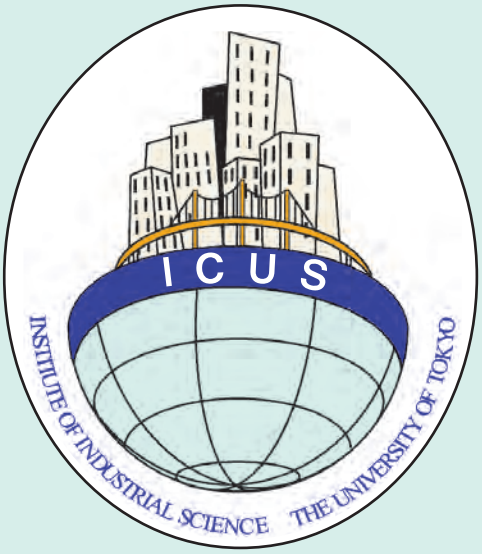
ICUS REPORT 2008 - 01



INTERNATIONAL CENTER FOR
URBAN SAFETY ENGINEERING

INSTITUTE OF INDUSTRIAL SCIENCE
THE UNIVERSITY OF TOKYO

RNUS ANNUAL REPORT 2007

Edited by

Kawin Worakanchana, Wataru Takeuchi, Shinji Tanaka,
Pennung Warnitchai and Kimiro Meguro

ICUS, IIS, The University of Tokyo, Japan

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RNUS Annual Report 2007

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International Center for Urban Safety Engineering
(ICUS)
Institute of Industrial Science
The University of Tokyo, Japan

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PREFACE

It has been five and half years since the establishment of Regional Network Office for Urban Safety (RNUS) at Asian Institute of Technology (AIT) in October 2002. This year, AIT and ICUS have agreed to extend the Memorandum of Agreement to continue their cooperative activities at RNUS for 2 more years until October 2009. During 2007, there have been many changes in ICUS and RNUS. Professor Kimiro Meguro became ICUS director. Dr. Wataru Takeuchi and Dr. Shinji Tanaka were assigned to RNUS as coordinators. In this year, I started working at RNUS from July 2007 as project researcher while Dr. Raktipong Sahamitmonkol finished his term and took over his new position as researcher at Sirindhorn International Institute of Technology (SIIT). Certainly, this does not change RNUS primary goal to promote urban safety engineering using both advanced and local applicable technologies through the international cooperation.

This ICUS report collects major RNUS activities in 2007. During the year, we have carried out 10 significant activities. These include 3 seminars which were held at AIT and Chulalongkorn University. RNUS was also involved in two projects which are "Seismic Hazard and Vulnerability Mapping of Dhaka, Chittagong & Sylhet City Corporation Areas" and "Master Plan for Earthquake and Building Collapse Hazard Prevention and Mitigation in Thailand (Phase I)", respectively. These two projects will continue in 2008. We hope that this report can give useful information for those who are interested in urban safety issues.

Kawin Worakanchana

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1. RNUS ACTIVITIES REPORT 2007

RNUS activities are organized every year since its establishment in order to build the safer urban environment by utilizing both advanced and local applicable technologies. In 2007, RNUS has carried out totally 10 major activities as below:

1.1 Seminar on "Ultrasonic and Its Application for Cement-Based Materials"

On February 8, 2007, Dr. Wonsiri Punurai from the Civil Engineering Department, Mahidol University gave lecture at RNUS seminar on 'An Introduction to Ultrasonic and Its Application for Characterization of Cement-Based Materials.' In the presentation, Dr. Wosiri explained about the examples of ultrasonic applications in concrete engineering. The seminar received a remarkable interest from graduate students, researchers, as well as instructors of the School of Engineering and Technology (SET), Asian Institute of Technology (AIT).

Figure 1: Dr.Wonsiri Punurai (second from left), with the instructors of the SET, AIT

1.2 Inspection of a Burnt Factory Facility in Rayong Province

A one-day site survey was carried out on May 5, 2007 to investigate a damaged portion of a burnt factory in Rayong Province. The objectives of the project are to evaluate a remaining structural capacity of the structural members (RC column & steel truss) as well as to determine the necessity of strengthening work. Both a well-known Schmidt rebound hammer and ultrasonic wave propagation technique were employed in this project.

Figure 2: Condition inside the factory after having been burnt

Figure 3: Testing of the surface hardness of columns by Schmidt hammer

Figure 4: Measurement of ultrasonic wave on columns

1.3 ICUS and RNUS Participated in Thailand Science and Technology Fair 2007

During August 8 to 19, 2007, ICUS and RNUS participated in Thailand Science and Technology Fair 2007. Prof. Kimiro Meguro, Dr. Takeuchi Wataru, Dr. Raktipong Sahamitmongkol, Dr. Kawin Worakanchana and Miss Aphisorn Suwannasuk under ICUS and RNUS as representatives from the University of Tokyo (UT) exhibited the latest in-house technology for urban safety mainly focused on a new proposal for earthquake disaster reduction using a touch screen workstation system and non-destructive testing for detecting void inside concrete using an infrared camera. During the exhibition, our booth was warmly welcomed by many Thai people. It was also a great honor for us that HRH Princess Maha Chakri Sirindhorn visited our booth and listened to the presentation from Prof. Meguro and Dr. Worakanchana on August 10, the official opening ceremony day. The total number of participants during the whole period of the exhibition was estimated as over 1 million.

Figure 5: Dr. Raktipong, Dr. Takeuchi, Prof. Meguro and Dr. Kawin (from left to right) during the official opening ceremony

Figure 6: Participants visited UT booth

1.4 RNUS and Geoinformatic Center (GIC) Donated a Forest Fire Monitoring System with Remote Sensing to GISTDA in Thailand

On September 12, 2007, Dr. Wataru Takeuchi and Dr. Vivarad Phonekeo from (GIC) at AIT visited Dr. Chaowalit Silapathong from Geo-Informatics and Space Technology Development Agency (GISTDA) of Thailand to install and donate a MODIS-based hotspot information detection and distribution system. This system was developed by Prof. Yasuoka and Dr. Takeuchi research group. It has been designed to monitor hotspot information such as forest fires, volcanic activities and field burning twice a day from the space with remote sensing technique. Satellite images used in this study are an archive of MODIS data received from satellite receivers at IIS in Tokyo and AIT in Bangkok. The stations of these receivers are in the Southeast and East Asia Satellite Observation Network (SEASON) which is designed to monitor both environmental and disaster phenomena such as

forest fires, floods, heat island issues, vegetation health, sea surface temperature, atmospheric pollution and so on, over the Asian region with the continental scale in a near-real time fashion (http://webmodis.iis.u-tokyo.ac.jp/). This is conducted on behalf of a triangle memorandum of understanding (MOU) among IIS, AIT and GISTDA. The programme is supported financially by the Japan Science and Technology Agency (JST) under the research project "Solution Oriented Research for Science and Technology (SORST)" initiated by Prof. Yoshifumi Yasuoka from October 2005 – March 2007. This is expected to be the first step to strengthen the relationship among IIS, AIT and GISTDA to bridge science and technology. Further efforts will also be made to explore more collaboration on knowledge and technology transfer aspects.

Figure 7: Dr. Vivarad Phonekeo, Dr. Wataru Takeuchi, and Dr.Chaowalit Silapathong (from left to right) are holding a MODIS-based hotspot information detection and distribution system

1.5 ICUS Renewed Contract of RNUS with AIT

ICUS and AIT agreed to renew Memorandum of Agreement (MOA) to continue their cooperating program in RNUS. The MOA objective is to continue reviewing and finding the new dimension in their cooperative activities to reaffirm the strong commitment and determination to make the urban environment safer. The contract signing ceremony between ICUS Director, Prof. Kimiro Meguro and the Dean of SET, AIT, Prof. Worsak Kanok-nukulchai, was held on 9th December 2007 during USMCA2007 at the Sheraton Hotel, Dhaka. The ceremony was witnessed by ICUS members, Prof. Yoshifumi Yatsuoka, Prof. Hiroshi Yokota, Dr. Reiko Kuwano, Dr. Ryozo Ooka, Dr. Yoshitaka Kato, Dr. Miho Yoshimura Ohara, Dr. Paola Mayorca and Dr. Kawin Worakanchana, IIS faculty member, Dr. Takeuchi Wataru and other participants in USMCA2007.

Since its establishment, RNUS, with the cooperation of AIT has carried out many successful joint researches and projects in the areas of urban safety and disaster management, sustainable engineering and infrastructure information dynamic, for example, the Study on Application of Fly Ash as Concrete Ingredient in Thailand & Japan in 2005, Evaluation of Water Use in Irrigated Paddy Fields in Eastern Part of Thailand Using Remote Sensing and Meteorological Data in 2005, Urban Flood Inundation Modeling in the Mekong River Basin Using a Physically Based Surface-River Model in 2003, and so on.

Figure 8: Contract signing between Prof. Kimiro Meguro, ICUS and Prof. Worsak Kanok-Nukulchai, SET, AIT

Figure 9: Group photo after signing ceremony

1.6 RNUS, GIC and Kyoto University Corporate for Carrying Out a Field Survey in Thailand

On October 13, 2007 and January 10, 2008, Dr. Wataru Takeuchi, Dr. Kawin Worakanchana, Dr. Junichi Susaki from Kyoto University, a former member of ICUS, and Mr. Yusuke Matsumura, a graduate student of the UT

carried out a field survey in Buriram, which is located 400 kilometers northeast of Bangkok, Thailand. This field survey, mainly led by Dr. Susaki, was conducted to install soil moisture and temperature probes. The data from these instruments were used as a validation data along with an estimation of soil moisture using active microwave satellite data for the mitigation of drought impact. At the beginning, probes were installed at 5 sites in flooded paddy fields in Buriram. However, some of them were damaged by water intrusion and human activities. As a result, only data from two sites are usable with the help of the farmers to keep the loggers and probes in a good condition.

The purposes of this trip are summarized as follows:

1. Calibration of soil moisture probes
2. Collection of soil samples
3. Deployment of a new steel shelf for the prevention of logger

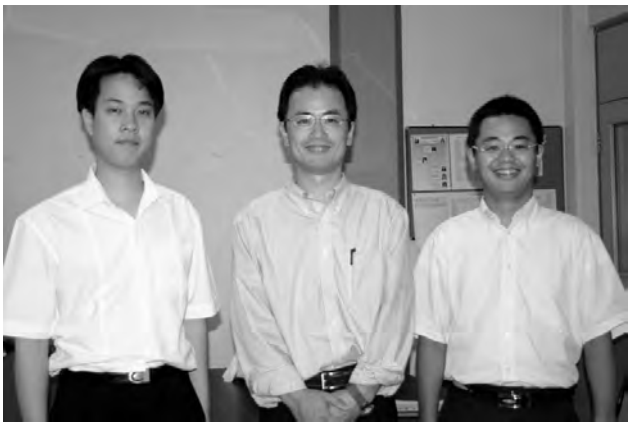

Figure 10: Dr. Kawin Worakanchana, Dr. Junichi Susaki and Dr. Wataru Takeuchi (from left to right) at the RNUS office

Figure 11: Setting up a soil moisture and land surface temperature sensors and data logger on the ground in a rice paddy field in Buriram, Thailand

The data collected by this field survey is expected to improve the accuracy of satellite-based soil moisture estimation studies.

1.7 Seminar on "Toward a Partnership on Disaster Management and Remote Sensing/GIS Technologies"

Recently, there has been an increase in the number of disasters around the world, resulting in a tremendous amount of casualty and economic loss. One of the causes is the increase in the world population and the complexity of social organizations without adequate sustainable development. Concerned about these problems, researchers and scientists have developed new technologies and techniques to help minimize these losses. Among them, remote sensing and Geographical Information System (GIS) are considered one the most beneficial tools for disaster management.

Figure 12: Registration

Figure 13: Opening speech by Prof. Worsak, AIT

Figure 14: Opening speech by Prof. Meguro, ICUS

Figure 15: Presentation by Dr. Pennung Warnitchai, AIT

Figure 16: Group photograph at the seminar room

Figure 17: Presentation by Prof. Tomonari Yashiro, IIS

Figure 18: Prof. Meguro delivering a gift to Prof. Yashiro for his presentation

Remote sensing is the acquisition of information of an object or phenomenon by using devices that are not in physical or intimate contact with the object. Along with mathematical models, it enables a greater understanding of where and when a particularly hazardous event is most likely to occur and results in significant socioeconomic impact. Remote sensing combining with GIS techniques provides a basis for estimating and mapping risks and for planning evacuation routes and shelters. Moreover, it also provides a basis for determining areas where human population is most likely to have effects after a disaster and for distributing resources during the recovery process, among many other vital tasks. This information is essential for the decision supported system used by policy makers, emergency managers, and responders from international organizations to the local authority.

Although there is rapid technology development in these fields, there is still a large gap between the modern technology and practical usage. One of the reasons is that there is a lack of communication between remote sensing/ GIS and disaster management specialists, which results in inadequate cooperation. Recognizing the problem, we organized a seminar on the topic "Toward a Partnership on Disaster Management and Remote sensing/GIS Technologies" at AIT Center on February 8, 2008 with three main objectives which were:

1. To create a friendly atmosphere for remote sensing/ GIS and disaster managing specialists to exchange their opinion, point of views and information
2. To assess the value of geospatial data and tools in disaster planning and disaster responses
3. To identify the mission-critical data requirement for effective decision-making

During the seminar, the total ten speakers made presentations. There are total ninety participants which most were from Thai government organization. The seminar was inaugurated by Dr. Wataru Takeuchi (RNUS), and followed by the welcoming address of Prof. Worsak Kanok-Nukulchai, Dean of SET. The opening speech was made by Prof. Kimiro Meguro, Director of ICUS. The list of speakers consisted of

- Prof. Kimiro Meguro (IIS, AIT)
- Dr. Pennung Warnitchai (Department of Structural Engineering, SET, AIT)
- Mr. Siri Akaakara (National Park, Wildlife and Plant Conservation Department)
- Mrs. Praneet Disariyakul (GISTDA)
- Dr. Manzul K Hazarika (GIC, AIT)
- Dr. Masahiko Honzawa (Japan Aerospace Exploration Agency, JAXA)
- Dr. Warakorn Mairaing (Civil Engineering, Kasetsart University)
- Dr. Sutat Weesakul (Department of Water Engineering and Management Program, SET, AIT)
- Prof. Tomonari Yashiro (IIS, UT) and
- Dr. Shinji Tanaka (IIS, UT)

All presentations can be found in the Appendix.

1.8 RNUS Participated in Mini-Project and Workshop on Application of Remote Sensing and GIS

On September 17-19, 2007, Dr. Takeuchi was invited to give a lecture on "Remote Sensing of Fires, Principles and Its Operational Use" and participated in the group discussion during the Mini-project and Workshop on Application of Remote Sensing and GIS held by GIC, AIT. The participants in this mini-project came from many countries in Asia:

Bangladesh, Bhutan, Cambodia, Indonesia, Laos, Myanmar, the Philippines, Srilanka and Vietnam. RNUS had a chance to contact several participants for establishing good relations and exchange information for the future corporation research.

Figure 19: Dr. Takeuchi giving his presentation

1.9 Site and Interview Survey for Sustainable Tsunami Disaster Mitigation System for the Indian Ocean Project in Phuket

Prof. Kimiro Meguro led a team joined by Dr. Masanori Takashima from Fuji Tokoha University, Shizuoka, Japan and Dr. Kawin Worakanchana to collect data by site survey and interviewing people for the Sustainable Tsunami Disaster Mitigation System for the Indian Ocean Region Project on February 9-10, 2008. During this trip, the research team visited Mr. Chairat Sukban, the Deputy Mayor of Pathong Municipality, Ms. Praulai Nootmorn, Director of the Andaman Sea Fisheries Research and Development Center, Ms. Suwalai Pinpradab, Director of the Tourism Authority of Thailand and Mr. Chotnarin Kerdsom, Head of the Phuket Disaster and Prevention and Mitigation Office.

1.10 Short Seminar on Transportation at Chulalongkorn University

A half day seminar focusing on transportation research was held on March 25, 2008 at Chulalongkorn University. The seminar was started by a welcome address and opening speech of Dr. Tanit Tongthong, Head of the Civil Engineering Department, Chulalongkorn University. Two lectures were presented during this seminar consisting of "Urban Railway Network Planning in Tokyo" by Dr. Hironori Kato (UT) and "Feasibility Study of Peak-hour Road Shoulder Usage in Urbanized Motorways" by Dr. Shinji Tanaka (RNUS, UT). The seminar was closed with a speech of Dr. Kasem Choocharukul.

2. RNUS PROJECT - SEISMIC HAZARD AND VULNERABILITY MAPPING OF DHAKA, CHITTAGONG & SYLHET CITY CORPORATION AREAS

2.1 Project Background

Bangladesh is susceptible to damaging earthquakes. Although, recently, there is no major earthquake occurred in Bangladesh or within its neighborhood, there have been several significant earthquake events recorded in Bangladesh in the past few hundred years. According to the data from Global Seismic Hazard Assessment Program, Bangladesh lies in a region with low to high seismic hazard that increases in the northern and eastern parts of the country. Historically, earthquakes in the M6.0-7.0 range were experienced in Khulna and Rajshahi divisions while events may result in severe damage and destruction of massive proportion with severe consequences for the entire country. These urban centers are fast growing and influence the economic development to the whole country. It is, therefore, essential to have a realistic understanding of the nature, severity and consequences of likely damage/loss that a possible event could cause in the urban centers since a strong earthquake affecting major urban centers may result in damage and destruction of massive proportions and may have disastrous consequences for the entire nation.

Comprehensive Disaster Management Programme (CDMP) of the Government of Bangladesh recognizes the important of the growing urban vulnerability to earthquakes caused by increasing population density and unplanned development. Therefore, CDMP proposed this project under the cooperation agreement which funded by European Commission (EC) and UNDP.

In order to accomplish this project, CDMP has proposed three assignments with EC financial assistance and allocated the responsibility to the Asian Disaster Preparedness Center (ADPC) for implementation of the assignment in three key areas. Within this, a key assignment is the preparation of seismic hazard and vulnerability mapping of Dhaka, Chittagong and Sylhet City Corporation areas. To deal with this project, the international consulting team has been set up of several partners including ADPC, RNUS/AIT, OYO International Corporation (OIC), National Society for Earthquake Technology (NSET)-Nepal, Univ. of Dhaka, Chittagong University of Engineering and Technology, Shahjalal University of Engineering and Technology.

2.2 Overall Objectives

This project will deal with the following works:

1. Prepare regional and local geological fault maps
2. Prepare engineering geological maps for three cities (Dhaka, Chittagong and Sylhet City Corporations) including the areas under future expansion.

3. Prepare seismic hazard maps for three cities by providing seismic, geological and ground conditions.
4. Prepare seismic vulnerability and risk maps for three cities by providing information on vulnerability and risk conditions of critical infrastructure.

2.3 Scope

The overall project will cover the following activities:

Activity Cluster 1: Seismic Hazard Assessment
Task 1.1 Seismic hazard assessment methodology
Task 1.2 Seismic hazard analysis
Task 1.3 Compilation of data and maps for seismic hazard
Task 1.4 Seismic hazard assessment report preparation
Task 1.5 GIS mapping and database preparation for seismic hazard
Task 1.6 Design of future hazard assessment & information dissemination system

Activity Cluster 2: Vulnerability Assessment
Task 2.1 Vulnerability assessment methodology
Task 2.2 Compilation of inventory of element at risk
Task 2.3 Compilation of data and maps for seismic hazard
Task 2.4 Seismic hazard assessment report preparation
Task 2.5 GIS mapping, database preparation for seismic hazard
Task 2.6 Design of future hazard assessment & information dissemination system

Activity Cluster 3: Risk Assessment
Task 3.1 Earthquake risk modeling methodology
Task 3.2 Earthquake scenario development and scenario study
Task 3.3 Risk and impact assessment, loss estimation and development of composite risk maps
Task 3.4 Loss Estimation study report for the city corporation areas
Task 3.5 Design of future risk assessment and information dissemination system
Task 3.6 Presentation

In this project, as RNUS/AIT is responsible organization for Activity Clusters 2 and 3: Vulnerability and Risk Assessment.

2.4 Preliminary visit to Dhaka during 15 -22 March, 2008

2.4.1 Background

An AIT team consisted of Mr. Chaiyapat Suesuttajit, Mr.Matrin Suthasit (researcher and doctoral student) and the editor departed from AIT to visit Dhaka from 15 to 22 March 2008. The AIT/RNUS team joined Dr. Anisur

Rahman, Mr. Amin Budiarjo (GIS specialist), Dr.Dicky Muslim (project manager), Miss Sharany Haque, Mr. Md. Nurul Alam (local structural engineers) from ADPC in Dhaka and Mr. Ramesh Guragain from NSET. The purpose of this visit was to develop a survey method for seismic damage assessment which consisted of developing the survey method itself and developing structural and occupancy type classification. Moreover, the AIT/RNUS team also had a chance to investigate the available inventory data and structures in the Dhaka City Corporation.

2.4.2 Developing of Structural Type Classification

The general idea to develop the structural type classification is to provide an ability to differentiate between buildings with substantially different damage and loss characteristics. Buildings usually behave differently due to the type of structural systems they have (i.e. masonry, concrete or steel), the codes to which they were designed, their heights, shapes or footprints, and local construction practices. Original HAZUS has classified the building into 38 types according to structural materials, structural types and heights. However, this classification cannot be directly used for Dhaka due to the difference in construction practice of Bangladesh and the United State. In this project, the classification must be modified to follow the Bangladesh practice of construction. The project team has carried out building surveys, reviews of Bangladesh National Building Codes and interview several engineers from Bangladesh to get a information of Bangladesh practice of construction. We found that Dhaka City Corporation consists of a relatively large number of non-engineering buildings which have not been covered by original HAZUS classification. Therefore, we decided to construct new structural type classification according to our survey.

2.4.3 Development of Occupancy Type Classification

The occupancy classification can be related to the number of people during the day and night and the replacement cost of each building which are needed for calculating casualties and the economic loss. The procedure to develop occupancy type classification was carried out in a similar manner to structural type classification, i.e. we modified the original HAZUS classification to fit with Bangladesh characteristics based on our additional survey.

2.4.4 Development of Survey Method for Seismic Damage Assessment

The building inventory data and fragility curve are necessary for carrying out the seismic vulnerability and risk assessment. Because building inventory and fragility curve must be developed based on extensive building data, in this project, the team carried out the building survey methods which are separated into three levels to develop for these two items. Survey level 1 will be conducted mainly to obtain the inventory data while levels 2 and 3

will be used to develop the fragility curve. The detailed description on the survey from all three levels is described below:

Level 1 survey
The level 1 survey was designed so that the survey can be conducted in relatively short time and in a large number. In this survey level, the team will be able to investigate the building just by visual inspection and make a minimum number of contacts with building owners. The objectives of this level are:

1. To collect information on structural and occupancy type, construction year and preliminary seismic vulnerability factor, i.e. first soft/weak storey, heavy overhangs (Figure 20) and cantilever, shape of building in plan, shape in elevation, poundings possibility, building in slope land, visible ground settlement and short columns.
2. To construct a mapping matrix to infer structural type from occupancy type database similar to Table 1. After investigating the available inventory data in Bangladesh, we found that the occupancy type database is very complete in term of building number and detail of classification. It is also much more complete comparing to structural type classification. Therefore, instead of conducting the complete survey for the structural type which requires a lot of resource, we can infer the number of structure in each structural type based on this mapping matrix.

Table 1: Example of mapping matrix showing structural type in occupancy class

Specific Occupancy Class	Model Building Type													
	2	3	6	9	10	13	16	19	22	25	26	29	31	34
	W2	S1L	S2L	S3	S4L	S5L	C1L	C2L	C3L	PC1	PC2L	RM1L	RM2L	URML
COM1	26%	4%	1%	4%	2%	11%	1%	15%	2%	6%	1%	13%	1%	13%

Level 2 survey
The objective of level 2 survey is to determine the major vulnerability factors for buildings in each classification. In addition to the level 1 survey, more parameters relating seismic vulnerability such as torsional irregularity and diaphragm discontinuity will be collected in case of reinforced concrete buildings. The different set of data i.e. wall thickness, maximum unsupported length of wall, initial corner separation, anchorage of wall to floor, anchorage of roof with wall, wall to wall anchorage, bracing of flexible floor/roof, existence of gable wall, horizontal band, reinforcement in vertical post and defect will be collected for masonry structure. In this level, the survey team must contact the building owner to sketch the building floor plan and measure the column geometry therefore the survey time will be longer than the level 1 survey. This level of survey will cover about 300-500 buildings in three cities.

Figure 20: Soft storey and heavily overhanging structure in Dhaka

Level 3 survey

The level 3 survey will be carried out to develop or modify the fragility curve. In this level, a number of nonlinear finite element analyses are required to determine the seismic performance of structures in Bangladesh. The finite element models will be constructed based on construction plan and material information. Ferroscan and Schmidt hammer investigation will be carried out for selected buildings to verify the quality of construction plan in case the tools are available.

Because, the distribution of structural and occupancy types in Dhaka City Corporation are different from ward to ward, GIS specialists, with extensive experience in Dhaka's urban planning, will set the survey plan so that each survey team can get the best representative data of buildings in each area.

3. MASTER PLAN FOR EARTHQUAKES AND BUILDING COLLAPSE HAZARD PREVENTION AND MITIGATION IN THAILAND (PHASE I)

3.1 Introduction and Project Background

Recently, it appears that large earthquakes tend to occur more frequently in Thailand and its surrounding areas. The latest scientific study indicates that the potential earthquake can affect 61 from total 76 provinces in Thailand.

The Department of Disaster Prevention and Mitigation (DPM) under Thailand's Ministry of Interior as the major authority for developing and implementing the plan for disaster related organizations has foreseen the possible earthquake damage therefore it initiated the project 'Master Plan for Earthquake and Building Collapse Hazard Prevention and Mitigation' (referred hereafter as the Master Plan) to provide the pro-active strategy for mitigating and reducing the damage and the number of building collapse in the future. The plan is also used as a supplement to the national disaster prevention and mitigation plan for broad range of Thailand's organizations which cover ministries, departments, district and local level government units, private sections, foundations, non-profit and non-government organizations to develop a sound and systematic earthquake disaster managing system.

This project will mainly focus on three tasks below.

1. Developing national seismic risk maps
2. Developing microzonation maps by including liquefaction and landslide effect
3. Developing statistical data to show the vulnerability of buildings in each category.

3.2 Brief Methodology

The brief methodology is described as the following:

1. *Developing national seismic risk map*: Data regarding seismic source and attenuation model will be collected and reviewed. Base on this data, seismic source model will be developed and used for generating the probabilistic ground acceleration map.
2. *Developing microzonation maps by including liquefaction and landslide effects*: The geological data will be collected. The soil will be classified and interpreted for the site amplification ratio. Also, the team will collect additional data relating to liquefaction and landslide, for example, DEM and water table, and analyze for possible damage from earthquake induced liquefaction and landslide effect.

3. *Developing statistical data to show the vulnerability of buildings and lifeline*: RNUS/AIT will collect the available data from previous study, for example, buildings, population and its contents, to develop the inventory database. The team will also cover the critical lifeline data such as power system, telephone, bridge and so on.

Due to resource limitation, this project will cover the assessment on only three provinces, which are Bangkok, Chiang Mai and Kanchanaburi. Among them, Bangkok is selected as the representative city that may be affected by long range earthquakes; Chiang Mai and Kanchanaburi are cities that represent large and medium sized cities in the moderate seismicity area, respectively.

APPENDIX : COLLECTION OF PRESENTATION FROM RNUS SEMINAR 2008

Order of Presentations

My Ideas for Efficient Disaster Mitigation Strategies
Prof. Kimiro Meguro

Lesson Learned from Tsunami 2004
Assoc. Prof. Pennung Warnitchai

Forest Fire Control in Thailand
Mr. Siri Akaakara

GISTDA Activities and Services
Mrs. Praneet Disariyakul

Capacity Building Program on Applications of Remote Sensing and GIS in Disasters
Dr. Manzul K. Hazarika

Sentinel Asia: Disaster Management Support in the Asia-Pacific Region
Dr. Masahiko Honzawa

Landslide Assessment and Warning: Case Study in Thailand
Assoc. Prof. Warakorn Mairaing

Flood Forecasting and its Application for Disaster Management
Dr. Sutat Weesakul

Link of Sustainable Forest and Safe Timber Houses by User Oriented Data Integration
Prof. Tomonari Yashiro

Transportation Management in Disaster
Dr. Shinji Tanaka

My Ideas for Efficient Disaster Mitigation Strategies

Prof. Kimiro Meguro
International Center for Urban Safety Engineering
Institute of Industrial Science
The University of Tokyo, JAPAN


My Ideas for Efficient Disaster Mitigation Strategies
Prof. Kimiro MEGURO
ICUS
International Center for Urban Safety Engineering
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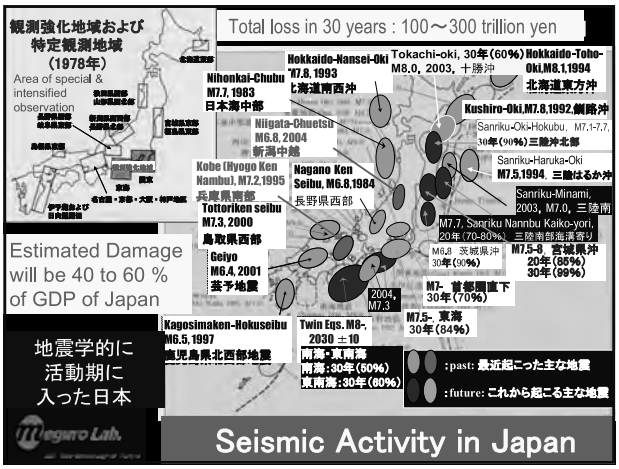
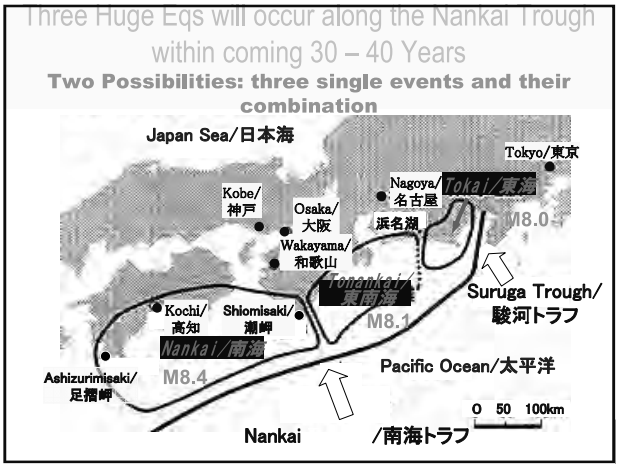
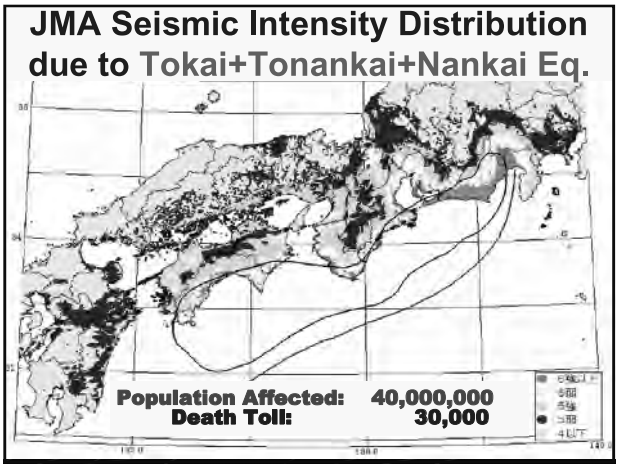
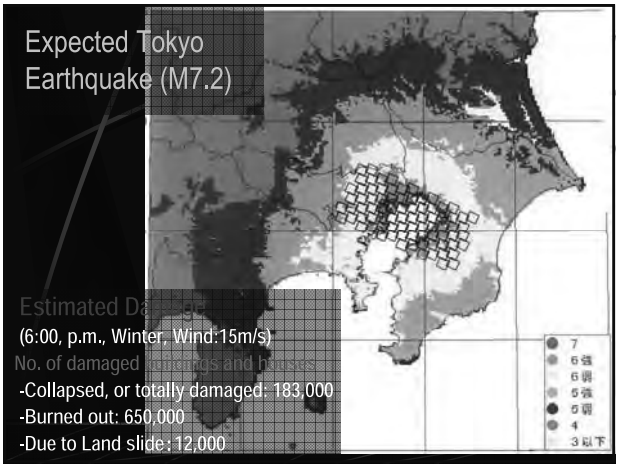
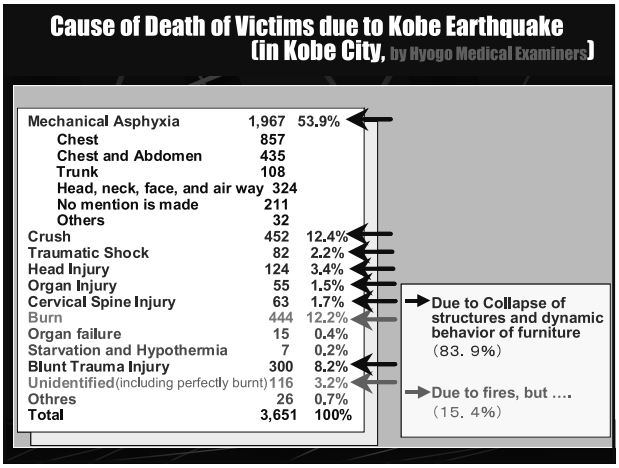

Total loss in 30 years : 100～300 trillion yen
観測強化地域および特定観測地域 (1978年)
Area of special & intensified observation
Hokkaido-Nansei-Oki M7.8, 1993 北海道南西沖
Tokachi-oki, 30年(60%) M8.0, 2003, 十勝沖
Hokkaido-Toho-Oki,M8.1,1994 北海道東方沖
Nihonkai-Chubu M7.7, 1983 日本海中部
Kushiro-Oki,M7.8,1992,釧路沖
Sanriku-Oki-Hokubu, M7.1-7.7, 30年(90%)三陸沖北部
Niigata-Chuetsu M6.8, 2004 新潟中越
Sanriku-Haruka-Oki M7.5,1994, 三陸はるか沖
Kobe (Hyogo Ken Nambu), M7.2,1995 兵庫県南部
Nagano Ken Seibu, M6.8,1984 長野県西部
Sanriku-Minami, 2003, M7.0, 三陸南
Tottoriken seibu M7.3, 2000 鳥取県西部
M7.7, Sanriku Nannbu Kaiko-yori, 20年(70-80%) 三陸南部海溝寄り
Estimated Damage will be 40 to 60 % of GDP of Japan
Geiyo M6.4, 2001 芸予地震
M6.8 茨城県沖 30年(90%)
M7.5-8, 宮城県沖 20年(85%) 30年(99%)
2004, M7.3
M7-, 首都圏直下 30年(70%)
Kagosimaken-Hokuseibu M6.5, 1997 鹿児島県北西部地震
Twin Eqs. M8-, 2030 ±10
M7.5-, 東海 30年(84%)
南海・東南海 南海:30年(50%) 東南海:30年(80%)
地震学的に活動期に入った日本
:past: 最近起こった主な地震
:future: これから起こる主な地震
Seismic Activity in Japan


Three Huge Eqs will occur along the Nankai Trough within coming 30 – 40 Years
Two Possibilities: three single events and their combination
Japan Sea/日本海
Tokyo/東京
Nagoya/名古屋
Tokai/東海
M8.0
Kobe/神戸
Osaka/大阪
浜名湖
Wakayama/和歌山
Tonankai/東南海
M8.1
Suruga Trough/駿河トラフ
Kochi/高知
Shiomisaki/潮岬
Nankai/南海
M8.4
Ashizurimisaki/足摺岬
Pacific Ocean/太平洋
0 50 100km
Nankai /南海トラフ


JMA Seismic Intensity Distribution due to Tokai+Tonankai+Nankai Eq.
Population Affected: 40,000,000
Death Toll: 30,000


Expected Tokyo Earthquake (M7.2)
Estimated Damage
(6:00, p.m., Winter, Wind:15m/s)
No. of damaged buildings and houses
-Collapsed, or totally damaged: 183,000
-Burned out: 650,000
-Due to Land slide : 12,000


Cause of Death of Victims due to Kobe Earthquake (in Kobe City, by Hyogo Medical Examiners)
Mechanical Asphyxia 1,967 53.9%
Chest 857
Chest and Abdomen 435
Trunk 108
Head, neck, face, and air way 324
No mention is made 211
Others 32
Crush 452 12.4%
Traumatic Shock 82 2.2%
Head Injury 124 3.4%
Organ Injury 55 1.5%
Cervical Spine Injury 63 1.7%
Burn 444 12.2%
Organ failure 15 0.4%
Starvation and Hypothermia 7 0.2%
Blunt Trauma Injury 300 8.2%
Unidentified(including perfectly burnt) 116 3.2%
Othres 26 0.7%
Total 3,651 100%
Due to Collapse of structures and dynamic behavior of furniture (83. 9%)
Due to fires, but …. (15. 4%)

Time when the casualties were killed due to Kobe Earthquake (in Kobe City)

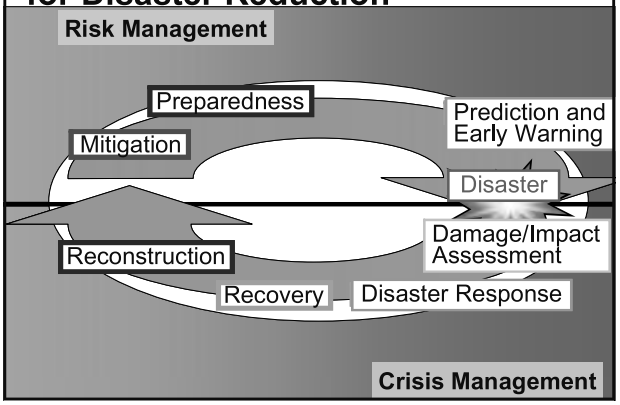
Time of death		No. of Casualties by Medical Examiners		by Ordinary Doctors		Total Number
1/17	～6:00	2,221	2,221 (91.9 %)	719	719 (58.2 %)	2,940 (80.5 %)
	～9:00	16	2,237 (92.6 %)	58	777 (62.9 %)	3,014 (82.6 %)
	～12:00	47	2,284 (94.5 %)	61	838 (67.9 %)	3,122 (85.5 %)
	～23:59	12	2,296 (95.0 %)	212	1,050 (85.0 %)	3,346 (91.6 %)
	unidentify	110	2,406 (99.6 %)	84	1,134 (91.8 %)	3,540 (97.0 %)
1/18		5	2,411 (99.8 %)	62	1,196 (96.8 %)	3,607 (98.8 %)
1/19			2,411 (99.8 %)	13	1,209 (97.9 %)	3,620 (99.2 %)
1/20		2	2,413 (99.9 %)	8	1,217 (98.5 %)	3,630 (99.4 %)
1/21		1	2,414 (99.9 %)	6	1,223 (99.0 %)	3,637 (99.6 %)
1/22		1	2,415 (100.0 %)	1	1,224 (99.1 %)	3,639 (99.7 %)
1/24			2,415 (100.0 %)	1	1,225 (99.2 %)	3,640 (99.7 %)
1/25		1	2,416 (100.0 %)	1	1,226 (99.3 %)	3,642 (99.8 %)
1/26			2,416 (100.0 %)	2	1,228 (99.4 %)	3,644 (99.8 %)
1/27			2,416 (100.0 %)	1	1,229 (99.5 %)	3,645 (99.8 %)
1/28			2,416 (100.0 %)	1	1,230 (99.6 %)	3,646 (99.9 %)
2/4			2,416 (100.0 %)	1	1,231 (99.7 %)	3,647 (99.9 %)
	No record		2,416 (100.0 %)	4	1,235 (100.0 %)	3,651 (100.0 %)
Total Number		2,416		1,235		3,651

(after Hyogo Medical Examiners)

Topics

- New Style Disaster Management Manual
- Universal Disaster Environmental Simulator

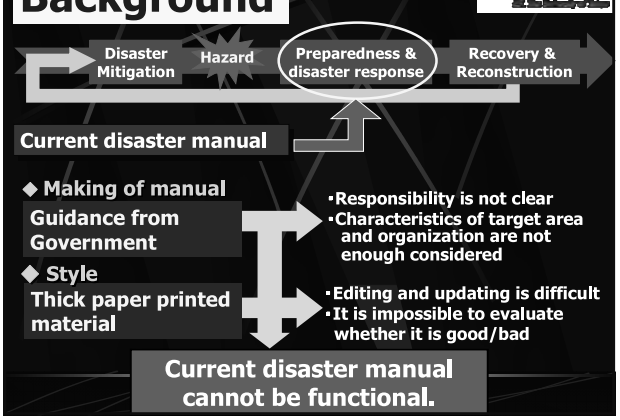
Disaster Management System for Disaster Reduction



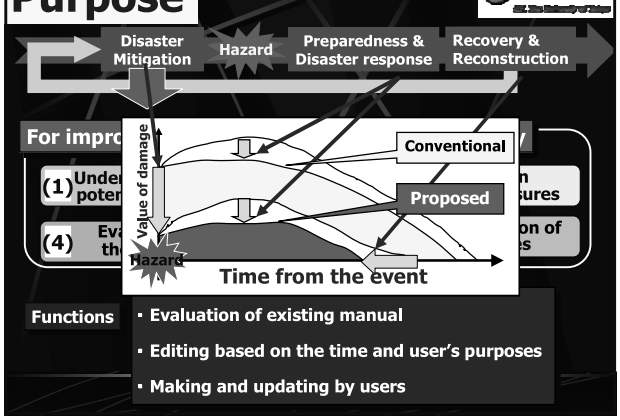
Three Major components for disaster reduction

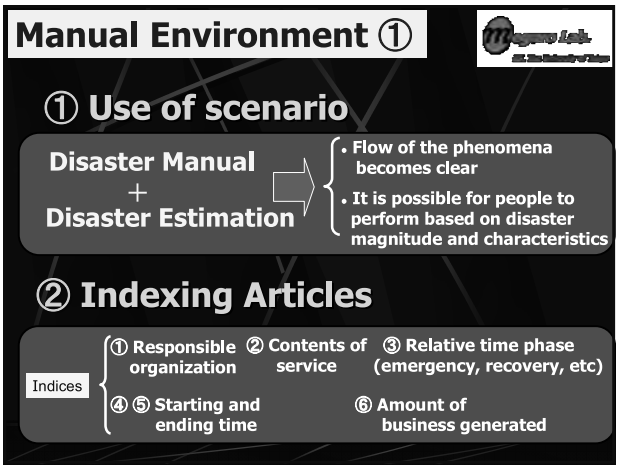
- **Mitigation**
  which makes an effort not to connect the Hazard, a physical phenomenon, to Disaster, a negative impact to the society taking optimal measures beforehand.
- **Preparedness/Disaster Response**
  which prevents wide spread impact after hazard occurs.
- **Optimum Recovery/ Reconstruction Strategy**
  which minimizes the negative influence due to the hazard by quick recovery and reconstruction.

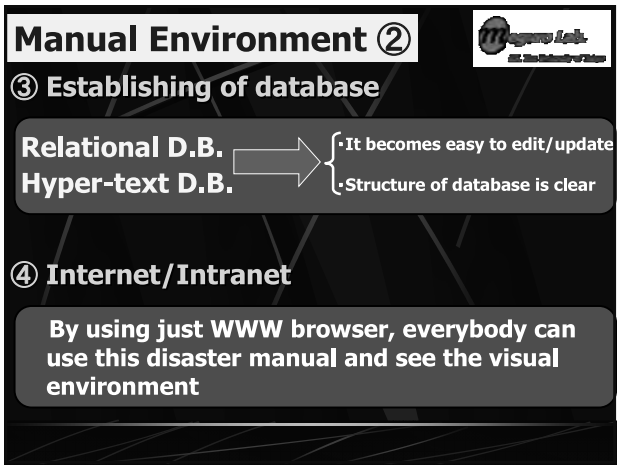
Background

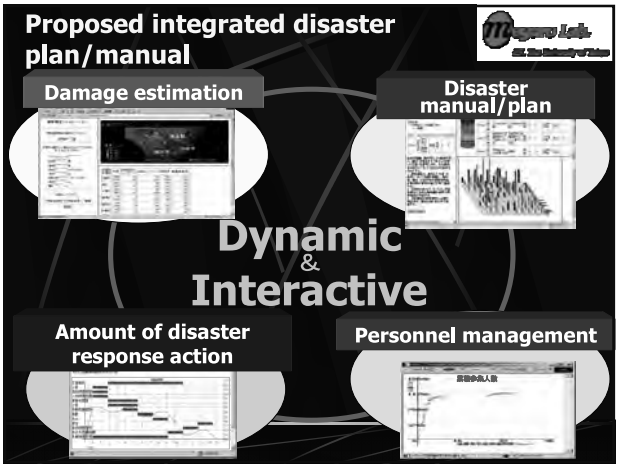


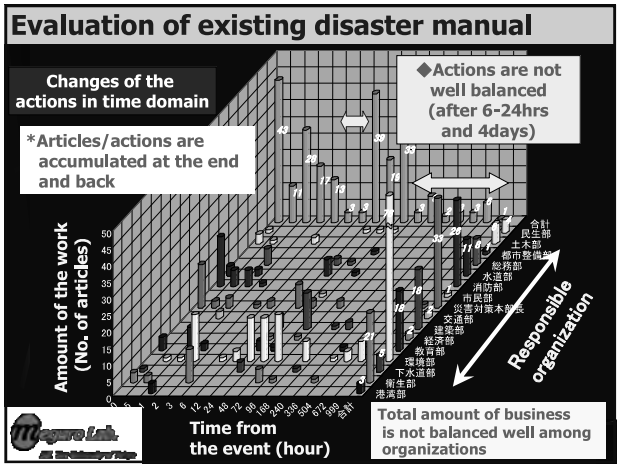
Purpose

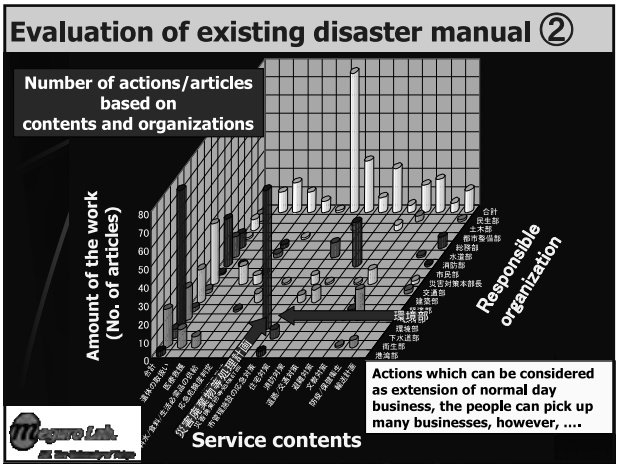


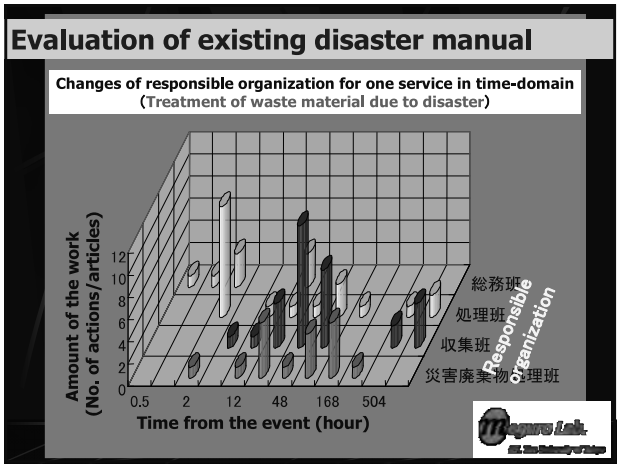

Manual Environment ①
① Use of scenario
Disaster Manual
+
Disaster Estimation
• Flow of the phenomena becomes clear
• It is possible for people to perform based on disaster magnitude and characteristics
② Indexing Articles
Indices
① Responsible organization
② Contents of service
③ Relative time phase (emergency, recovery, etc)
④ ⑤ Starting and ending time
⑥ Amount of business generated

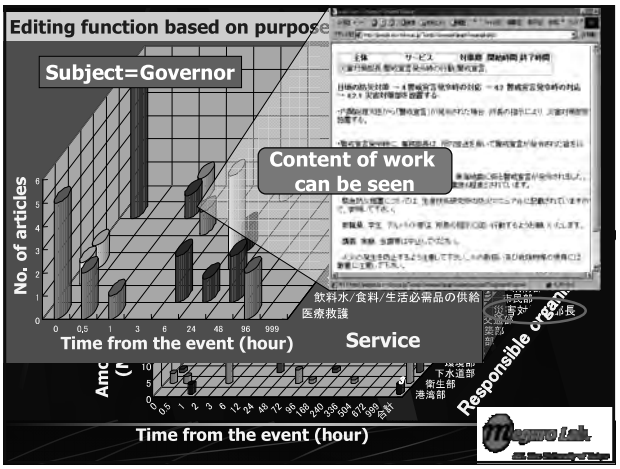

Manual Environment ②
③ Establishing of database
Relational D.B.
Hyper-text D.B.
•It becomes easy to edit/update
•Structure of database is clear
④ Internet/Intranet
By using just WWW browser, everybody can use this disaster manual and see the visual environment

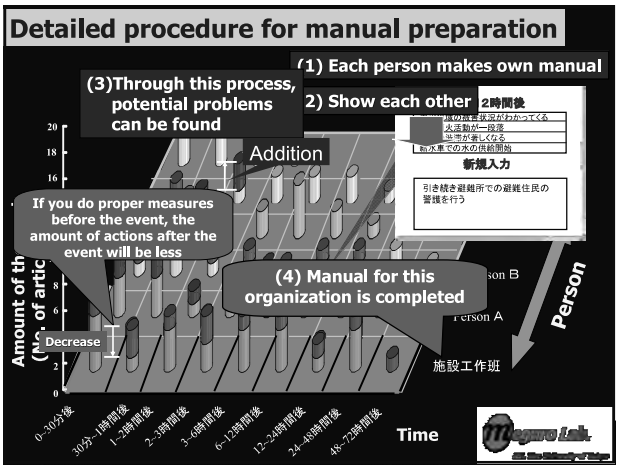

Proposed integrated disaster plan/manual
Damage estimation
Disaster manual/plan
Dynamic
&
Interactive
Amount of disaster response action
Personnel management

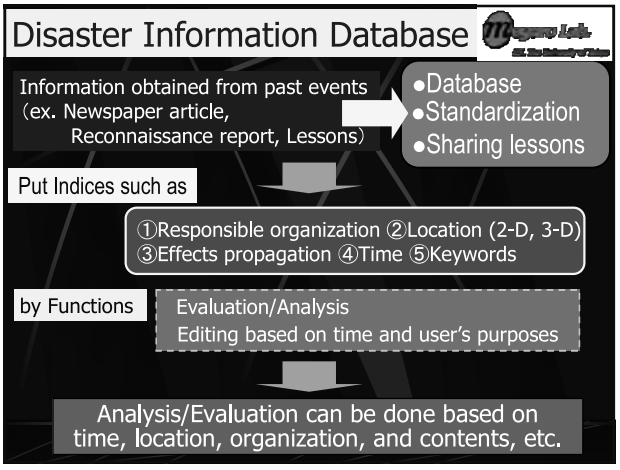

Evaluation of existing disaster manual
Changes of the actions in time domain
*Articles/actions are accumulated at the end and back
◆Actions are not well balanced (after 6-24hrs and 4days)
Amount of the work (No. of articles)
Responsible organization
Time from the event (hour)
Total amount of business is not balanced well among organizations


Evaluation of existing disaster manual ②
Number of actions/articles based on contents and organizations
Amount of the work (No. of articles)
Responsible organization
Actions which can be considered as extension of normal day business, the people can pick up many businesses, however, ...
Service contents

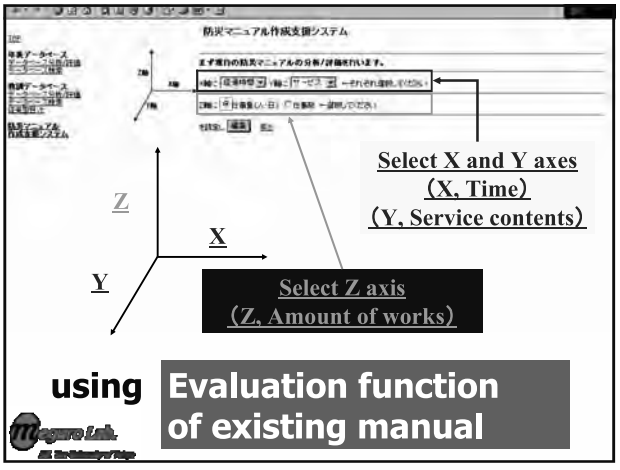

Evaluation of existing disaster manual
Changes of responsible organization for one service in time-domain
(Treatment of waste material due to disaster)
Amount of the work (No. of actions/articles)
総務班
処理班
収集班
災害廃棄物処理班
Responsible organization
0.5
2
12
48
168
504
Time from the event (hour)

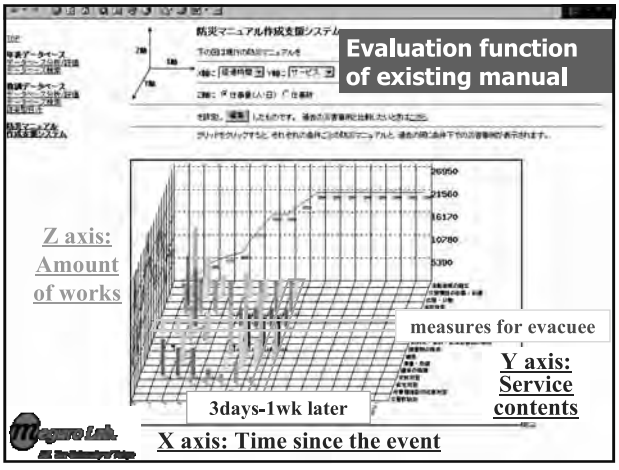

Editing function based on purpose
Subject=Governor
Content of work can be seen
No. of articles
Time from the event (hour)
Service
Responsible organization
Time from the event (hour)


Detailed procedure for manual preparation
(1) Each person makes own manual
(2) Show each other
(3)Through this process, potential problems can be found
Addition
If you do proper measures before the event, the amount of actions after the event will be less
Decrease
(4) Manual for this organization is completed
Person
Time


Disaster Information Database
Information obtained from past events (ex. Newspaper article, Reconnaissance report, Lessons)
●Database
●Standardization
●Sharing lessons
Put Indices such as
①Responsible organization ②Location (2-D, 3-D)
③Effects propagation ④Time ⑤Keywords
by Functions
Evaluation/Analysis
Editing based on time and user's purposes
Analysis/Evaluation can be done based on time, location, organization, and contents, etc.

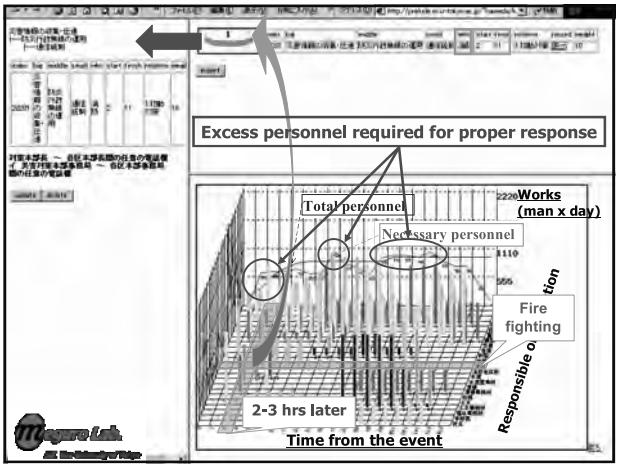

Prototype system
防災マニュアル作成支援システム
New Style Disaster Manual
Disaster Information Database

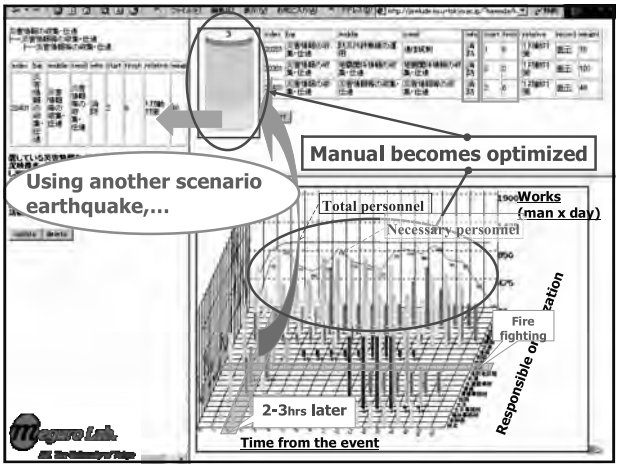

Select X and Y axes
(X, Time)
(Y, Service contents)
Z
X
Y
Select Z axis
(Z, Amount of works)
using
Evaluation function of existing manual

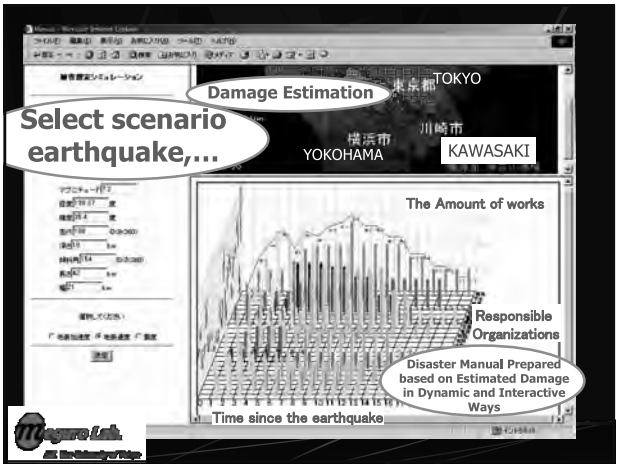

Evaluation function of existing manual
Z axis: Amount of works
measures for evacuee
Y axis: Service contents
3days-1wk later
X axis: Time since the event


Contents of Current Disaster Manual
Comparison/Evaluation
Past Real Events
Details


Contents of Current Disaster Manual
Addition
Modification
Past Real Events

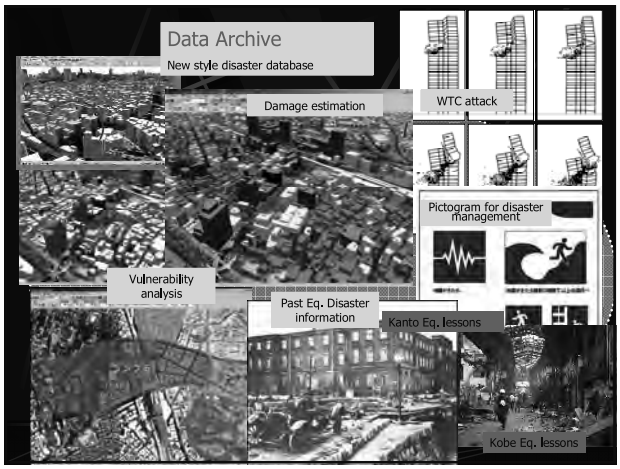

Excess personnel required for proper response
Total personnel
Necessary personnel
Works (man x day)
Fire fighting
2-3 hrs later
Time from the event


Manual becomes optimized
Using another scenario earthquake,...
Total personnel
Necessary personnel
Works (man x day)
Fire fighting
2-3hrs later
Time from the event

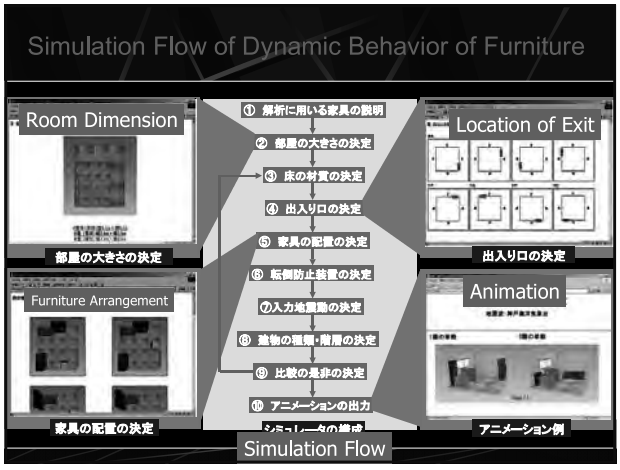

Select scenario earthquake,...
Damage Estimation
TOKYO
YOKOHAMA
KAWASAKI
The Amount of works
Responsible Organizations
Disaster Manual Prepared based on Estimated Damage in Dynamic and Interactive Ways
Time since the earthquake


Integrated Disaster Information Station
Damage estimation
Kobe Eq. lessons
WTC attack
Ground motion
Dynamic behavior of Interior facility
Data Archive
New style disaster database
Structural Collapse
Vulnerability analysis
Universal Disaster Environment Simulator
To Generate Disaster Information
Human Evacuation
Web3D -GIS
Past Eq. Disaster information
Fire spreading
Nest generation disaster management manual
Meguro Method, Disaster imagination tool
E-learning System
Information Gateway
Information interface using touch panel
Evaluation of effects of countermeasures
Economical effects
Internet


Universal Disaster Environment Simulator
To Generate Disaster Information
Ground motion
Structural Collapse
Buildings
Dynamic behavior of Interior facility
Room
Nest generation disaster management manual
Meguro Method, Disaster imagination tool
City
Economical effects
Fire spreading
Human Evacuation
Evaluation of effects of countermeasures


Data Archive
New style disaster database
Damage estimation
WTC attack
Pictogram for disaster management
Vulnerability analysis
Past Eq. Disaster information
Kanto Eq. lessons
Kobe Eq. lessons


E-learning System
Information Gateway
Information interface using touch panel
Internet


Simulation Flow of Dynamic Behavior of Furniture
Room Dimension
Location of Exit
Furniture Arrangement
Animation
① 解析に用いる家具の説明
② 部屋の大きさの決定
③ 床の材質の決定
④ 出入り口の決定
⑤ 家具の配置の決定
⑥ 転倒防止装置の決定
の入力地震動の決定
⑧ 建物の種類・階層の決定
⑨ 比較の是非の決定
⑩ アニメーションの出力
部屋の大きさの決定
出入り口の決定
家具の配置の決定
アニメーション例
Simulation Flow

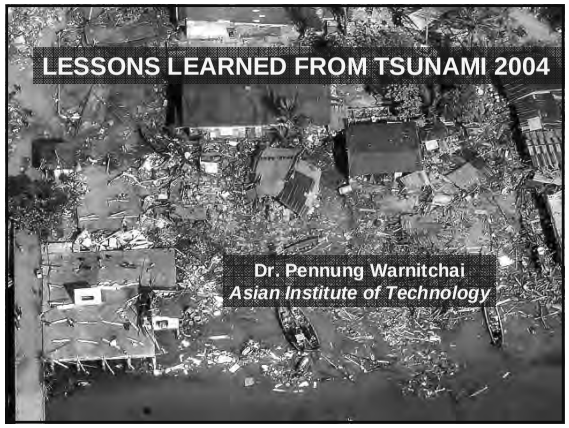

確認した住所を選ぶことができます
You can select your address below.
あなたの町の地域危険度
千代田区
中央区
港区
新宿区
文京区
台東区
墨田区
江東区
品川区
目黒区
大田区
世田谷区
渋谷区
中野区
杉並区
豊島区
北区
荒川区
板橋区
練馬区
足立区
葛飾区
江戸川区
あなたの町は
千代田区 飯田橋１
東京23区
危険度表示
建物表示
2D
防災情報表示
拡大・縮小

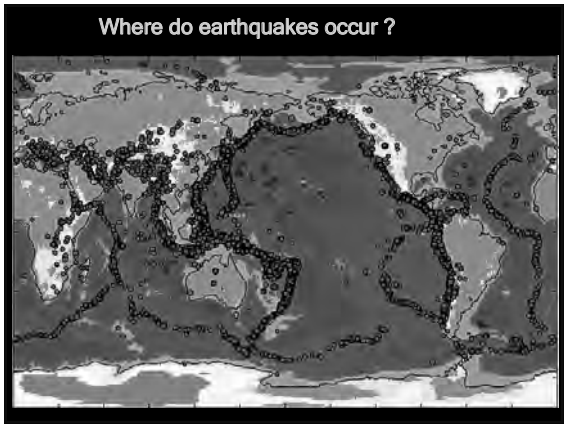

選択した地域から最寄の避難所までの経路と距離を地図上に示す。
Shortest path from user's selected area to evacuation space is shown on the map with its distance.
東京23区
危険度表示
建物表示
2D
防災情報表示
拡大・縮小

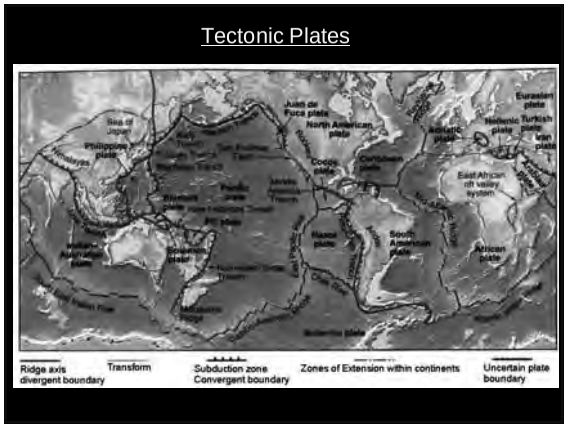

火災
避難
総合
建物倒壊危険度
地域に存在している建物の耐震性から地域の地震危険度評価したもの
Vulnerable rank in terms of structural seismic capacity of the area.
東京23区
危険度表示
建物表示
2D
防災情報表示
拡大・縮小

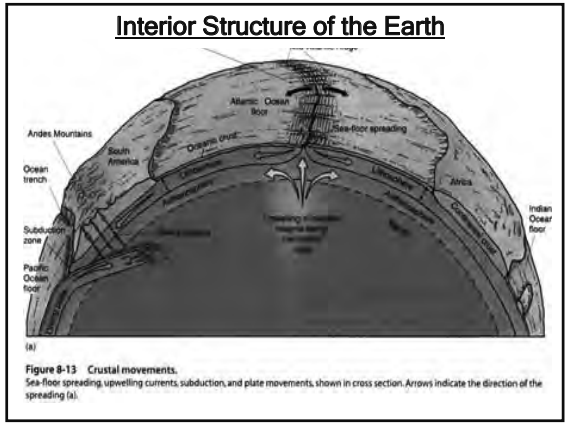
Lesson Learned from Tsunami 2004

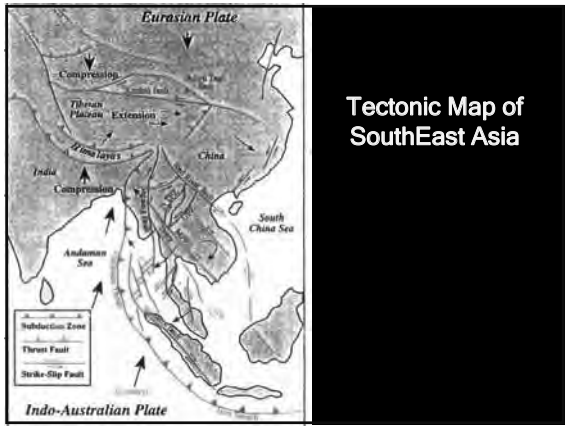
Assoc. Prof. Pennung Warnitchai
School of Engineering and Technology
Asian Institute of Technology, THAILAND

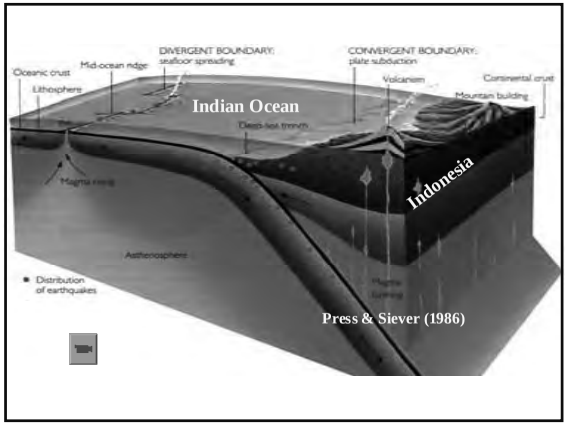

LESSONS LEARNED FROM TSUNAMI 2004
Dr. Pennung Warnitchai
Asian Institute of Technology

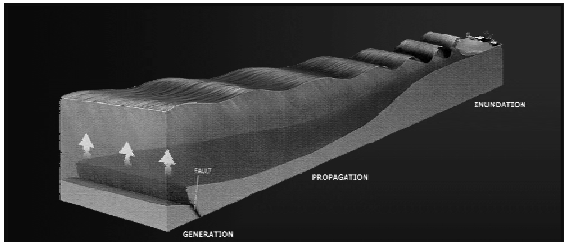

Where do earthquakes occur ?


Tectonic Plates
Ridge axis divergent boundary
Transform
Subduction zone Convergent boundary
Zones of Extension within continents
Uncertain plate boundary


Interior Structure of the Earth
Andes Mountains
Ocean trench
Subduction zone
Pacific Ocean floor
Atlantic Ocean floor
Sea-floor spreading
Indian Ocean floor
Figure 8-13 Crustal movements.
Sea-floor spreading, upwelling currents, subduction, and plate movements, shown in cross section. Arrows indicate the direction of the spreading (a).


Eurasian Plate
Compression
Tibetan Plateau
Extension
China
India
Compression
South China Sea
Andaman Sea
Subduction Zone
Thrust Fault
Strike-Slip Fault
Indo-Australian Plate
Tectonic Map of SouthEast Asia


DIVERGENT BOUNDARY: seafloor spreading
CONVERGENT BOUNDARY: plate subduction
Oceanic crust
Mid-ocean ridge
Lithosphere
Volcanism
Continental crust
Mountain building
Indian Ocean
Deep-sea trench
Indonesia
Magma rising
Asthenosphere
Distribution of earthquakes
Press & Siever (1986)



Three basic stages of tsunami behavior: generation, propagation and inundation

Slip zones of major previous earthquakes

Slip zones of major previous earthquakes

Magnitude: 9.3

Type: Subduction Earthquake

Rupture Length = 1200 km

Average Slip = 15 m
(in the southern 400~600 km of the rupture)

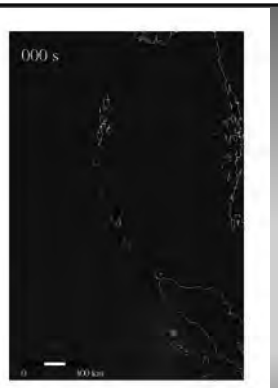
Sea floor Uplift = 1 – 4 m

(Source: USGS)

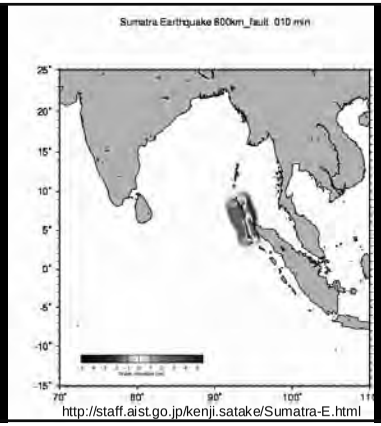
The 26 December 2004 Megathrust Earthquake

Magnitude: 9.3

Rupture Length: 1200 km

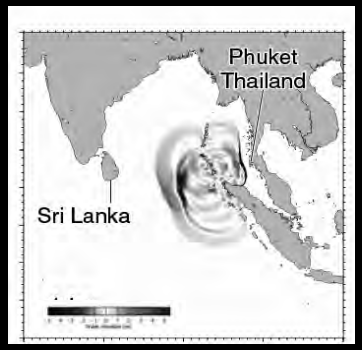


Ishii et al., 2005 Nature

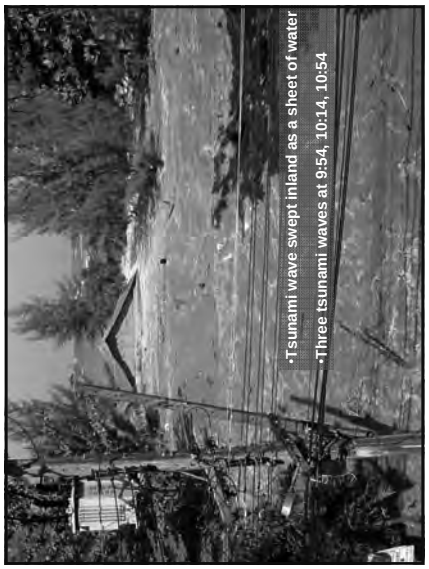


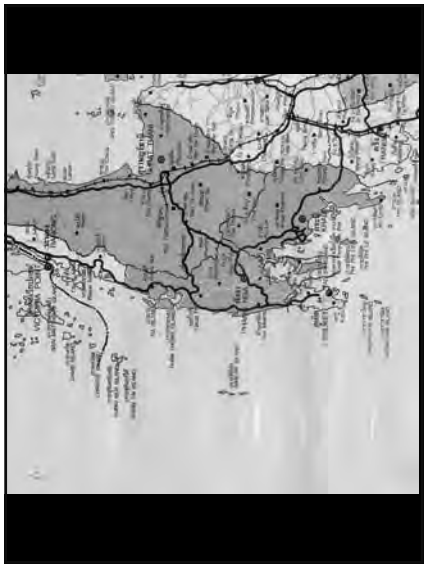
http://staff.aist.go.jp/kenji.satake/Sumatra-E.html

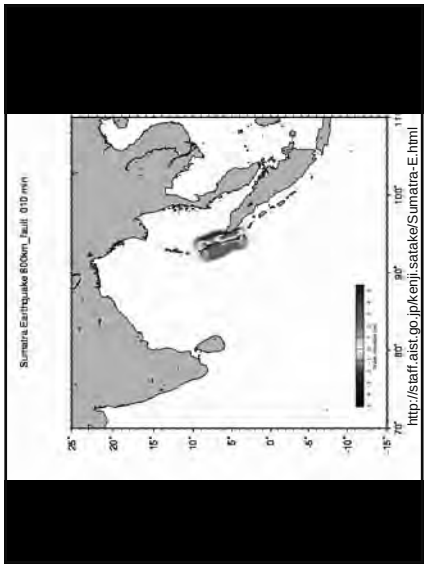
Tsunami generation and propagation

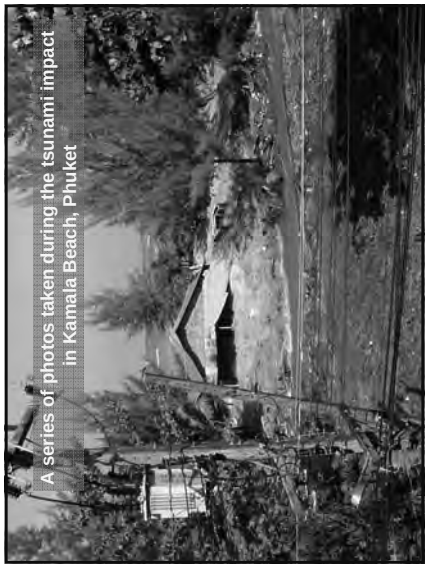


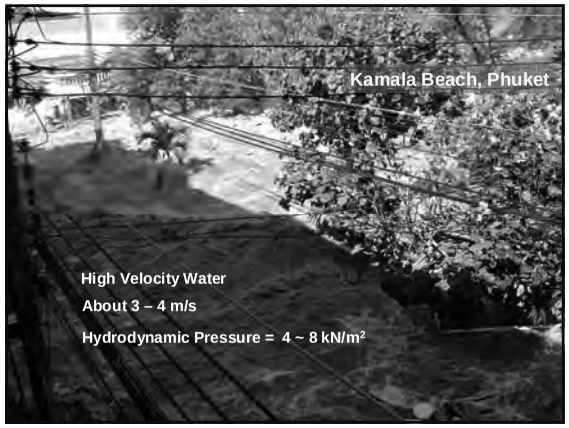

An international survey team—AIT, Chiba Univ., EDM/NIED (Japan), JICA, MCEER (USA), GISTDA (Thailand), TMD (Thailand)

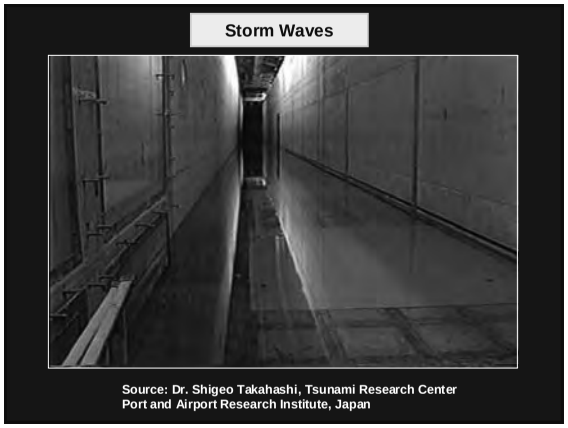

•Tsunami wave swept inland as a sheet of water
•Three tsunami waves at 9:54, 10:14, 10:54




Sumatra Earthquake 600km_fault 010 min
http://staff.aist.go.jp/kenji.satake/Sumatra-E.html


A series of photos taken during the tsunami impact in Kamala Beach, Phuket


Kamala Beach, Phuket
High Velocity Water
About 3 – 4 m/s
Hydrodynamic Pressure = 4 ~ 8 kN/m²

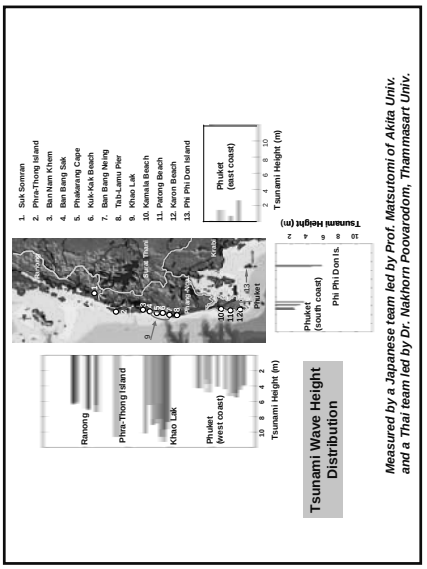

Storm Waves
Source: Dr. Shigeo Takahashi, Tsunami Research Center
Port and Airport Research Institute, Japan


Destructive Tsunami Waves
Source: Dr. Shigeo Takahashi, Tsunami Research Center
Port and Airport Research Institute, Japan


Kamala Beach, Phuket


Storm Wave
Source: Dr. Shigeo Takahashi, Tsunami Research Center
Port and Airport Research Institute, Japan


Tsunami Wave (I)
Source: Dr. Shigeo Takahashi, Tsunami Research Center
Port and Airport Research Institute, Japan


1. Suk Soman
2. Phra-Thong Island
3. Ban Nam Khem
4. Ban Bang Sak
5. Phakarang Cape
6. Kuk-Kak Beach
7. Ban Bang Neng
8. Tab-Lamu Pier
9. Khao Lak
10. Kamala Beach
11. Patong Beach
12. Karon Beach
13. Phi Phi Don Island
Ranong
Phra-Thong Island
Khao Lak
Phuket (west coast)
Tsunami Height (m)
Phuket (east coast)
Phuket (south coast)
Phi Phi Don Is.
Tsunami Wave Height Distribution
Measured by a Japanese team led by Prof. Matsutomi of Akita Univ. and a Thai team led by Dr. Nakhorn Poovarodom, Thammasart Univ.


Tsunami Wave (III)
Source: Dr. Shigeo Takahashi, Tsunami Research Center
Port and Airport Research Institute, Japan


Khao Lak, Phang-Nga
Maximum Water Level


Tsunami Wave (II)
Source: Dr. Shigeo Takahashi, Tsunami Research Center
Port and Airport Research Institute, Japan


Kamala Beach, Phuket
Maximum Water Level


Khao Lak
Breaking of frame-infill masonry walls by large hydrodynamic pressure and/or impact of major floating debris


Severe scouring of sand underneath building spread footings (Kamala Beach)


Completely destroyed building in Kuk-Kak Beach, Khao Lak


Scouring of road by highly turbulent and strong current waves (Khao Lak)

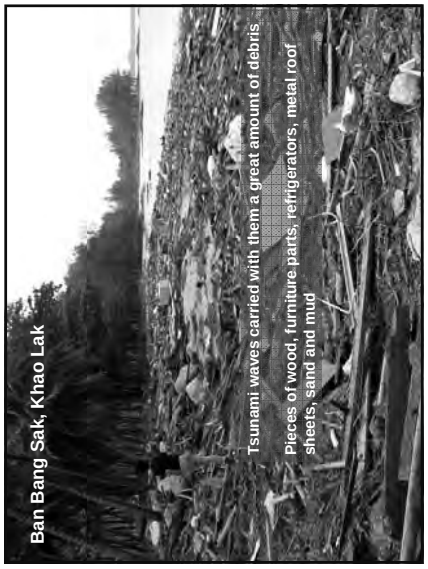

Khao Lak Princess Resort
Water velocity = 6 – 8 m/s
Hydrodynamic pressure = 20 – 30 kN/m²


Damaged Building in Phi Phi Don Island
The breaking of infill walls reduced the hydrodynamic pressure, and thus helped saving the structure.

Many fishing boats were pushed from the shore toward the land and crashed into buildings (Ban Nam Khem)

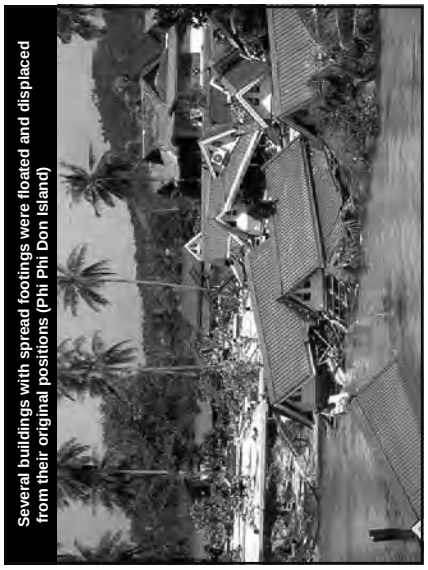
Ban Bang Sak, Khao Lak

Tsunami waves carried with them a great amount of debris. Pieces of wood, furniture parts, refrigerators, metal roof sheets, sand and mud



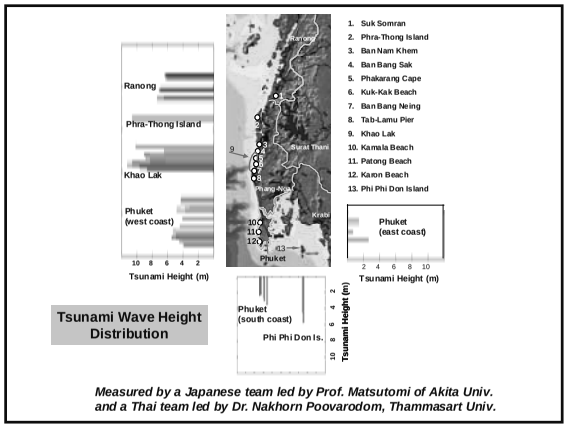
A car on the roof of a building in Phakarang Cape, Khao Lak

Several buildings with spread footings were floated and displaced from their original positions (Phi Phi Don Island)



Cars were rolled, pushed around, or thrown against buildings and obstacles


A battleship was tossed on to the shore
In front of a naval base at Tap La-mu Pier in Phang-Nga


Ranong
Phra-Thong Island
Khao Lak
Phuket (west coast)
Tsunami Height (m)
1. Suk Somran
2. Phra-Thong Island
3. Ban Nam Khem
4. Ban Bang Sak
5. Phakarang Cape
6. Kuk-Kak Beach
7. Ban Bang Neing
8. Tab-Lamu Pier
9. Khao Lak
10. Kamala Beach
11. Patong Beach
12. Karon Beach
13. Phi Phi Don Island
Phuket (east coast)
Phuket (south coast)
Phi Phi Don Is.
Tsunami Wave Height Distribution
Measured by a Japanese team led by Prof. Matsutomi of Akita Univ.
and a Thai team led by Dr. Nakhorn Poovarodom, Thammasart Univ.


All fisherman houses in Phra-thong Island
were completely wiped out


Most wooden houses were completely destroyed by tsunami
They are much more vulnerable than concrete buildings
Phra-thong Island, Phang-Nga


Phra-thong Island, Phang-Nga

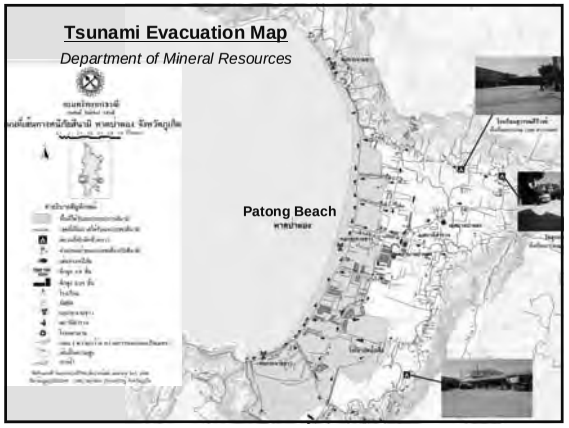

Water Tank Tower, Phra-thong Island
Phang-Nga
Tsunami Tower, Japan

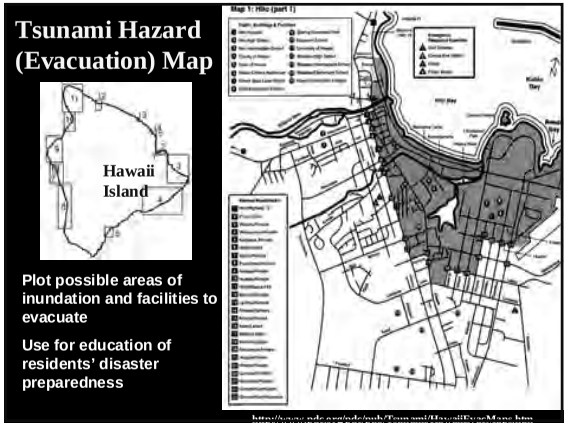

Sand belt area in Phi Phi Don Island was attacked by tsunami waves from both sides
Ton Sai Bay
Loh Dalum Bay

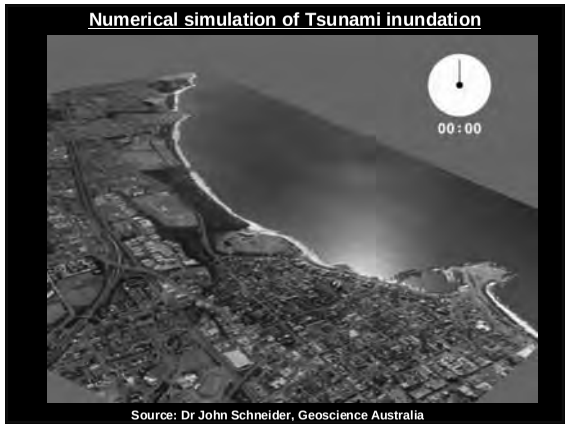

Green Belt

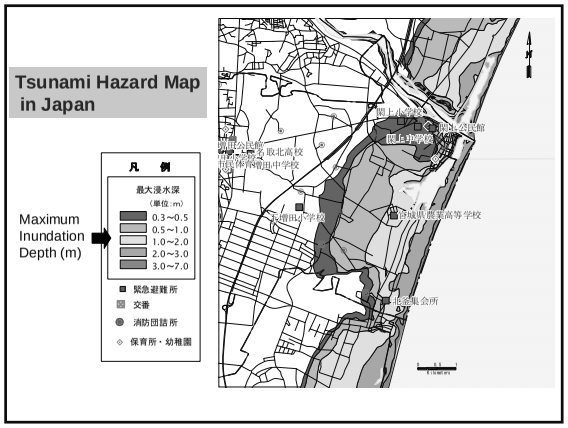

Mangrove trees absorb tsunami wave energy

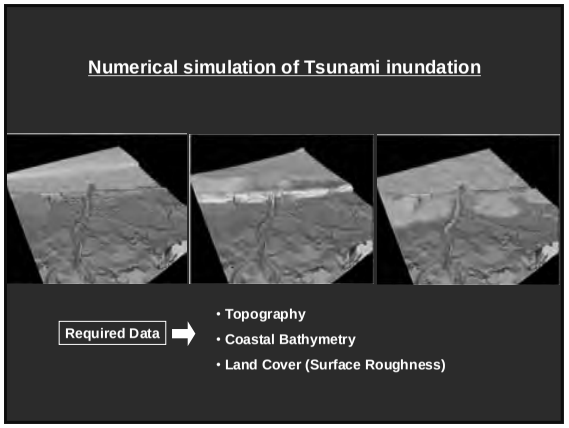

Reconstruction of Houses in Ranong

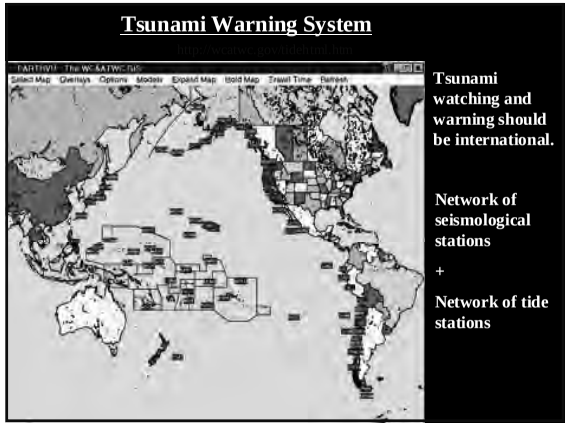

Tsunami Evacuation Map
Department of Mineral Resources
Patong Beach

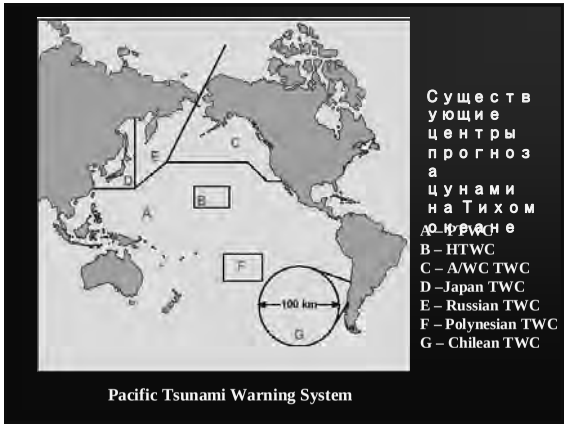

Tsunami Hazard (Evacuation) Map
Hawaii Island
Plot possible areas of inundation and facilities to evacuate
Use for education of residents' disaster preparedness

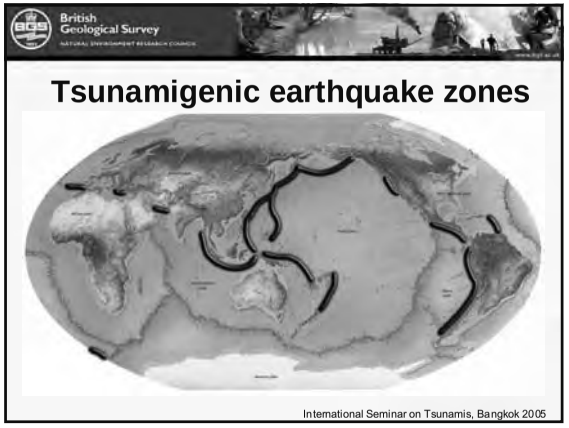

Numerical simulation of Tsunami inundation
00:00
Source: Dr John Schneider, Geoscience Australia


Tsunami Hazard Map in Japan
Maximum Inundation Depth (m)
凡 例
最大浸水深
(単位:m)
0.3～0.5
0.5～1.0
1.0～2.0
2.0～3.0
3.0～7.0
緊急避難所
交番
消防団詰所
保育所・幼稚園

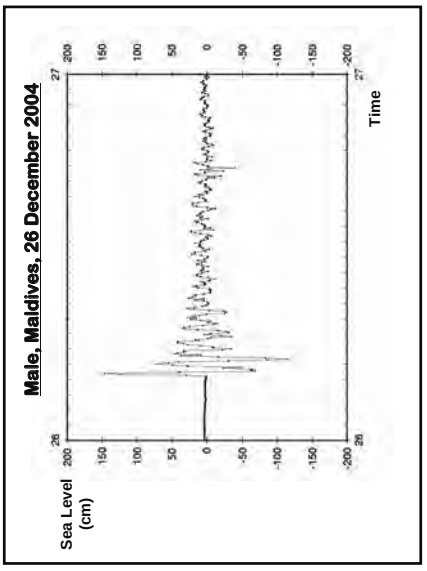

Numerical simulation of Tsunami inundation
Required Data
• Topography
• Coastal Bathymetry
• Land Cover (Surface Roughness)

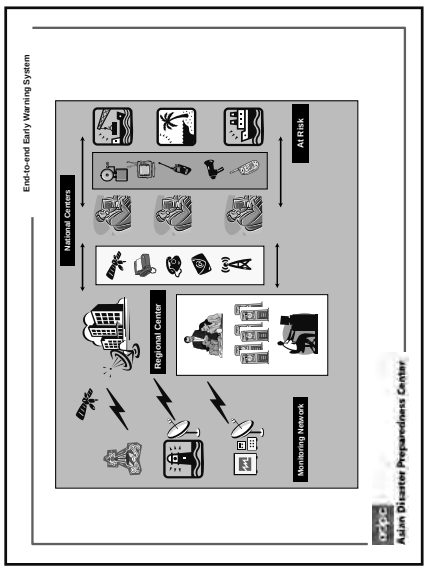

Tsunami Warning System
Tsunami watching and warning should be international.
Network of seismological stations
+
Network of tide stations


Существующие центры прогноза цунами на Тихом океане
A – PTWC
B – HTWC
C – A/WC TWC
D –Japan TWC
E – Russian TWC
F – Polynesian TWC
G – Chilean TWC
100 km
Pacific Tsunami Warning System

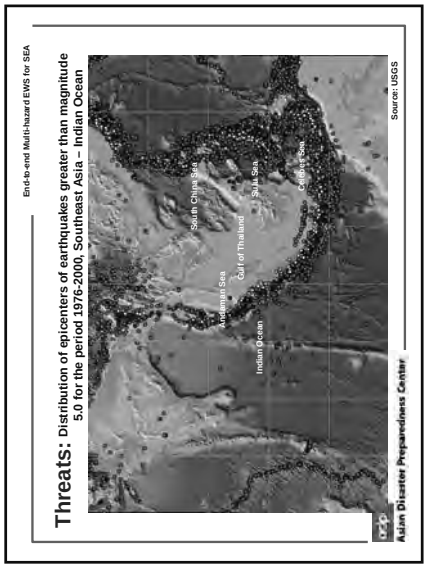

British Geological Survey
Tsunamigenic earthquake zones
International Seminar on Tsunamis, Bangkok 2005

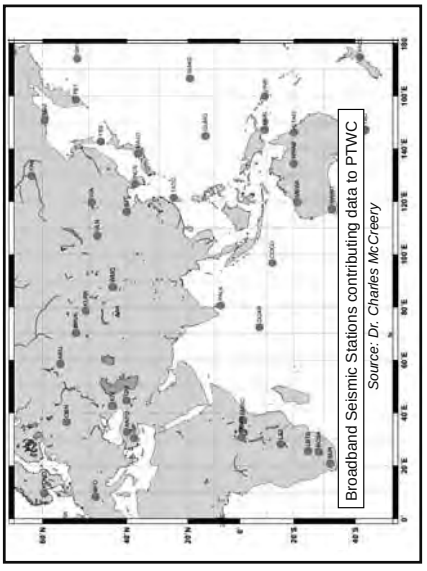

Broadband seismograph station

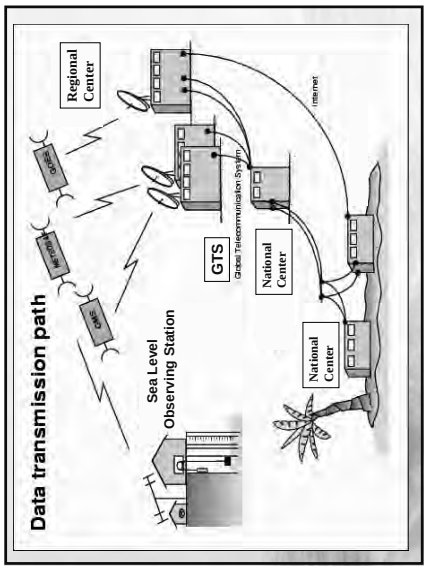

Male, Maldives, 26 December 2004
Sea Level (cm)
Time

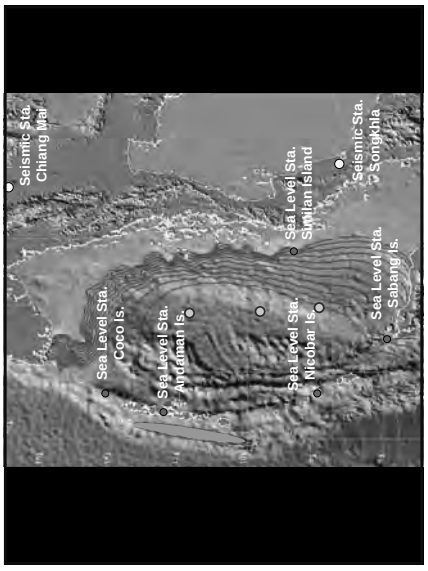

End-to-end Early Warning System
National Centers
Regional Center
Monitoring Network
At Risk
Asian Disaster Preparedness Center

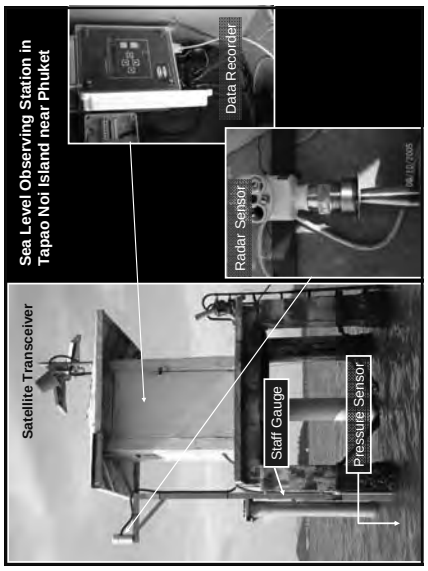

Sea Level Observing Station


End-to-end Multi-hazard EWS for SEA
Threats: Distribution of epicenters of earthquakes greater than magnitude 5.0 for the period 1976-2000, Southeast Asia – Indian Ocean
Source: USGS
Asian Disaster Preparedness Center

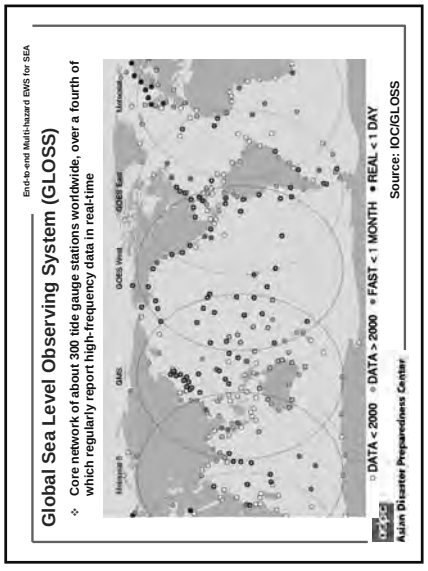

Broadband Seismic Stations contributing data to PTWC
Source: Dr. Charles McCreery


Data transmission path
Regional Center
GOES
Inmarsat
GPRS
Sea Level Observing Station
GTS
Global Telecommunication System
National Center
National Center
Internet

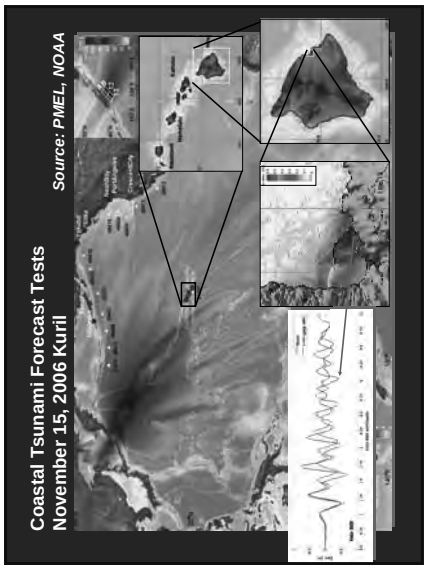

Seismic Sta. Chiang Mai
Sea Level Sta. Coco Is.
Sea Level Sta. Andaman Is.
Sea Level Sta. Nicobar Is.
Sea Level Sta. Similan Island
Seismic Sta. Songkhla
Sea Level Sta. Sabang Is.

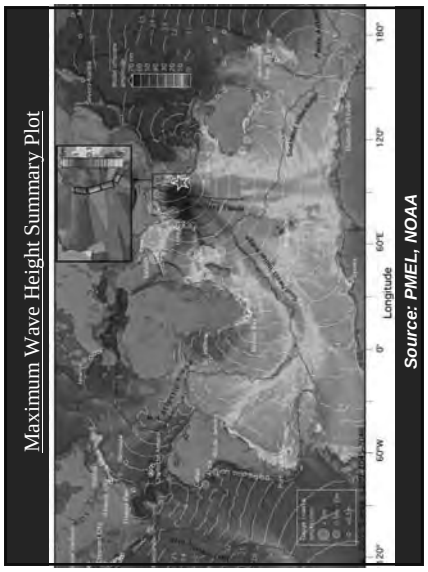

Sea Level Observing Station in Tapao Noi Island near Phuket
Satellite Transceiver
Staff Gauge
Pressure Sensor
Radar Sensor
Data Recorder

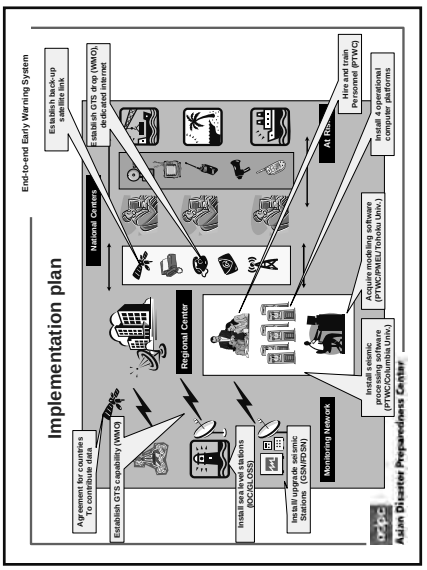

Data Collection/Processing Center
To be located in the AIT Campus, Thailand

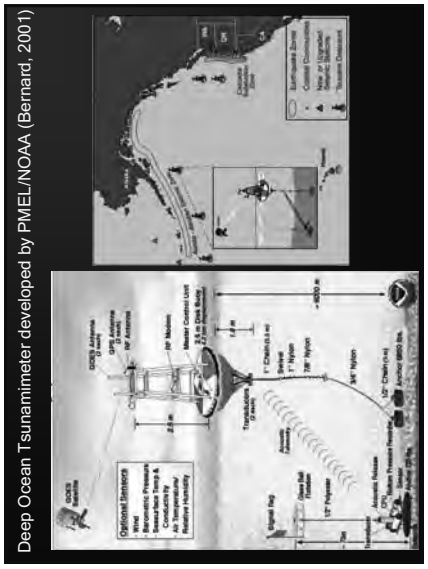

Global Sea Level Observing System (GLOSS)
End-to-end Multi-hazard EWS for SEA
Core network of about 300 tide gauge stations worldwide, over a fourth of which regularly report high-frequency data in real-time
DATA < 2000
DATA > 2000
FAST < 1 MONTH
REAL < 1 DAY
Source: IOC/GLOSS
Asian Disaster Preparedness Center


Site Survey for New Sea Level Observing Station in Similan Island, Thailand
Coco Island, Myanmar


Coastal Tsunami Forecast Tests
November 15, 2006 Kuril
Source: PMEL, NOAA


Maximum Wave Height Summary Plot
Source: PMEL, NOAA


End-to-end Early Warning System
Implementation plan
National Center
Regional Center
Monitoring Network
Establish back-up satellite link
Establish GTS drop (WMO) dedicated internet
Hire and train Personnel (PTWC)
Install 4 operational computer platforms
Agreement for countries To continue data
Establish GTS capability (WMO)
Install sea level stations (IOC/GLOSS)
Install upgrade seismic Stations (GSN/FDSN)
Install seismic processing software (PTWC/Columbia Univ.)
Asian Disaster Preparedness Center

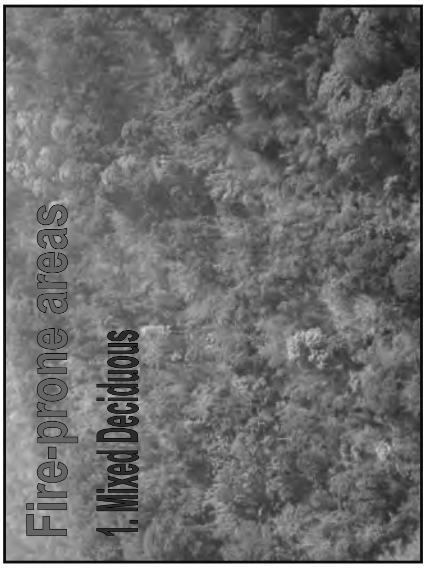

Deep Ocean Tsunamimeter developed by PMEL/NOAA (Bernard, 2001)


Warning Siren Tower at Patong Beach, Phuket

Forest Fire Control in Thailand

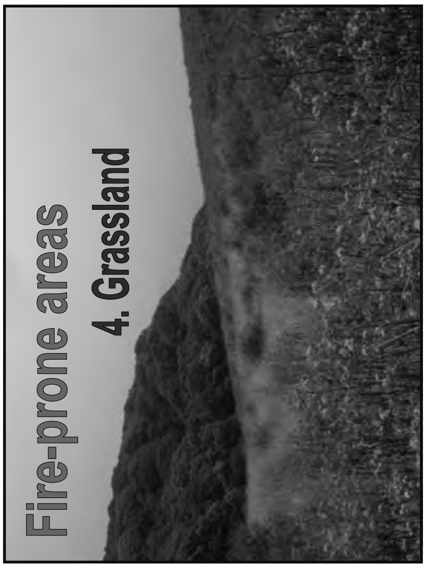
Mr. Siri Akaakara
National Park, Wildlife and Plant Conservation Department
THAILAND

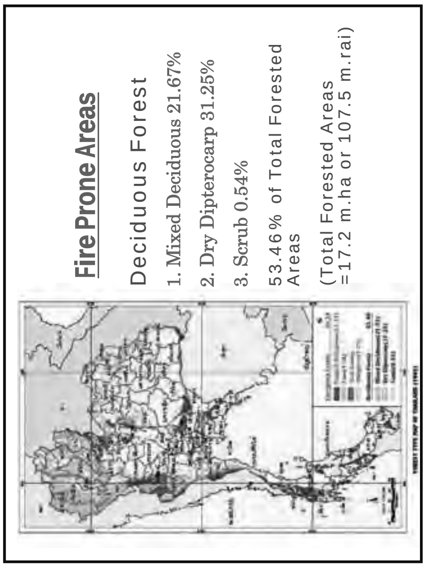

Forest Fire Control in Thailand
Forest Fire Control Division
National Park, Wildlife and Plant Conservation Dept.
Ministry of Natural Resource and Environment

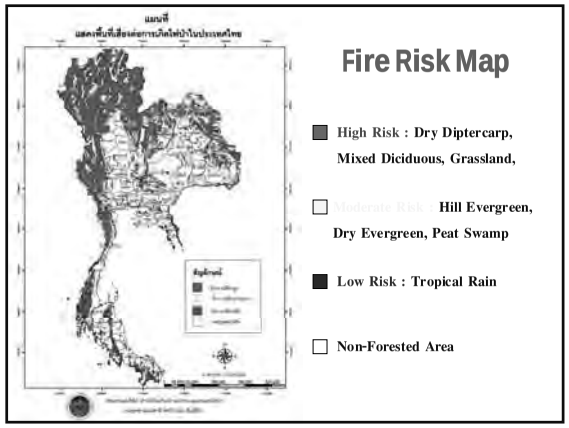

Fire-prone areas
1. Mixed Deciduous


Fire-prone areas
2. Dry Dipterocarp


Fire-prone areas
(Bush)


Fire-prone areas
4. Grassland


Fire Prone Areas
Deciduous Forest
1. Mixed Deciduous 21.67%
2. Dry Dipterocarp 31.25%
3. Scrub 0.54%
53.46% of Total Forested Areas
(Total Forested Areas =17.2 m.ha or 107.5 m.rai)


Fire Risk Map
High Risk : Dry Diptercarp, Mixed Diciduous, Grassland,
Hill Evergreen, Dry Evergreen, Peat Swamp
Low Risk : Tropical Rain
Non-Forested Area

