# Ⅸ-1 Program

**The 14th Conference on Public Works Research and Development in Asia**

## The 14th International Symposium on National Land Development and Civil Engineering in Asia

*Flood, Sediment and Tsunami Related Disasters in Asia*

Thursday October 27, 2005
13:10 - 17:00

Sendai International Center

National Institute for Land and Infrastructure Management (NILIM)
Ministry of Land, Infrastructure and Transport (MLIT)
JAPAN

〔Contents〕

| | | |
|---|---|---|
| 13:10–13:20 | Opening Address | Mr. Tsuneyoshi MOCHIZUKI<br>Director General, NILIM, MLIT |
| | Guest Address | Mr. Michio TANAHASHI<br>(for Mr. Masato SEIJI, Vice Minister for Engineering Affairs, MLIT) |
| | Overseas Participant's Address | Mr. Nguyen Xuan Hien from Vietnam |
| 13:20–14:20 | Keynote Speech | |

**"Global Disaster – Lessons from the 2004 Sumatra Earthquake and Indian Ocean Tsunami"**

Prof. Fumihiko IMAMURA
Professor, Disaster Control Research Center,
Graduate School of Engineering, TOHOKU UNIVERSITY

**The earthquake of M9.0 took place on December 26, 2004, followed by the oceanic tsunami affecting all coast in the Indian Ocean. The number of casualties in the ocean exceeds 200,000. We carried out the field survey and numerical analysis to clarify the mechanism of the source and damage in the suffered areas. The video and satellite information are also compiled to have the lesson*

| | | |
|---|---|---|
| 14:20–14:30 | Case of Japan<br>Mr. Tsuneyoshi MOCHIZUKI, Director General, NILIM | |
| 14:30–14:45 | Case of Tohoku District<br>Mr. Masaharu SHINOHARA, Director, River Department, Tohoku Regional Bureau, MLIT | |
| 14:45–15:00 | Case of Korea<br>Dr. Chang Wan KIM<br>Research Fellow, Korea Institute of Construction Technology | |
| 15:00–15:15 | Setting up the International Centre for Water Hazard and Risk Management (ICHARM) under the auspices of UNESCO<br>Mr. Akira TERAKAWA<br>Director, Secretariat for Preparatory Activities of UNESCO-PWRI Centre, Public Works Research Institute | |
| 15:15–15:35 | Break | |
| 15:35–16:55 | **Panel Discussion**<br>**"Flood, Sediment and Tsunami Related Disasters in Asia"**<br>〔Chair: Mr. Ryosuke TSUNAKI, Director, Research Center for Disaster Risk Management〕 | |

〈PANELISTS〉

| | |
|---|---|
| 1. Prof. Fumihiko IMAMURA | Professor, Disaster Control Research Center, Graduate School of Engineering, TOHOKU UNIVERSITY |
| 2. Mr. Tsuneyoshi MOCHIZUKI | Director General, NILIM |
| 3. Mr. Masaharu SHINOHARA | Director, River Department, Tohoku Regional Bureau |
| 4. Dr. Bunna YIT | Director, Public Works Research Center, Ministry of Public Works and Transport, Kingdom of Cambodia |
| 5. Mr. Janak Jerambhai SIYANI | Chief Engineer (R&B) & Add Secretary, Roads & Buildings Department, Government of Gujarat, India |
| 6. Dr. Chang Was KIM | Research Fellow, Water Resources Research Department, Korea Institute of Construction Technology, Republic of Korea |
| 7. Mr. Keophilavanh APHAYLATH | Director General, Urban Research Institute, Ministry of Communication, Transport, Post and Construction, Lao People's Democratic Republic |
| 8. Ms. Rebecca Trazo GARSUTA | Chief, Development Planning Div. Planning Service, Dept. of Public Works and Highways (DPWH) Republic of the Philippines |
| 9. Mr. Akkapong BOONMASH | Director, Improvement and Maintenance Division, Office of Hydrology and Water Management, Royal Irrigation Department, Ministry of Agriculture and Cooperatives, Kingdom of Thailand |
| 10. Mr. NGUYEN Xuan Hien | Deputy Director, Sub-Institute for Water Resources Planning (SIWRP), Ministry of Agriculture and Rural Development, Socialist Republic of Viet Nam |

| | | |
|---|---|---|
| 16:55–17:00 | Closing Address | Mr. Shin-ichiro TANAKA (for Mr. Norio MORINAGAI, Director General, Tohoku Regional Bureau, MLIT) |

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17:30-19:00 Reception hosted by Vice Minister for Engineering Affairs, MLIT

# Global disaster; Lessons from the 2004 Sumatra Eq. and Indian ocean tsunami

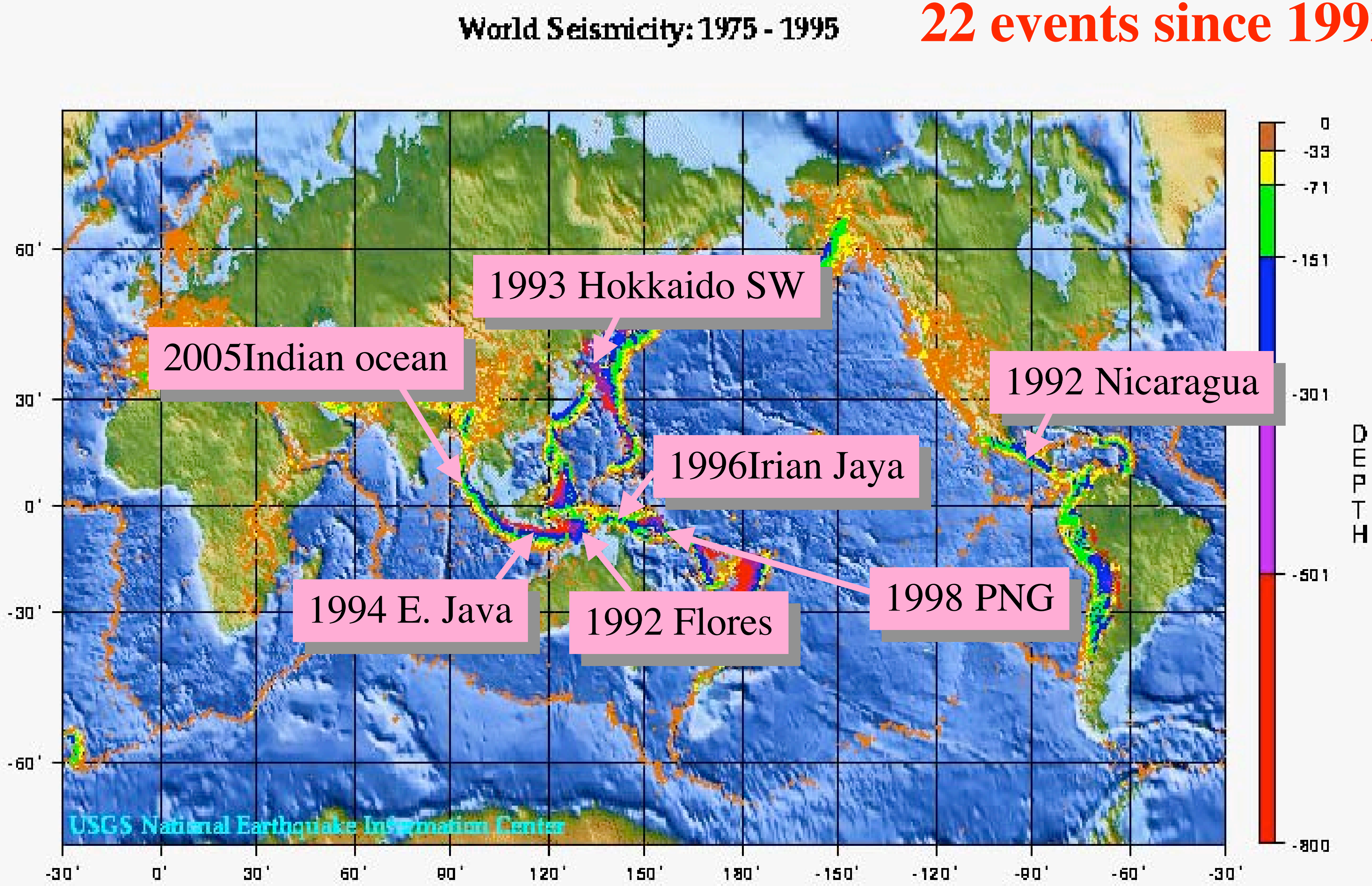
F.Imamura
Prof. Tsunami Eng, DCRC, Tohoku Univ.

- **Recent tsunamis in Asia and Pacific regions**
- **1993 Okushiri in Hokkaido, Japan**
- **1998 Aitape in PNG**
- **2004 Sumatra Eq. And Indian Ocean Tsunami**
  - **Damage in SW coast in Sri Lanka**
  - **Damage at Banda Aceh in Indonesia**
- **Community based workshop to make regional hazards map**

DCRC TSUNAMI ENGINEERING

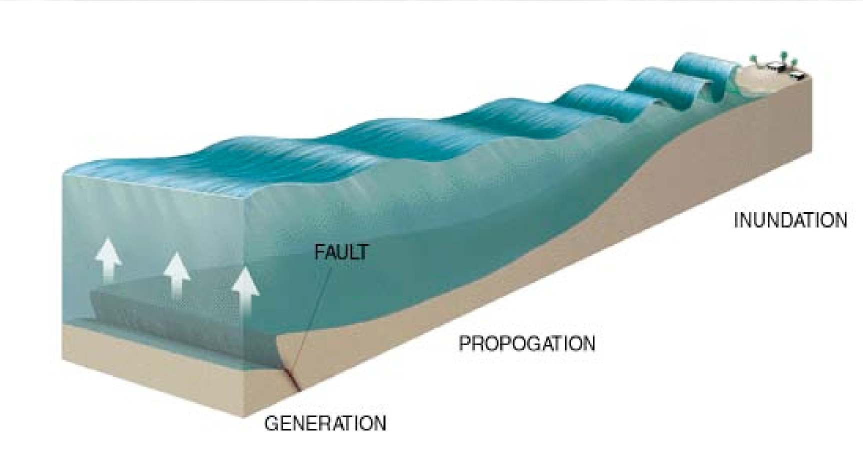
# Recent Major Tsunami Disasters

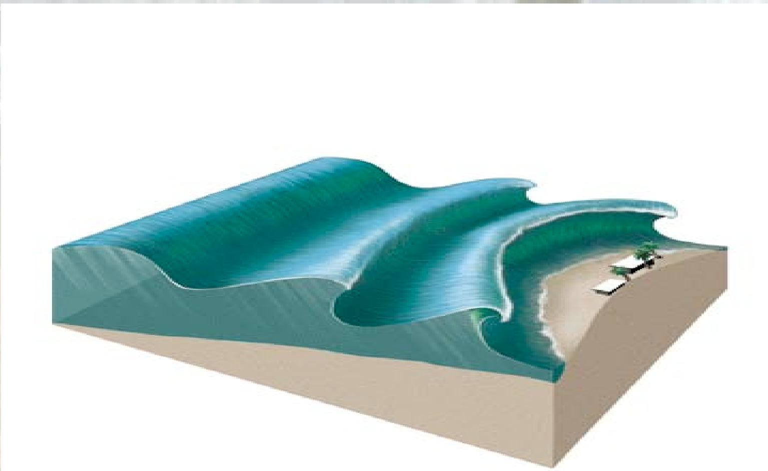
**22 events since 1992**



# Tsunami Wave System

- Generation
  - A seafloor disturbance, such as motion along a fault, pushes up and down the overlying water.
- Propagation
  - The wave propagates across the deep ocean at jetliner speeds
  - Shoaling and refraction to amplify the wave
- Inundation
  - As the wave moves into shallower water, increased energy density increases both the wave height and the currents.
  - Runup on a land and run-down



# 1993 Hokkaido SW, Multiple Disaster

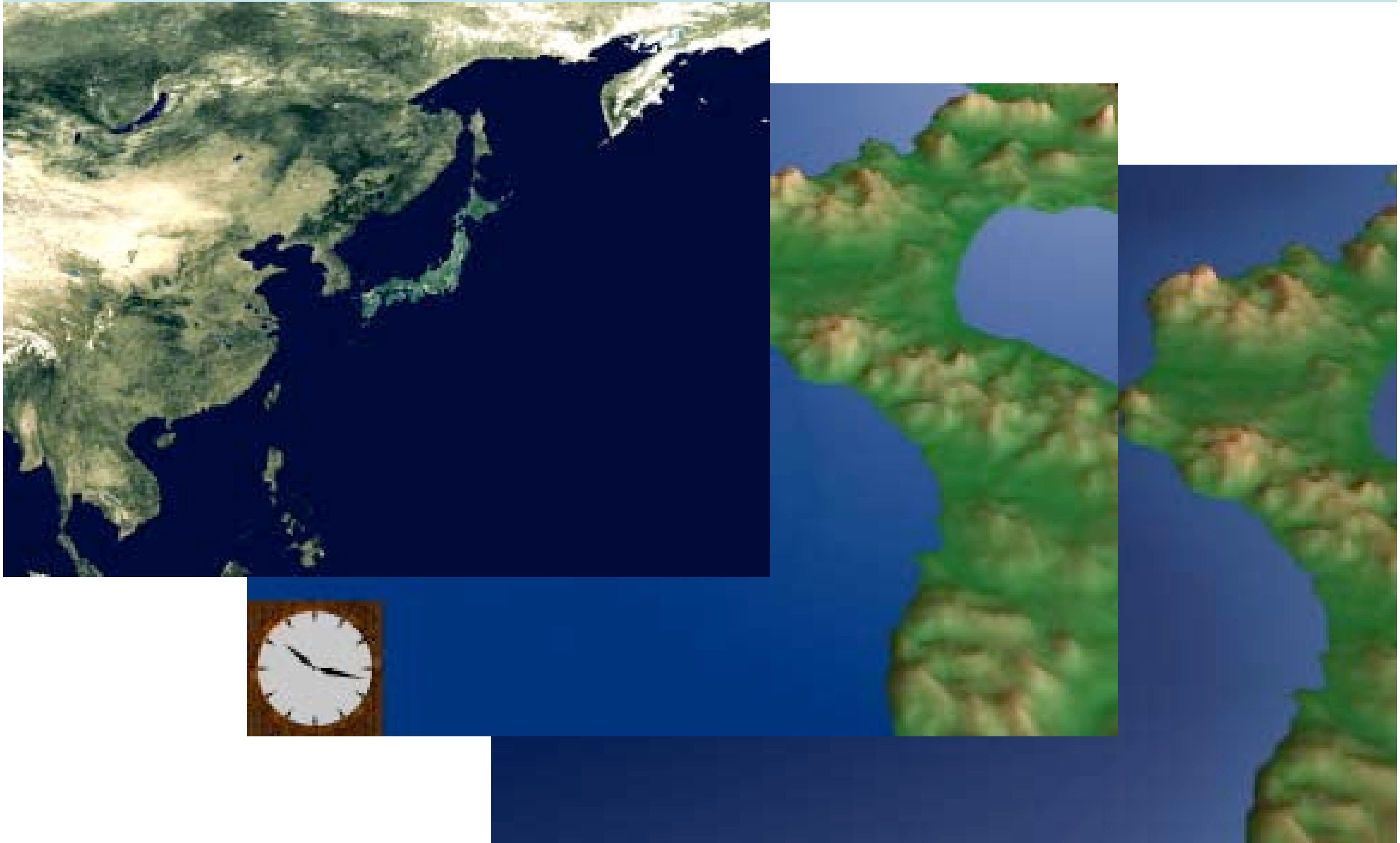

1. Earthquake

2. Tsunami

3. Fires

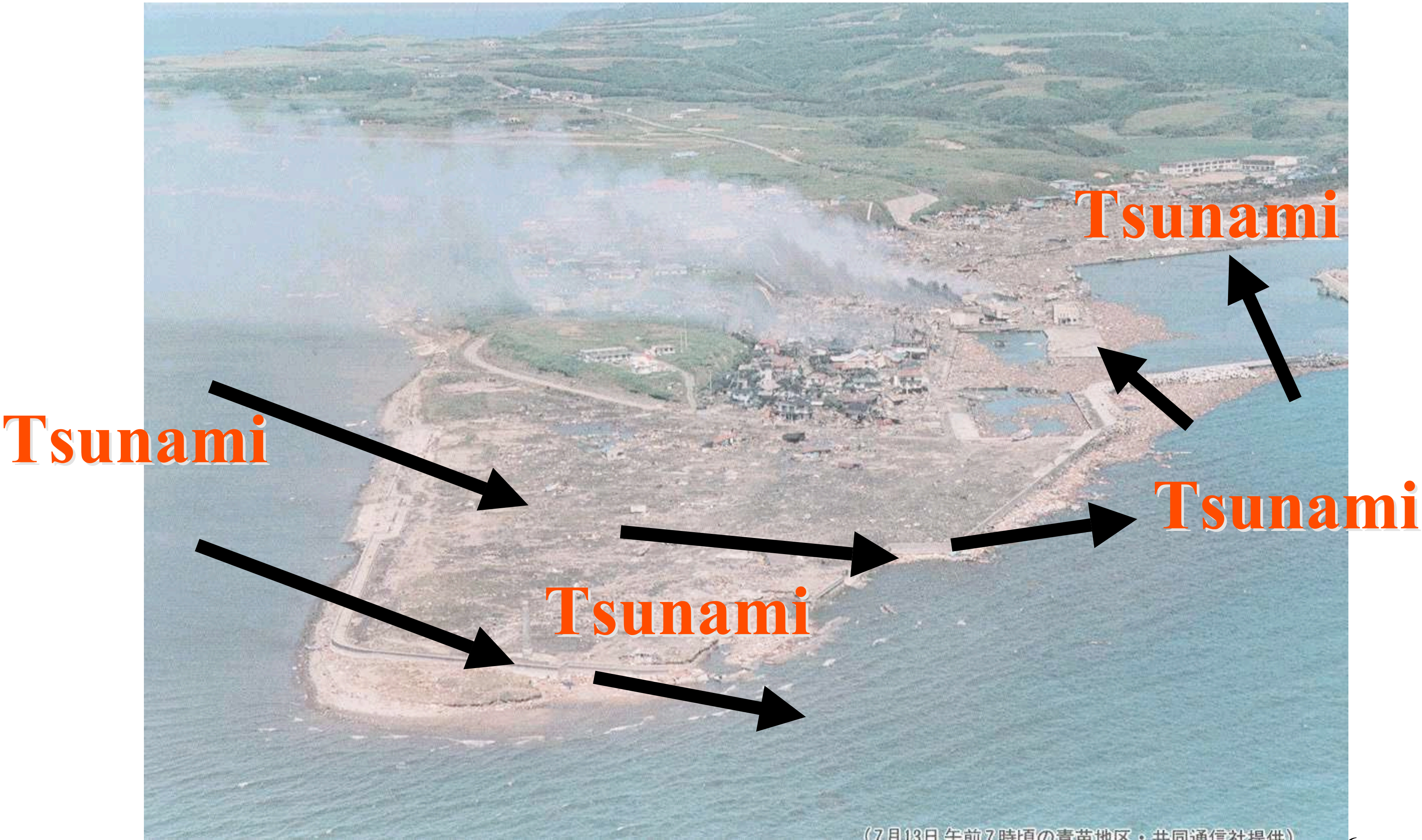
- 12 July 1993
- Magnitude of the earthquake: M 7.8
- Maximum wave height: 31m
- Fatalities: 239 (198 in Okushiri)
- Fire and landslide as secondary disaster
- Tsunami arrival: 2 - 3 minutes(Inaho)
  5 minutes (Aonae)

# 1993 Hokkaido SW Tsunami



# Aonae District, Okushiri Is.

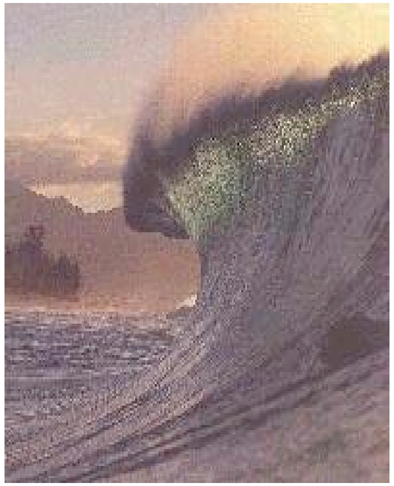
Tsunami and fires devastated this fishermen’s town.






At 7 am 13 July 1993, Kyodo

# PNG Tsunami Awareness Pamphlet/Booklet Project



**17 July 1998**

**Magnitude of the earthquake:**

**M 7.1**

**Maximum wave height: 15m**

**Fatalities: more than 2,200**
**cause: earthquake.**

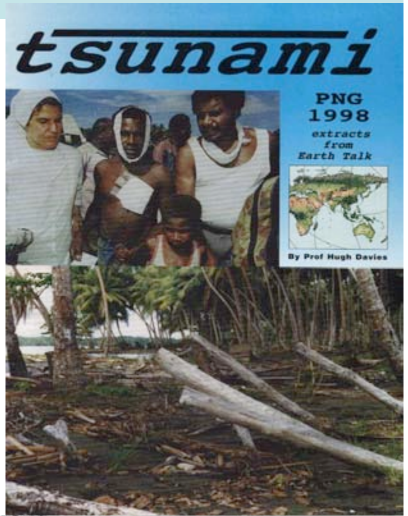
**In addition, submarine landslide?**

# Why Such Disaster?

- Aitape at PNG was attacked by the tsunami in 1907 and by the earthquake in 1935.
- The past disaster experiences had not been transferred to the present generations sufficiently.
- People did not know what to do when they felt strong ground motion.
- People lived on the low-lying areas without knowing such risk. No place for evacuation.

# Awareness with experts

- Booklet “Tsunami PNG 1998”, ADC
- Tsunami awareness pamphlet/booklet/video
- All PNG children have learned about tsunamis at schools

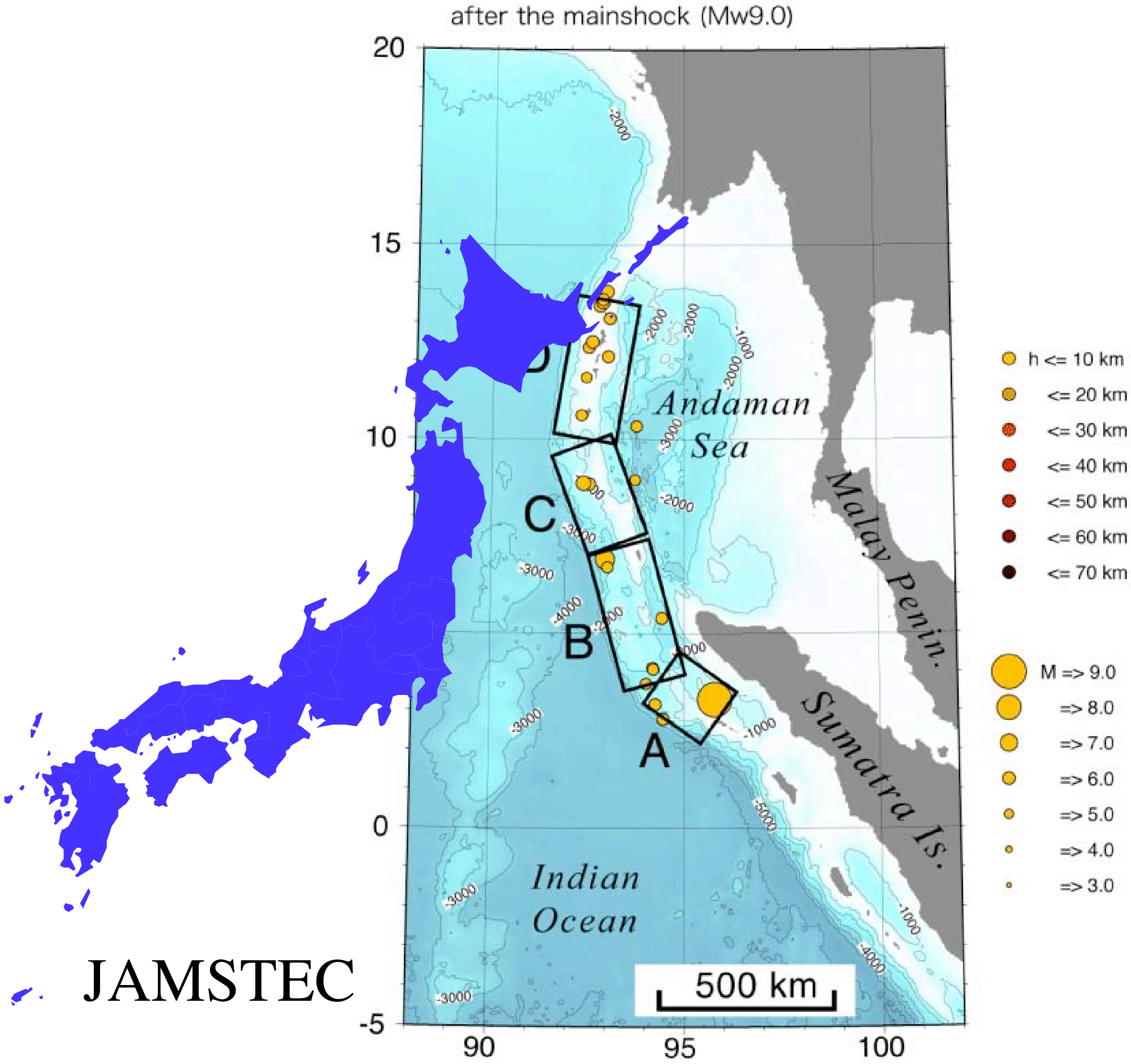



PARTIC (PNG and Region Tsunami Conference) Sep. 1999

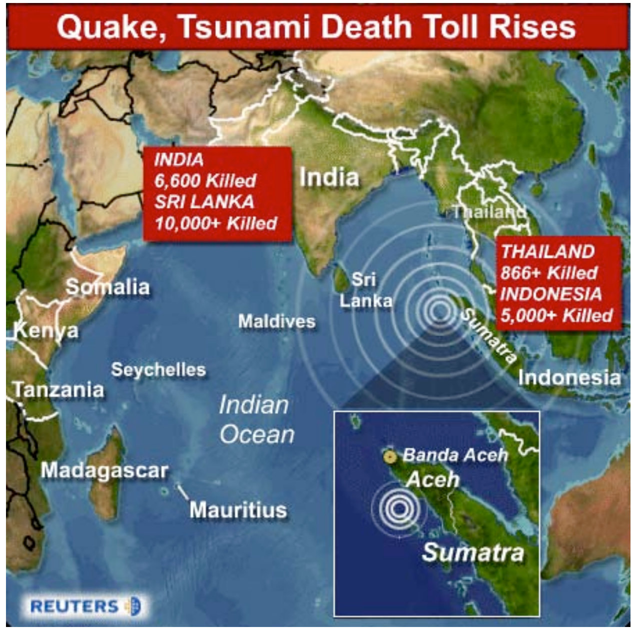
1. Public Awareness to visit the areas, talk with the people
2. Tsunami Science Information
3. Disaster Management

F.Imamura, DRCR

# 2004 Sumatra Earthquake M=9.0 & Indian ocean tsunami




JAMSTEC

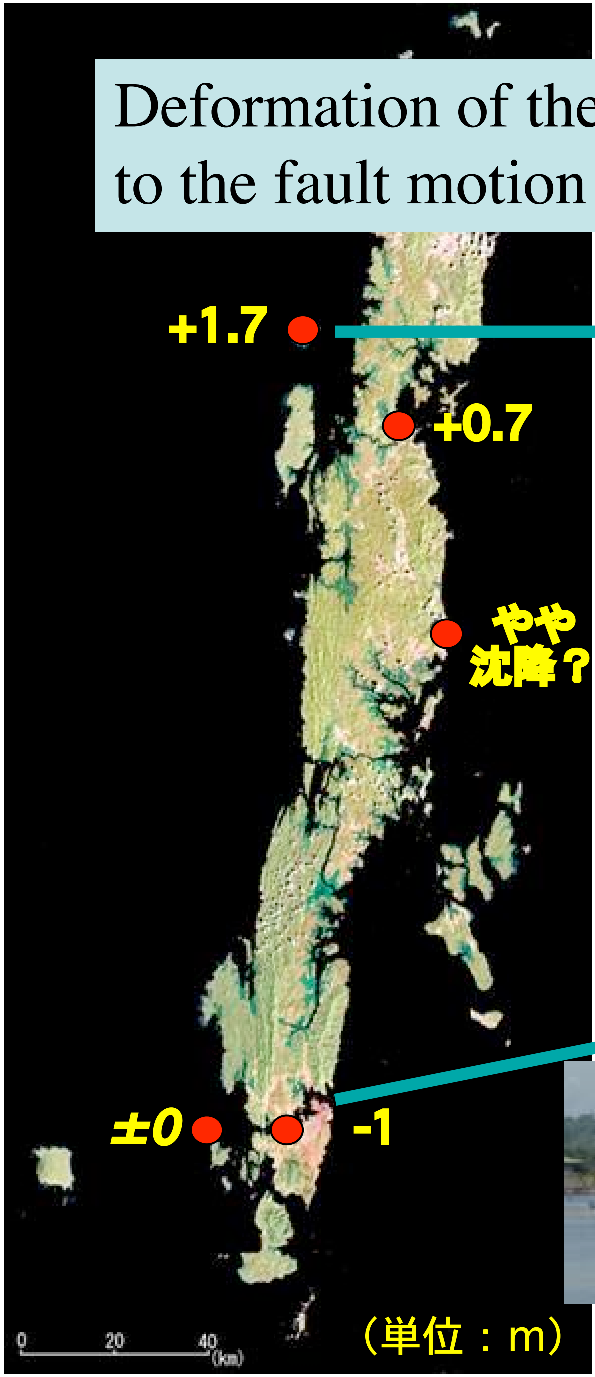


# Earthquake & Tsunami generation, Propagation

# アンダマン諸島における地殻変動（暫定値）

東京大学・産総研

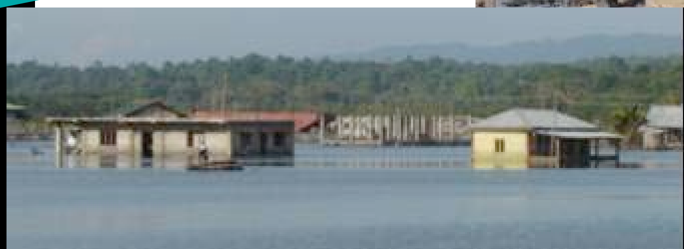
Deformation of the sea floor and land due to the fault motion




隆起した地域

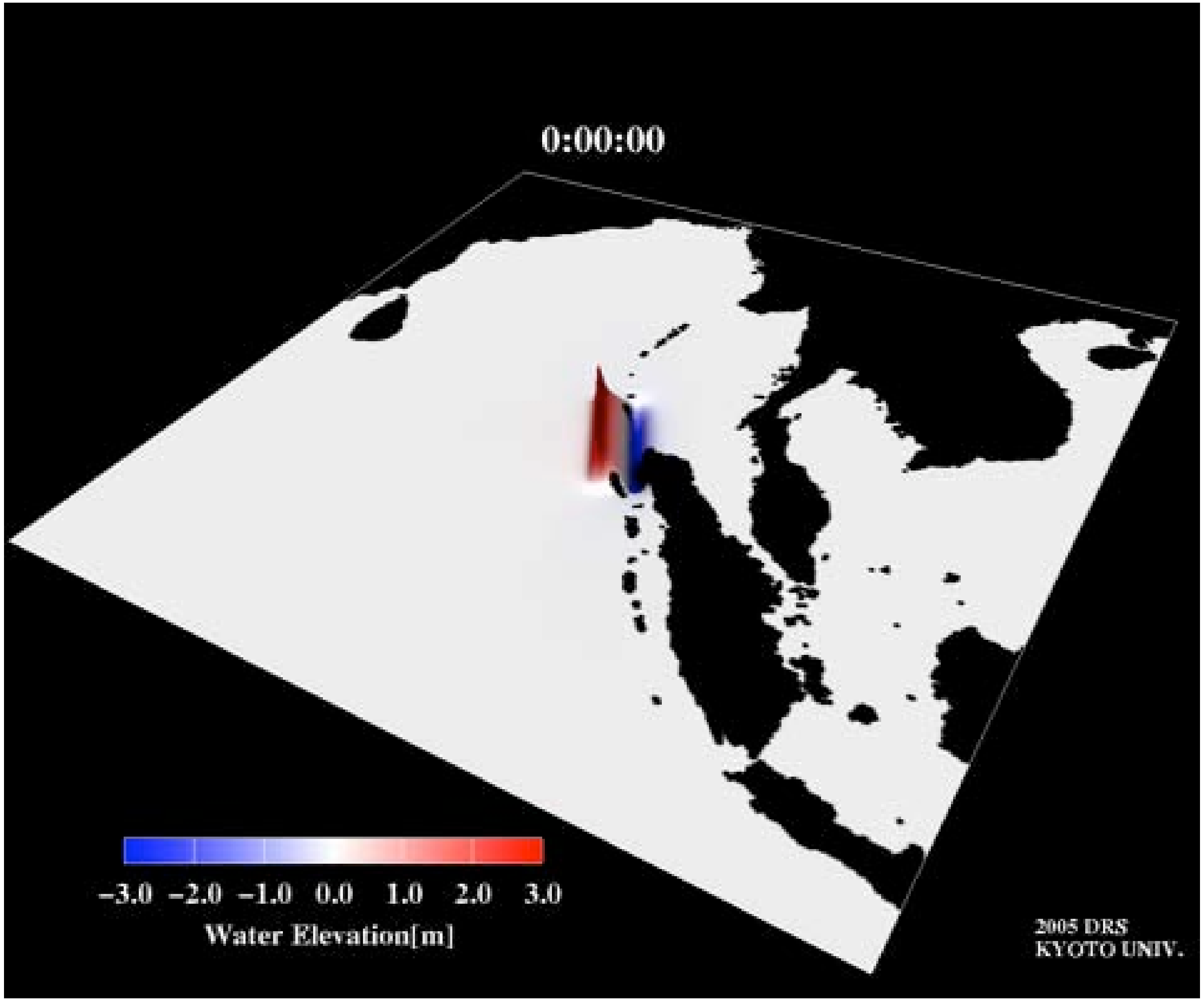
地震隆起によって離水し，一斉に死滅した各種のサンゴ群体．
北アンダマン島西方 North Reef.

沈降した地域

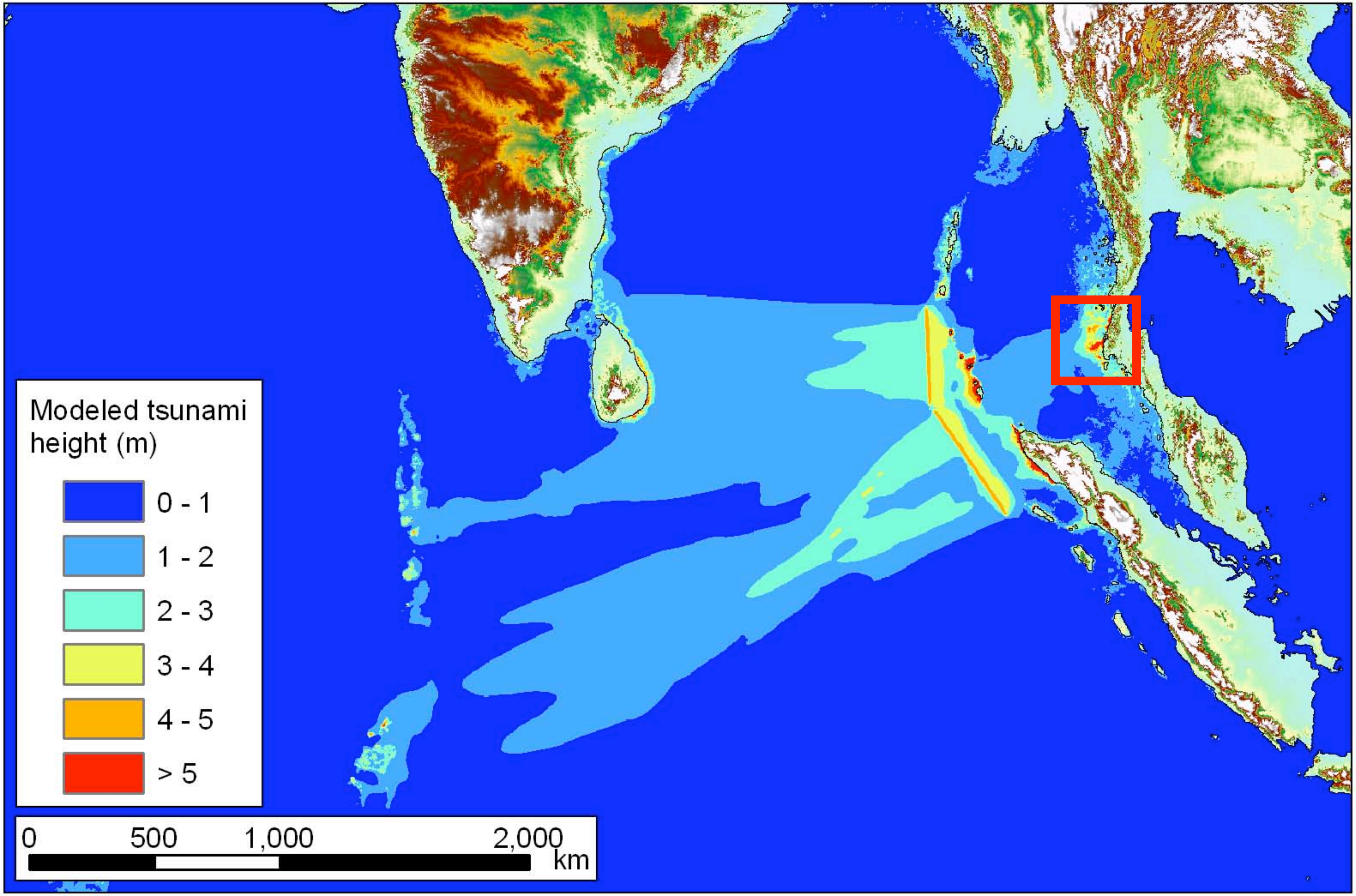


沈降のため，満潮時には家屋床上まで浸水する．南アンダマン島 Wandoor付近．

# The 2004 Tsunami Generation and Propagation
# By DPRI, Kyoto Univ.



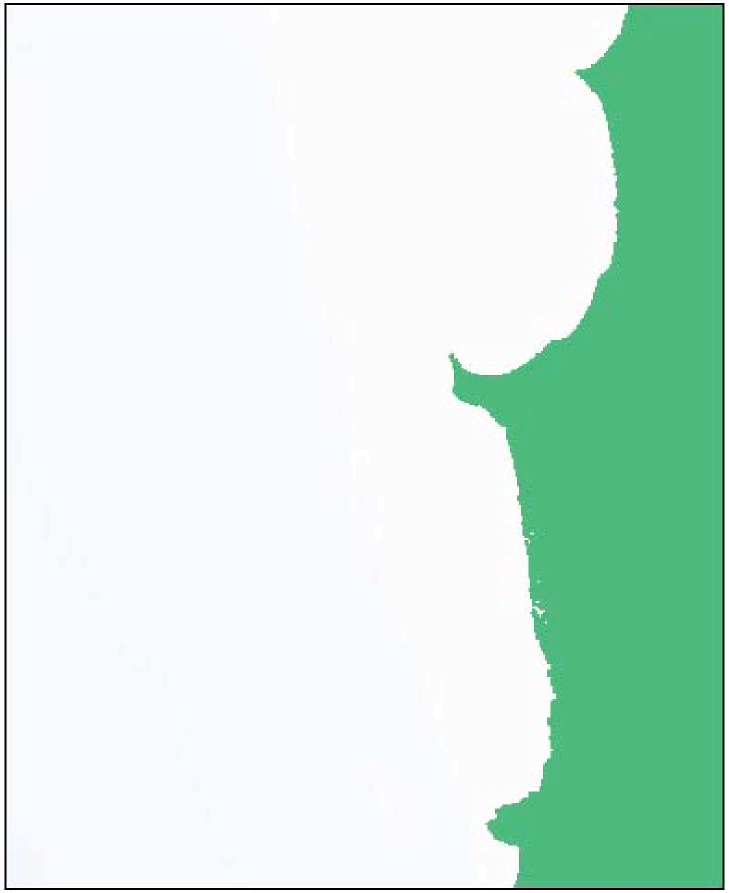
# Tsunami Energy from source

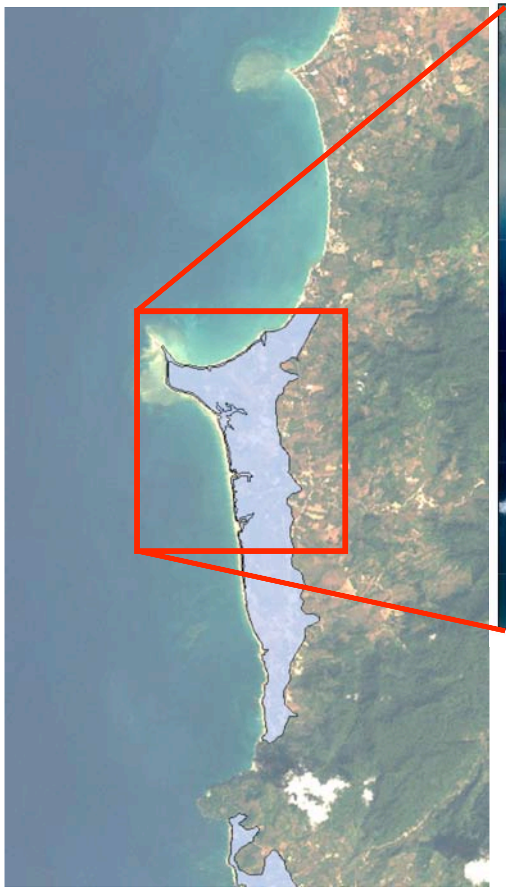


# Tsunami Model : Thailand,Khao Lak north

## With the cooperation of Dr.Anat, Chula Univ.

**Model** **Field Survey** **Satellite Imagery**







**Extent of inundation zone**

F.Imamura, DRCR

IKONOS imagery provided through

Centre for Remote Imaging, Sensing and Processing (CRISP)

SPACE IMAGING

# Newspaper on the damaged train by the tsunami

TRAPPED by the sea and river

Stricken with fear, passengers of an ill-fated train had very little chance to survive Sri Lanka's worst-ever rail disaster

