regional Network Office for Urban Safety (RNUS) established jointly by ICUS and AIT last year. The main objective of RNUS is to expand the international activities of ICUS by collaborating in research and sharing information with leading institutions of Asia for urban safety. One of the major issues that I would like to focus on at RNUS is urban flood risk management. It is our strong believe that through mutual cooperation with AIT and other institutions, ICUS would be able to adequately address the problems and contribute towards urban safety and security of the region.

(D. Dutta)

International Center for Urban Safety Engineering, ICUS/INCEDE
Institute of Industrial Science, The University of Tokyo
4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan