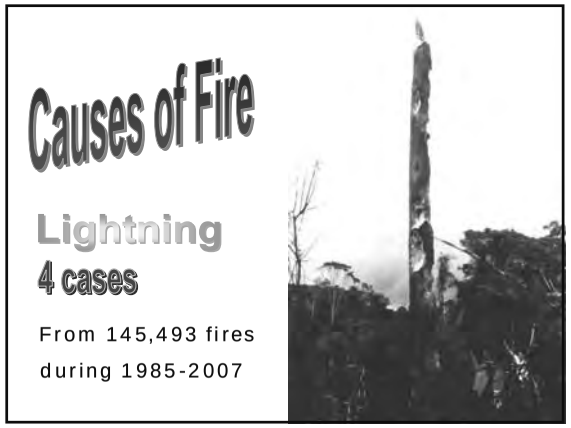

Fire Season
Dec, Jan, Feb, Mar, Apr, May


Types of Fire
Surface Fire

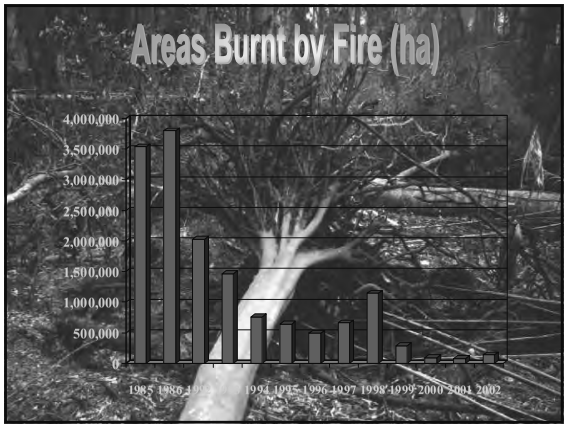

ENSO Episode
Surface Fire in Dry Evergreen Forest

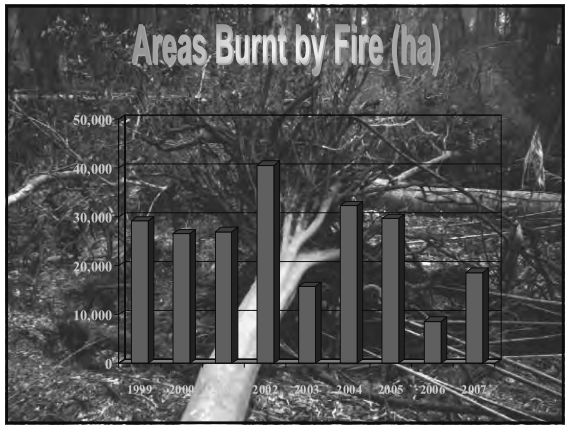

ENSO Episode
Crown Fire in Pine Forest


ENSO Episode
Semi-ground fire in Peat Swamp


Causes of Fire
Lightning
4 cases
From 145,493 fires
during 1985-2007

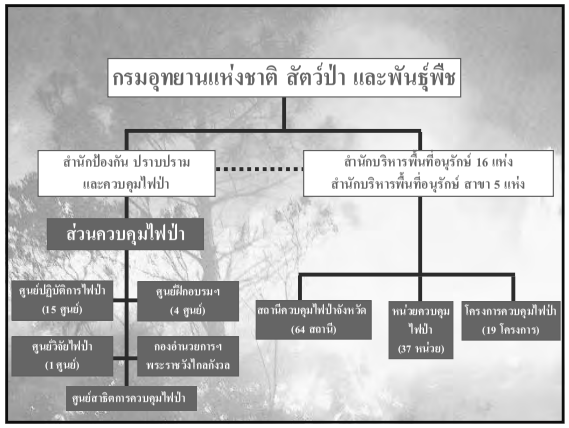

Human Activities
1. Gathering non-timber products 26 %
2. Agriculture debris burning 18 %
3. Incendiary fire 17 %
4. Carelessness 16 %
5. Hunting 15 %
6. Unidentified causes 8 %

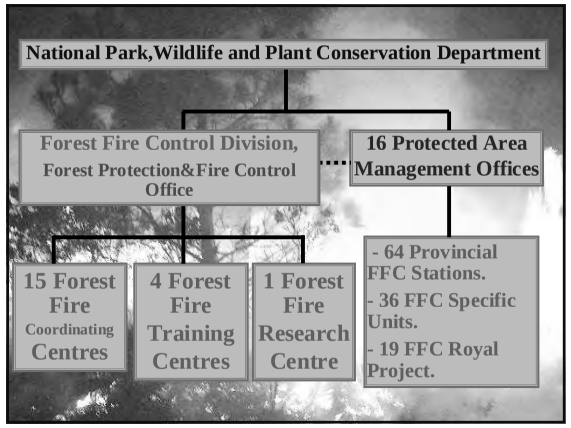

Areas Burnt by Fire (ha)
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1985 1986 1994 1995 1996 1997 1998 1999 2000 2001 2002


Areas Burnt by Fire (ha)
50,000
40,000
30,000
20,000
10,000
0
1999 2000 2002 2003 2004 2005 2006 2007


Forest Fire Control Division
Established in 1980
พื้นที่ป่าอนุรักษ์ที่รับผิดชอบ 21.06 ล้านไร่
คิดเป็น 19.78 % ของพื้นที่ป่าอนุรักษ์ทั้งหมด
(พื้นที่ป่าอนุรักษ์ทั้งหมด 106.45 ล้านไร่)

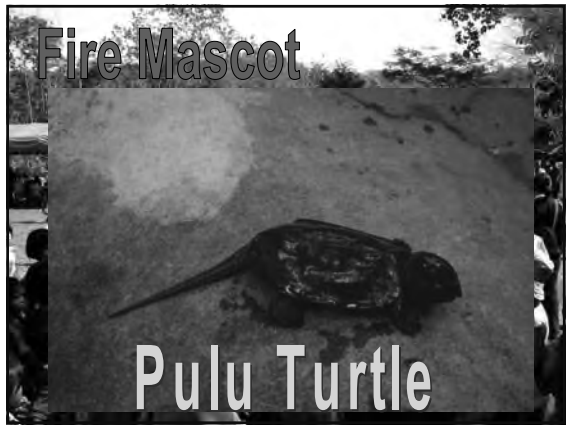

โครงการควบคุมไฟป่าภูพิงค์ตามพระราชดำริ ปี 2523


กรมอุทยานแห่งชาติ สัตว์ป่า และพันธุ์พืช
สำนักป้องกัน ปราบปราม และควบคุมไฟป่า
สำนักบริหารพื้นที่อนุรักษ์ 16 เหง่
สำนักบริหารพื้นที่อนุรักษ์ สาขา 5 เหง่
ส่วนควบคุมไฟป่า
ศูนย์ปฏิบัติการไฟป่า (15 ศูนย์)
ศูนย์ฝึกอบรมฯ (4 ศูนย์)
สถานีควบคุมไฟป่าจังหวัด (64 สถานี)
หน่วยควบคุมไฟป่า (37 หน่วย)
โครงการควบคุมไฟป่า (19 โครงการ)
ศูนย์วิจัยไฟป่า (1 ศูนย์)
กองอำนวยการฯ พระราชวังไกลกังวล
ศูนย์สาธิตการควบคุมไฟป่า


National Park,Wildlife and Plant Conservation Department
Forest Fire Control Division, Forest Protection&Fire Control Office
16 Protected Area Management Offices
15 Forest Fire Coordinating Centres
4 Forest Fire Training Centres
1 Forest Fire Research Centre
- 64 Provincial FFC Stations.
- 36 FFC Specific Units.
- 19 FFC Royal Project.


Fire Control Station
1. Fire Prevention
2. Fuel Management
3. Fire Detection
4. Fire Suppression


1. Fire Prevention
No honor to fight the fire which can be prevented !!!


Fire Mascot
Pulu Turtle


11 National Fire Campaign Day
February, 24


1.1 Fire Campaign Mobile Unit


1.2 Education Programme


1.3 Printed Materials


1.4 Billboard


1.5 Campaign via mass media


1.6 Fire Exhibition


1.7 Participate in Community's Activities
POLICE


1.8 Fire Volunteer Brigade
Youth Fire Volunteer


2. Fuel Management
To reduce chances and hazards from fires

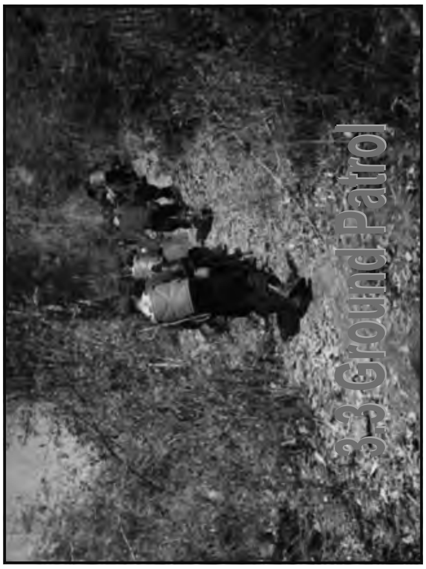

2.1 Early Burning


2.2 Firebrake Construction


3. Fire Detection


3.1 Fire Look-out Tower


3.2 Motorcycle

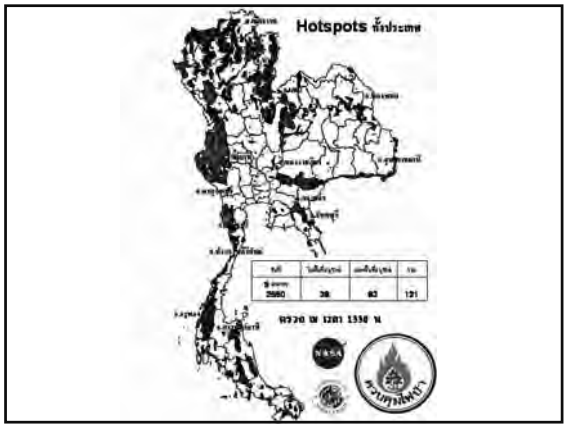

3.3 Ground Patrol


3.4 Air Patrol


จุดรับแจ้งเหตุ
ไฟป่า
3.5 Reported by Public


www.dnp.go.th/forestfire/
Hot line 1362

By satellite : in collaborating with Univ. of Maryland USA who provides daily hotspot informations through "Web Fire Mapper : Thailand"




4.


4.1 Fire Fighter (The Red Ant)


4.2 Fire Tiger Special Force
Speed Strength Smart


Helijump


Rappelling


Law Enforcer


4.3 Fire Equipment mainly hand tools


4.3 Fire Equipment mainly hand tools


Small Crew (7)


Standard Crew (14)


4.4 Supporting Unit
4.4.1 Slip-on Tank (400 litres)


4.4.2 Water Tank (6,000 litres)


4.4.5 Helicopter with Water Bucket


4.4.6 Buck-hoe
Digging trench to serve as fireline

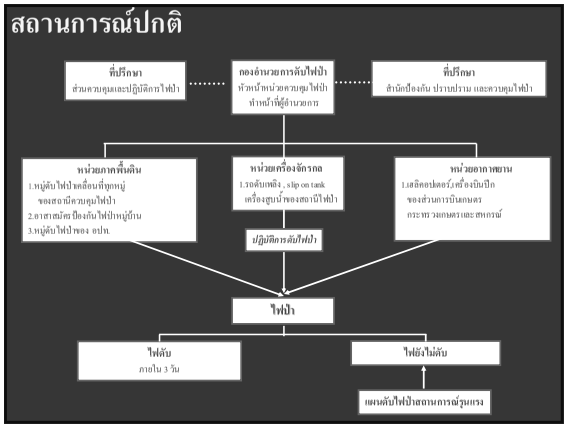

4.4.4 Powerful Fire Tender


4.4.3 Farm Tractor


4.4.5 Helicopter with Water Bucket


4.5 In Case of Large Fire
Activate the suppression mobilizatiob plan (3 levels)

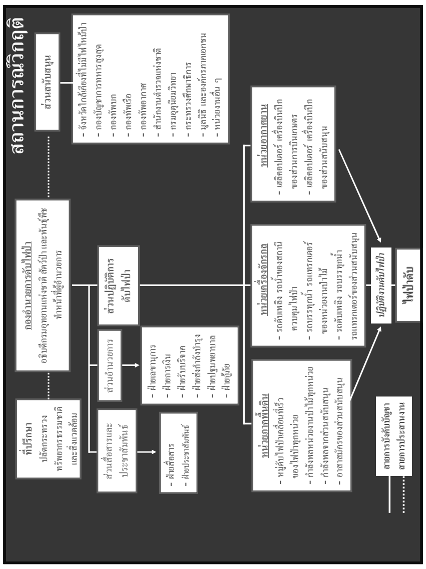

แผนระดมพลดับไฟป่าระดับที่ 1
สถานการณ์ปกติ
สถานการณ์
- ไฟป่าเพิ่งเกิดและถูกตรวจพบทันที
หรือ เพิ่งตรวจพบไฟป่า โดยไฟได้ลุกลามไปแล้วเป็นเนื้อที่
ไม่เกิน 100 ไร่


สถานการณ์ปกติ
ที่ปรึกษา
ส่วนควบคุมและปฏิบัติการไฟป่า
กองอำนวยการดับไฟป่า
หัวหน้าหน่วยควบคุมไฟป่า
ทำหน้าที่ผู้อำนวยการ
ที่ปรึกษา
สำนักป้องกัน ปราบปราม และควบคุมไฟป่า
หน่วยภาพพื้นดิน
1.หมู่ดับไฟป่าเคลื่อนที่ทุกหมู่
ของสถานีควบคุมไฟป่า
2.อาสาสมัครป้องกันไฟป่าหมู่บ้าน
3.หมู่ดับไฟป่าของ อปท.
หน่วยเครื่องจักรกล
1.รถดับเพลิง , slip on tank
เครื่องสูบน้ำของสถานีไฟป่า
ปฏิบัติการดับไฟป่า
หน่วยอากาศยาน
1.เฮลิคอปเตอร์,เครื่องบินปีก
ของส่วนการบินกองตร
กระทรวงกลาโหม และ ทอ
ไฟป่า
ไฟดับ
ภายใน 3 วัน
ไฟยังไม่ดับ
แผนดับไฟป่าสถานการณ์รุนแรง


แผนระดมพลดับไฟป่าระดับที่ 2
สถานการณ์รุนแรง
สถานการณ์
- เพิ่งตรวจพบไฟป่า โดยไฟได้ลุกลามไปแล้วเป็นเนื้อที่มากกว่า 100 ไร่
หรือ ตรวจพบไฟ แล้วดับด้วยแผนระดมพลดับไฟป่าในสถานการณ์ปกติ
แต่ไม่สามารถควบคุมไฟได้ภายในเวลา 3 วัน


สถานการณ์รุนแรง
กองอำนวยการดับไฟป่า
ผู้ว่าราชการจังหวัดหรือผู้ที่ได้รับมอบหมาย
ทำหน้าที่ผู้อำนวยการ
ที่ปรึกษา
อธิบดีกรมอุทยานแห่งชาติ สัตว์ป่าและพันธุ์พืช
ฝ่ายแผน
สำนักบริหารพื้นที่อนุรักษ์ที่ของพื้นที่
- กำหนดแผน
- ประสานงาน และประเมินผล
ฝ่ายปฏิบัติการ
หัวหน้าสถานีควบคุมไฟป่าจังหวัด
ฝ่ายบริการ
หัวหน้าสำนักงานป้องกันจังหวัด
- จัดหายานพาหนะส่งกำลังบำรุง
- ปฐมพยาบาล และผู้ช่วย
หน่วยภาพพื้นดิน
1.หมู่ดับไฟป่าเคลื่อนที่ทุกหมู่
ของสถานีควบคุมไฟป่า
2.หน่วยงานป่าไม้ทุกหน่วยในจังหวัด
3.อาสาสมัครป้องกันไฟป่า
4.หมู่ดับไฟป่าของ อปท.
หน่วยเครื่องจักรกล
1.รถดับเพลิง , slip on tank ,
รถบรรทุกน้ำ ของสถานีไฟป่า
2. รถบรรทุกน้ำ ,แทรกเตอร์
ของหน่วยงานป่าไม้ในจังหวัด
หน่วยอากาศยาน
1.เฮลิคอปเตอร์,เครื่องบินปีก
ของส่วนการบินกองตร
2. เฮลิคอปเตอร์ , เครื่องบินปีก
ของหน่วยงานอื่นๆ ในจังหวัด
ปฏิบัติงานดับไฟป่า
ไฟป่า
ไฟดับ
ภายใน 15 วัน
ไฟยังไม่ดับ
แผนดับไฟป่าสถานการณ์วิกฤติ
สายการบังคับบัญชา
สายการประสานงาน


แผนระดมพลดับไฟป่าระดับที่ 3
สถานการณ์วิกฤติ
สถานการณ์
- ตรวจพบไฟ แล้วดับด้วยแผนระดมพลดับไฟป่าในสถานการณ์รุนแรง
แต่ไม่สามารถควบคุมไฟได้ภายในเวลา 15 วัน


สถานการณ์วิกฤติ

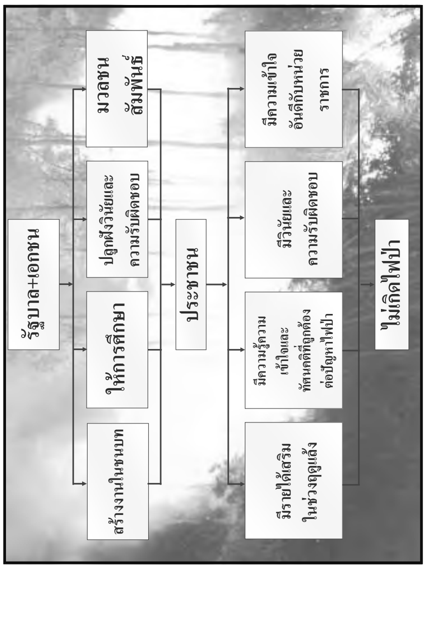

CL-215 (Amphibian)

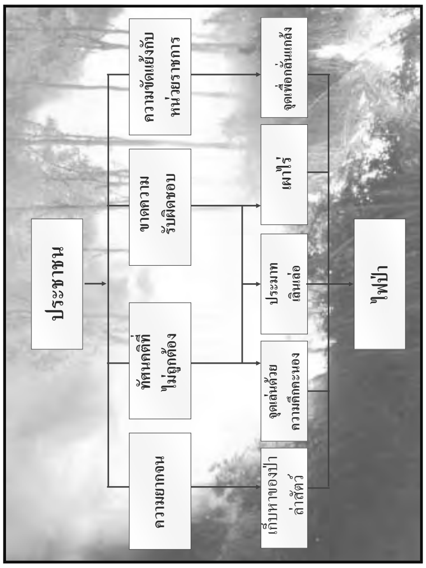

All man power and resources in the country are mobilized


C-130 (Hercules)

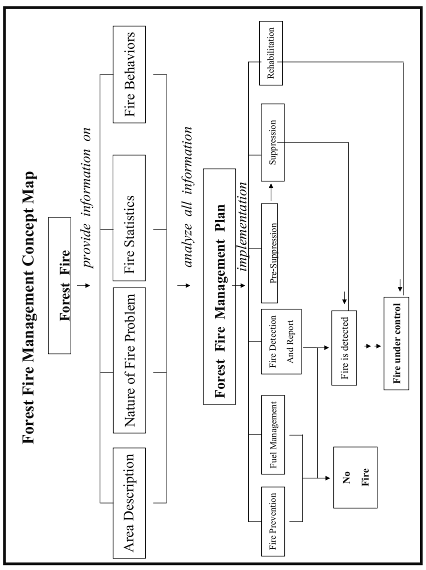

CH-47 (Chinook)


BT-67


รัฐบาล+เอกชน
สร้างงานในชนบท
ให้การศึกษา
ปลูกฝังวินัยและความรับผิดชอบ
มวลชนสัมพันธ์
ประชาชน
มีรายได้เสริมในช่วงฤดูแล้ง
มีความรู้ความเข้าใจและทัศนคติที่ถูกต้องต่อปัญหาไฟป่า
มีวินัยและความรับผิดชอบ
มีความเข้าใจอันดีกับหน่วยราชการ
ไม่เกิดไฟป่า


ประชาชน
ความยากจน
ทัศนคติที่ไม่ถูกต้อง
ขาดความรับผิดชอบ
ความขัดแย้งกับหน่วยราชการ
เก็บหาของป่า ล่าสัตว์
จุดเล่นด้วยความคึกคะนอง
ประมาทเลินเล่อ
เผาไร่
จุดเพื่อกลั่นแกล้ง
ไฟป่า


Thank You


Forest Fire Management Concept Map
Forest Fire
provide information on
Area Description
Nature of Fire Problem
Fire Statistics
Fire Behaviors
analyze all information
Forest Fire Management Plan
implementation
Fire Prevention
Fuel Management
Fire Detection And Report
Pre-Suppression
Suppression
Rehabilitation
No Fire
Fire is detected
Fire under control

GISTDA Activities and Services

Mrs. Praneet Disariyakul
Geo-Informatics and Space Technology Development Agency
THAILAND

RNUS Seminar 2008
Feb. 8, 2008, AIT

GISTDA's Activities and Services

Praneet Ditsariyakul

User Services and Business Development Office
Geo-Informatics and Space Technology Development Agency
(Public Organization)
Bangkok, Thailand

1

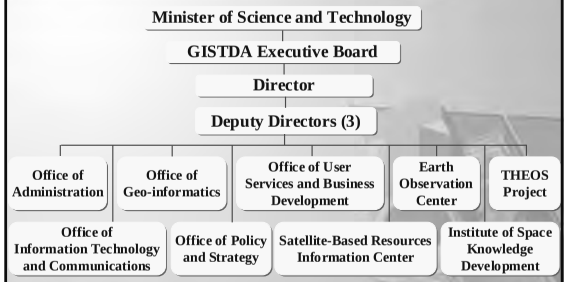
Topics

- About GISTDA
- Space Technology Development
- Geoinformatics Development
- EO Data Products and Services
- International Cooperation
- THEOS Program Status
- Conclusions

About GISTDA

- Thailand has been involved in earth observation satellite technology since 1971 in the NASA Earth Resources Technology Satellite Programme (ERTS)
- Thailand Landsat Ground Receiving Station has been in operation since 1982. (under the National Research Council of Thailand)
- GISTDA was officially established as a public organization on November 2, 2000.
- Assumes responsibilities for space technology and geo-informatics development of the country as provided in the Royal Decree

GISTDA's Organization Structure



GISTDA's Vision

To be the center of excellence in space technology and geo-informatics through national and international cooperative networks aiming at supporting sustainable development of natural resources and environment, improvement of quality of life and strengthening of national security.

Space Technology Development


9 Meters


10 Meters


13 Meters


5.6 Meters


GISTDA's Ground Station at Lad Krabang

Thailand GS Compound

Reception Facility

Operation Room

Space Technology Development (Cont.)

- Established ground receiving station in 1982 with footprint covering 17 countries in the region.

Space Technology Development (Cont.)

GISTDA's Ground Receiving Station

Current Status : - Landsat-5
- Radarsat-1
- SPOT-2, 4, 5
- ALOS

Satellite Data Archives :
- Landsat, SPOT, MOS, JERS, IRS
- Terra: MODIS (Cooperation with AIT of Univ. of Tokyo)
- IKONOS
- QuickBird

Future : - THEOS
- Radarsat-2

Geoinformatics Development

- Development of common standards for GIS/Geoinformatics of the country in view of data sharing and exchange.
- Establishment of web-based GIS (Map server) and satellite-based geoinformation.
- Application development with data from various sources (high, medium and low resolution satellite data)

Geoinformatics Development

- Development of "Digital Thailand" : Open source Web Map Server System, open access for public.
- Development of "Thailand Monitoring System" web-based geoinformation providing system for operational uses of the government agencies in the areas of disaster, natural resources management etc.

EO Data Products and Services

EO Products (Optical & SAR)

- Standard products : - digital form in CD-ROM
  - paper prints
- Value-added products :
  - Mosaic of Thailand from LANDSAT-5 TM
  - Satellite Image Map
  - Provincial Map
  - 3D image map
- Others : Marine Observation Data
- Master Reseller of QuickBird, WorldViews-1 and Terra-ASTER data in Thailand


QuickBird Imagery
RNUS Seminar 2008
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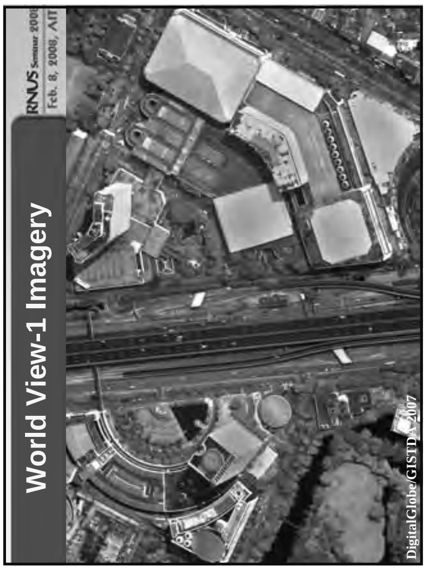
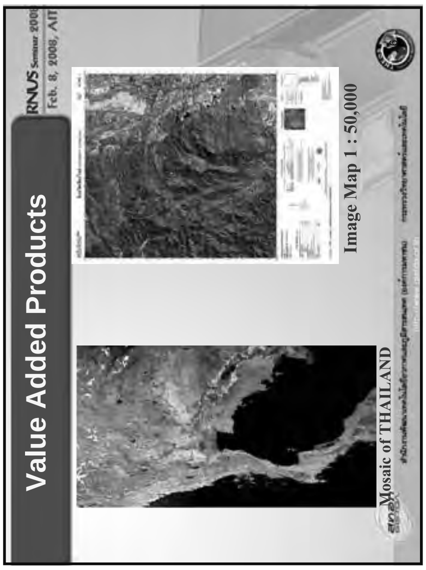
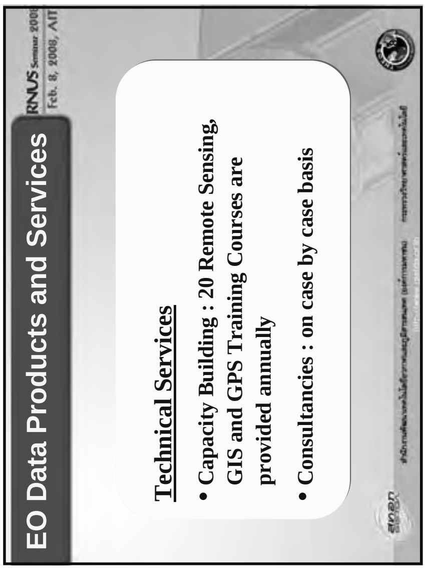
DigitalGlobe/GISTDA 2006


World View-1 Imagery
RNUS Seminar 2008
Feb. 8, 2008, AIT
DigitalGlobe/GISTDA 2007


Radarsat-1 Imagery
RNUS Seminar 2008
Feb. 8, 2008, AIT


Value Added Products
RNUS Seminar 2008
Feb. 8, 2008, AIT
Mosaic of THAILAND
Image Map 1 : 50,000


Value Added Products
RNUS Seminar 2008
Feb. 8, 2008, AIT
Image Map 1 : 250,000


EO Data Products and Services
RNUS Seminar 2008
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Technical Services
• Capacity Building : 20 Remote Sensing, GIS and GPS Training Courses are provided annually
• Consultancies : on case by case basis

International Cooperation

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- **International Organizations**
  - **UN-COPUOS (UN-The Committee on the Peaceful Uses of Outer Space)**
  - **ESCAP-RESAP (Regional Space Application Programme for Sustainable Development)**
  - **ASEAN – COST/SCOSA**
  - **GEO (Group on Earth Observation)**
  - **APRSAF, APSCO**

International Cooperation

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- **International Countries**
  - **USA, FRANCE, India, Canada, Japan Republic of Korea, China, Russia, ASEAN Countries.**

THEOS Program Status

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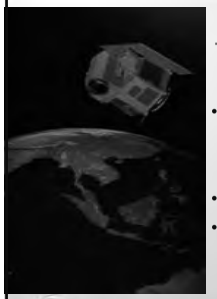

THailand Earth Observation System (THEOS)

- The First Operational Earth Observation Satellite of Thailand designed to work for national interests.
- Development started in July 2004
- Scheduled to be launched early 2008

THEOS Characteristics

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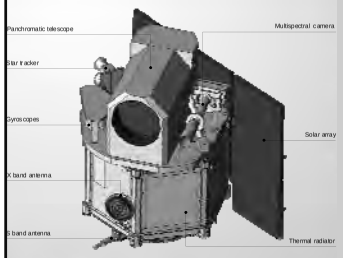

- **Mass**: 750 kg.
- **Orbit**: Sun Synchronous
- **Altitude**: 822 km.
- **Inclination**: 98.7
- **Repeat Cycle**: 26 days
- **Mean Local Time**: 10.00 a.m.
- **Payload**:
  - Panchromatic telescope
  - Multi-spectral camera
- **On-board Memory**: 51Gb
- **Mission Data**: X-band Link
- **TT&C**: S-band Link
- **Attitude Orbit Control and Orbit Determination**: 3-axis stabilized, Star Tracker, Gyro, GPS, Magnetic Torque, Sun Sensor
- **Design Life Time**: At least 5 Years
- **Launch Date**: End 2007

THEOS Payload

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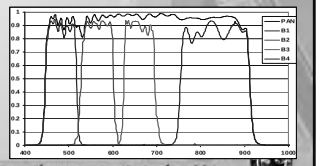
	PAN	MS
Resolution	2 m	15 m
Spectral band	P: 0.45-0.90 μm	Blue: 0.45-0.52 μm Green: 0.53-0.60 μm Red: 0.62 –0.69 μm NIR: 0.77-0.90 μm
Swath Width	22 km	90 km
Off viewing	±50 degree	±50 degree



THEOS Global Orbits

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THEOS Products

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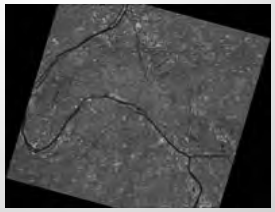

PAN and Multi-Spectral

Products Available at Different levels

Level 1A - Radiometric correction

Level 2A - Radiometric and Geometric correction with UTM projection

Level 2B – Geometric correction with Ground Control Points and Map Projection

Ortho Image - Geometric correction with DEM

Pansharpened image

Output Format: DIMAP (GeoTIFF)

Output Product: CD/DVD

THEOS Control Center

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THEOS Control Ground Segment

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Satellite Control Center

THEOS Control Ground Segment is located in telecommunication Gateway in Chonburi province.

Mission Operation Center

THEOS Business Development

RNUS Seminar 2008 Feb. 8, 2008, AIT

- **Business Development in Thailand.**
- **International Business Development.**

THEOS Business Development In Thailand (Cont)

RNUS Seminar 2008 Feb. 8, 2008, AIT

Program

Government Sector	THEOS Operational Application Programs
Private Sector	Public-Private Partnership Program in Thailand
Public Sector	Public Good Information

THEOS Operational Data Program Priority

RNUS Seminar 2008 Feb. 8, 2008, AIT

GISTDA → MOU ← Government Departments

THEOS Operational Data Application Program Priority

THEOS Distribution Channel

RNUS Seminar 2008
Feb. 8, 2008, AIT

- International Ground Stations
- Distributors/Reseller

THEOS Contribution to International Community

RNUS Seminar 2008
Feb. 8, 2008, AIT

- International Charter for Disaster
- Asia-Pacific Regional Space Agency Forum, Sentinel Asia for Disaster Management.

Conclusion

RNUS Seminar 2008
Feb. 8, 2008, AIT

- As one of the centers with large archives of multi-sensor satellite data of the region, GISTDA is ready to provide data available with reasonable price or at cost in case of disasters.
- As the operator of THEOS, GISTDA is expecting that THEOS shall be able to enhance EO technological capability of Thailand for national development.

RNUS Seminar 2008
Feb. 8, 2008, AIT

THANK YOU

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Tel.+66(0)-2940-6345 Fax. +66(0)-2579-5618
http://www.gistda.or.th

Capacity Building Program on Applications of Remote Sensing and GIS in Disasters

Dr. Manzul K. Hazarika
Geoinformatics Center
Asian Institute of Technology, THAILAND

Capacity Building Program on Applications of Remote Sensing and GIS in Disasters

Manzul Hazarika *Ph.D.*
Geoinformatics Center
Asian Institute of Technology
E-mail: manzul@ait.ac.th

JAXA Sponsored Capacity Building Activities

Background and Objective

- This capacity building program was started in 2004
- Being sponsored by Japan Aerospace Exploration Agency (JAXA)
- JAXA provides necessary satellite data free of charge based on project requirements.
- Since 2006, this program has been recognized as part of JAXA's Sentinel Asia Project

Objective

The objective of this program is to develop in-country capacity in applications of Remote Sensing and GIS in disaster and environment related issues in the developing countries of the south and south-east Asian region.

Eligibility Criterions

- Project should be on disasters or environmental problems related to disasters
- There should be at least two national agencies to implement a project, one of them could represent a mapping agency and other one a user agency.

Program Execution

Duration of projects are generally for one year, but may be extended depending on availability of funds and the significant of first year results. Projects are executed in three phases:

Phase-1: Basic training and project planning at AIT (3 weeks)

Phase-2: Fieldwork and local consultation (1 week)

Phase-3: Workshop for data analysis and report writing at AIT (5-6 weeks).

Capacity Building Projects

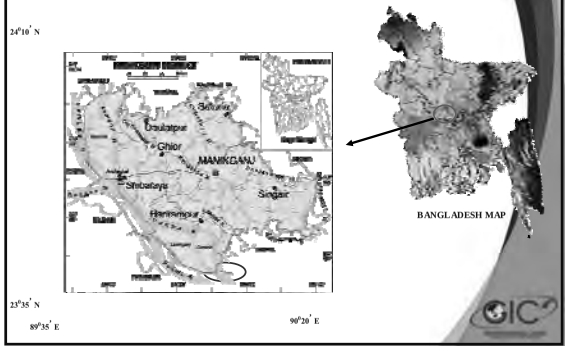
2006-07

1) Flood	: Bangladesh, Cambodia, China, Laos and Nepal
2) Drought	: Philippines
3) Landslide	: Philippines, Sri Lanka and Vietnam

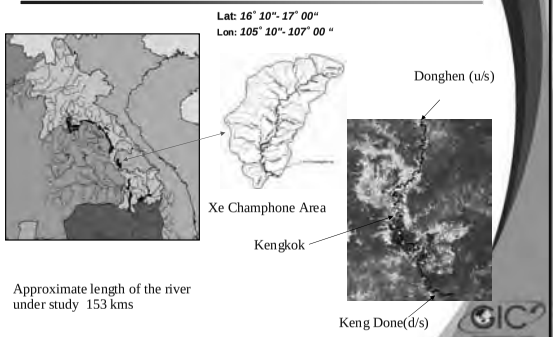
2007-08

1) Flood	: Bangladesh, Laos, Myanmar, Nepal and Sri Lanka
2) Volcano	: Philippines
3) Tsunami	: Indonesia
4) Forest Fire	: Vietnam
5) Mapping	: Bhutan and Cambodia

Bangladesh: Flood Forecasting improvement using Remote Sensing, GIS and Flood Model

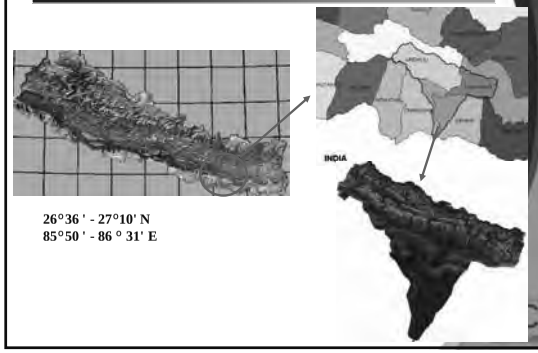


Laos: Flood Hazard Mapping in Xe Champhone



Myanmar: Flood Risk Assessment in Ayeyarwaddy, Division, Yangoon

Nepal: Flood Risk Assessment in Kamla River Using Remote Sensing and GIS



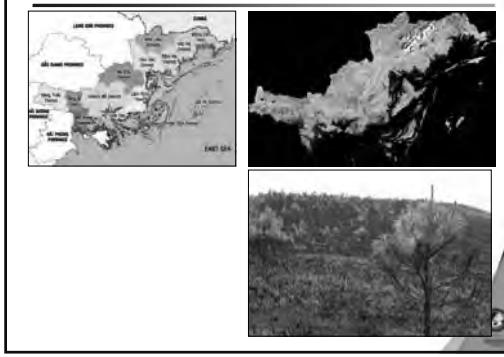
Sri Lanka: Flood Area Mapping in Lower reach of Kelani River

Philippines: Lahar Hazard Mapping of Mayon Volcano Using RS/GIS-Based Modeling Techniques

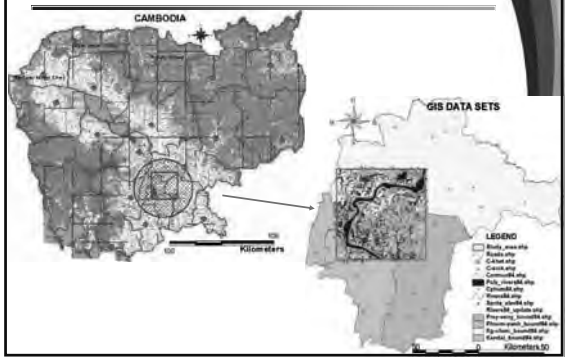
Indonesia: Integrating Numerical model with RS & GIS for Tsunami hazard assessment in Cilacap

Cilacap, Central Java (7° 25'– 7° 40 S and 108° 30'– 109° 30' E)

Vietnam: Forest Fire Risk Zone Mapping by using Remote sensing and GIS



Cambodia: Using ALOS dataset for DEM generation, Building extraction and Hydrological feature classification



Others – USAID Sponsored Project

Strengthening Capacity on multi-hazard Risk Assessment in Tsunami affected Countries (SCRATCH)

Under

U.S. Indian Ocean Tsunami Warning System (IOTWS) Program

USAID

ITC

US IOTWS Program Approach

- Regional, national, and local level interventions
  - Capacity building with targeted technology transfer
- Multi-hazard
  - Tsunamis and other coastal hazards
- Catalytic impact
  - Regional institutions strengthened for long-term IOTWS support and sustainability
  - Combination of model actions at national levels with regional replication of best practices
  - Partnerships and coordination

SCRATCH Project Goal

Develop a cadre of professionals in four Tsunami affected countries in application of Geoinformatics in multi-hazard risk assessment.