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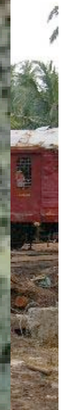
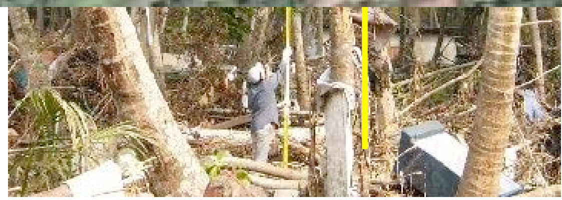
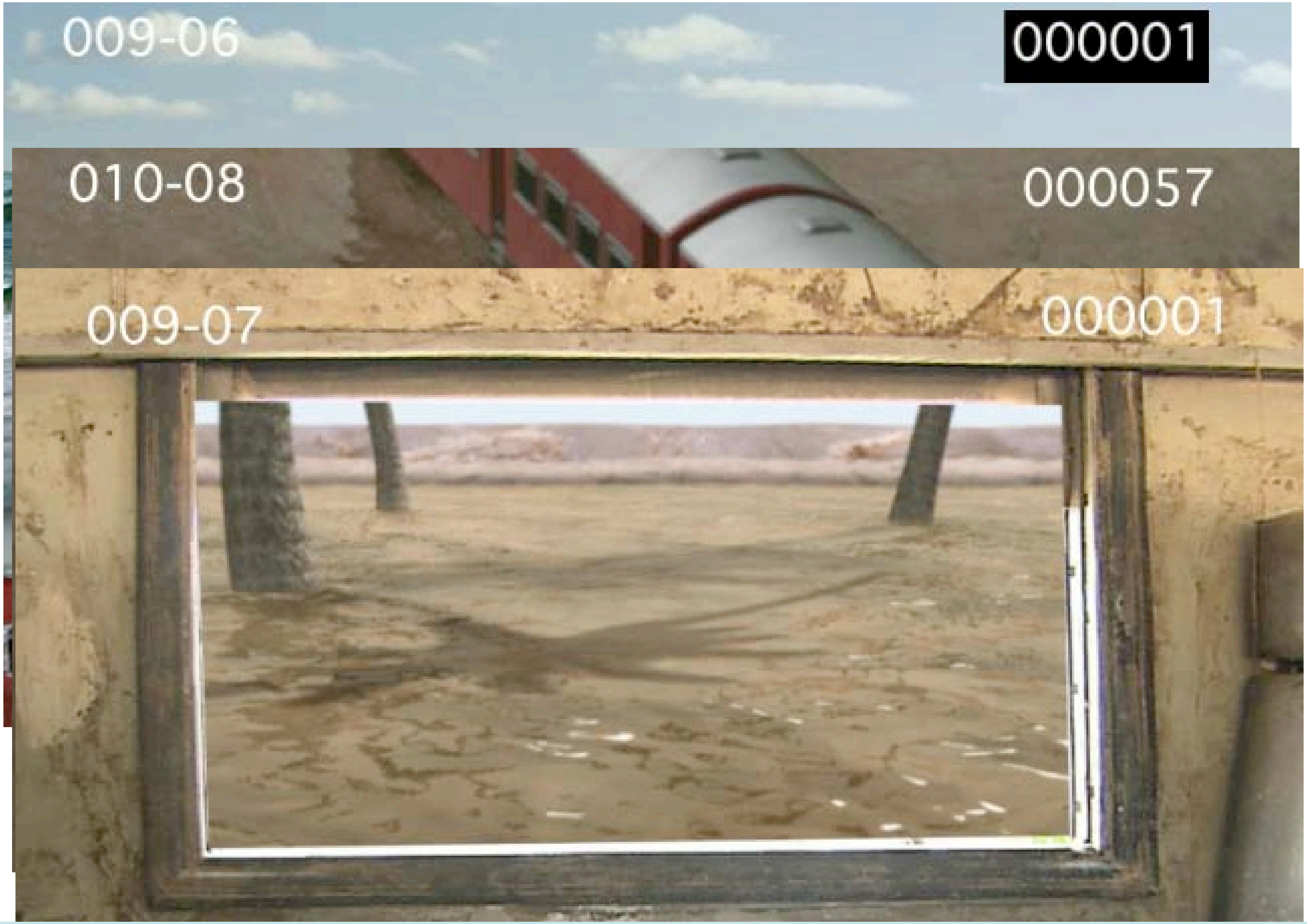
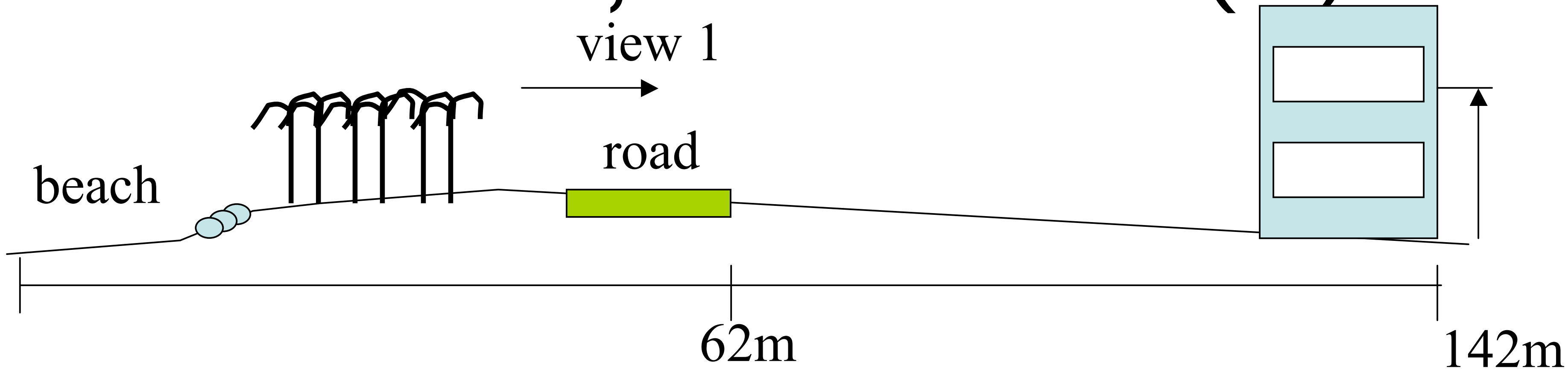



# Hikkaduwa　列車事故の発生した場所

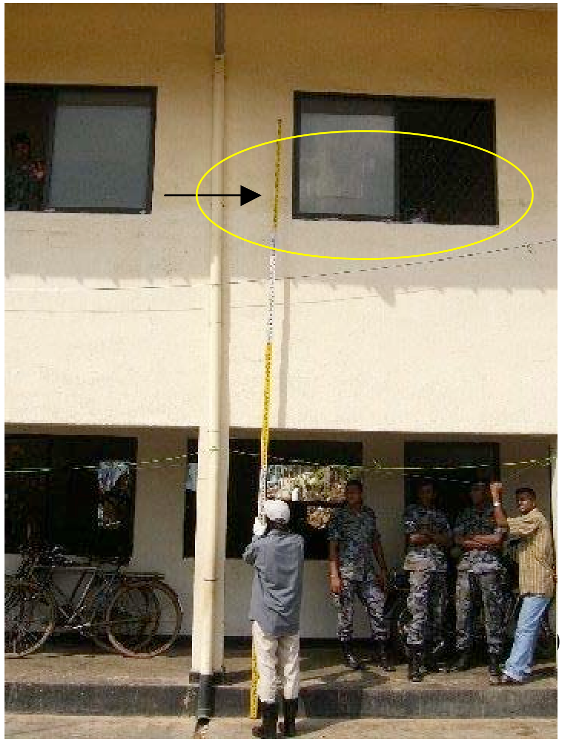



The Computer Graphic which is made for public awareness, cooperated by NHK, Japan

# KAHAWA, Hikkaduwa (2)




view 1

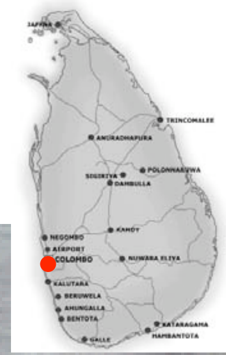


All houses at Kahawa were destroyed completely by the tsunami

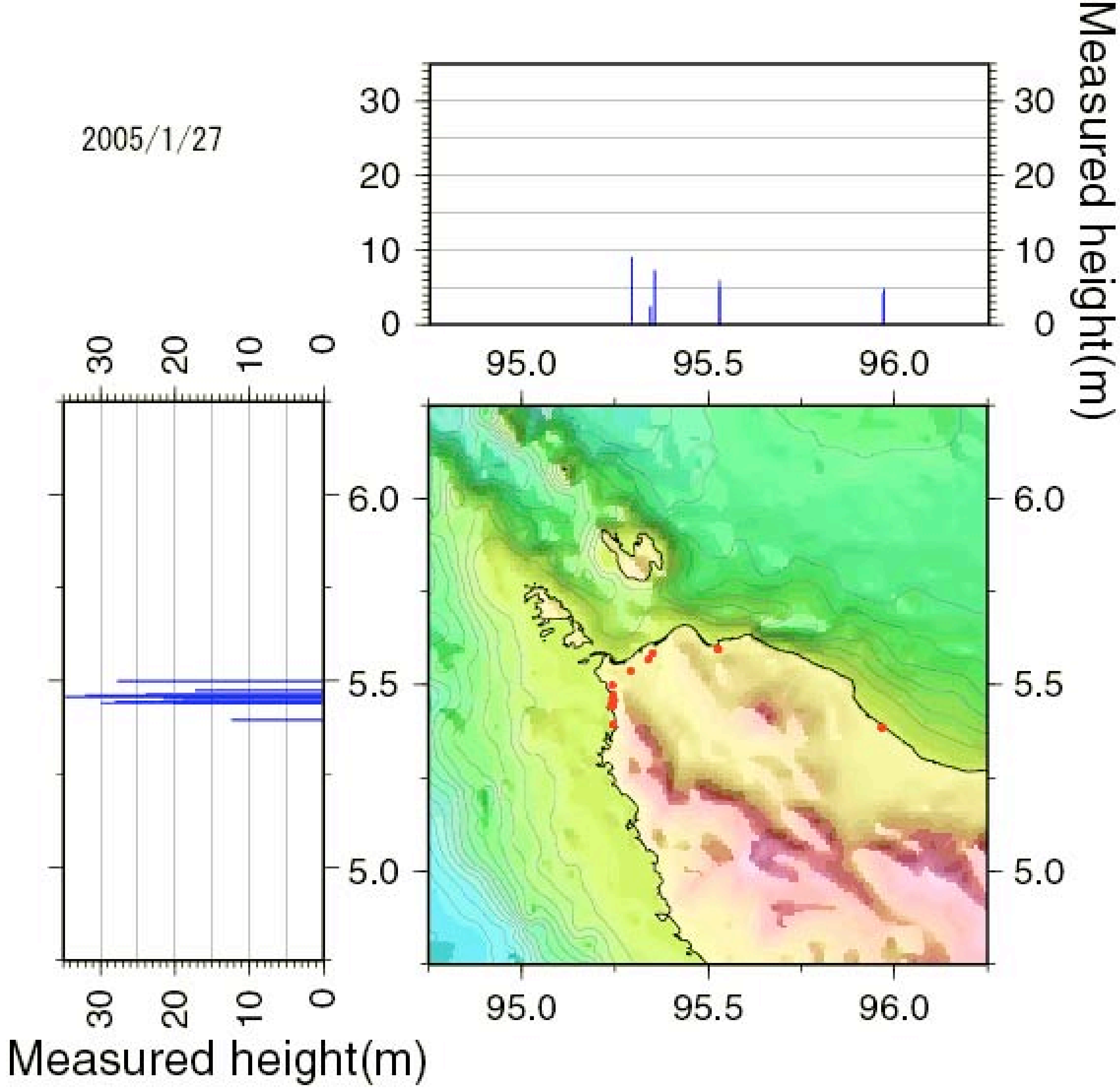
Study on the effect of the green to reduce a tsunami impact

Criteria of building damage by including impact as well as its design, structure, material

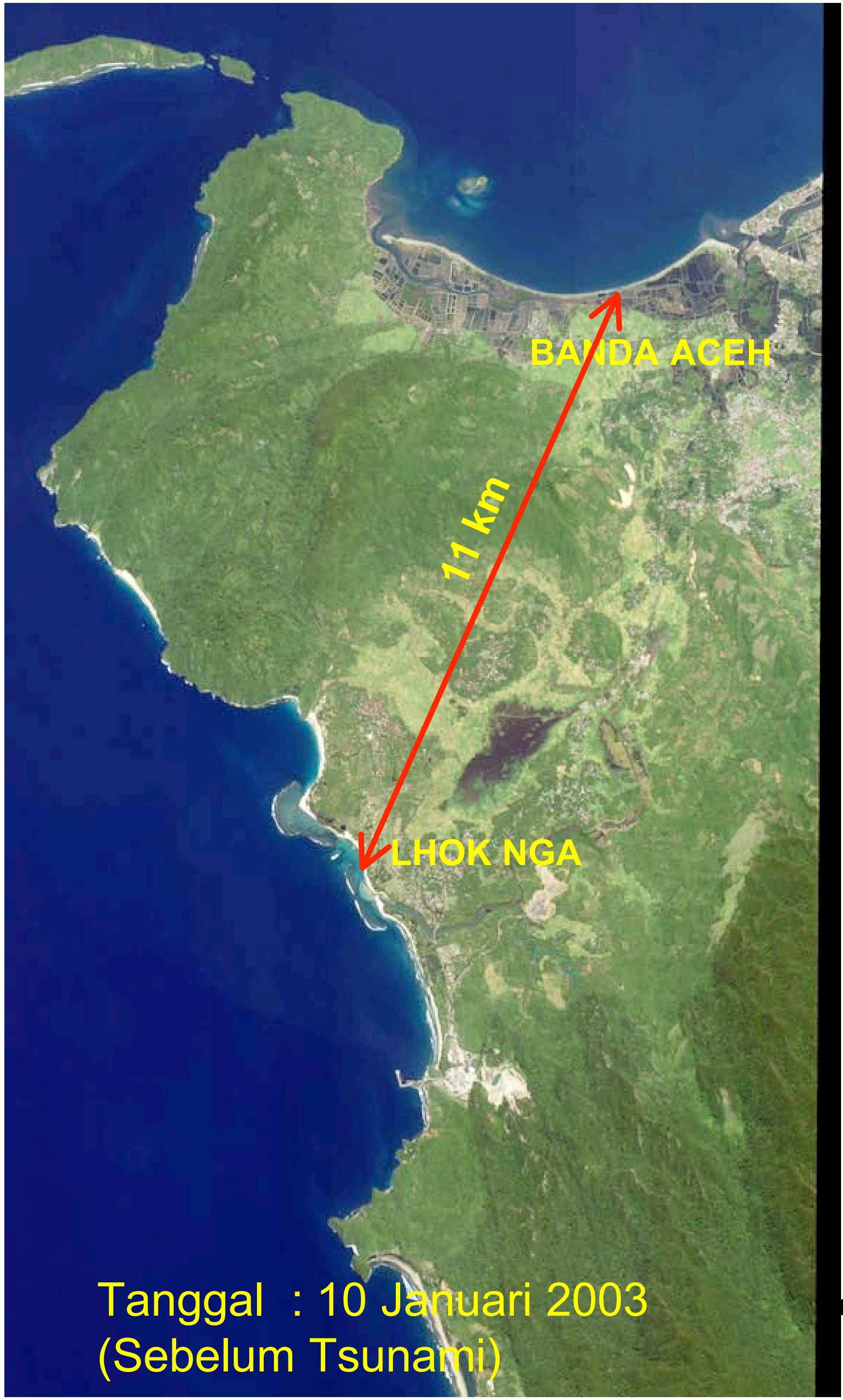
# Moratuwa　モロツア，　住宅の被害



# インドネシア・バンダアチェ周辺での津波遡上高さ
# Measured tsunami runups at Banda Aceh and surround




人工衛星データ(RADARSAT)


BANDA ACEH
11 km
LHOK NGA
Tanggal : 10 Januari 2003
(Sebelum Tsunami)

mu


Arah Gempuran Tsunami
Gempuran tsunami
dari selatan dan utara
Hampir tembus
BANDA ACEH
LHOK NGA
Arah Gempuran Tsunami
Tanggal : 29 Desember 2004
(Sesudah Tsunami)


PLTD APUNG 1

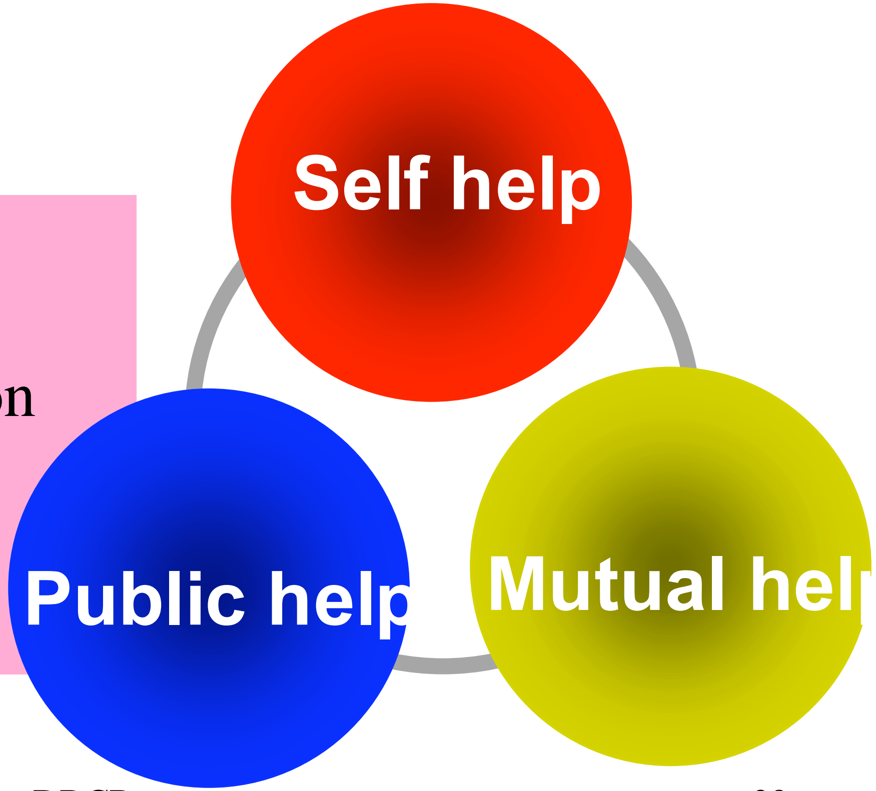
# インドネシア，バンダアチェでの映像

# To reduce damage and casualties

## The “Three Helps” for disaster measures

## One of lessons through 1995 Kobe earthquake

Tsunami warning
Facility to reduce impact
Risk evaluation and communication
Education system
Memorial Activity to remind experience



# Response of the people on tsunami warning in Japan

# Hazards map and WS
## making HM with the residents




# Powerful tool to increase the awareness;
## Example of Hazards map with the image on GIS

# Public awareness and education at Banda Aceh

- **Example Radio program on RRI**
- **Cooperated by the Syiah Kuala Univ. and JICA**
- **Started on 25 July 2005**
- **Every Saturday 10-11 AM**

Meeting at univ.