Case Studies

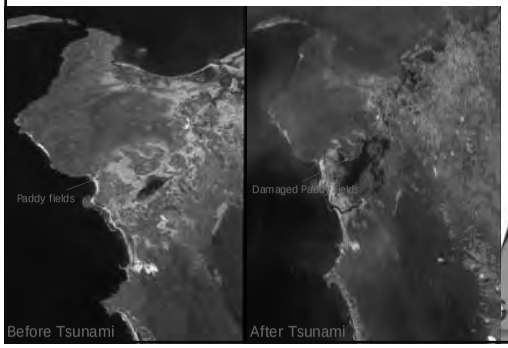
INDONESIA
Geoinformation Technology for Damage Assessment and Recovery Planning in the Tsunami Affected Areas of NAD

THAILAND
Tsunami Damage Assessment and Evacuation Planning

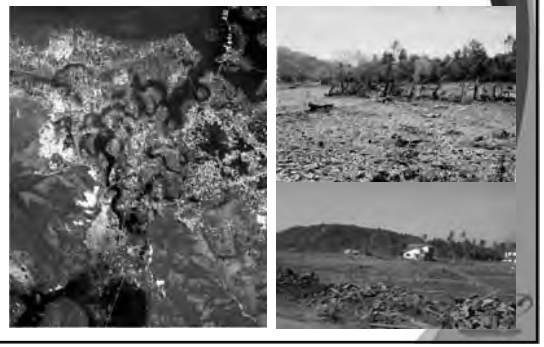
SRI LANKA
Tsunami hazard and damage Assessment

INDIA
Risk Assessment of Multi Hazards along Indian Coast

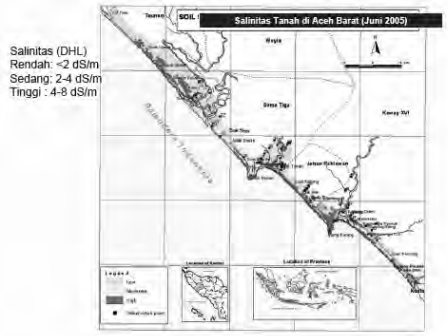
Indonesia: Damage Assessment & Recovery Planning



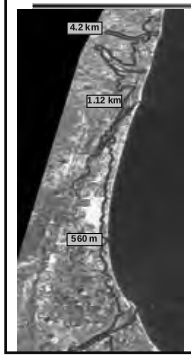
Damaged Agricultural Lands



Soil Salinity Map



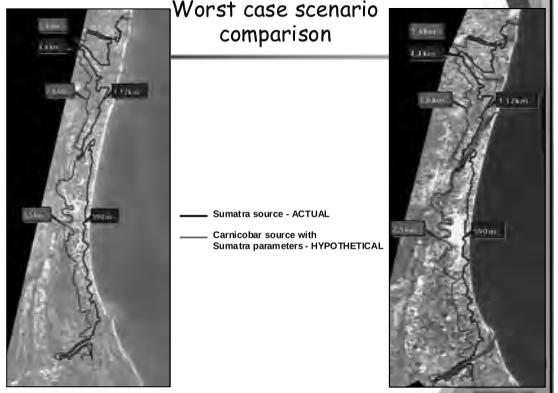
India: Tsunami Inundation Map by Modelling



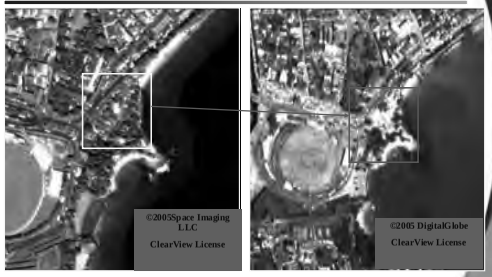
Date	: 26-Dec-2004
source	: Sumatra
Location	: 95.85 E, 3.32 N
EQ magnitude	: 9.3 Mw
Slip magnitude	: 15 m
Fault length	: 500 km
Fault width	: 150 km
Strike	: 345 deg.
Dip	: 15 deg.
Rake	: 90 deg.
Depth	: 20 km

—— Predicted Inundation for Sumatra source

Worst case scenario comparison



Sri Lanka: Galle Area

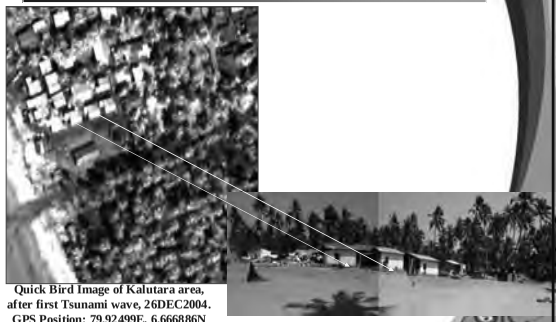


Ikonos Pansharpenning Image of Galle City area taken in March 2001, Resolution 1m

Quick Bird Multispectral Image of Galle City area taken in 26JAN2005, Resolution 2.4m

Field Survey for Tsunami Run up

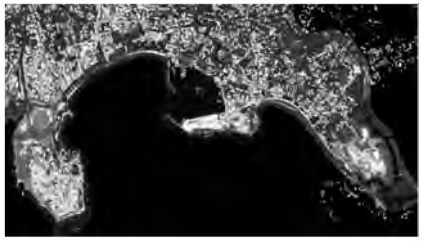
Ground Truth Collection



Quick Bird Image of Kalutara area, after first Tsunami wave, 26DEC2004. GPS Position: 79.92499E, 6.666886N

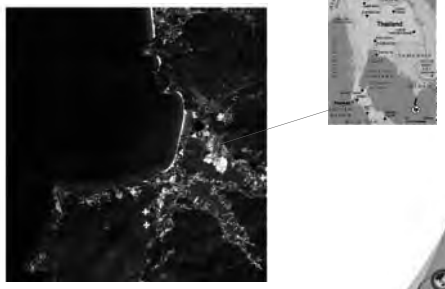
Panoramic view taken at the Minden Village

Damaged Buildings from Field Survey

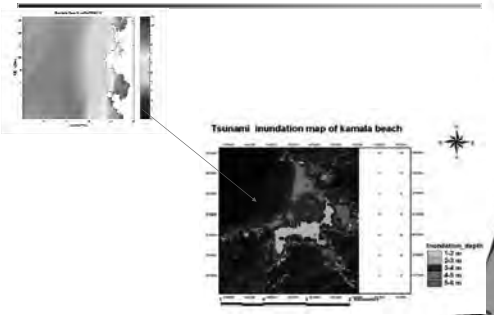


IKONOS Pan-sharpening image of Galle area taken in March 2001, overlaid with damaged buildings (red colour)

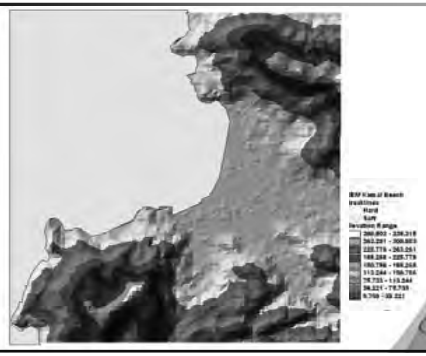
Thailand: Evacuation planning in Phuket



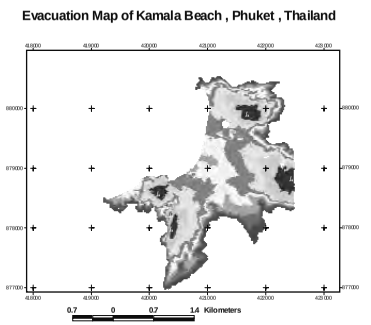
Inundation Map of Kamala Beach, Phuket



DEM of Kamala Beach



Evacuation Planning



Training Activities for Capacity Building

Trainings Courses

2007

- Regional Training Course on Use of GIS and RS in Disaster Management – 2 Weeks
- Applications of remote sensing and GIS in detecting and monitoring tsunami damage to mangroves and other terrestrial forests and coastal zone resources – 2 Weeks

2008 (Planned)

- Regional Training Course on Use of GIS and RS in Disaster Management – 2 Weeks
- Disaster Risk Management for Professionals – 1 Week
- Community Based Disaster Risk Management – 2 Weeks

Geoinformatics Center organizes tailor-made training courses designed specifically to meet client's requirements. The course content, its timing and fees can be determined through mutual agreement.

Sentinel Asia: Disaster Management Support in the Asia-Pacific Region

Dr. Masahiko Honzawa
Japan Aerospace Exploration Agency
JAPAN

Sentinel Asia

contributing to
Disaster Management Support in the Asia-Pacific Region

RNUS Seminar
Toward a partnership on disaster management and remote sensing/GIS technologies

AIT Center, Bangkok, Thailand
February 8, 2008

Masahiko Honzawa
Secretariat
Asia Branch of the Disaster Management Support Systems Office (DMSS),
Satellite Applications and Promotion Center (SAPC),
Japan Aerospace Exploration Agency (JAXA)

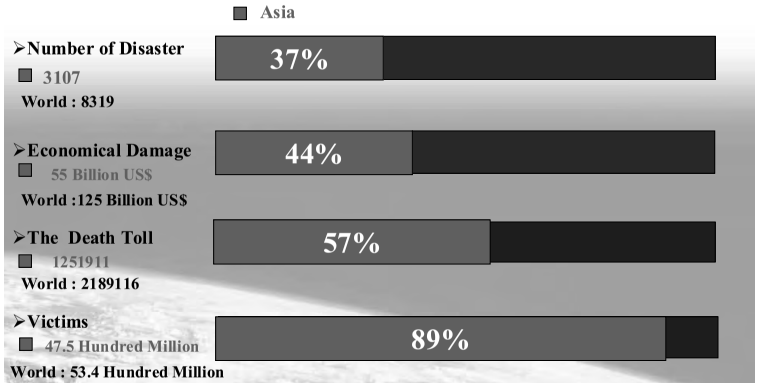
Sentinel Asia Web Site

http://dmss.tksc.jaxa.jp/sentinel/

Contents

Natural Disaster Damages in Asia

Total number during 1975- 2005
quoted from 'ADRC-Natural Disasters Data Book-2005'
originated in CRED-EMDAT, 2005



Established in 1993 after the Asia-Pacific International Space Year Conference (APIC) in 1992
Enhance the development of space programs in the Asia-Pacific region and promote regional cooperation in the field of space technology and its applications.
[Participation] Space agencies, related governments, regional and international organizations, institutions responsible for applying space technology.
[Organizers] MEXT, JAXA and co-host organizations
- **Past co-organizers: Government entities of Mongolia, Malaysia, The Republic of Korea, Thailand, Australia, Indonesia**

Sentinel Asia Project
establishing Disaster Management Support System

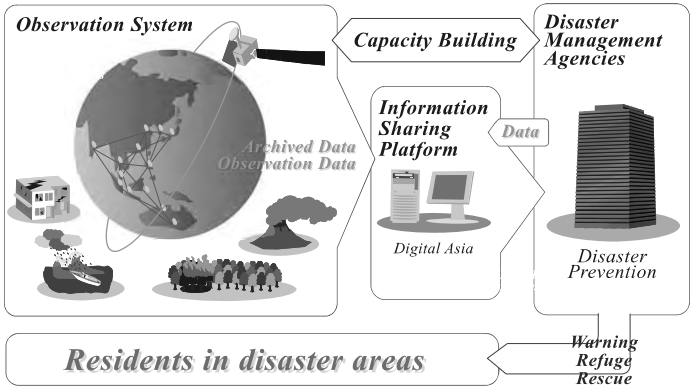
Working Groups

Earth Observation | **Communication Satellite Applications** | **ISS** | **Space Education & Awareness**

History

- **Oct 2004**: APRSAF-11, Canberra, Australia, Sentinel Asia project proposed and conceptualized
- **Oct 2005**: APRSAF-12, in Kitakyushu, Japan, approved the plan to initiate the pilot project.
- **Feb 2006**: Joint Project Team (JPT) was organized and implementation of Sentinel Asia was initiated in the meeting in Hanoi, Vietnam
- **Oct 2006**: Operations of Sentinel Asia commenced by opening its Web site. JAXA also started to provide ALOS data and accept ALOS observation requests.
- **Nov 2007**: APRSAF-14, Bangalore, India, STEP2 was agreed to initiate

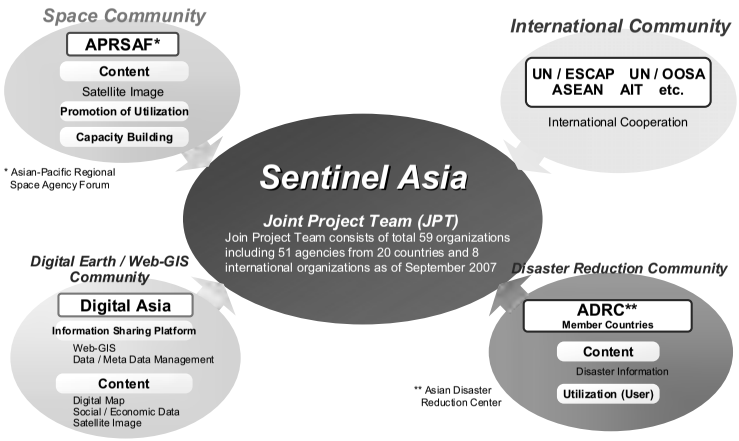
Concept of Sentinel Asia STEP1



Concept of Sentinel Asia STEP1

- Contribution from space community (APRSAF) to the disaster management in the Asia-Pacific region in cooperation with disaster management community
- To share disaster-related information obtained by space, remote sensing technology and ICT
- Voluntary initiative by participating organizations
- Step-by-step approach: Sentinel Asia STEP1(2006-2007) is the 1st Step as a pilot project

Framework of Sentinel Asia STEP1



JPT Member (1/2)

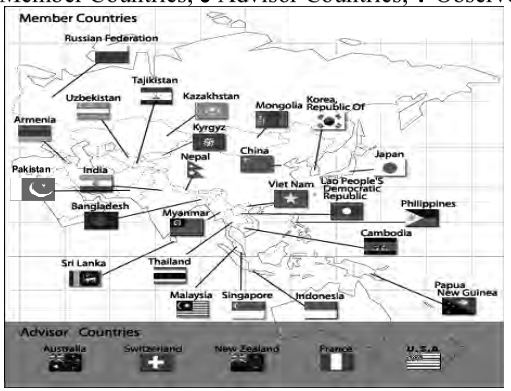
No.	Country	No.	Organization	Data Provider Nodes	Local Service Provider Nodes (User Nodes)	Research and Training Nodes
1	Australia	1	CSIRO Office of Space Science and Applications (COSSA)	■	■	■
		2	Geoscience Australia (GA)	■	■	
		3	Australian Bureau of Meteorogy (ABM)	■	■	
2	Bangladesh	4	Bangladesh Space Research and remote Sensing Organization (SPARRSO)		■	
3	Bhutan	5	Ministry of Home & Cultural Affairs (MFCA)		■	
		6	Department of Survey and Land Records (DSLR)		■	
4	Brunei	7	Survey Department (SD), Ministry of Development		■	
5	Cambodia	8	Geography Department (GD), Ministry of Land Management, Urban Planning and Construction		■	
6	China	9	National Disaster Reduction Center of China (NDRCC)	■	■	■
		10	Beijing Normal University (BNU)			■
7	India	11	Indian Space Research Organization (ISRO)	■	■	■
8	Indonesia	12	National Coordinating Board for Disaster Management (BAKORNAS PBP)		■	
		13	National Institute of Aeronautics and Space (LAPAN)	■		■
		14	Institute of Technology Bandung (ITB)		■	■
		15	Universitas Jenderal Achmad Yani (UNJANI)			■
9	Japan	16	Keio University	■	■	■
		17	Japan Aerospace Exploration Agency (JAXA)	■	■	■
		18	Infrastructure Development Institute (IDI), Japan (IFNet)		■	
		19	Hokkaido University		■	■
10	Korea	20	Korea Aerospace Research Institute(KARI)			
11	Lao P.D.R.	21	National Disaster Management Office (NDMO), Ministry of Labor and Social Welfare		■	
		22	Water Resources and Environment Administration (WREA), Prime Minister Office		■	
12	Malaysia	23	National Security Division (NSD), Prime Minister's Department		■	
		24	Malaysian Centre for Remote Sensing (MACRES)	■		■
13	Mongolia	25	National Remote Sensing Center of Mongolia (NRSC)		■	
14	Myanmar	26	Department of Meteorology and Hydrology (DMD)		■	
		27	Relief and Resettlement Department (RRD)		■	

JPT Member (2/2)

No.	Country	No.	Organization	Data Provider Nodes	Local Service Provider Nodes (User Nodes)	Research and Training Nodes
15	Nepal	28	Department of Water Induced Disaster Prevention (DWIDP)		■	
		29	Survey Department (SD)		■	
16	Philippines	30	Office of Civil Defense, National Disaster Coordinating Council (NDCC)		■	
		31	National Mapping and Resource Information Authority (NAMRIA)		■	
		32	Bureau of Soils and Water Management (BSWM)		■	
		33	Mines and Geosciences Bureau (MGB)		■	
		34	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)		■	
		35	Philippine Council for Advanced Science and Technology Research and Development (PCASTRD)		■	
		36	Philippine Institute of Volcanology and Seismology (PHIVOLCS)		■	
17	Singapore	37	Centre for Remote Imaging, Sensing and Processing (CRISP), National University of Singapore	■		
18	Sri Lanka	38	Survey Department (SD)		■	
		39	Ministry of Disaster Management (MDM)		■	
19	Thailand	40	Geo-Informatics and Space Technology Development Agency (GISTDA)	■	■	■
		41	Department of Disaster Prevention and Mitigation (DDPM)		■	
		42	Department of Water Resources(DWR)		■	
		43	Royal Forest Department(RFD)		■	
		44	National Park, Wildlife and Plant Conservation Department (DNP)		■	
		45	Royal Irrigation Department (RID)		■	
		46	Land Development Department(LDD)		■	
20	Vietnam	47	Vietnamese Academy of Science and Technology (VAST)			■
		48	Ministry of Agriculture and Rural Development (MARD)			■
		49	Ministry of Natural Resources and Environment (MONRE)		■	
		50	Ministry of Defense (MOD)		■	
		51	Ministry of Science and Technology (MOST)		■	
21	International Organization	52	Asian Institute of Technology (AIT)	■	■	■
		53	ASEAN-Secretariat			
		54	UNESCAP			
		55	UNOOSA			
		56	International Center for Integrated Mountain Development (ICIMOD)			■
		57	Coordinating Committee for Geoscience Programmes In East and South East Asia (CCOP)		■	■
		58	International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO		■	■
		59	Asian Disaster Reduction Center (ADRC)		■	

ADRC Member Countries

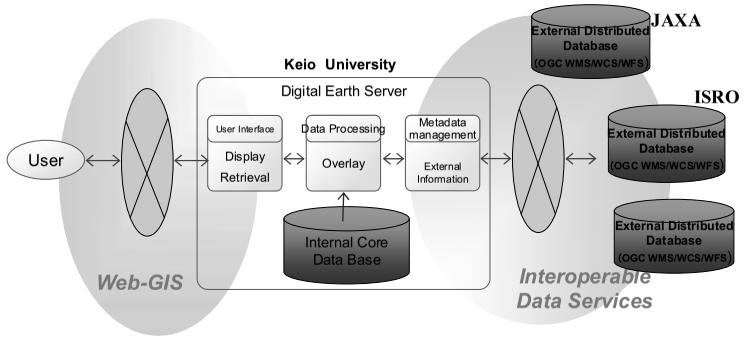
25 Member Countries, **5** Advisor Countries, **1** Observer



※Implement Various Projects in cooperation with UN/ISDR, UN/OCHA, UNESCO, UNU, WMO, UN/ESCAP, etc.

Digital Asia

Internet
Web-GIS
Dispersed Data Servers



Contents

1. What's "Sentinel Asia"?
   Background / History / Concept / Framework

2. **Main Activities**
   Wildfire Monitoring / Flood Monitoring / Emergency Observation / Capacity Building

3. Future Plan
   Results of STEP1 / Concept of STEP2

Main Activities

Emergency Observation

Emergency observation in case of major disasters by ALOS and others based on observation requests from ADRC members and JPT members

Wildfire Monitoring

Wildfire monitoring by MODIS and others

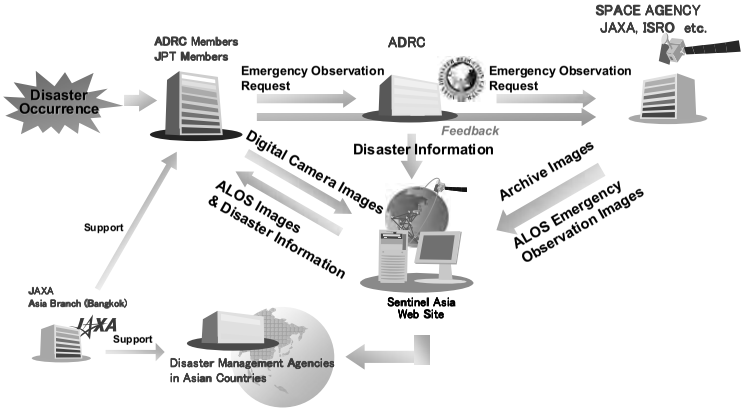
Flood Monitoring

Flood monitoring by TRMM and AMSER-E

Capacity Building

Capacity building for utilization of satellite images for disaster management

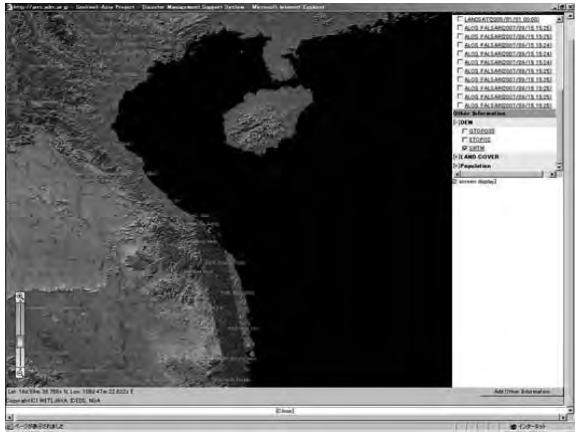
Flow of Emergency Observation in Sentinel Asia



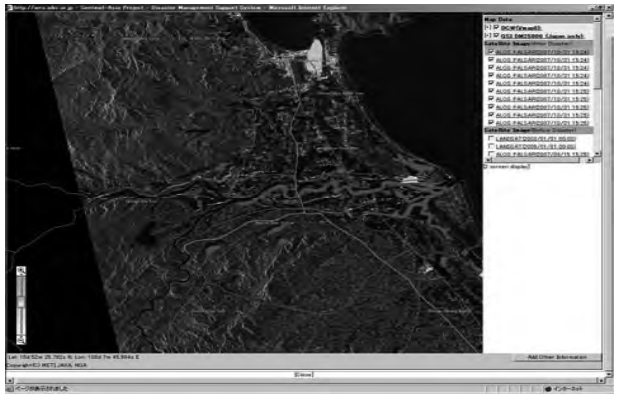
Emergency Observation by ALOS

- 14 requests /14 accepted
- 5 flood/landslide,
  4 earthquake/landslide
  2 cyclone
  1 landslide, volcano eruption, snowstorm
- 5 Indonesia
  2 Bangladesh
  1 Australia (for Solomon Islands), Nepal, Thailand, Pakistan, Tajikistan, Vietnam, India

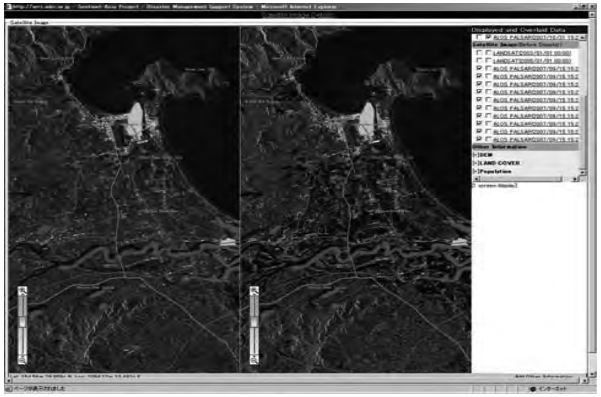
Flood in Vietnam in October-November 2007



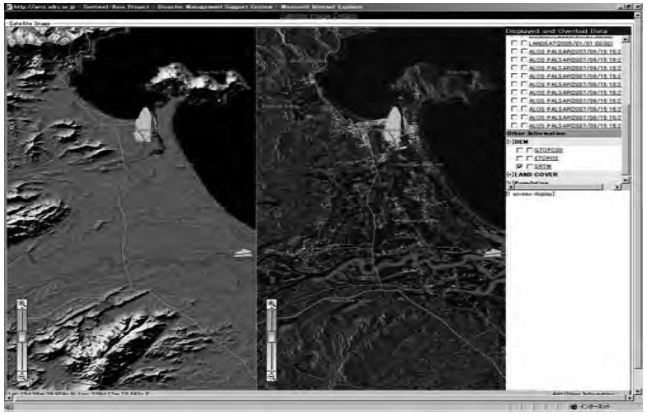
ALOS/PALSAR Image around Da Nang City



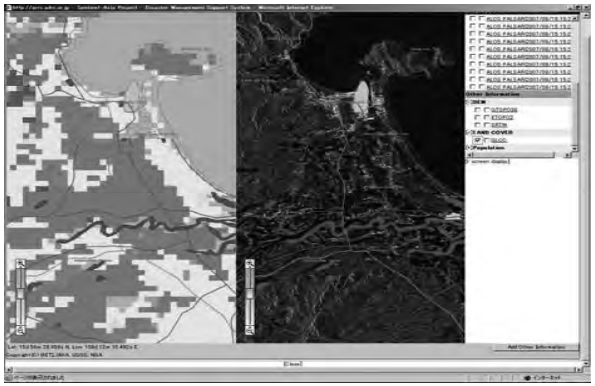
ALOS/PALSAR Image before (left) and during (right) Flood



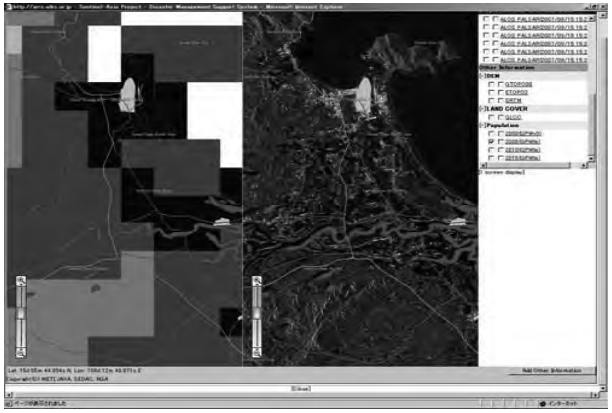
SRTM/DEM and ALOS/PALSAR Image



Land Cover Data and ALOS/PALSAR Image

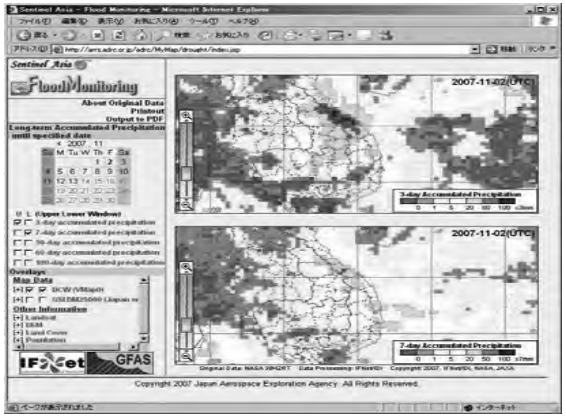


Population and ALOS/PALSAR Image

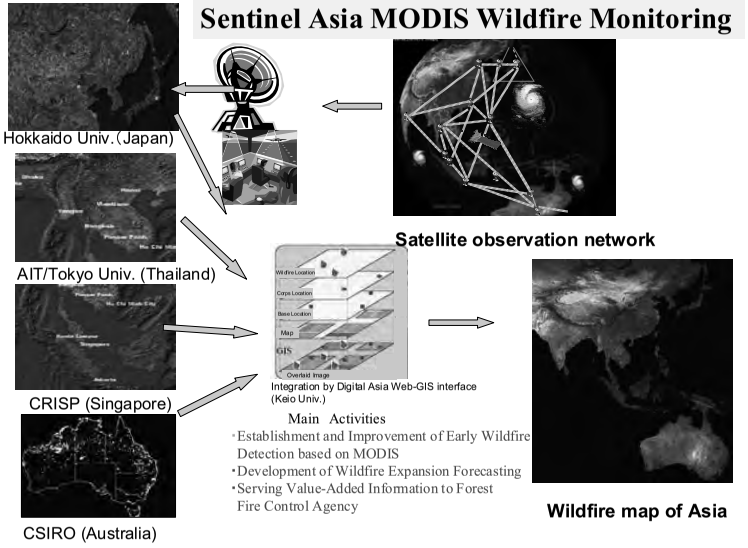


MTSAT Image

Accumulated Precipitation Data

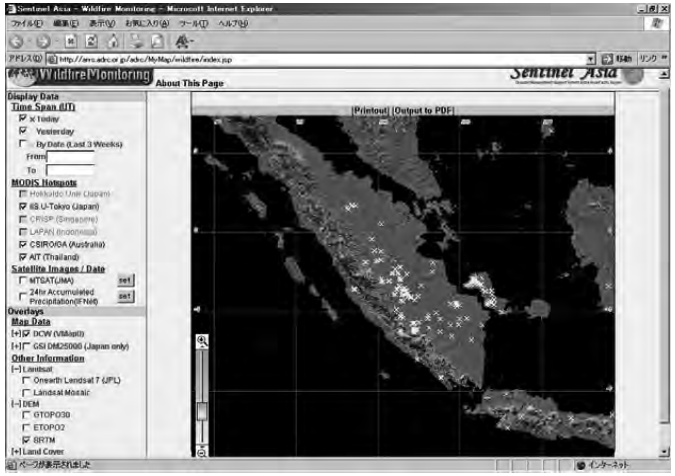


Sentinel Asia MODIS Wildfire Monitoring

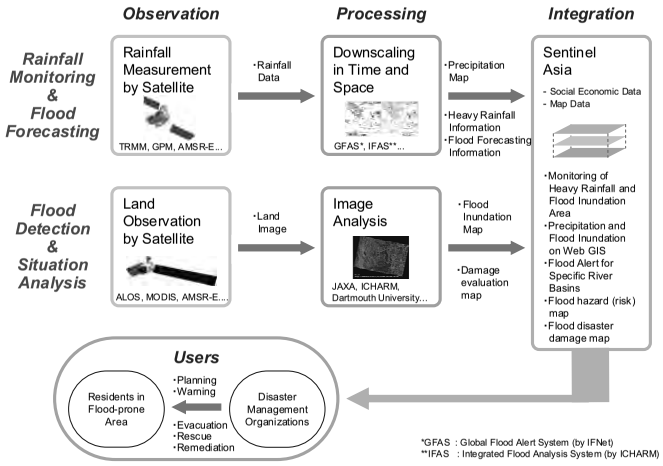


MODIS Hotspots Data on GIS

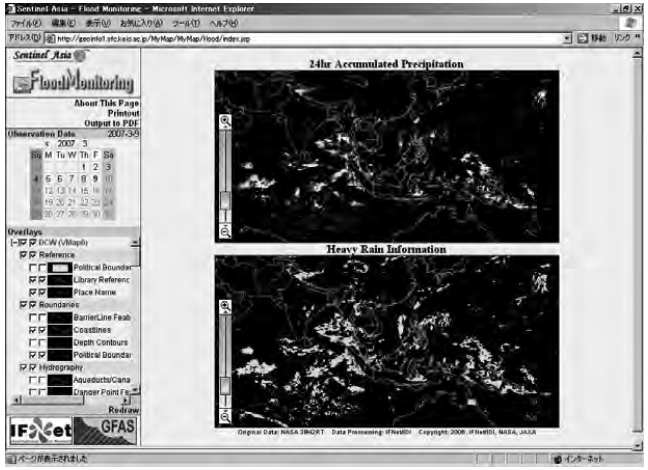
MODIS Hotspots and SRTM/ DEM



Sentinel Asia Flood Monitoring

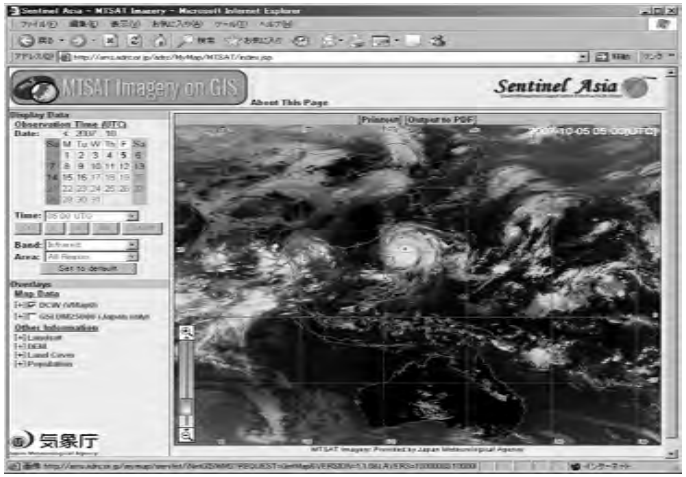


GFAS Precipitation Data on GIS

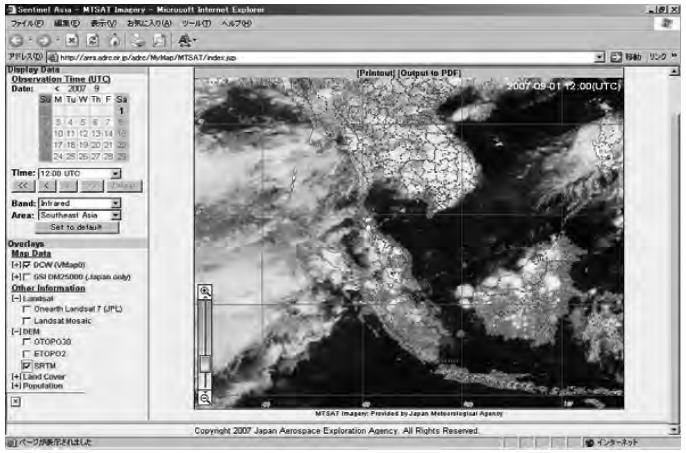


Long-term Accumulated GFAS Precipitation data and Land Cover data

MTSAT Imagery



MTSAT Imagery and SRTM/ DEM



Capacity Building

- "1st Sentinel Asia system operation training" was held successfully with 12 attendees at the end of August 2007 at Bangkok by JAXA.
- "2nd Sentinel Asia system operation training" was held successfully with 15 attendees at the end of November 2007 at Bangkok by JAXA
- "Mini Project" is being carried out for 10 projects of 10 countries in 2007 by JAXA under cooperation with AIT

Contents

1. What's "Sentinel Asia"?
   Background / History / Concept / Framework

2. Main Activities
   Wildfire Monitoring / Flood Monitoring /
   Emergency Observation / Capacity Building

3. **Future Plan**
   Results of STEP1 / Concept of STEP2

Results of STEP1

Sentinel Asia STEP1 has achieved its overall goals:

- The website of Sentinel Asia has operated since October 2006. It has served as a good demonstrator project, to share disaster-related information obtained by several earth observation satellites such as ALOS, IRS, MTSAT-1R, Terra & Aqua
- It also demonstrates recent advances in web-mapping technologies and ICT systems

Following findings are to be worked on at STEP2:

- There are narrow band areas where it is hard to see Web-GIS information
- More robust and user-friendly website system is required
- Users request GeoTiff data (by Space agency or Institutes) and easily comprehensible interpretations from images (by Disaster management organization)

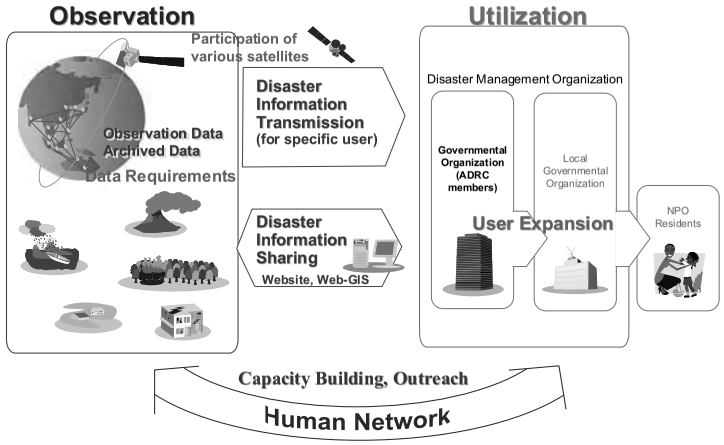
Future Plan: Sentinel Asia STEP2

STEP2 will start from 2008 succeeding and strengthening STEP1 :

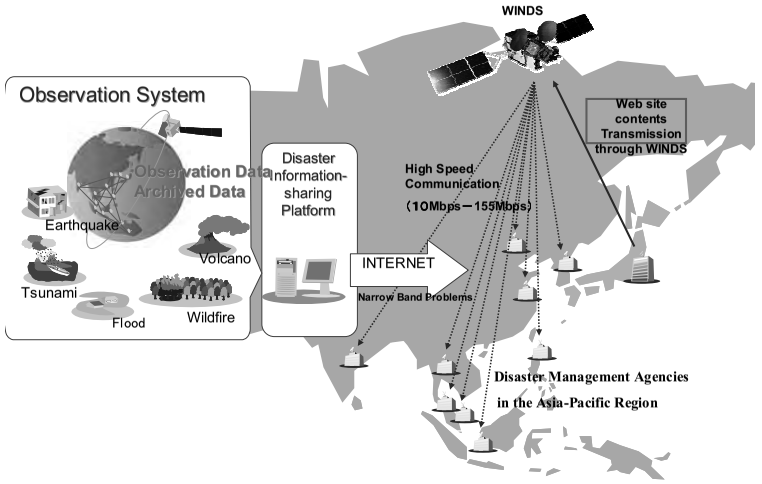
- **Participation of Various Satellites**
  EO satellites: ALOS (JAXA), Terra & Aqua (NASA), IRS (I SRO), KOMPSAT-1(KARI), THEOS (GISTDA) etc.
  Com satellites: WINDS (JAXA) etc.
- **Accessibility to Information**
  Facilitate access to disaster-related information through various means including satellite communication
- **Variety of Providing Data**
  GeoTiff data/ Raw data (by Space agency or Institutes) and easily comprehensible interpretations from images (by Disaster management organization)
- **User Expansion**
  To expand users to local disaster authority in cooperation with UNESCAP

Concept of Sentinel Asia SETP2

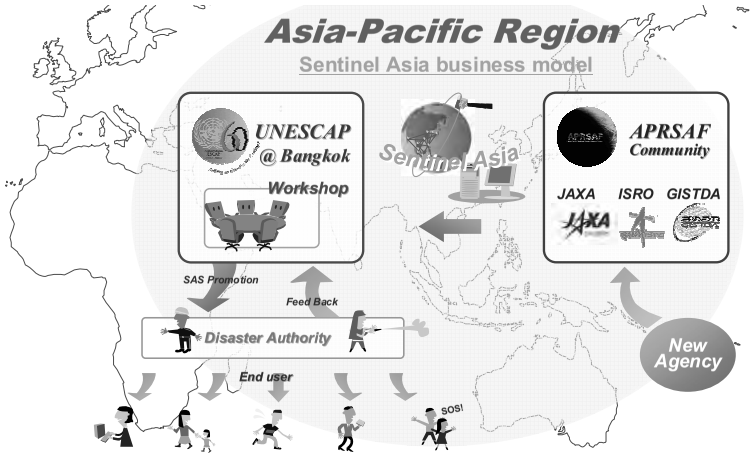
<To Promote Utilization>



Application of WINDS for Sentinel Asia



Expansion stream of Sentinel Asia Utilization in cooperation with UNESCAP



Thank you for your attention.

Please visit Sentinel Asia at
http://dmss.tksc.jaxa.jp/sentinel/

Landslide Assessment and Warning: Case Study in Thailand

Assoc. Prof. Warakorn Mairaing
The Department of Civil Engineering
Kasetsart University, THAILAND

LANDSLIDE ASSESSMENT AND WARNING :CASE STUDY IN THAILAND

Dr. Warakorn Mairaing and Dr. Suttisak Soralump
Civil Engineering Department
Kasetsart University, Thailand
mairaing@yahoo.com

Natural Disasters

The Internation Emergency Disasters Database(EM-DAT)
Classify natural disasters into two main groups.

1. Hydrometeorological Disasters:
   - Avalanches/landslides
   - Droughts/famines
   - Extrene temperatures
   - Floods
   - Forest fires
   - Windstorms
   - Others
2. Geophysical Disasters:
   - Earthquakes
   - Tsunamis
   - Volcanic Eruptions.

Natural Disasters

Natural Factors **Human Factors**

Natural disasters exert an enormous toll on development. Annual economic losses associated with such disasters averaged;

US$ 75.5 billion in the 1960s,
US$ 138.4 billion in the 1970s,
US$ 213.9 billion in the 1980s
US$ 659.9 billion in the 1990s.

Mark Malloch Brown, Administrator, United Nations Development Programme

Who are suffering from natural disasters?

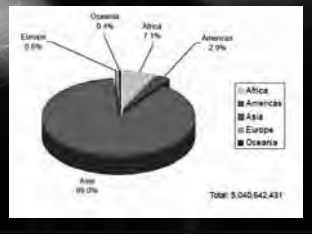
The majority of these losses are concentrated in the developed world and fail to adequately capture the impact of the disaster on the poor who often bear the greatest cost in terms of lives and livelihoods, and rebuilding their shattered communities and infrastructure. Today, 85 percent of the people exposed to earthquakes, tropical cyclones, floods and droughts live in countries having either medium or low human development.

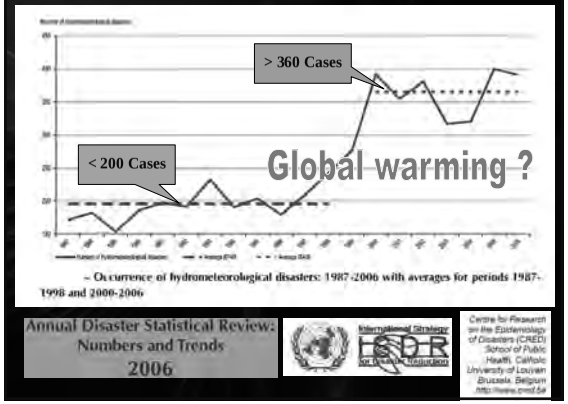
Mark Malloch Brown, Administrator, United Nations Development Programme

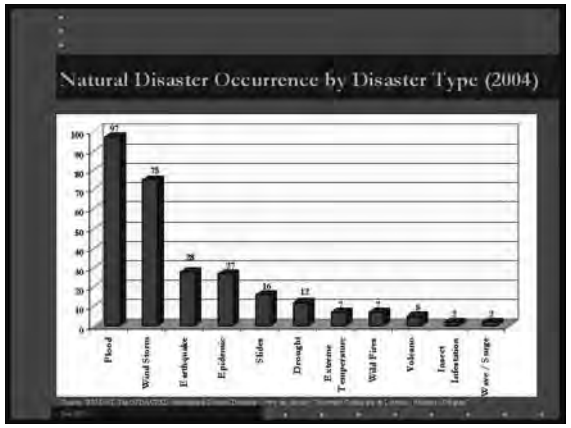
Why developing countries are suffering from natural disasters?

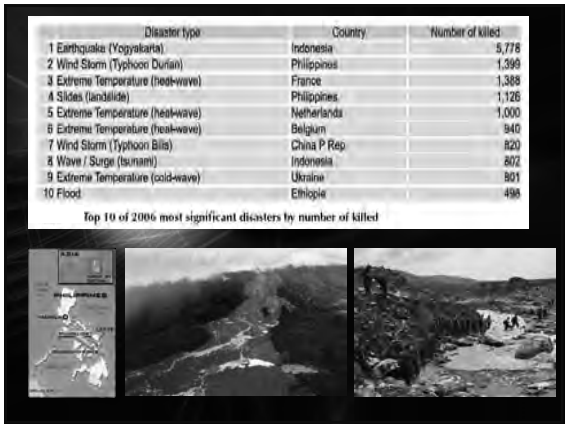
Because they are lacking of :

- **Basic knowledge leading to the effective warning system.**
- **Budget for prevention and mitigation.**
- **Systematic rescue and recovery processes after the dissater.**







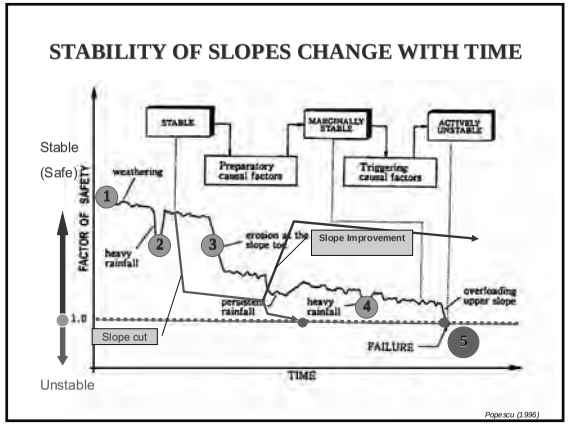


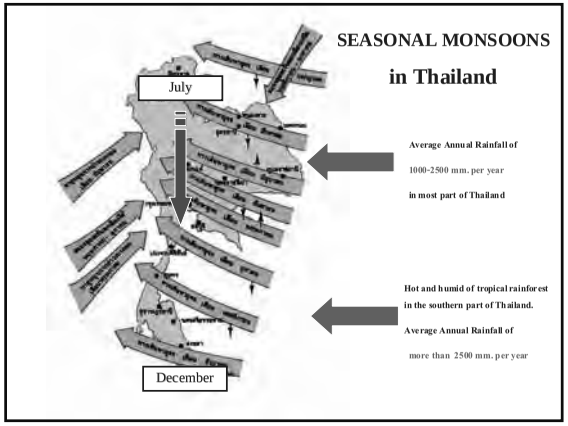
Disaster type	Country	Number of killed
1 Earthquake (Yogyakarta)	Indonesia	5,778
2 Wind Storm (Typhoon Durian)	Philippines	1,399
3 Extreme Temperature (heat-wave)	France	1,388
4 Slides (landslide)	Philippines	1,126
5 Extreme Temperature (heat-wave)	Netherlands	1,000
6 Extreme Temperature (heat-wave)	Belgium	940
7 Wind Storm (Typhoon Bilis)	China P Rep	820
8 Wave / Surge (tsunami)	Indonesia	802
9 Extreme Temperature (cold-wave)	Ukraine	801
10 Flood	Ethiopia	498

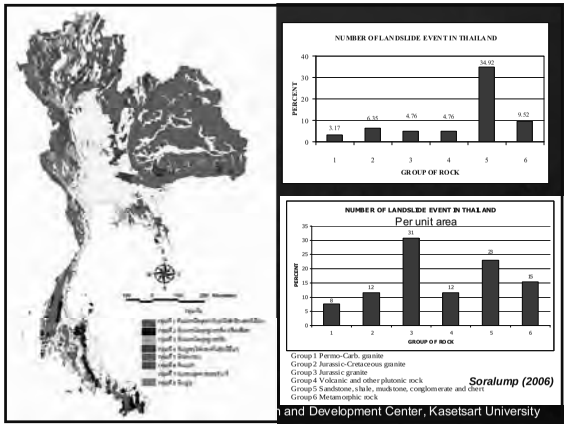
Top 10 of 2006 most significant disasters by number of killed

Potential Natural Disasters in Thailand

Disaster types	Frequency of Occurrence	Area Affected	Potential Loss of lives	Severity Rating
Hydro-meteorological				
-Floods	3-5 y	Large	10-200	High
-Storms	5-10 y	Large	10-200	Medium
-Drought	3-5 y	Large	non	Low
-Landslides	3-5 y	small	1-200	Low
Geophysical				
-Earthquakes	3-5 y	Large	non	Low
-Tsunami	>100 y	Very large	5000	High
Biological				
-Epidemics	1-2 y	Large	10-100	Medium
-Insect infestations	5-10 y	small	non	Very low







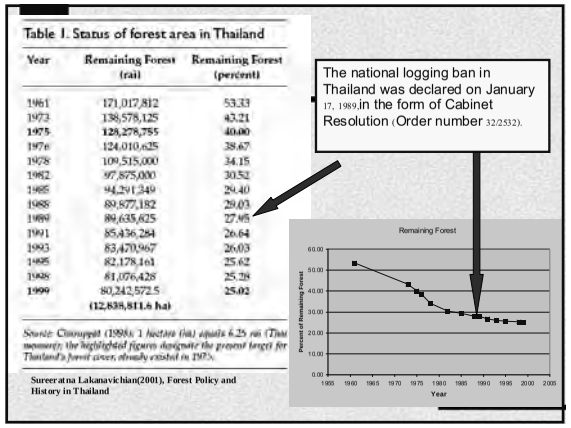
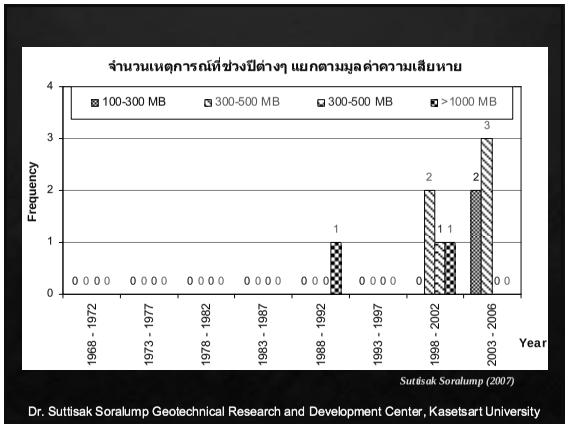
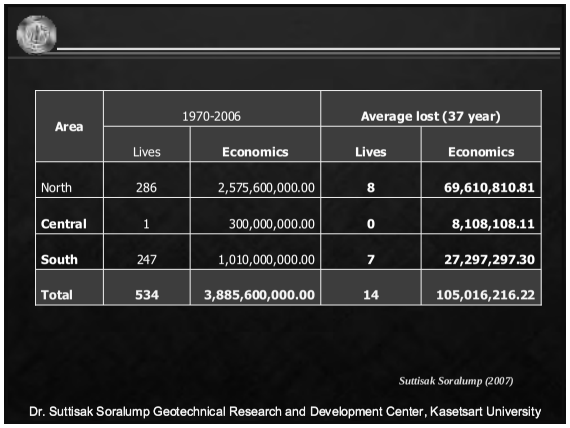
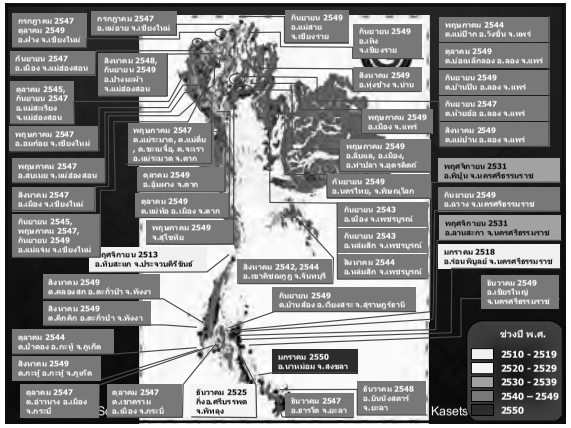
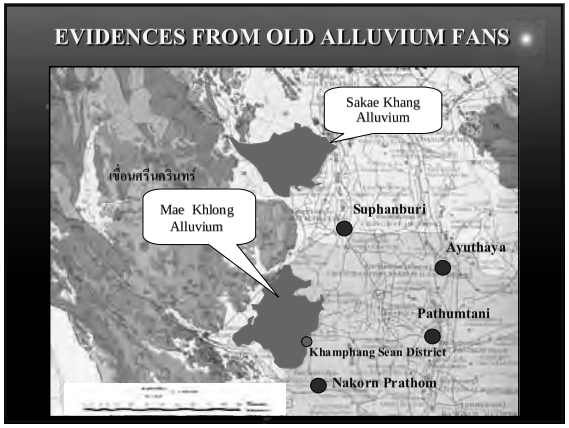


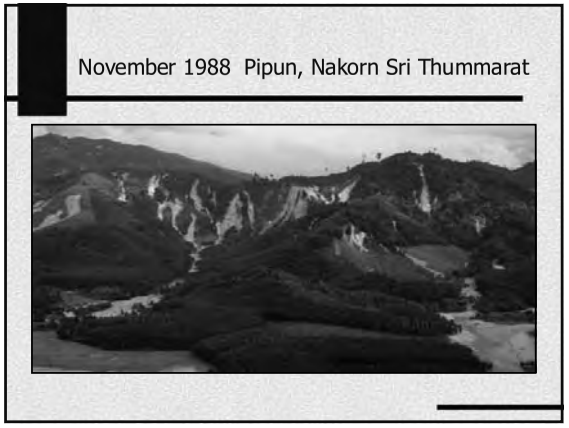
Table 1. Status of forest area in Thailand
Year
Remaining Forest (rai)
Remaining Forest (percent)
1961 171,017,812 53.33
1973 138,578,125 43.21
1975 128,278,755 40.00
1976 124,010,625 38.67
1978 109,515,000 34.15
1982 97,875,000 30.52
1985 94,291,249 29.40
1988 89,877,182 28.03
1989 89,635,625 27.95
1991 85,436,284 26.64
1993 83,470,967 26.03
1995 82,178,161 25.62
1998 81,076,428 25.28
1999 80,242,572.5 25.02
(12,838,811.6 ha)
The national logging ban in Thailand was declared on January 17, 1989 in the form of Cabinet Resolution (Order number 32/2532).
Remaining Forest
Sureeratna Lakanavichian(2001), Forest Policy and History in Thailand


จำนวนเหตุการณ์ที่ช่วงปีต่างๆ แยกตามมูลค่าความเสียหาย
100-300 MB
300-500 MB
300-500 MB
> 1000 MB
Frequency
Year
1968 - 1972
1973 - 1977
1978 - 1982
1983 - 1987
1988 - 1992
1993 - 1997
1998 - 2002
2003 - 2006
Suttisak Soralump (2007)
Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University


Area
1970-2006
Average lost (37 year)
Lives
Economics
Lives
Economics
North 286 2,575,600,000.00 8 69,610,810.81
Central 1 300,000,000.00 0 8,108,108.11
South 247 1,010,000,000.00 7 27,297,297.30
Total 534 3,885,600,000.00 14 105,016,216.22
Suttisak Soralump (2007)
Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University


ช่วงปี พ.ศ.
2510 - 2519
2520 - 2529
2530 - 2539
2540 – 2549
2550
Kasets


EVIDENCES FROM OLD ALLUVIUM FANS
Sakae Khang Alluvium
เขื่อนศรีนครินทร์
Mae Khlong Alluvium
Suphanburi
Ayuthaya
Pathumtani
Khamphaeng Saen District
Nakorn Prathom


November 1988 Pipun, Nakorn Sri Thummarat

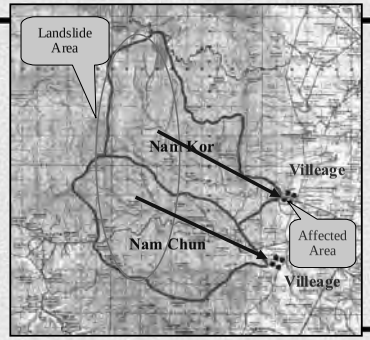
November 1988 Pipun, Nakorn Sri Thummarat

August 1999 Kao-Kichakud, Chantaburi

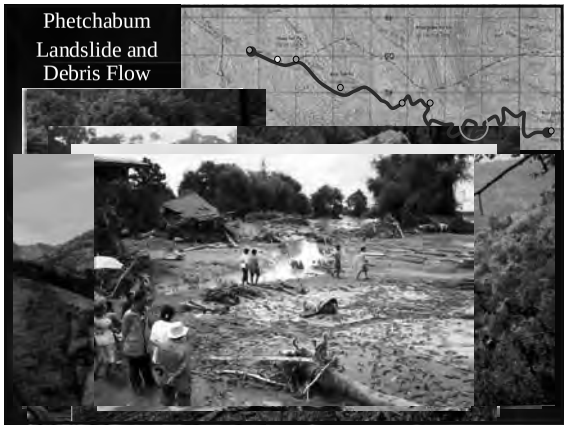
August 1999 Kao-Kichakud, Chantaburi

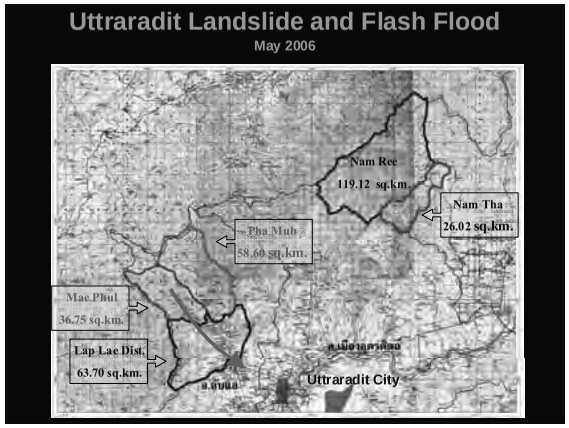
August 2001 Lumsak, Phetchabun

Landslide and Debris Flow at Phetchabun



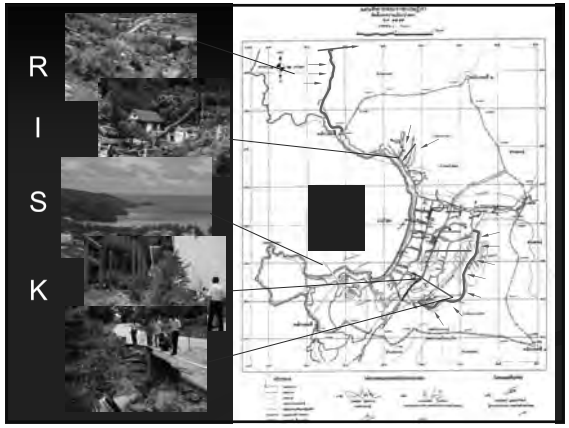
Phetchabum Landslide and Debris Flow

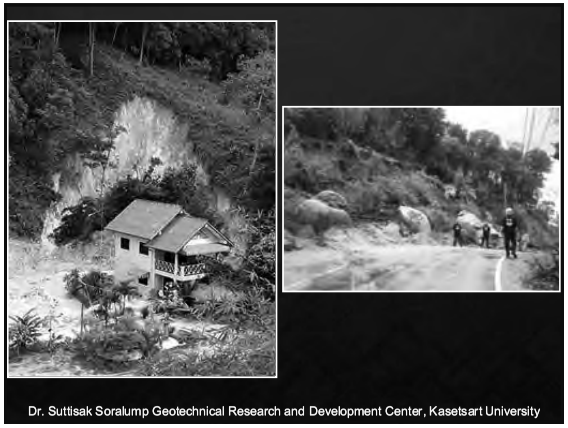


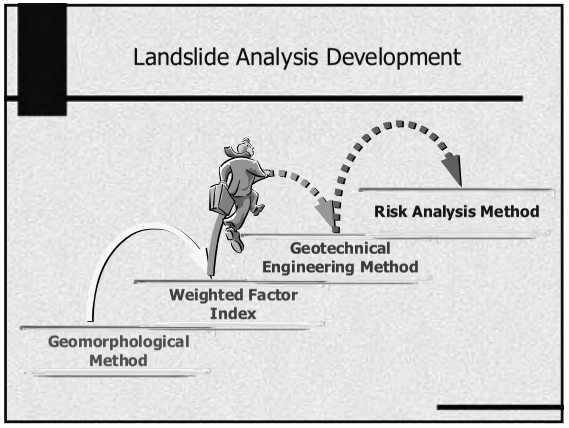

Uttraradit Landslide and Flash Flood
May 2006
Nam Ree
119.12 sq.km
Nam Tha
26.02 sq.km.
Pha Mub
58.66 sq.km.
Mae.Phul
36.75 sq.km.
Lap Lae Dist.
63.70 sq.km.
Uttraradit City


การเกิดน้ำท่วม-ดินถล่ม จ.อุตรดิตถ์
จังหวัด
ปริมาณฝน (วันที่) , mm
16 17 18 19 20 21 22 23 24 25 26
อุตรดิตถ์ 0.5 0.0 7.9 0.0 14.5 120.4 263.7 21.4 0.0 0.0 0.0
Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University


Landslide at Lap Lae District, Uttraradit


R
I
S
K

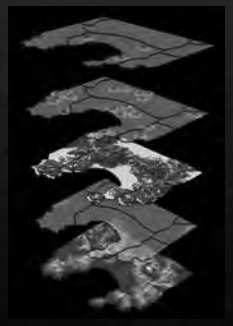

Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University


Landslide Analysis Development
Risk Analysis Method
Geotechnical Engineering Method
Weighted Factor Index
Geomorphological Method

Method/ Organization	FACTORS RELATED TO LANDSLIDE															
	ROCK TYPE	LANDFORM (SLOPE)	RAINFALL	Rainfall Analyses	LANDUSE /LAND COVER	ELEVATION	GEOLOGY	TOPOGRAPHIC	Regional Climate	PAST EVENTS	WATERSHED	DRAINAGE	WETNESS	SOIL DEPTH	GROUNDWATER	ENGINEERING SOIL PROPERTIES
1. Weighting factor																
1.1 WICHAI (1995)	✓	✓	✓		✓	✓										
1.2 DLD	✓	✓	✓		✓		✓									
1.3 FRC (KU)			✓				✓	✓	✓	✓						
1.4 DMR		✓	✓			✓	✓				✓	✓	✓			
1.5 Thassanapak (2001)	✓	✓	✓		✓	✓	✓					✓				
1.6 GERD (KU)	✓	✓	✓	✓	✓	✓	✓					✓				✓
2. Geotechnical																
2.1 GERD (KU)		✓	✓	✓	✓		✓						✓	✓	✓	

Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University

Weighting Factor Method



Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University

Hazard Map

by Weighted Factor Index

8 Important Factors

1. ELEVATION
2. ADJUSTED ASPECT
3. TM4
4. FLOW ACCUMULATION
5. BRIGHTNESS
6. WETNESS
7. SLOPE
8. FLOW DIRECTION

Department of Mineral Resource (2001)

Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University

Hazard Map

by Weighted Factor Index

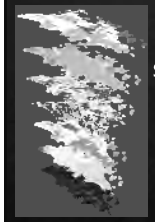
5 Important Factors

1. Rock Type
2. Slope
3. Annual Rainfall
4. Landuse
5. Soil Characteristic

Department of Land Development (August, 2001)

Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University

Landslide Factors as GIS Layers



Static

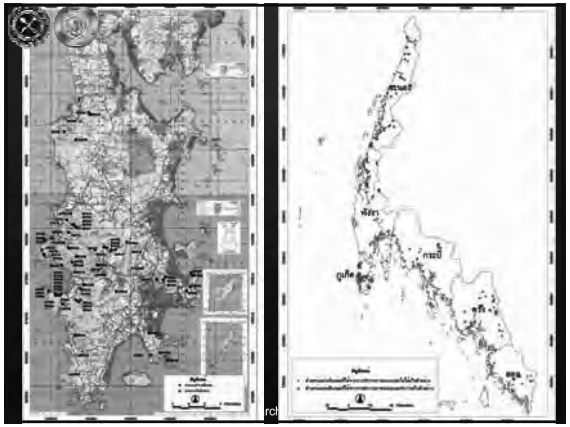
1. Geologic structure and Rock type
2. Slope and elevation
3. Surface water
4. Soil characteristics
5. Engineering soil properties-Strength reduction
6. Land use

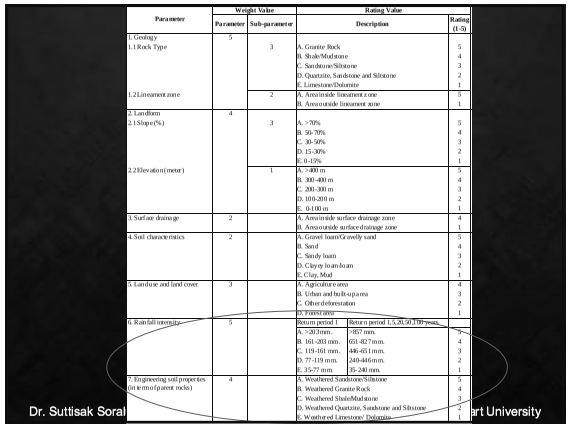
Triggered Factors

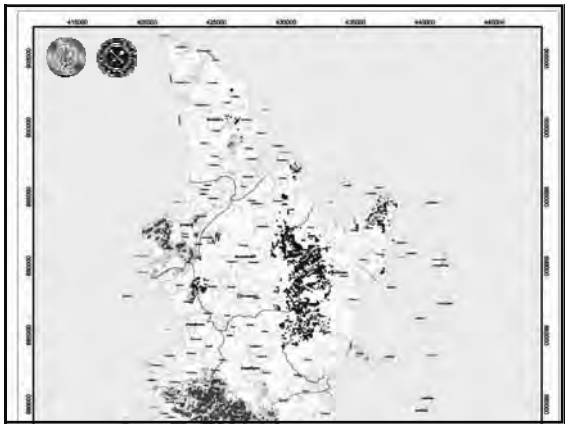
Dynamic

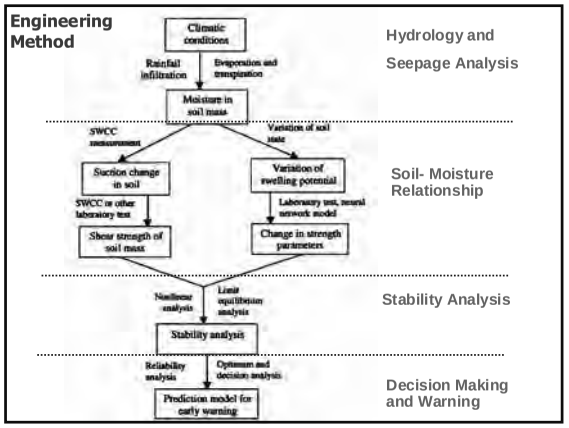
1. Rainfall Intensity and cumulative rainfall
2. Peak ground acceleration and duration

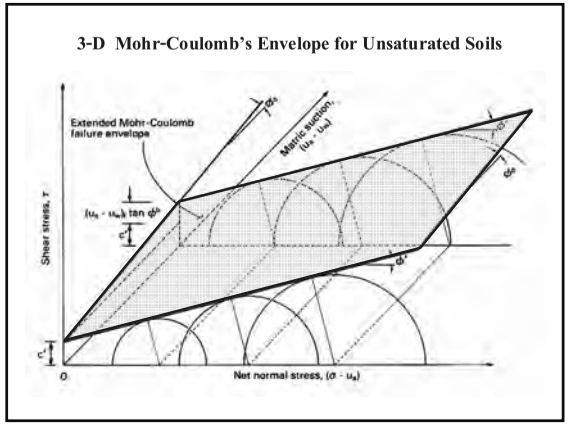
Dr. Suttisak Soralump Geotechnical Research and Development Center, Kasetsart University

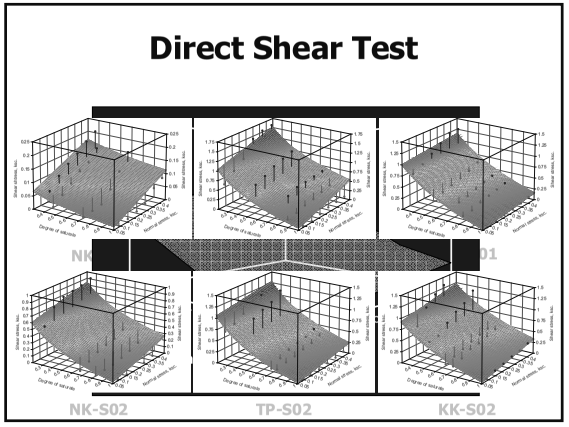



Parameter
Weight Value
Parameter
Sub-parameter
Rating Value
Description
Rating (1-5)
1. Geology
1.1 Rock Type
A. Granite Rock
B. Shale/Mudstone
C. Sandstone/Siltstone
D. Quartzite, Sandstone and Siltstone
E. Limestone/Dolomite
1.2 Lineament zone
A. Area inside lineament zone
B. Area outside lineament zone
2. Landform
2.1 Slope (%)
A. >70%
B. 50-70%
C. 30-50%
D. 15-30%
E. 0-15%
2.2 Elevation (meter)
A. >400 m
B. 300-400 m
C. 200-300 m
D. 100-200 m
E. 0-100 m
3. Surface drainage
A. Area inside surface drainage zone
B. Area outside surface drainage zone
4. Soil characteristics
A. Gravel loam/Gravelly sand
B. Sand
C. Sandy loam
D. Clayey loam/loam
E. Clay, Mud
5. Landuse and land cover
A. Agriculture area
B. Urban and built-up area
C. Other deforestation
D. Forest area
6. Rainfall intensity
Return period 1
Return period 1,5,20,50,100 years
A. >20.1 mm.
>807 mm.
B. 161-203 mm.
651-827 mm.
C. 119-161 mm.
446-651 mm.
D. 77-119 mm.
310-446 mm.
E. 35-77 mm
35-240 mm.
7. Engineering soil properties (in terms of parent rocks)
A. Weathered Sandstone/Siltstone
B. Weathered Granite Rock
C. Weathered Shale/Mudstone
D. Weathered Quartzite, Sandstone and Siltstone
E. Weathered Limestone/ Dolomite
Dr. Suttisak Soral
rt University



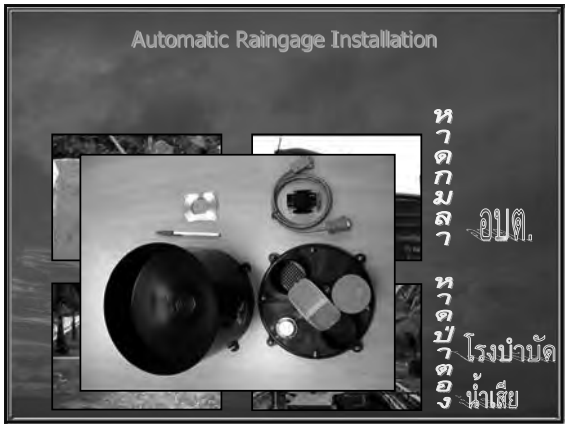

Engineering Method
Climatic conditions
Rainfall infiltration
Evaporation and transpiration
Moisture in soil mass
SWCC measurement
Variation of soil state
Suction change in soil
Variation of swelling potential
SWCC or other laboratory test
Laboratory test, neural network model
Shear strength of soil mass
Change in strength parameters
Nonlinear analysis
Limit equilibrium analysis
Stability analysis
Reliability analysis
Optimum and decision analysis
Prediction model for early warning
Hydrology and Seepage Analysis
Soil- Moisture Relationship
Stability Analysis
Decision Making and Warning

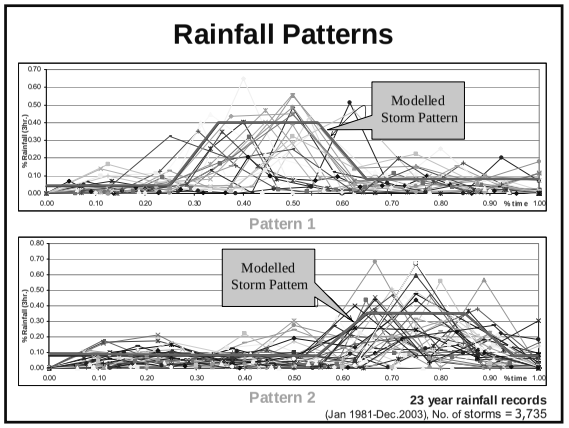

3-D Mohr-Coulomb's Envelope for Unsaturated Soils
Extended Mohr-Coulomb failure envelope
Matric suction, (ua - uw)
Shear stress, τ
Net normal stress, (σ - ua)