Program at RRI on 24 Sep

# Lessons from 2004 Indian Ocean tsunami

- High activity of tsunamis at the period of 1992-Now

- Developing the monitoring and warning system with information technology and evacuation system
- Data base to compile the all data; runup, tidal records, visual record
- Criteria of house/infrastructure damage by adding design, structure, materials & green belt information
- Integrated disaster mitigation program for each region to mitigate tsunamis as well as typhoons, erosion and flood.
- International network for the community, education and Hazards map

# Disaster Reduction and Risk Management Approach to Flood, Landslide, and Tsunami Problems in Japan

Tsuneyoshi Mochizuki

Director General

National Institute for Land and Infrastructure Management

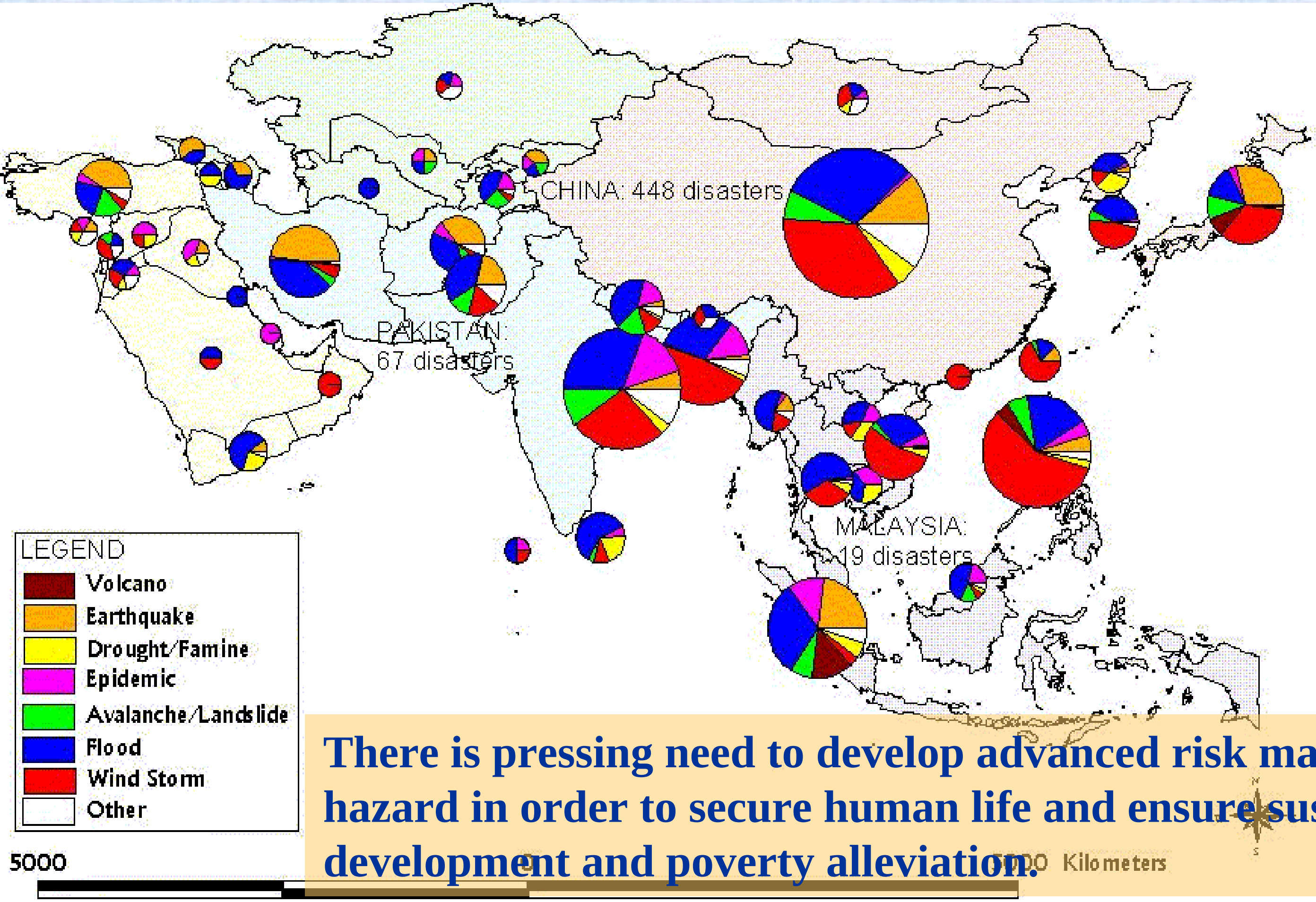
27 Oct. 2005





# Asia Most Affected by Flood Disasters

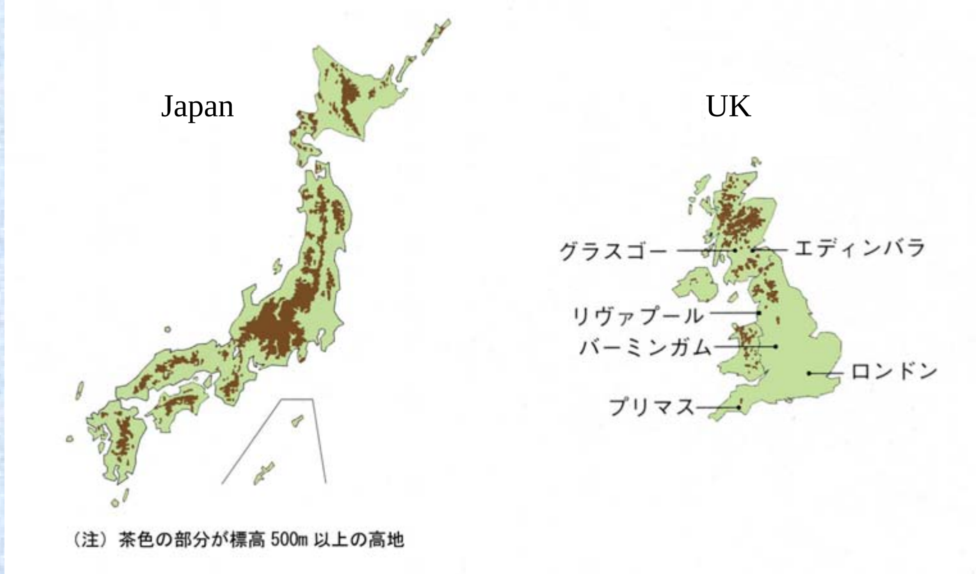
**People outlook to disasters! Can it make a difference**



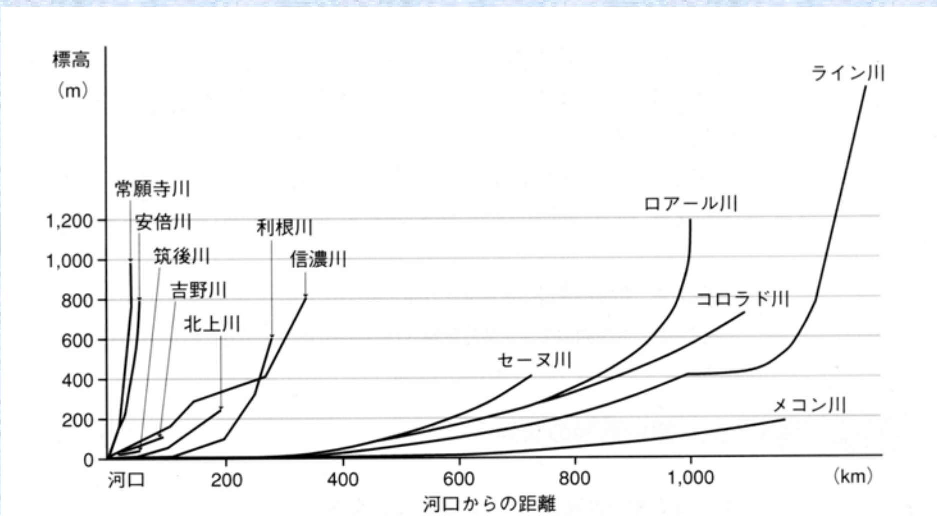


**There is pressing need to develop advanced risk management on water hazard in order to secure human life and ensure sustainable socio-economic development and poverty alleviation.**

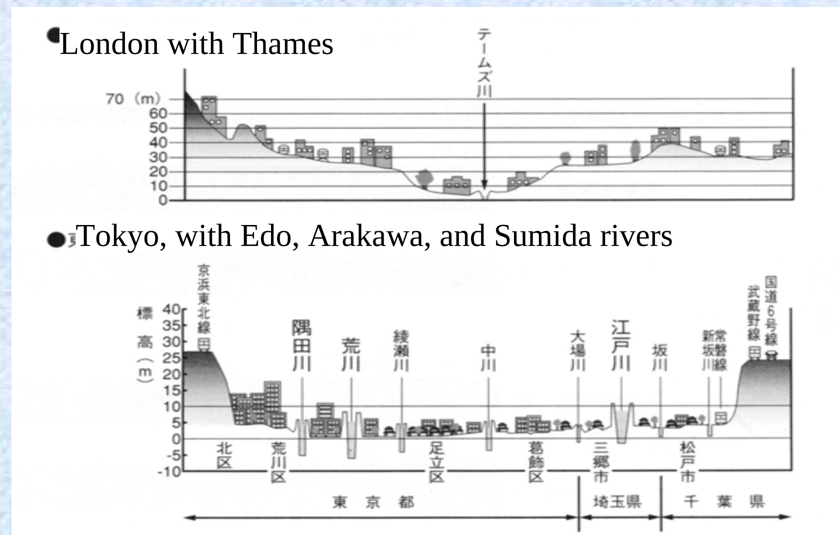
# Geographical Features of Japan




Smaller area of level ground (as compared with UK)




Steeply sloping rivers (in terms of longitudinal slope)

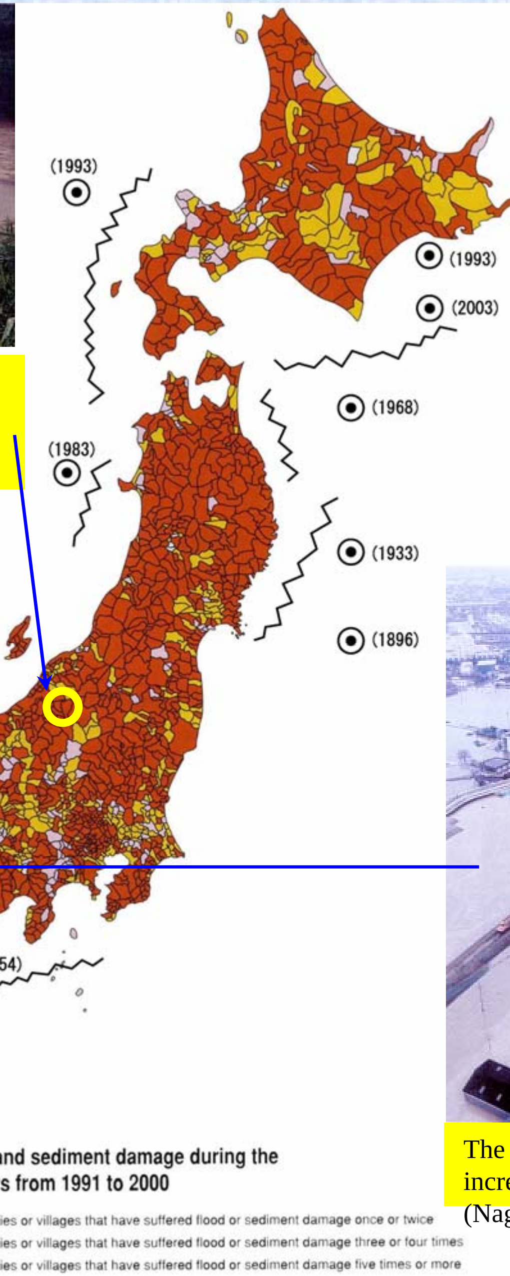



Concentration of population and properties in flood plains
(The ground levels in Tokyo and London)

# Characteristics of Recent Flood Damages

Increased number of floods in 2004: Broken at six points of the Kariyata-river embankment, Niigata

Underground flood in the urban area (Fukuoka)




The urban flood disaster caused increased damage cost (Nagoya)

# Overview and Characteristics of Flood Disasters

・The numbers of missing and dead and damaged houses have been reduced.

←Improvement of flood control system and weather information

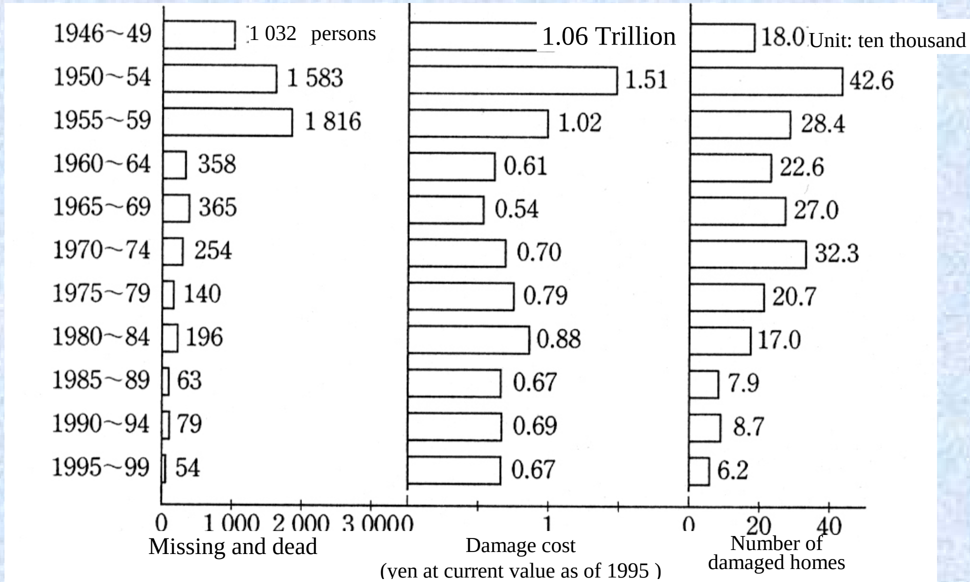
Rate of completed embankment: 38%（1976）→56%（2002）

The number of warning increased six-fold after the introduction of AMeDAS (in early 1970s).

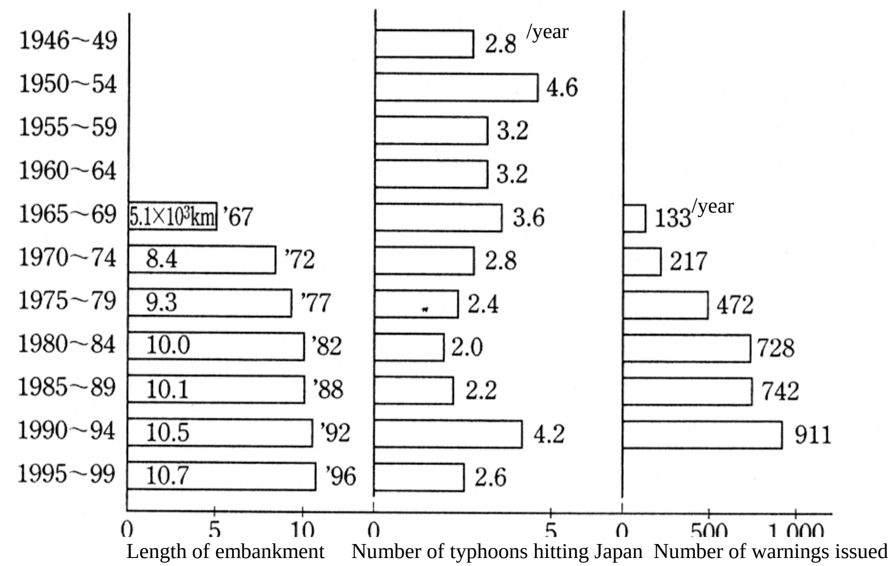
・The monetary amount of damages has remained flat.

←The area of submerged surface has decreased, but it tends to concentrate large and midsized cities.

＊The disaster victims realized that lifeline disruption has a large impact (accounting for 1% of the damages)



(1) Year-to-year changes in damages from flood disasters



(2) Factors contributing to flood disaster prevention

# Lessons from and Mitigation Measures against Flood Disasters

Water running over or passing through the embankment.

→ Develop and improve embankment systems

Delay in collection and distribution of information

→ Put rain and water gauge systems in place, and improve the information transmission systems.

No guidelines on issuing evacuation advisories, or delay in issuing.

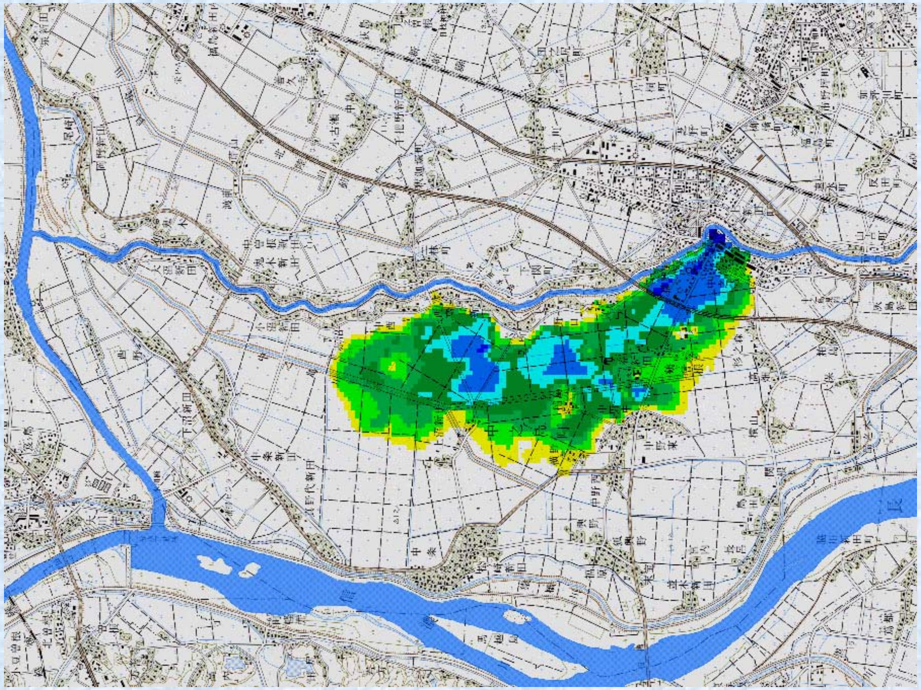
→ Establish the warning water levels allowing for the rising rate of flood water level.

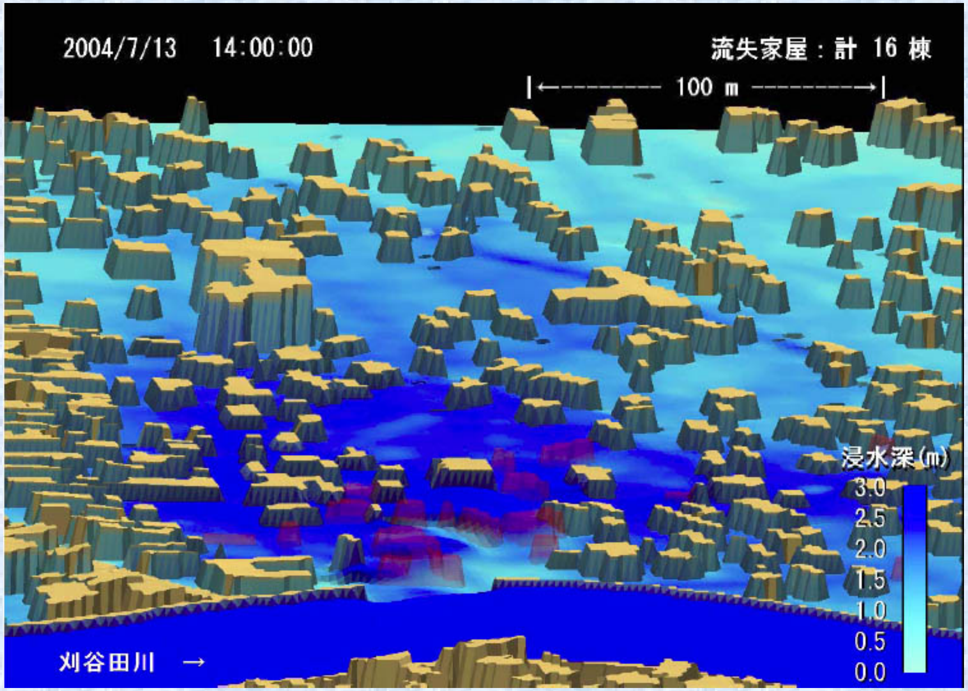
Improve the information transmission systems

**Increased the number of elderly victims**

# Enhancement of Flood Simulation Technology

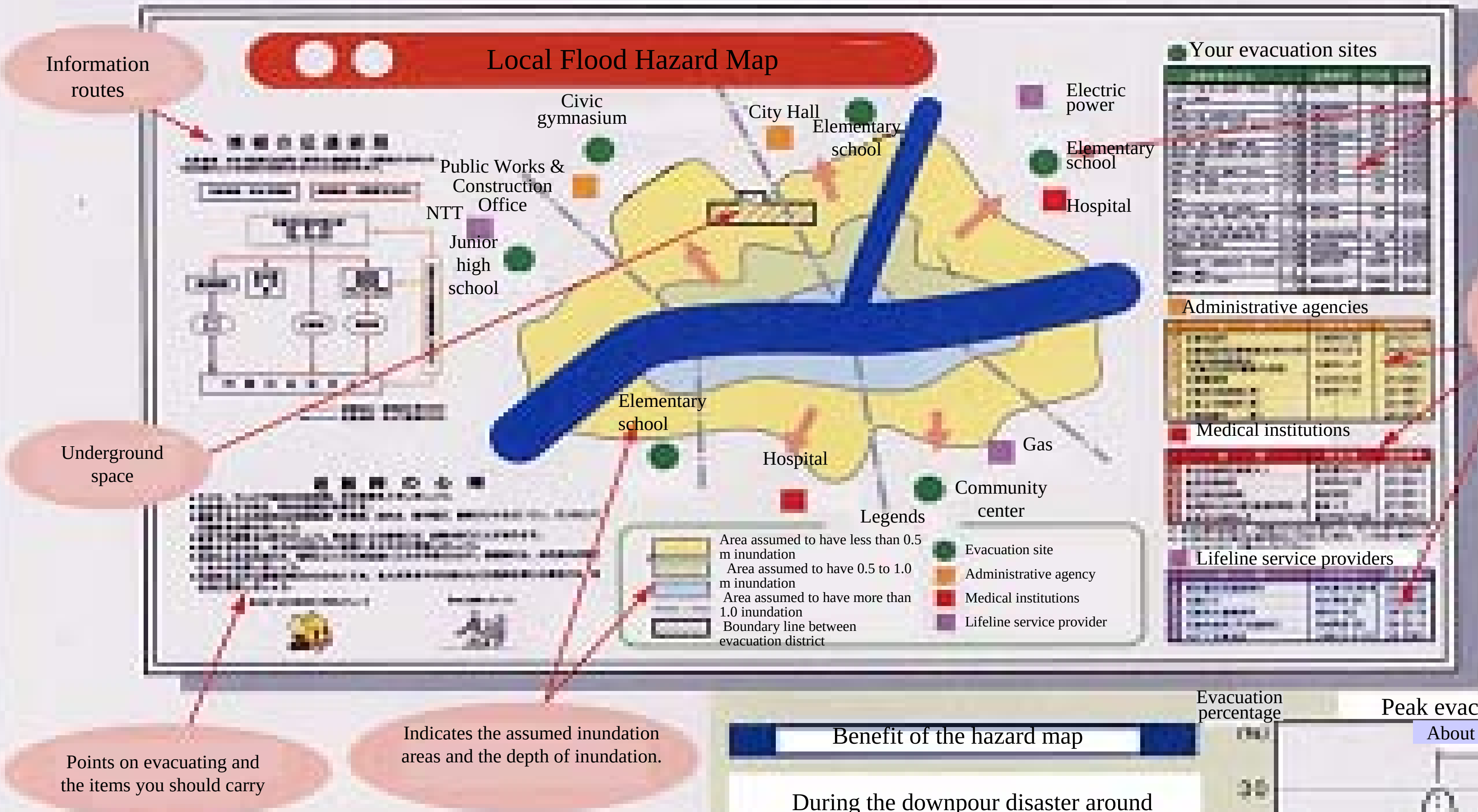
Analysis of the flood and inundation flows in combination by using the Flux Difference Splitting (FDS) Method will reveal the behaviors of inundation flow in the vicinity of the dike break spot and contribute to mitigation of damages.





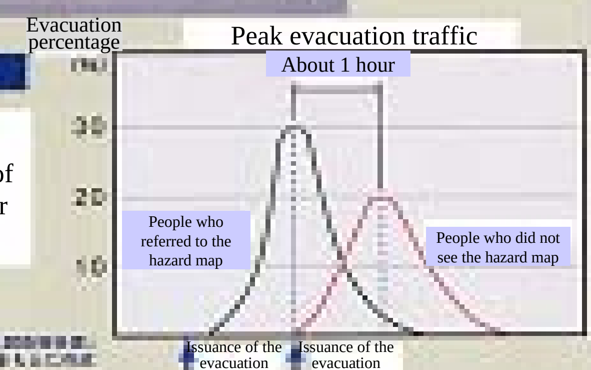
# Disaster Risk Management Activities
## – Flood Hazard Map -

The Flood Hazard Map indicates the assumed inundation areas and evacuation sites intelligibly, which will assist people to take speedy and reasonable evacuation activities in a disaster as well as raise their awareness about disaster preparedness.




### Benefit of the hazard map

During the downpour disaster around Koriyama, Fukushima, in the late August of 1998, the hazard map proved helpful in for earlier evacuation.



# Characteristics of Sediment Disasters

**Debris flow:**
A mixture of earth, rocks and water moves downstream at 20 to 40 km per hour, resulting in destruction of farms and homes.

Sakurajima, Kagoshima (Sept., 1986)

**Landslide**:
A heap of earth on a slope moves downward slowly. It occurs in an extensive slope area at a time and carries a huge volume of earth, causing vast destruction.

Nagano (Sept., 1986)

**Rock fall**:
A cliff may fall suddenly during sever rainfall or earthquake. Many of the victims might fail to escape and be killed.

Minamata, Kumamoto (Sept., 1997)

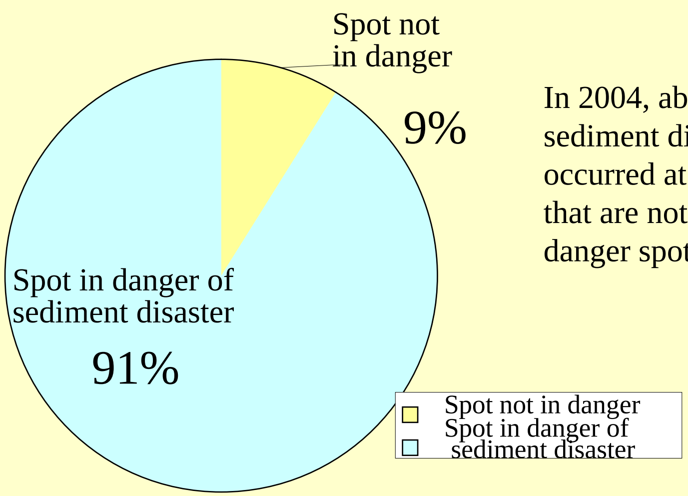
**Volcanic disaster**:
Volcanic disaster are caused by lava flow,volcanic mudflows and pyroclastic flows and so on.

Izu-Oshima, Tokyo (1986)

**Avalanche**:
A large mass of snow falls down the side of a mountain, causing an extensive coverage of damage.

Obanazawa, Yamagata (1986)

# Lessons from and Mitigation Measures against Sediment Disasters



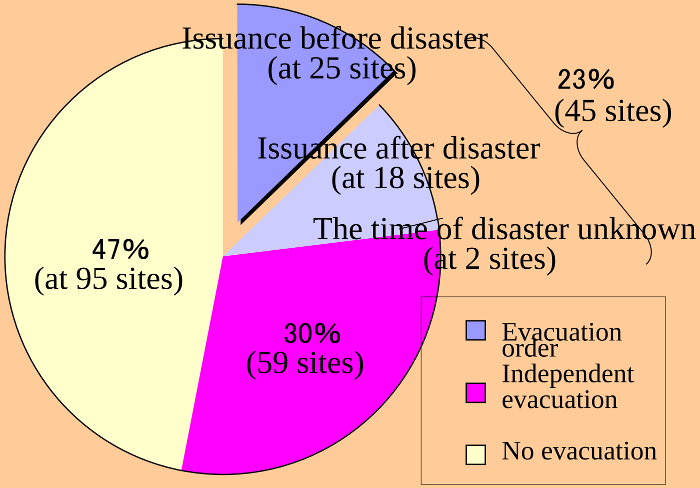

In 2004, about 10% of sediment disasters occurred at those spots that are not recognized as danger spots.