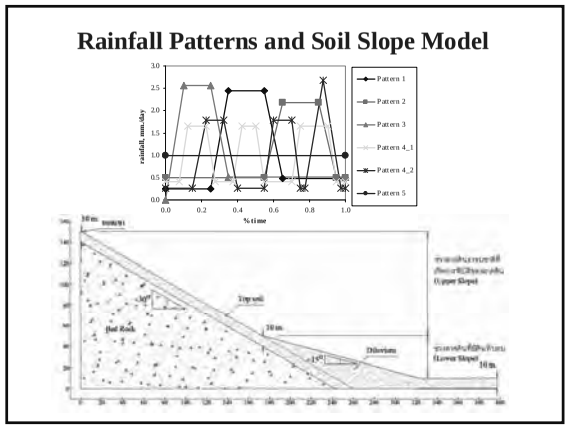

Direct Shear Test
NK-S02
TP-S02
KK-S02

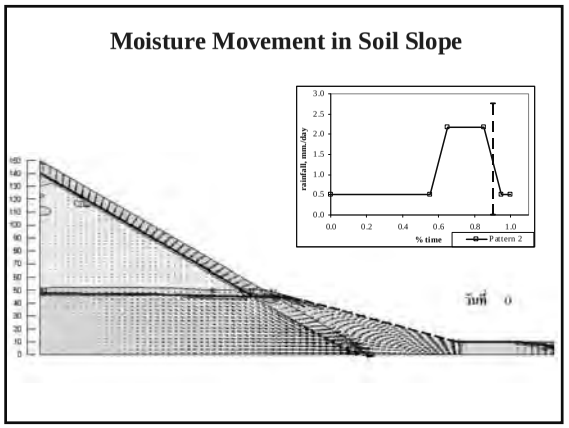

Field Investigation

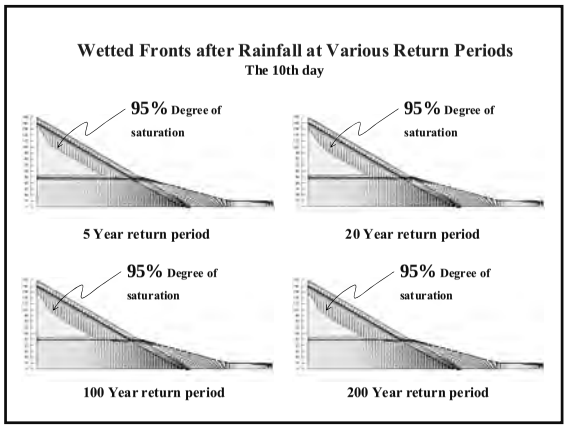

Soil Mapping and Sampling

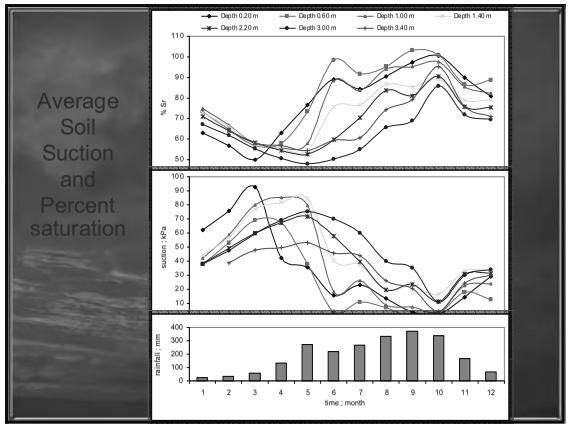

Automatic Raingage Installation
หาดกมลา
อบต.
หาดป่าตอง
โรงบำบัด
น้ำเสีย

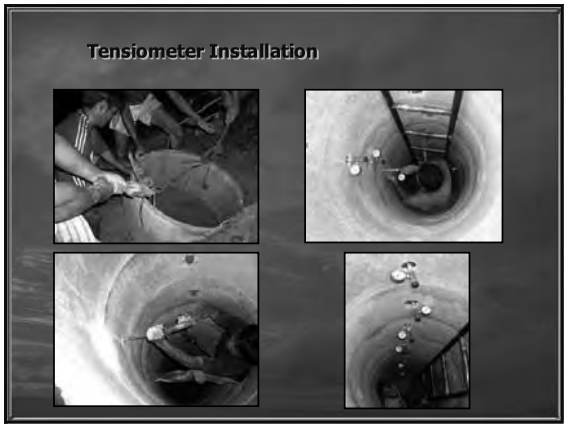

Rainfall Patterns
Modelled Storm Pattern
Pattern 1
Modelled Storm Pattern
Pattern 2
23 year rainfall records
(Jan 1981-Dec.2003), No. of storms = 3,735

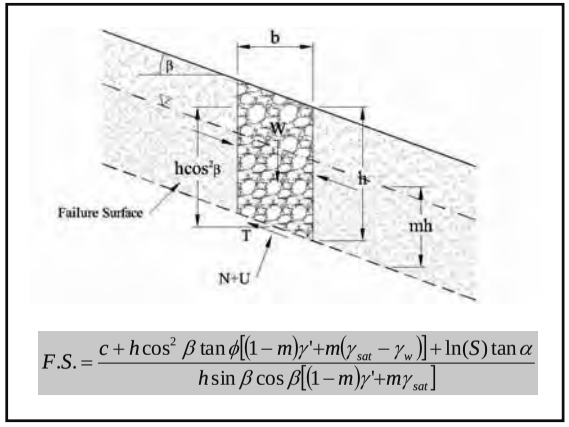

Rainfall Patterns and Soil Slope Model
Pattern 1
Pattern 2
Pattern 3
Pattern 4_1
Pattern 4_2
Pattern 5
% time
rainfall, mm./day


Moisture Movement in Soil Slope
% time
Pattern 2
rainfall, mm./day

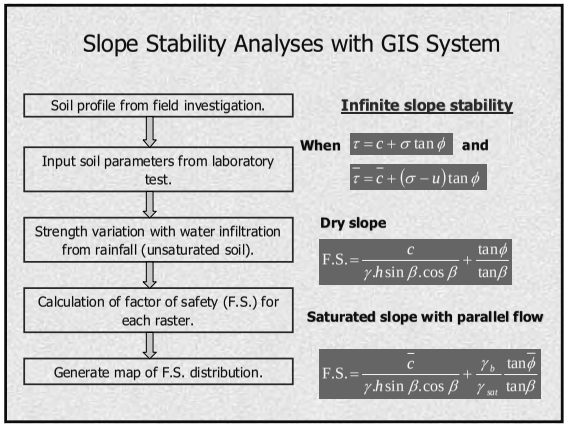

Wetted Fronts after Rainfall at Various Return Periods
The 10th day
95% Degree of saturation
5 Year return period
95% Degree of saturation
20 Year return period
95% Degree of saturation
100 Year return period
95% Degree of saturation
200 Year return period

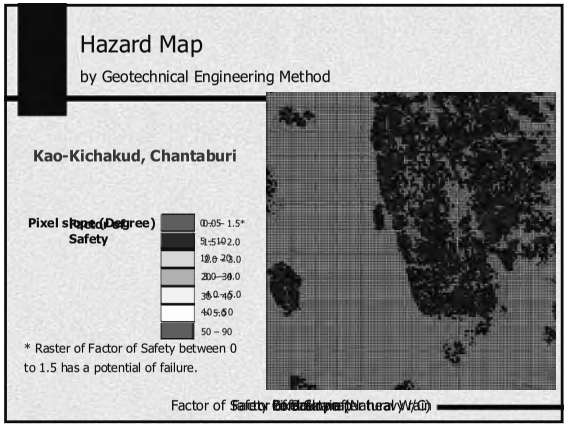


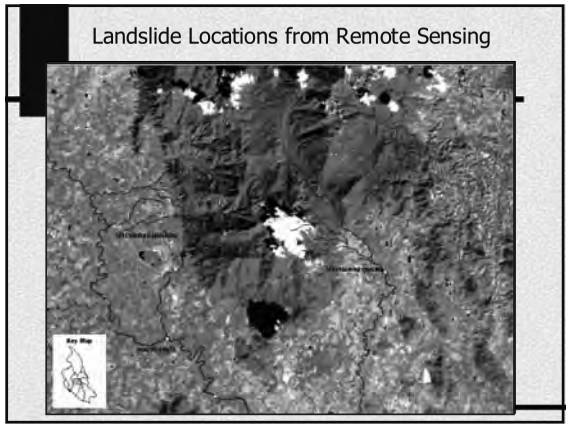


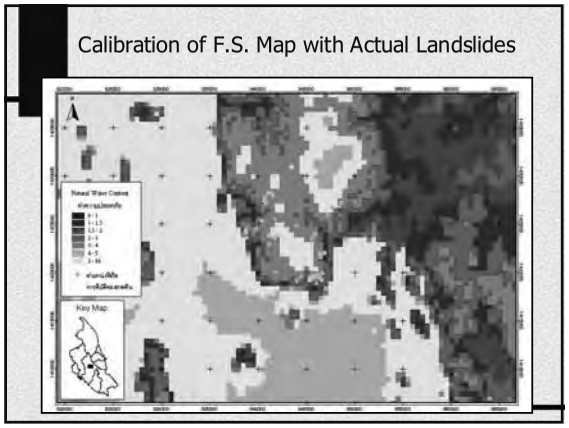


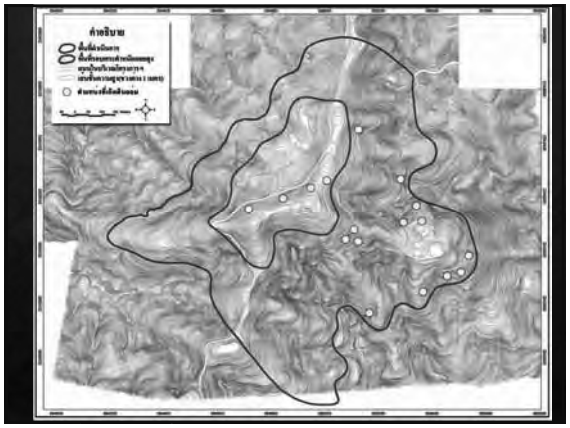
$$F.S. = \frac{c + h\cos^2\beta\tan\phi\left[(1-m)\gamma' + m(\gamma_{sat} - \gamma_w)\right] + \ln(S)\tan\alpha}{h\sin\beta\cos\beta\left[(1-m)\gamma' + m\gamma_{sat}\right]}$$



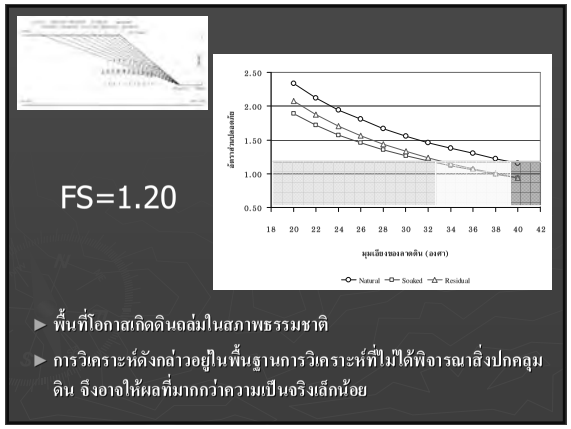


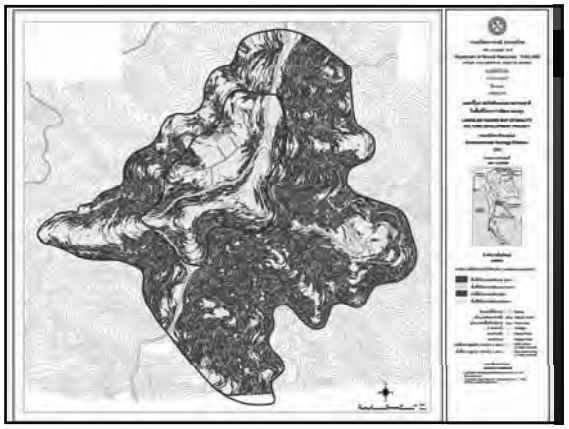

Landslide Locations from Remote Sensing

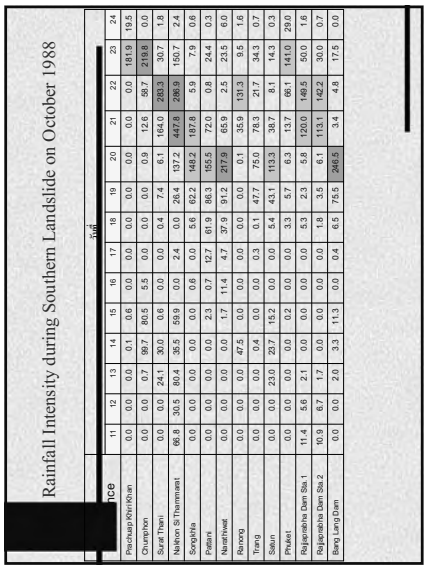

Calibration of F.S. Map with Actual Landslides



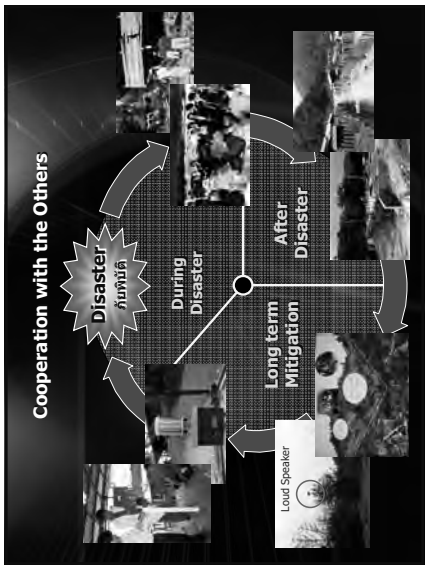

เสถียรภาพตามความลาดเอียงของพื้นที่
- กรณีพื้นที่เป็นพื้นที่ลาดต่อเนื่อง
ผศ.ดร.สุทธิศักดิ์ ศรสัมพี ศูนย์วิจัยและพัฒนาวิศวกรรมปฐพีและฐานราก มหาวิทยาลัยเกษตรศาสตร์

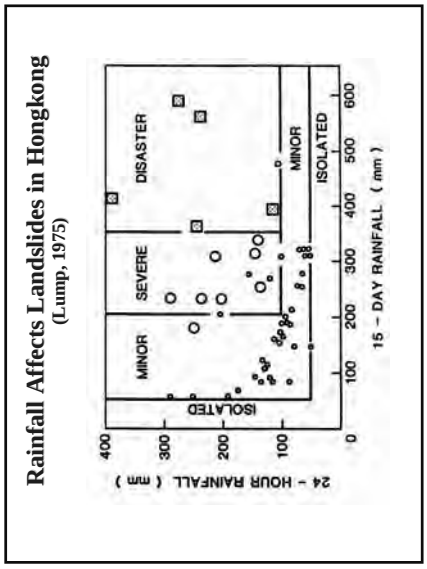

FS=1.20
► พื้นที่โอกาสเกิดดินถล่มในสภาพธรรมชาติ
► การวิเคราะห์ดังกล่าวอยู่ในพื้นฐานการวิเคราะห์ที่ไม่ได้พิจารณาสิ่งปกคลุมดิน จึงอาจให้ผลที่มากกว่าความเป็นจริงเล็กน้อย

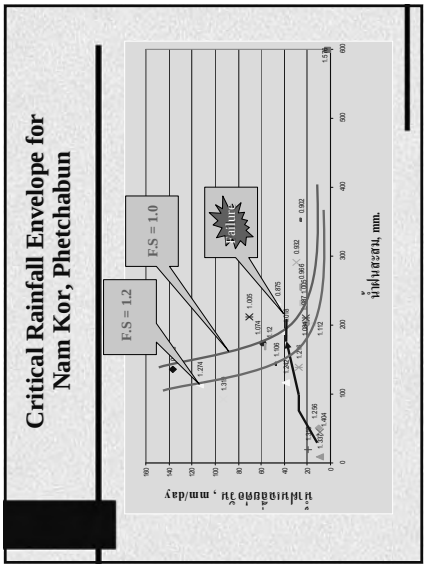


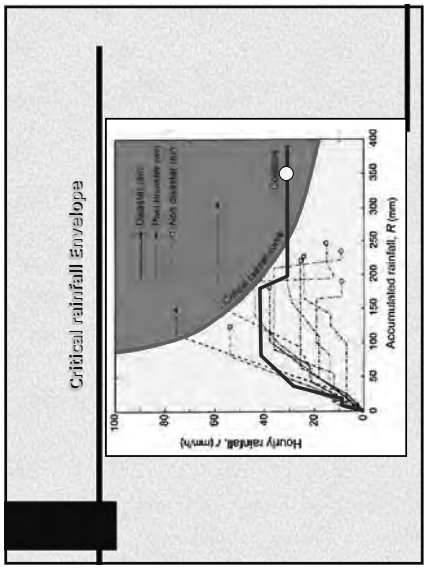


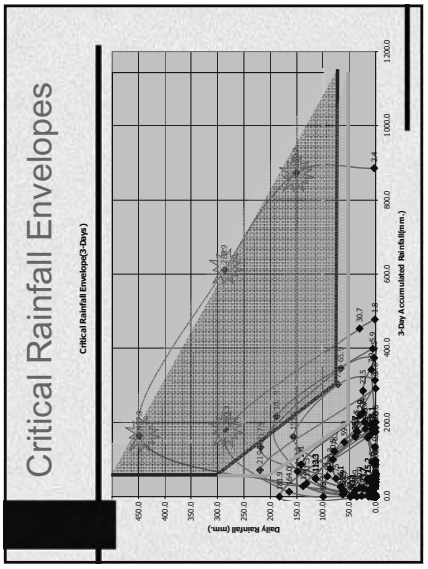
ce	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Prachuap KhiriKhan	0.0	0.0	0.0	0.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	181.9	19.5
Chumphon	0.0	0.0	0.7	99.7	80.5	5.5	0.0	0.0	0.0	0.9	12.6	58.7	219.8	0.0
Surat Thani	0.0	0.0	24.1	30.0	0.6	0.0	0.0	0.4	7.4	6.1	164.0	283.3	30.7	1.8
Nakhon Si Thammarat	66.8	30.5	80.4	35.5	59.9	0.0	2.4	0.0	26.4	107.2	447.8	296.9	150.7	2.4
Songkhla	0.0	0.0	0.0	0.0	0.0	0.6	0.0	8.6	62.2	148.2	187.8	5.9	7.9	0.6
Pattani	0.0	0.0	0.0	0.0	2.3	0.7	12.7	61.9	86.3	155.5	72.0	0.8	24.4	0.3
Narathiwat	0.0	0.0	0.0	0.0	1.7	11.4	4.7	37.9	91.2	217.9	65.9	2.5	23.5	6.0
Ranong	0.0	0.0	0.0	47.5	0.0	0.0	0.0	0.0	0.0	0.1	35.9	131.3	9.5	1.6
Trang	0.0	0.0	0.0	0.4	0.0	0.0	0.3	0.1	47.7	75.0	78.3	21.7	34.3	0.7
Satun	0.0	0.0	23.0	23.7	15.2	0.0	0.0	0.0	5.4	43.1	113.3	38.7	8.1	14.3	0.3
Phuket	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	3.3	5.7	6.3	13.7	66.1	141.0	29.0
Rajamakha Dam Sta.1	11.4	5.6	2.1	0.0	0.0	0.0	0.0	0.0	5.3	2.3	5.8	120.0	140.5	50.0	1.6
Rajamakha Dam Sta.2	10.9	6.7	1.7	0.0	0.0	0.0	0.0	0.0	1.8	3.5	6.1	113.1	142.2	30.0	0.7
Bang Lang Dam	0.0	0.0	2.0	3.3	11.3	0.0	0.4	6.5	75.5	248.5	3.4	4.8	17.5	0.0

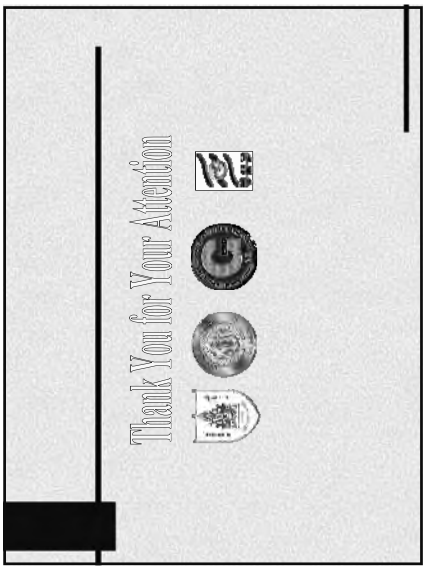











Thank You for Your Attention

Flood Forecasting and its Application for Disaster Management

Dr. Sutat Weesakul
School of Engineering and Technology
Asian Institute of Technology, THAILAND

Seminar "Toward a Partnership on Disaster Management and Remote Sensing/GIS Technologies"

Flood Forecasting and its Application for Disaster Management

Sutat Weesakul, Supot Thammasittirong, Nguyen Quang Hung and Watchara Sinlapasuwanchai

Water Engineering and Management Program, School of Engineering and Technology, AIT

Organized by Regional Network Officer for Urban Safety (RNUS)
Friday, 8th February 2006
Room B108, AIT Center

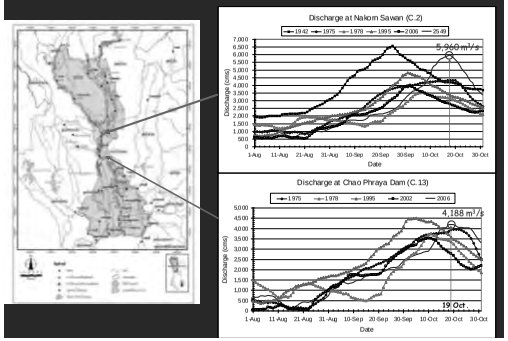
Three Selected Floods

1) Regional Flood Scale
(Chao Phraya River Basin : 2006)

2) Urban Flood
(Sukumvit Area : 2002 and 2003)

3) Flash Flood
(Uttaradit : 2006)

· Discharge at Nakorn Sawan



Background

Different type of flood recently occur in Thailand. Disseminate warning massage to local people will reduce loss of life and provide information for people to adapt themselves to flood

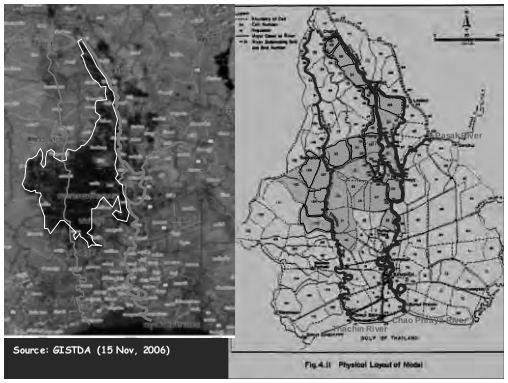
Objective of Study

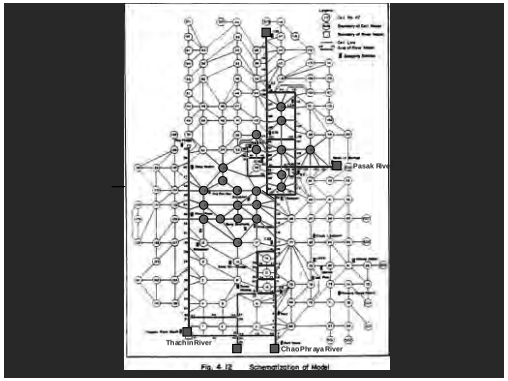
To study different types of floods for their forecasting and management

1. Flood in Chao Phraya River Basin

Effect Area: 47 provinces
Damage Cost: 20,000 million Baht

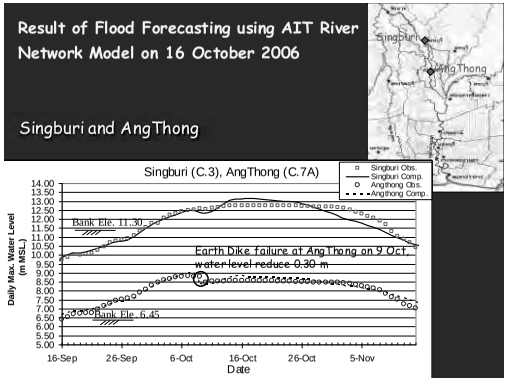
Aids: 6,737 million Baht (90% Agricultural Sector)
Flood Duration: 2 – 4 months





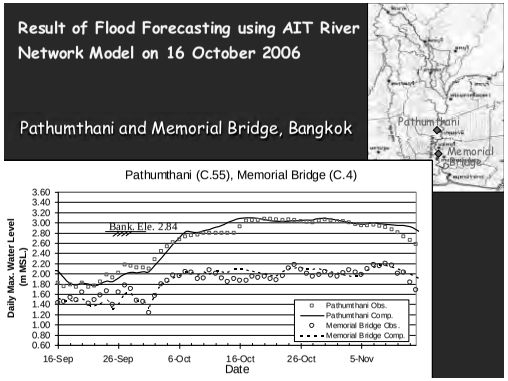
Result of Flood Forecasting using AIT River Network Model on 16 October 2006

Singburi and AngThong

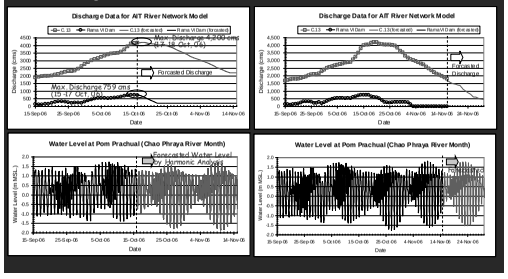


Result of Flood Forecasting using AIT River Network Model on 16 October 2006

Pathumthani and Memorial Bridge, Bangkok

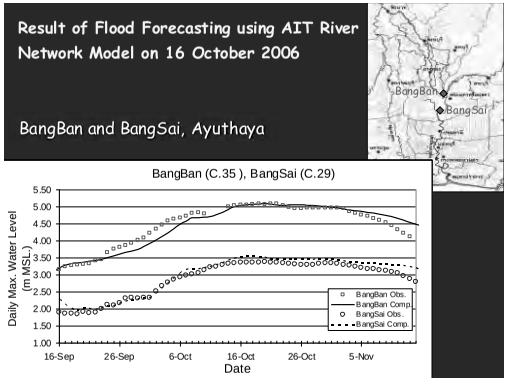


Boundary Condition for AIT River Network



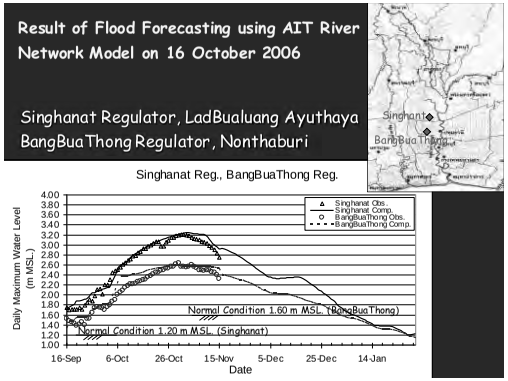
Result of Flood Forecasting using AIT River Network Model on 16 October 2006

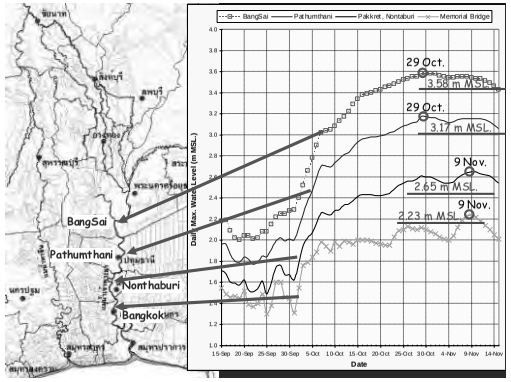
BangBan and BangSai, Ayuthaya



Result of Flood Forecasting using AIT River Network Model on 16 October 2006

Singhanat Regulator, LadBualuang Ayuthaya
BangBuaThong Regulator, Nonthaburi

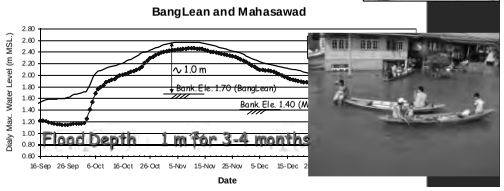




Result of Flood Forecasting using AIT River Network Model on 16 October 2006

BangLean, NakonPathom

The computed results show that water level is gradually decreased because there are about 2,000 mcm of flood still in Banglean area.

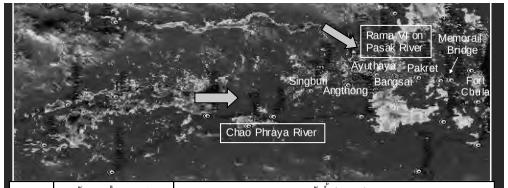


Flood

Flood Area	:	Large
Flood Time	:	2 - 4 months
Flood Depth	:	1 - 2 m
Flood Warning	:	Enough time to disseminate flood information (from forecasting result)
Management Approach	:	- Flood Fighting/Proofing - Live with Flood - ……

Comparison of Water Level at Memorial Bridge (C.4)

Date	Measured (m. MSL.)	Computed (m. MSL.)	Diff. (m)
· 12/10	2.00	1.99	-0.01
· 13/10	1.91	1.98	+0.07
· 14/10	1.84	1.96	+0.12
· 15/10	1.90	2.01	+1.01
· 16/10	1.87	2.00	+0.13
· 17/10	1.87	2.00	+0.13
· 18/10	1.94	1.99	+0.05
· 25/10	**2.17**	**2.10**	**-0.07**
· 08/11	2.15	2.21	+0.06
· 09/11	**2.20**	**2.23**	**+0.02**
· 10/11	2.16	2.20	+0.04



ปี พ.ศ.	อัตราการไหล ลบ.ม./ว. แม่น้ำเจ้าพระยา	อัตราการไหล ลบ.ม./ว. เขื่อนพระรามที่ 6 แม่น้ำป่าสัก	ระดับน้ำ (ม. รทก.) สิงห์บุรี	อ่างทอง	พระนครศรีอยุธยา	บางไทร	ปากเกร็ด	สะพานพุทธ	ป้อมพระจุลฯ
1975	3,957	800	11.69	7.05	4.37	3.22	2.17	1.93	1.75
1978	3,741	1800	11.59	7.23	4.60	3.22	2.10	1.89	1.69
1980	3,795	1002	11.85	7.46	4.69	3.14	2.08	1.80	1.66
1983	3,290	986	11.84	7.73	4.55	3.06	2.16	1.90	1.78
1995	4,501	1480	12.55	8.28	5.00	3.67	2.62	2.27	1.87
1996	3,034	970	12.31	8.33	4.38	3.19	2.34	2.13	1.79
2002	3,920	1216	12.98	8.55	4.52	3.45	2.52	2.10	1.80
2006	4,030	759	13.15	8.99	4.87	3.58	2.65	2.23	1.61

2. Forecasting in a City

- **Provide technical flood information for decision maker**
  (Part of Decision Support System and Operation)
- **Information directly to people in the city**
  (For personnel's management)

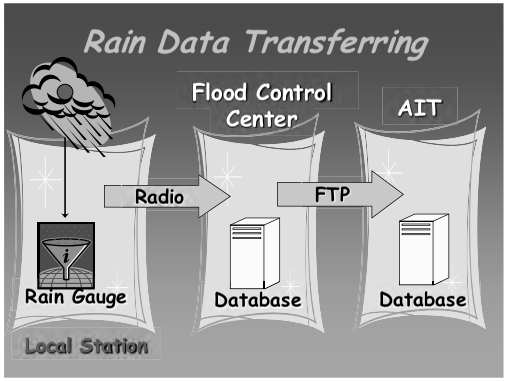
❖ **Sukumvit Area in Bangkok:**

- AIT and DHI, 2002 - 2003
- Model: MOUSE
- Study Area 24 km^2

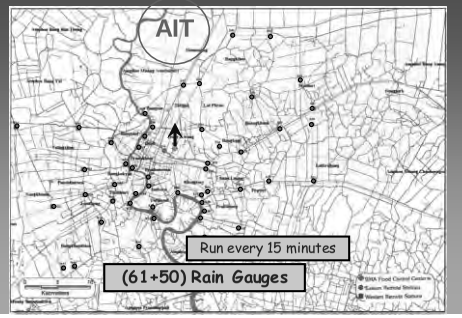
Why ?

- Most important business area in town
- Highly urbanized area
- High traffic

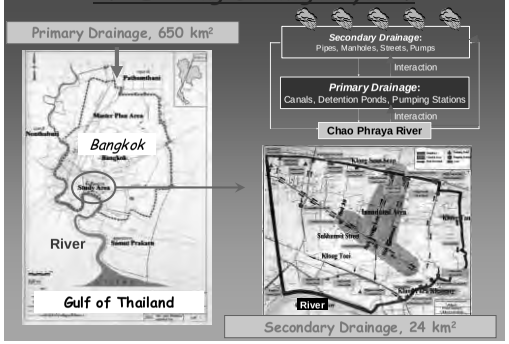
Rain Data Transferring



Rain data in real time to AIT



2.1 Existing Drainage System



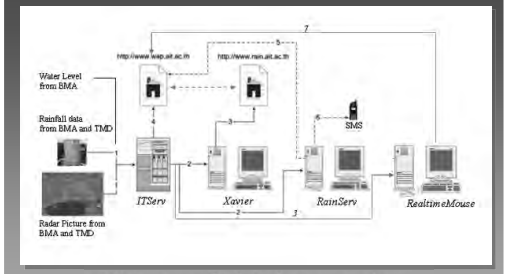
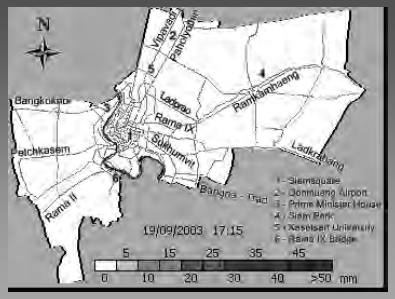
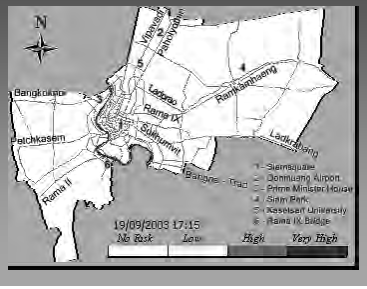


Diagram of database system

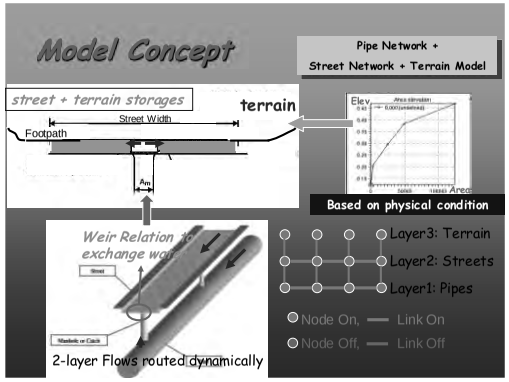
Real time hyetographs

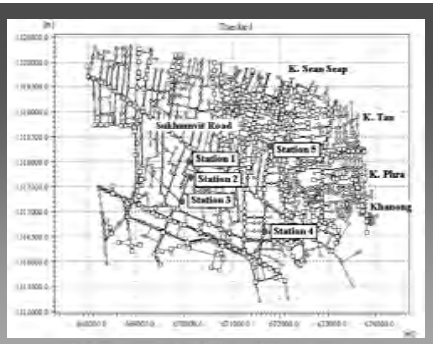


Flood risk maps in real time provides information about locations to avoid



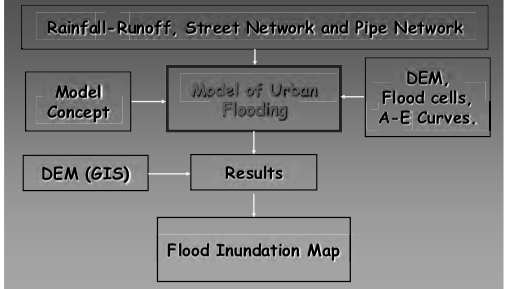
- Urban drainage of Sukumvit area is formulated using MOUSE model.
- There is 2,022 subcatchments. Impervious Area is approximately 12-75 %.
- Drainage network is consist of pipe network and open channel. Connecting points is called link while each location such manholes along network is called node.
- There are totally 2,836 nodes and 3,136 links.