Improve the accuracy of identifying the danger spots.


Install check dams that can trap the logs more efficiently.


In the Niigata Chuetsu Earthquake, a river was blocked at several spots.

Review and revise the manual for responding to a large-scale waterway blockage.




Evacuation order was issued before occurrence of sediment disaster only at 10% of the relevant sites.

Develop the objective guidelines for issuing evacuation orders.

# Disaster Risk Management Activities

## －Lifesaving of Persons from a Car Trapped under Sediment (Chuetsu, Niigata)－

The experts from PWRI were monitoring without a break until a boy was rescued successfully.
（the upper left corner on the photo)
Photo credit: Asahi Shimbun.

The full view of the slope failure site. This disaster attacked across a 200 m long portion of the road.

The rescue operation in progress, which was carefully carried out under the continuous aftershocks.

## Course of events

Oct., 23, 2004, a large-scale slope failure occurred in Myoken-cho, Nagaoka, when the earthquake attacked the Chuetsu region,

Around 15:00, Oct., 26, a car was found trapped under sediment.

In the night of Oct., 26, the Niigata Governor asked MLIT, through the Cabinet Office, to dispatch the experts to the disaster site.

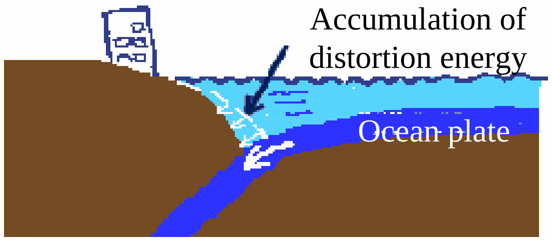
Around 12:00, Oct., 27, the experts from PWRI arrived at the site via helicopter.

**・The expert from P.W.R.I checked if the site conditions allow the rescue party to start their operations.**
**→Operations started.**
**・The team determined and advised which rocks could be moved or not.**
**・The team continued monitoring the operations for the safety of the rescue party .**

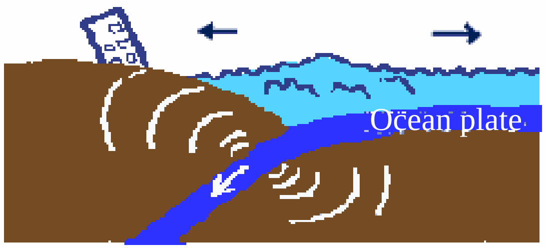
Around 14:30,Oct.,27,a boy was rescued！

# Overview and Characteristics of Tsunami Disaster

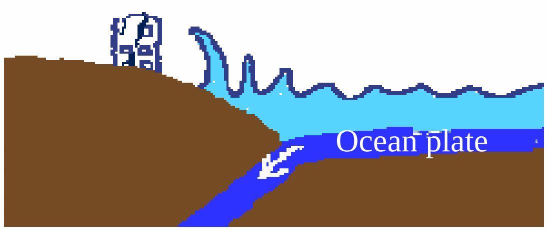
## Formation of Tsunami



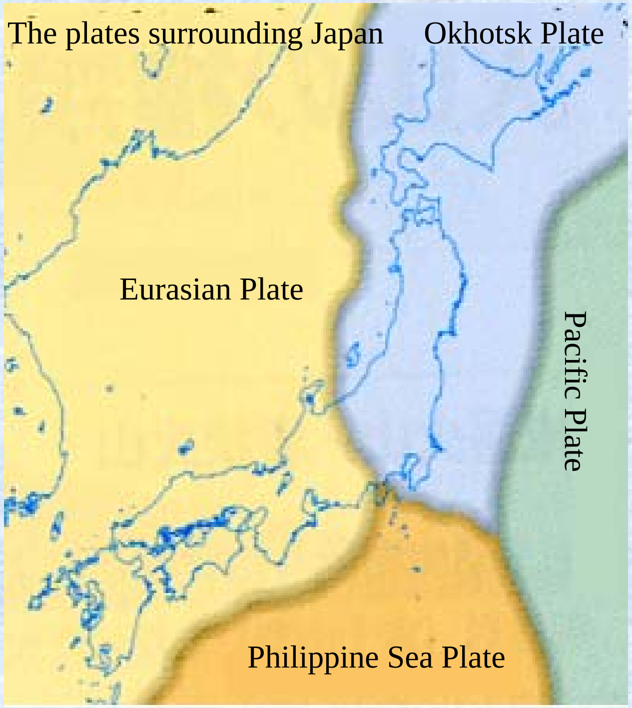

The distortion increases as the edge of the continental plate is dragged downward, which increases the distortion.




When the distortion reaches its limit, the end of the plate is broken away and the remaining part of the plate edge springs back up .




Upon entering shallow coastal waters, tsunami suddenly grows in height.




Data source: the Meteorological Agency

# Disaster Risk Management Activities

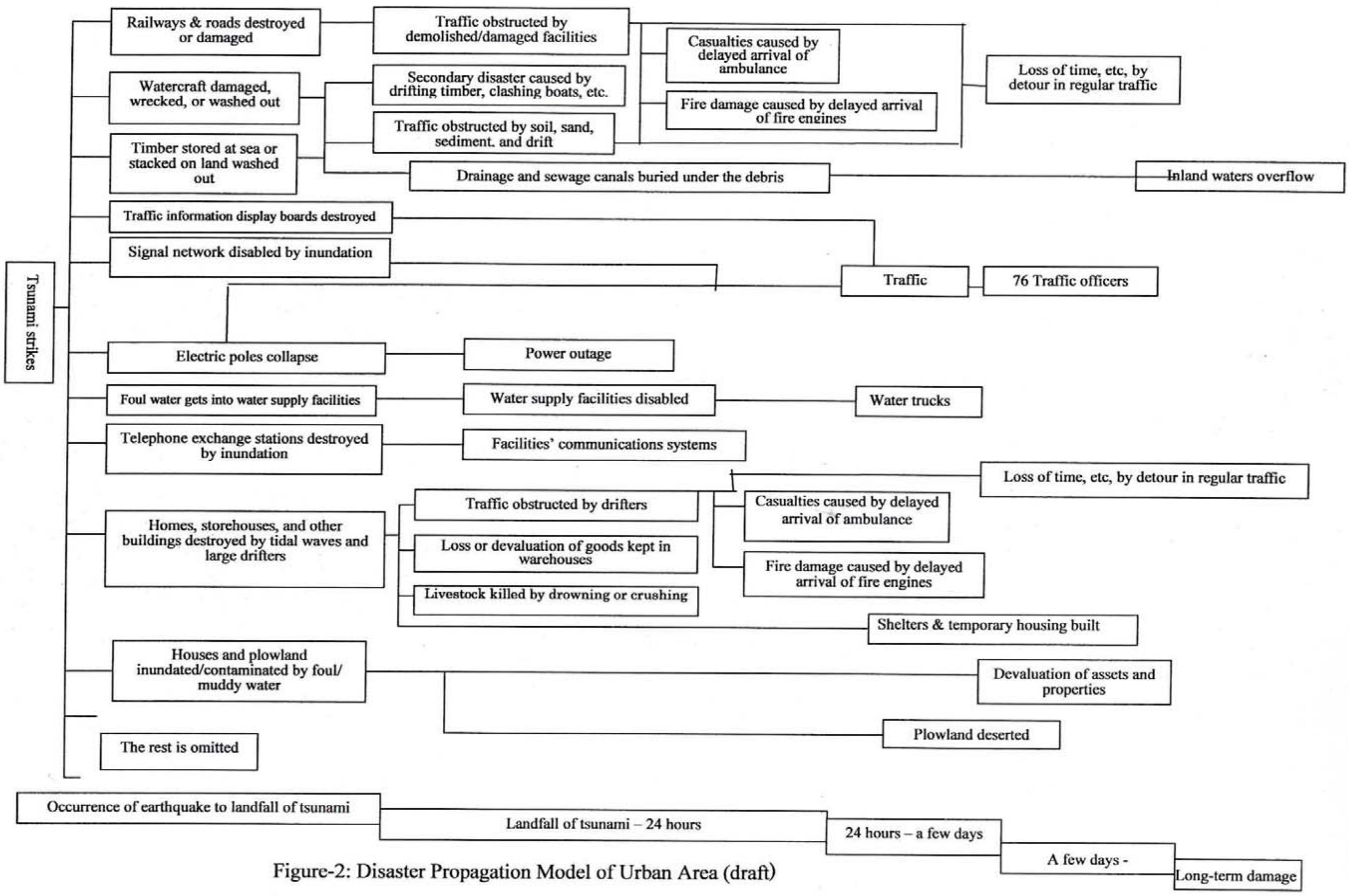



Figure-2: Disaster Propagation Model of Urban Area (draft)

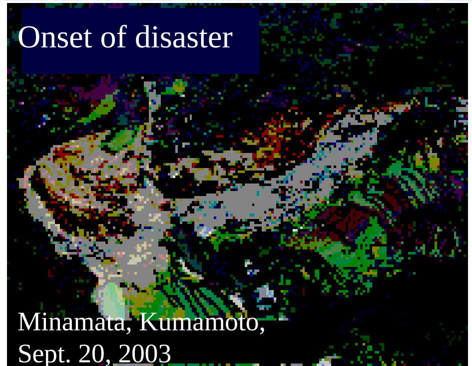
# Japan's Disaster Prevention Scheme

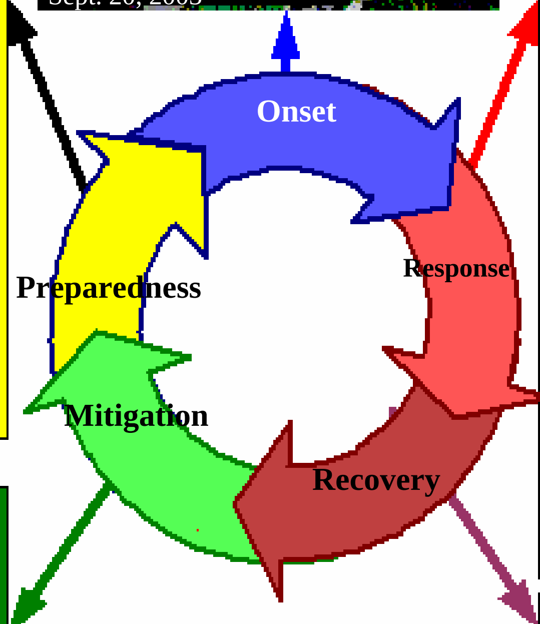
- The Japanese disaster prevention scheme consists of the four phases: Response, Recovery, Mitigation, and Preparedness.
- As part of the designated administrative system, the Ministry of Land, Infrastructure and Transport has worked on development of the anti-disaster operation plan and taken the response, recovery, and mitigation measures.

## Well-planned systematic government administration of disaster prevention

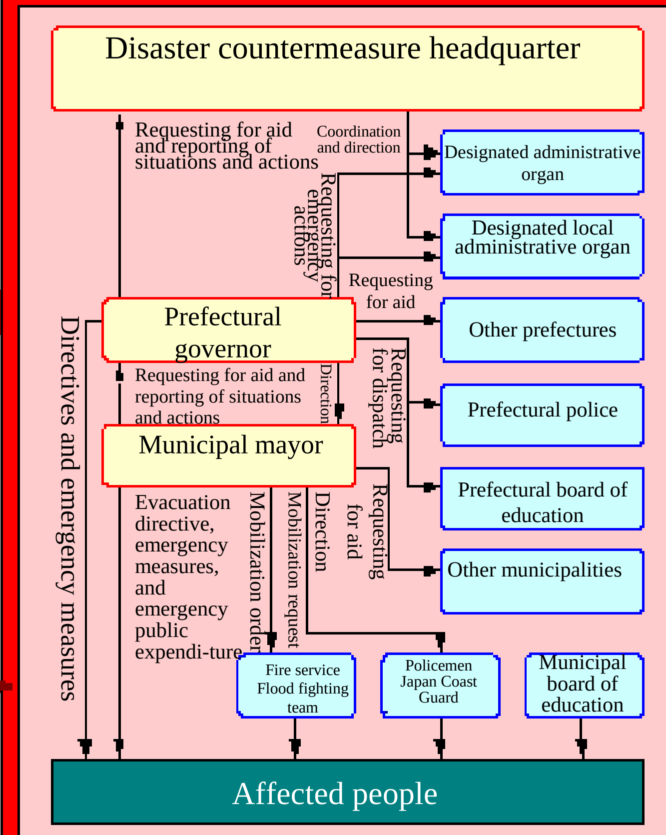
| | |
|---|---|
| Central Disaster Management Council | Basic Disaster Prevention Planning |
| Designated administrative organs and public corporations | Disaster Prevention Activities Plan |
| Prefectural Disaster Management Councils | Basic Disaster Prevention Plan at prefecture level |
| Municipal Disaster Management Council | Basic Disaster Prevention Plan at municipality level |

<u>Definition of alarming areas, development of disaster prevention organization, and conduct of disaster drills,</u>etc.




## Division of roles in the emergency responses




<u>Construction or improvement of the preventive structures</u>

(Facilities of river management, flood prevention, coastal protection, etc.)

<u>Financial support to the affected people and conduct of disaster restoration activities</u>

# Our Challenges for the Future

Future Directions

- To seek the best combination of structural and nonstructural alternatives for each river basin

- To seek effective scheme of involving people in decision process

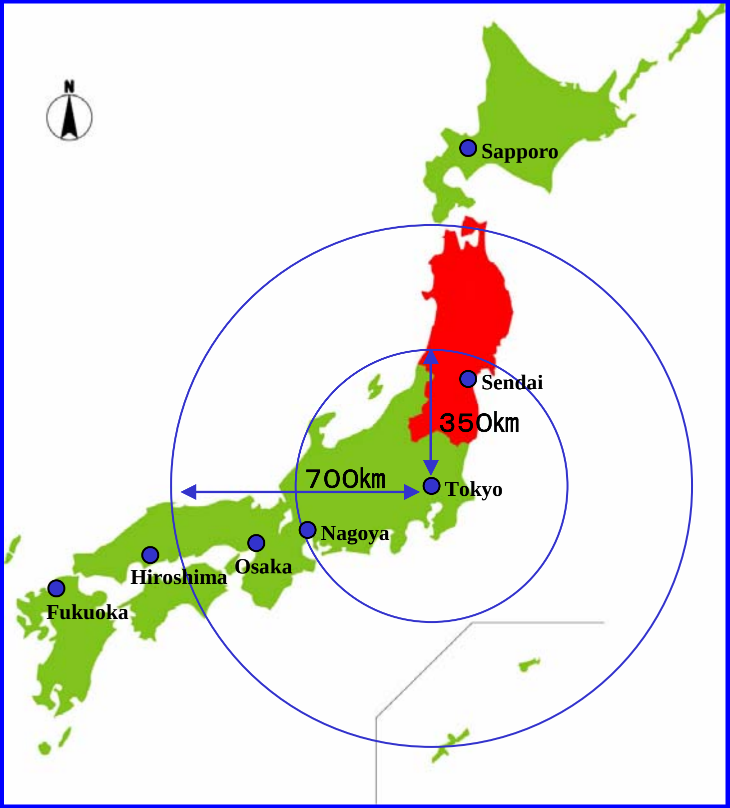
- To seek appropriate role and responsibility sharing between the national gov, local gov., municipality and individuals.