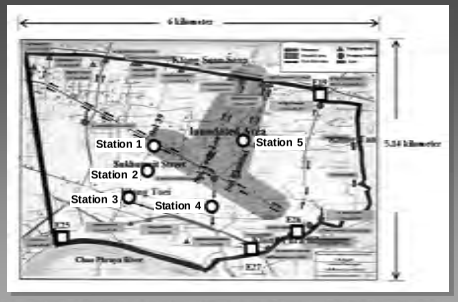




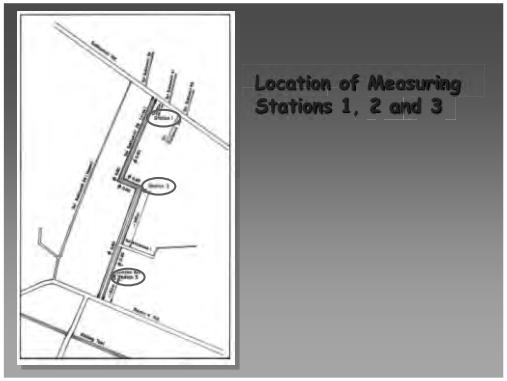
Drainage network in Sukhumvit area

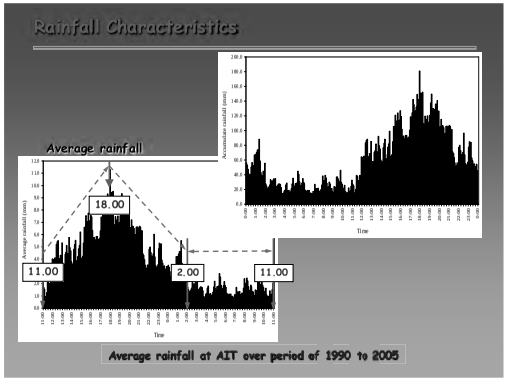
2.2 Model Development

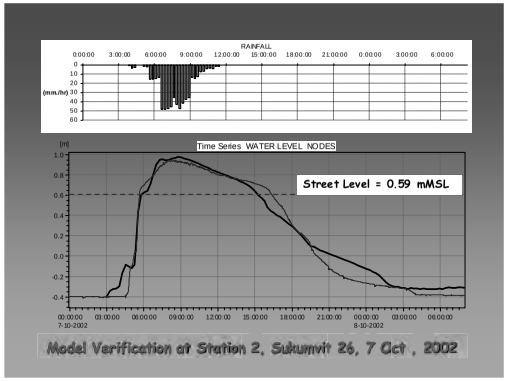




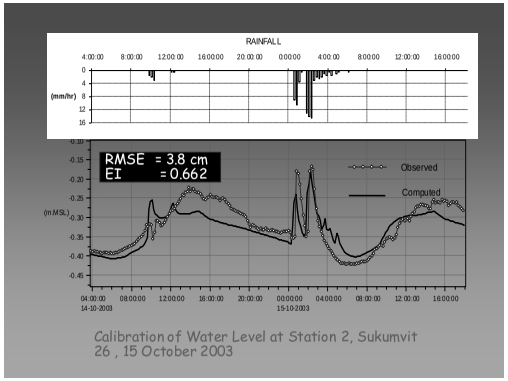
Location of Water Level and Rainfall Stations in Sukhumvit Area

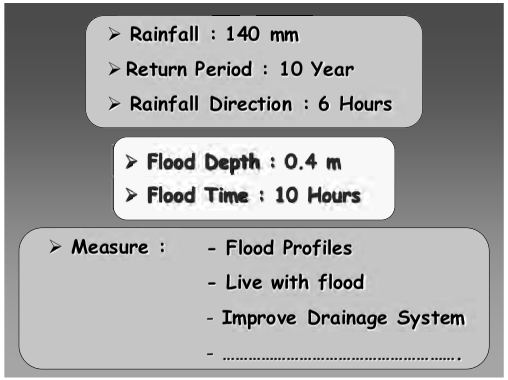

Location of Measuring Stations 1, 2 and 3


Rainfall Characteristics
Average rainfall
18.00
11.00
2.00
11.00
Average rainfall at AIT over period of 1990 to 2005


RAINFALL
Time Series WATER LEVEL NODES
Street Level = 0.59 mMSL
Model Verification at Station 2, Sukumvit 26, 7 Oct , 2002


Installation of Flow Measurement at Sukhumvit Area on October 2003


RAINFALL
RMSE = 3.8 cm
EI = 0.662
Observed
Computed
Calibration of Water Level at Station 2, Sukumvit 26 , 15 October 2003


Rainfall : 140 mm
Return Period : 10 Year
Rainfall Direction : 6 Hours
Flood Depth : 0.4 m
Flood Time : 10 Hours
Measure :
- Flood Profiles
- Live with flood
- Improve Drainage System
- .....

3. Flash Flood in Uttaradit on 22 – 25 May 2006

Three Sub-basins : 1) Mae Phrong (Ampoe Lab Lae)
2) Rit (Ampoe Muang)
3) Li (Ampoe Tha Pla)

Death : 27 + 23 + 29 = 79
Loss : 4 + 0 + 24 = 28
Effect Families : 825 + 924 + 142 = 1,891

Dead Tree at Huay Kam bi, Sub-basin : Mae Phrong (30 June 2006)

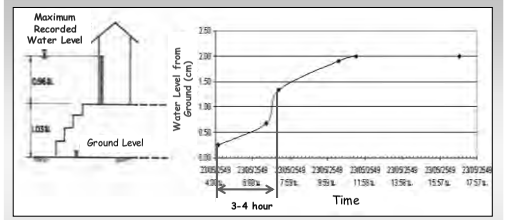
Khun Tongchan's house

Flood depth is 1.4 m wth 0.15 mud in the house, Anphoe Lop Lae, Uttaradit

Location of Sub-basins

Damaged Car at Huang Kam Bi, Sub-basin : Mae Phrong (30 June 2006)

Flood Mark at Khlong Pho, Amphoe Muang, Uttaradit
(30 June 2006)



Recored Water Level at Office of Uttaradit Irrigation Project, Amphoe Muang

Bank Erosion at Huay Nam Li Sub-basin, Bridge Damage only box culvert

Sub-basin	Highest Elevation (m MSL)	Lowest Elevation (m MSL)	Stream Length (km)	Average Slope
Mae Phrong	+660	+60	30	1:17 to 1:375
Rit	+555	+60	35	1:20 to 1:360
Li	+750	+150	50	1:30 to 1:300

Source : Irrigation Regional Office 3

Bank Erosion at Khlong Pho, Nan River (30 June 2006)

- Short Time Flood Occurrance : 4 hr at Amphoe Muang
- High Flood Depth : ~ 2 m with Mud Flow
- Damage : - People in rural and urban are change of river morhology
  - Infrastructures Damage

Sub-basin	Max one day Rainfall (m)m	Return Period (year)	Accumulated 5 days Rainfall (mm)
Mae Phrong	330	375	452
Rit	246	428	206
Li	121	-	172

Source : Irrigation Regional Office 3

It is necessary to warn people in time

Use : - Mathematical model
- Rainfall Data
  - Rainfall Gauge (Field Measurement – TMD
  - Radar

Problem of using radar in Hydrology

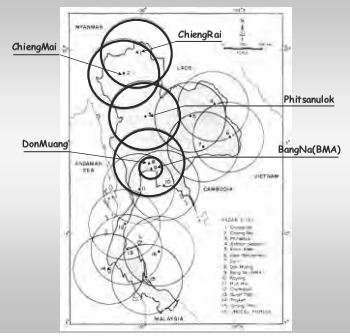
Calibration of Reflectivity (Z) - Rainfall (R)

$$Z = aR^b$$

a = 200 b = 1.6	Marshall & Palmer (1948) (Various Types of Rain)
a = 18.05 b = 1.45	Piman (2007) window correlation matching method (WCMM) [orographic rain]
a = 1.97 b = 1.56	Natapon (2008) (WCMM)

*No calibration process has been done

Data: 5 radar stations



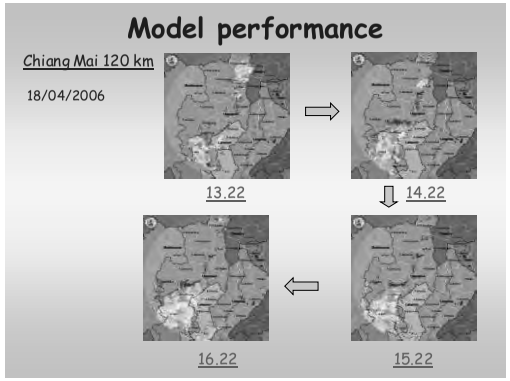
- Problem is Using Radar in Hydrology
- Rainfall forecasting Using Radar Image

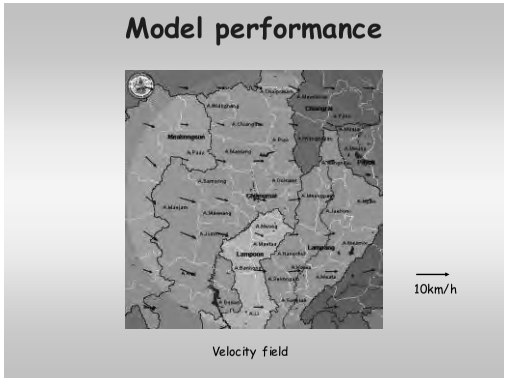
Computed Rainfall

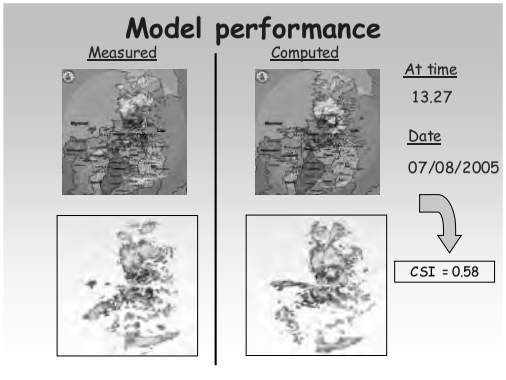
Date	Measured Rainfall (mm)	Computed Rainfall (mm) Natapon Equation	Piman Equation	Marshall Equation
20-May-06	15	11	3	1
21-May-06	120	86	23	4
22-May-06	264	232	64	12
23-May-06	13	35	10	2
SUM	412	364	100	19
16-Sep-06	20	40	10	2
20-Sep-06	48	63	16	3
21-Sep-06	13	65	16	3
SUM	61	128	32	6

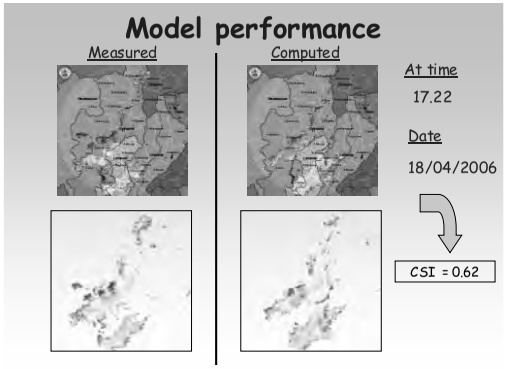
Translation method

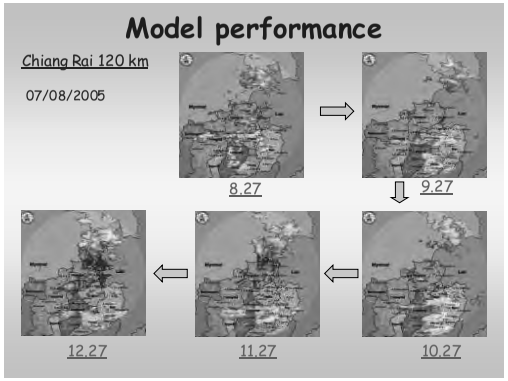
- First developed by Takasao T. and Shiiba M (1984)
- Estimate movement of rainfall or reflectivity using past and current rainfall data
- Parallel translation vector, rotation, shearing strain and expansion of rainfall pattern
- Extension of cross-correlation method

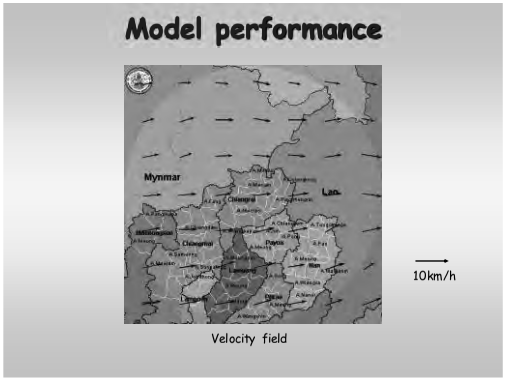

Model performance
Chiang Mai 120 km
18/04/2006
13.22
14.22
15.22
16.22


Model performance
10km/h
Velocity field


Model performance
Measured
Computed
At time
13.27
Date
07/08/2005
CSI = 0.58


Model performance
Measured
Computed
At time
17.22
Date
18/04/2006
CSI = 0.62


Model performance
Chiang Rai 120 km
07/08/2005
8.27
9.27
10.27
11.27
12.27


Model performance
Mynmar
Lao
10km/h
Velocity field

Rainfall forecast by radar

Station	CSI(%)			
	Max	Min	Mean	Standard deviation
BangNa	88.13	12.5	51.3	24
DonMuang	82.6	37.5	58	13.5
Pitsanulok	81.6	35.5	60.2	13.3
ChiengMai	83.2	32.1	56.6	14.3
ChiengRai	84.6	31.7	64.4	13.1

Conclusion

	Chao Phraya	Sukumvit Area	Uttaradit
Spatial Scale	Regional Scale (River Basin)	Sub-basin Scale	Sub-basin Scale
Time Scale of Flood	Months	day	Day
Geographical Condition	Flat Area	Flat Area	Hill Slope (cause high velocity huge damage)
Tool	AIT River Network Model	Drainage Model & Rainfall Forecast	Rainfall forecast
Management	·Flood fighting/Proofing ·Live with flood ·..... ·Engineering Approach	·Flood Proofing ·Live with flood ·Improve Drainage System	·Evacuation ·Construct Reservoir

Link of Sustainable Forest and Safe Timber Houses by User Oriented Data Integration

Prof. Tomonari Yashiro
Institute of Industrial Science
The University of Tokyo, JAPAN

Link of sustainable forest and safe timber houses by user oriented data integration

Tomonari Yashiro
Institute of Industrial Science
University of Tokyo

Outline of presentation

1. Self introduction - GIS interface for supply/demand chain design of regional biomass
2. 'SMILE' system - Residents aided interface for house history records for user oriented data integration
3. Support system for management of information, living, and environment
4. Input to SMILE system - Photos/images record of construction procedure
   especially on reinforced hardware installation to timber houses
5. Input to SMILE system - Provision of evidence of products from sustainable forest and traceable engineering data

1 Self introduction - GIS interface for supply/demand chain design of regional biomass

Japanese Context of Biomass Resources

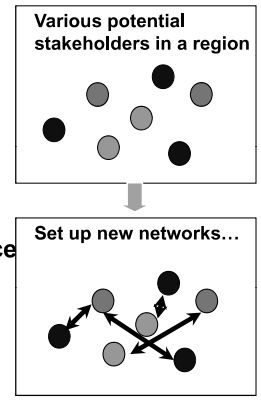
Dependency on local conditions and their variety

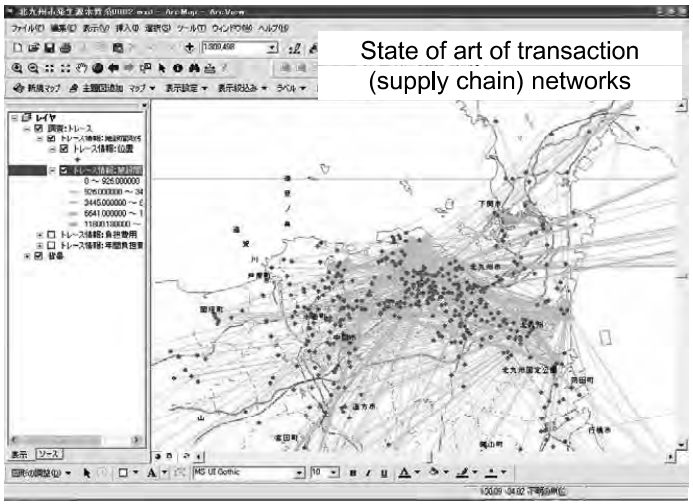
- **Various biomass resources from forest / agricultural industry and from industrial / domestic wastes.**
- **However, geographically, biomass resources are generated and exist in low density manner**

Need of feasible demand/supply chain system suitable for unique regional conditions

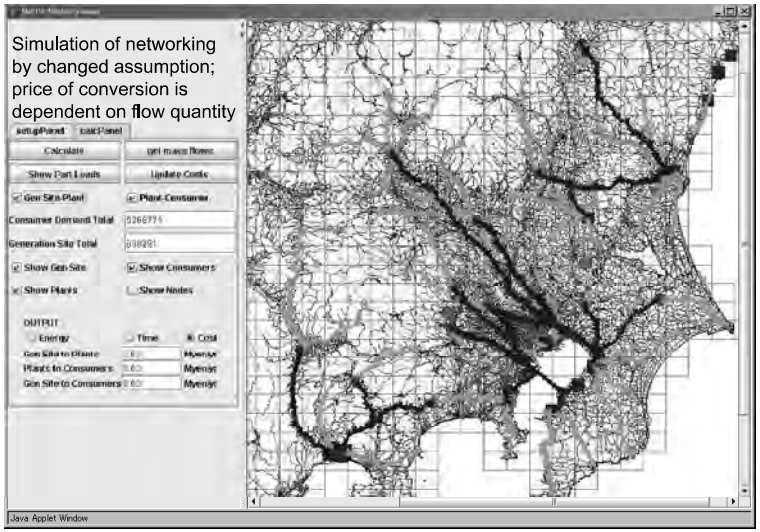
(1) Regional data base with GIS interface
(2) Simulation tool development for demand/supply chain design
(3) Monitoring system of biomass logistics
(4) Movable biomass generator

Demand / Supply Chain Design





5



再計算前 （中間処理施設が、稼働率によって、処理コストを上下 ⇒ 輸送ルートが変わる）

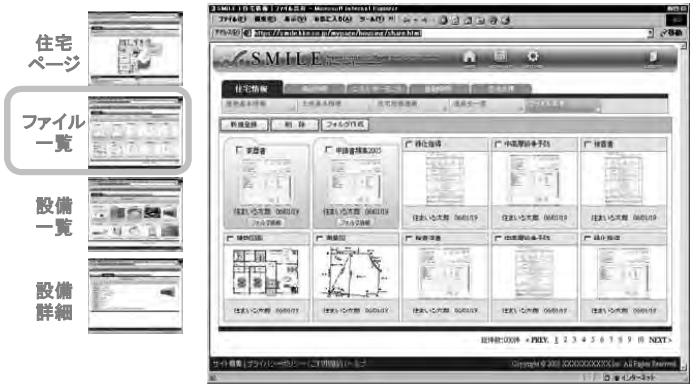
2 Residents aided interface for house history records for user oriented data integration

‘SMILE’ system

Support system for management of information, living, and environment

1 Display of schematic design

2 Detailed drawings + inspection record
+ photos during construction process
+ maintenance records



3 Maintenance records

登録した情報は
PDFファイルで印刷可能

資産価値を評価

4 energy monitoring records

電気・ガス・水道などCO_2排出源を
トータルにモニタリング

月々の使用量をロボットで『自動収集』

3 Photos/images record of construction procedure
especially on reinforced hardware installation to timber houses

Input to SMILE system

4 Provision of evidence of products from sustainable forest and traceable engineering data

Input to SMILE system

Monitoring system of biomass logistics

Legislated “Electric Manifesto” for wastes

+ Management of Container IDs (by RF tugs)

+ Tracing trucks by GPS

As the identity of each container is made clear, single truck can pick up biomass resources from several sites.

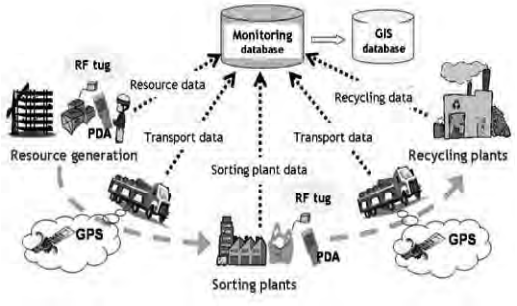
The quality is controllable with this system. Thus the value of the resource can be higher.

This can result in distribution of trucks flexible.

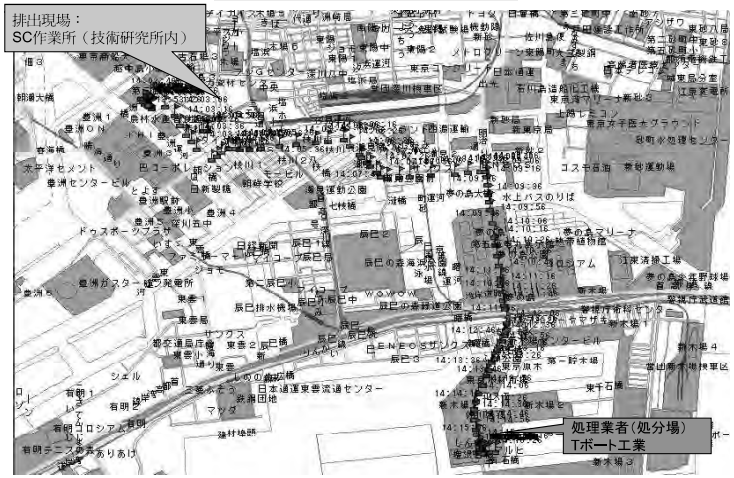
Data analysis can make logistics efficient.

an RF tug on a container

Reading an RF tug

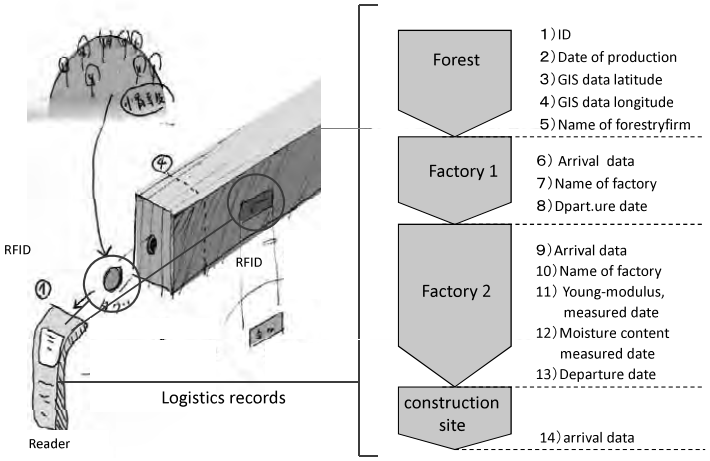


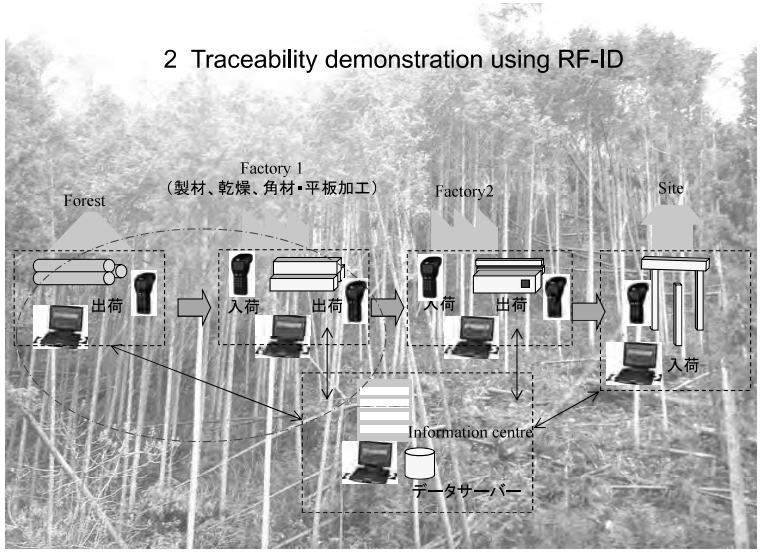
Trace of traffic using GPS



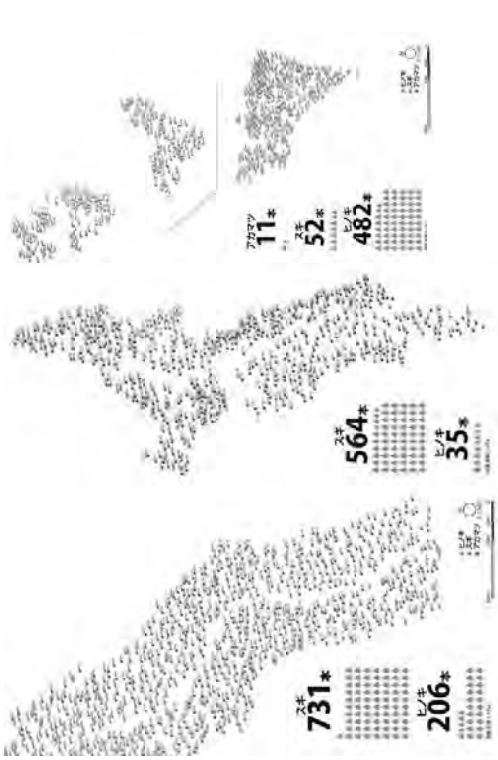
Japanese forest industry

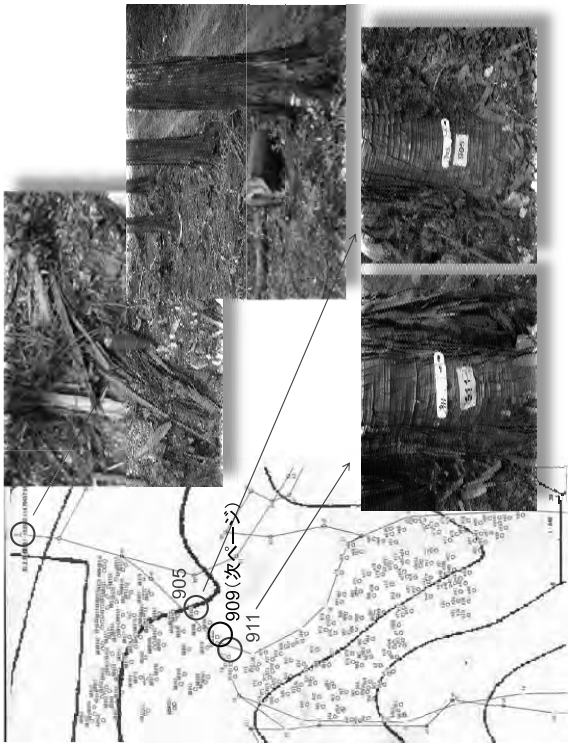
- Certain potential among unused biomass
- However, forest industry is rapidly declining industry
- Need of regeneration of forest industry by assurance of sustainable forest products and by assurance of engineering data





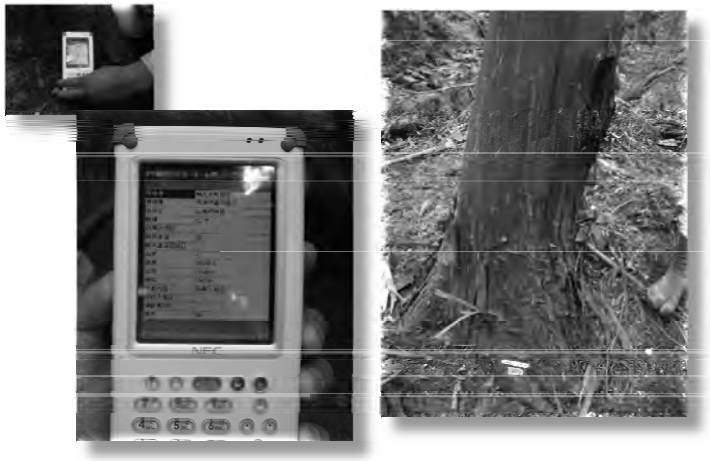
Individual timber based map





Individual timber recorded forest

Input of data to RFID

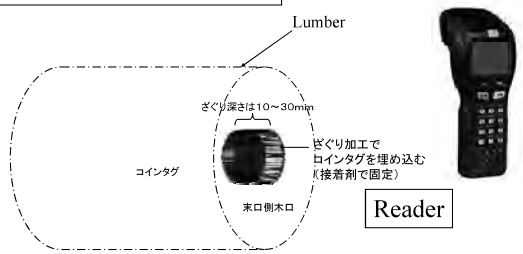


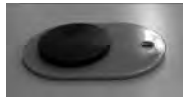
Latitude/Longitude identification by Digital Compass

◆デジタルコンパスによるデータ計測数：70～100本/日・2人
◆今年度中に4～5,000本を整備の予定

RF-ID Tag

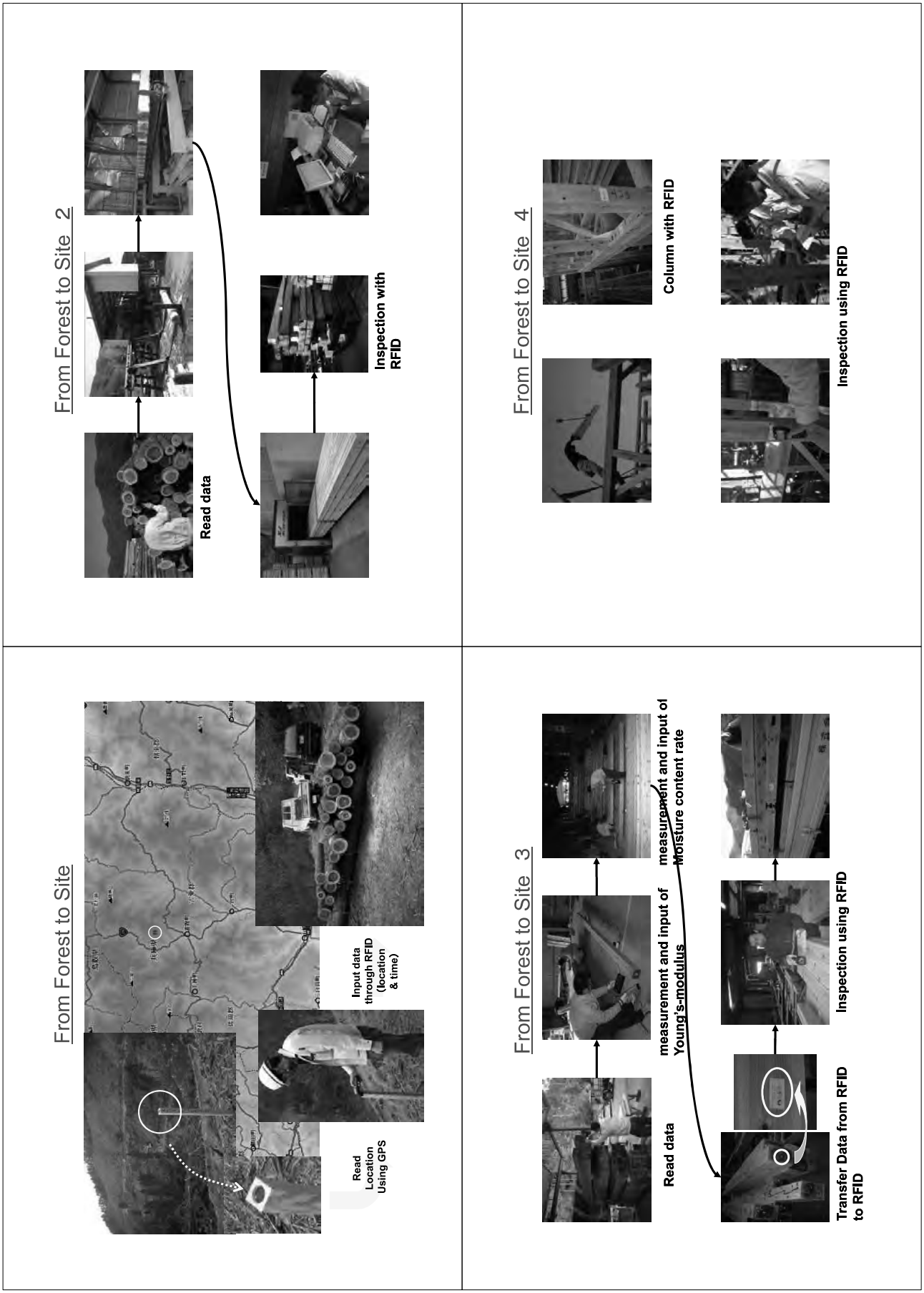
Contains information on quality + “birth place”





コインタグ実物（緑の台座は今回の実験とは無関係）

UC：Ubiquitous communicator by Prof. Sakamura


From Forest to Site 2
Read data
Inspection with RFID
From Forest to Site 4
Column with RFID
Inspection using RFID
From Forest to Site
Read Location Using GPS
Input data through RFID (location & time)
From Forest to Site 3
Read data
measurement and input of Young's-modulus
measurement and input of moisture content rate
Transfer Data from RFID to RFID
Inspection using RFID

Transportation Management in Disaster

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Transportation Management in Disaster

Feb 8, 2008
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RNUS/TRE, AIT
ICUS, IIS, The Univ. of Tokyo

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Background

- Transportation in disaster (earthquakes)
  - damage of road network
  - unusual traffic demand
  - ⇩
  - Serious traffic congestion
  - Troubles in rescue & recovery activities

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Traffic management plan for disaster

- Designed in disaster prevention plans by local governments
  - Reservation of emergency routes
  - Traffic regulation (road closure) in the event
- Does it really work in a disaster?

emergency routes in Tokyo

road sign

3

Purpose of the analysis

- Estimation of traffic demand in disaster
  - demand related to disaster – unclear
- Scenario evaluation by traffic simulation
  - to evaluate unrealized situation
  - ⇩
- Case study in Tokyo

Toward establishment of traffic management strategies to maintain the network performance

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Estimation of traffic demand

- Scope
  - traffic demand related to disaster by general public
- Assumption
  - traffic demand – in proportion to the population
  - trip generation rate – common in nationwide
- Source
  - "Human traffic behavior in disaster", by Japan Safe Driving Center, 1997
    - a questionnaire survey to drivers who experienced the Hanshin-Awaji Earthquake Disaster
  - "Damage estimation by Tokyo inland earthquake", by Tokyo Metropolitan Government, 1997

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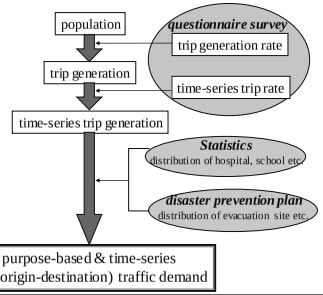
Flow of traffic demand estimation



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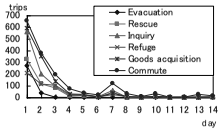
Trip purposes & Time-series trip rate

- Evacuation
  - temporary evacuation & refuge
- Return home
  - from work, school and goods acquisition
- Rescue & Inquiry
  - to inquire after friends & relatives
- Goods acquisition
  - not including daily shopping
- Commute
- Time-series trip rate
  - set referring Hanshin-Awaji Earthquake experience



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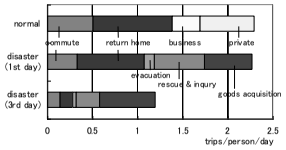
Case study in Tokyo

- Damage estimation in Tokyo
  - Magnitude: 7.2
  - Intensity distribution
  - Fatalities, facility damages

- Result
  - demand by purposes



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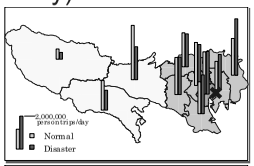
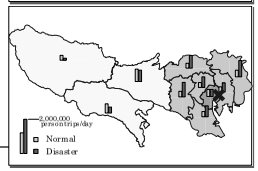
Trip generation (1st day)

- All modes

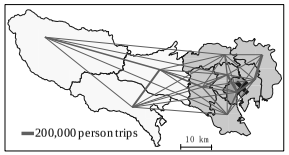


- Vehicles

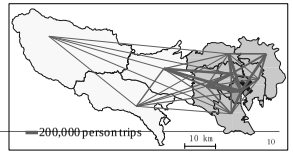


Trip distribution of vehicles (1st day)

- Normal



- Disaster



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Traffic simulation for scenario evaluation

- Requirements
  - To reproduce traffic condition
  - To describe traffic regulation in disasters

Tokyo road network

nodes : 418
links : 1,400
centroids : 70

red : closed
blue, green: half capacity

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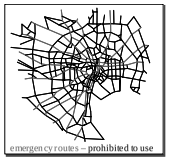
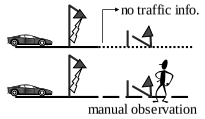
Scenarios

1. Effect of emergency routes
   - Regulated immediately
   - Regulated 5 hrs later
2. Validity of traffic information
   - Information missing
   - Supplement by info with 20% errors
3. Demand restraint
   - 70% reduction from the total demand





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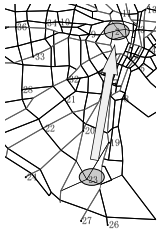
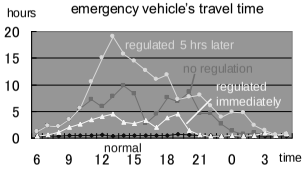
1. Effect of emergency routes



—: emergency routes



- Travel time becomes shorter by emergency routes.
- Access & Egress time is dominant.
- Situation becomes worse if regulation delayed.

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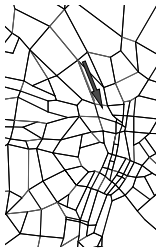
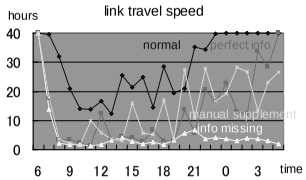
2. Validity of traffic information



—: link travel time information missing



- Congestion get worse by information missing.
- Situation improved even by info with 20% errors.

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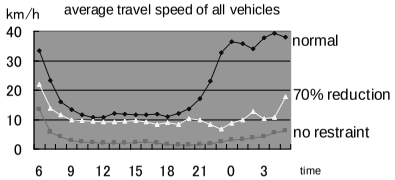
3. Demand restraint



- 70% reduction needed to get avg. speed of 10km/h.

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Summary

- Demand estimation
  - A measure to estimate unusual traffic demand is proposed.
  - Returning home is large at first, then goods acquisition becomes large.
- Scenario evaluation
  - A couple of scenarios are evaluated by simulation.
  - Emergency routes should be regulated immediately.
  - To collect accurate traffic information is important.
  - Traffic demand should be restrained to maintain the network performance.

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Utilization of Remote sensing / GIS technologies

- To implement appropriate traffic management, accurate information collection is very important.
- We need to cover quite a wide area in a very limited time.

⇩

- Remote sensing / GIS technologies can be good and powerful tools.

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Examples of implementation

- Remote sensing
  - detection of road blockage by collapsed buildings
  - detection of traffic congestion?

road closure

- GIS
  - information collection / sharing
    - Web GIS
  - planning of traffic management strategies
    - in the event / in advance

trafficable map

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