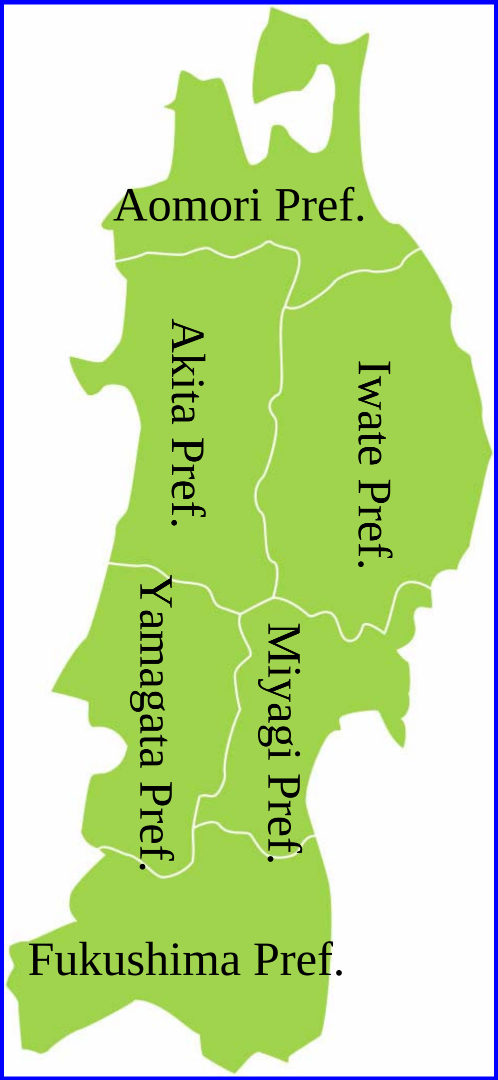
# Disaster Reduction and Crisis Control

# On Flood, Landslide and Tsunami Disaster in Tohoku Region

River Department, Tohoku Regional Bureau,
Ministry of Land, Infrastructure and Transport

# Position of Tohoku Region in Japan




Area: Approx. 18% of the national territory
(66,889km²)

*Resource: National survey of land by prefecture and municipality

Population: Approx. 8% of the national population
(9,812,849 people)

* Resource: Population Digest of 2002 Basic Resident Register

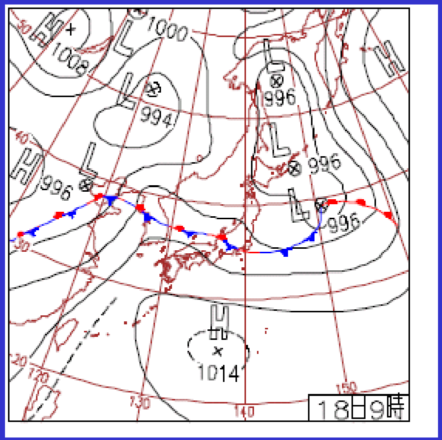
# Characteristics of Floods in Tohoku - 1

## [Typhoon and Front Activities]

■ Many floods occur on the coastal area of Sea of Japan due to the effect of fronts.

### [Downpour in July 2004]

■ Flooding by front activities (Sake River of Mogami River System)

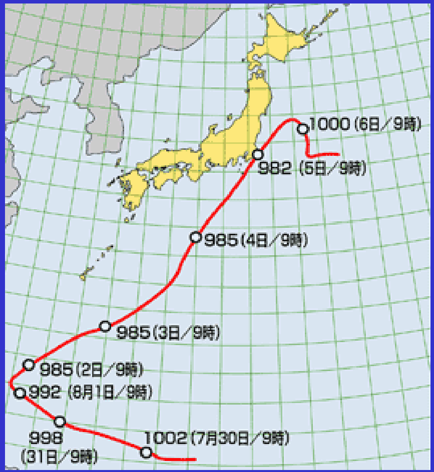


■ Meteorological Chart (July 18, 2004)

■ Many floods occur on the coastal area of the Pacific Ocean due to the effect of typhoons.

### [Flood on August 5, 1986] (Entire coastal area of the Pacific Ocean)

■ Flooding by typhoon **(Surikami River of Abukuma River System)**



■ Typhoon route diagram (August 1986)

# Characteristics of Floods in Tohoku - 2

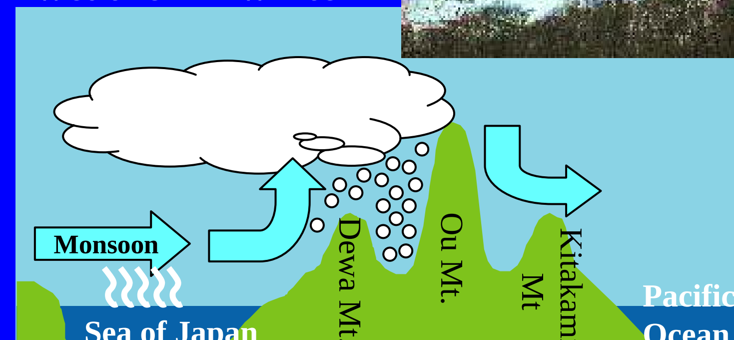
## [Snowmelt Floods]

◆ Tohoku region is a heavy snowfall area

◆ Melting of remaining snow due to south wind and rise of temperature

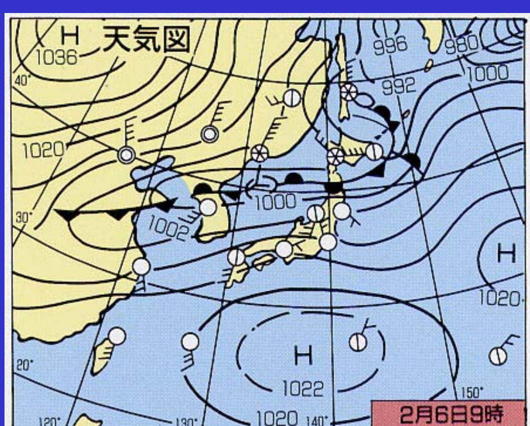
◆ **“Snowmelt floods”** may occur even under small rainfall due to snow melting.

**Characteristics of weather in winter**

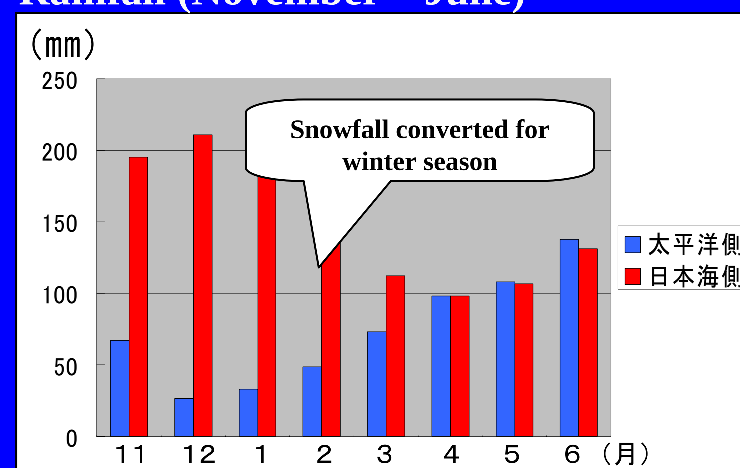

### [Flood on February 7, 1993]

Flooding by rainfall and snowmelt (Naraoka River of Omono River System)

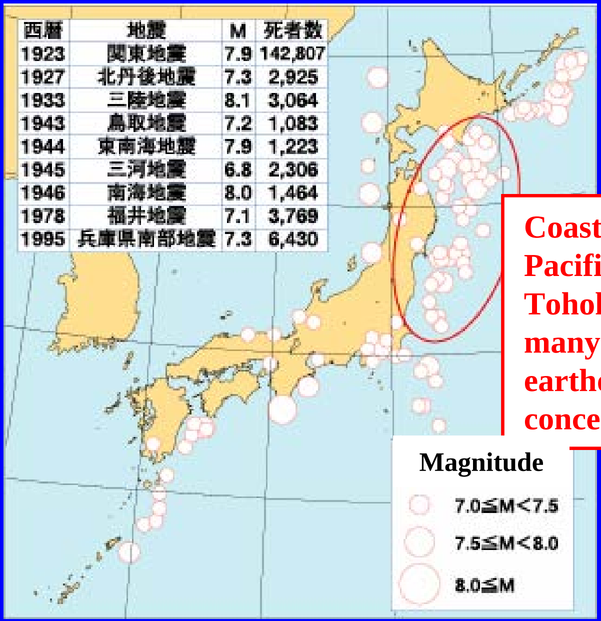




**Rainfall (November – June)**



# Points of Earthquake Occurrence and Tsunami Damage




**Coastal area of Pacific Ocean in Tohoku where many large earthquake foci concentrate**

**Earthquake foci of M7 or larger during the past 100 years (1900 – 1999)**

Damages of Tsunami by Sanriku Earthquake (1933)

**Miyako City, Iwate Prefecture**

**Taro Town, Iwate Prefecture**

## Damage Record

| Date | Name of Earthquake | Description |
|---|---|---|
| June 15, 1896 | Meiji Sanriku Earthquake Tsunami | [M8.5] Tsunami attacked coasts from Hokkaido to Oshika Peninsula. 21,959 deaths and more than 10,000 houses were lost in runoff or collapsed completely/partially. |
| March 3, 1933 | Sanriku Earthquake Tsunami | [M8.1] Tsunami attacked the Pacific Ocean and damage was great on Sanriku Coast. 3,064 people were reported as dead or missing, houses lost to runoff 4,034, 1,817 houses were collapsed, and 4,018 houses flooded. |
| May 23, 1960 | Chile Earthquake Tsunami | [Ms8.5] 142 people reported as dead or missing for entire Japan, over 1,500 houses were collapsed completely and over 2,000 partially.<br>* Ms (surface wave magnitude): The method in which magnitude is calculated based on the maximum fluctuation of surface wave for a cycle of earthquake waves of about 20 seconds observed by seismograph (time from wave peak to another peak) and the distance between the seismograph and earthquake center (not origin). |
| May 16, 1968 | Tokachi Offshore Earthquake | [M7.9] 52 deaths, 330 injuries, 673 totally collapsed houses, and 3,004 partially collapsed houses. Many damaged roads in Aomori Prefecture. |
| June 12, 1978 | Miyagi Pref. Offshore Earthquake | [M7.4] 28 deaths, 1,325 injuries, 1,183 totally collapsed houses and 5,574 partially collapsed houses. 888 locations of road damage and 529 locations of landslide. |
| Dec. 28, 1994 | Sanriku Haruka Offshore Earthquake | [M7.6] 3 deaths, 788 injuries, and 501 totally or partially collapsed houses. There were also damaged roads and coasts. |

**2003 Scientific Chronology (edited by National Astronomical Observatory, Ministry of Education, Culture, Sports, Science and Technology)**

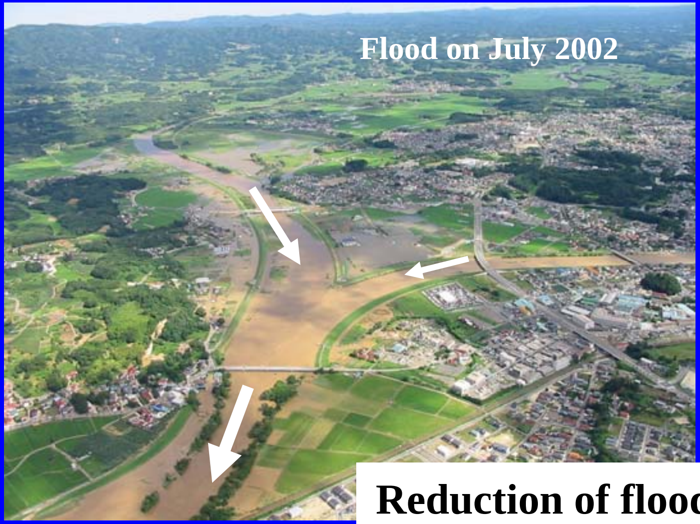
**Tohoku region has**
**many earthquakes and tsunamis**

# River Improvements

Flood by downpour at the end of August 1998



Flood occurred in the same scale




**Reduction of flood damages**

**Damages of downpour at the end of August 1998**

| | |
|---|---|
| Deaths | 11 |
| Severe injuries | 9 |
| Totally/partially collapsed houses | about 240 |
| Flooded houses | about 3,800 |
| Total damages | Approx. 40 billion yen |

(Total of Miyagi and Fukushima Prefectures)

**Implementation of comprehensive river improvement and short-term, concentrated disaster restoration project**

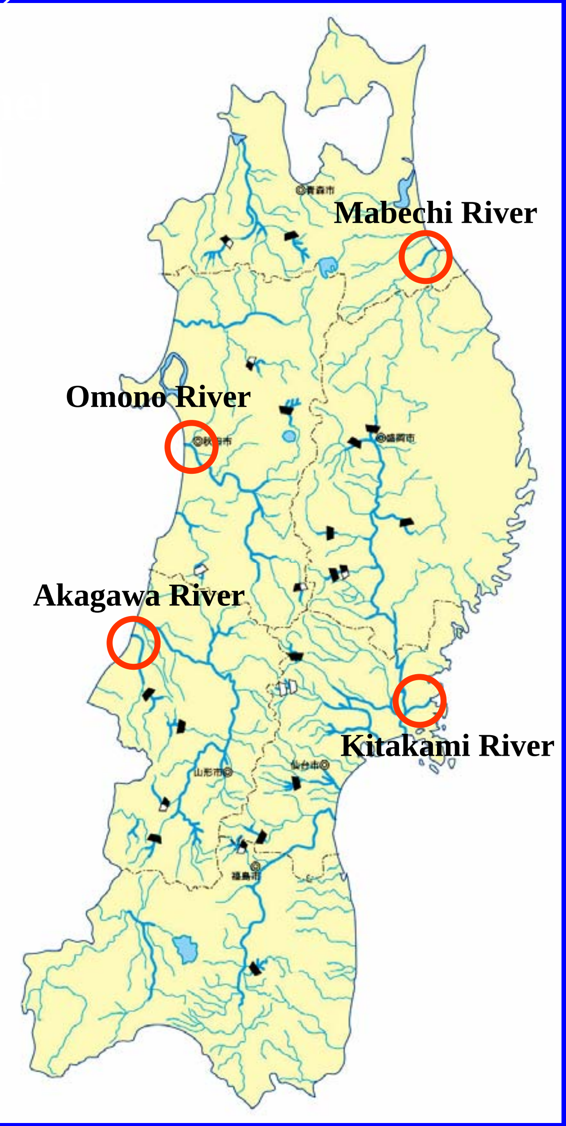
**Project term: Approx. 3 years**

# Discharge Channel Establishment Project

## Discharge channels in Tohoku region

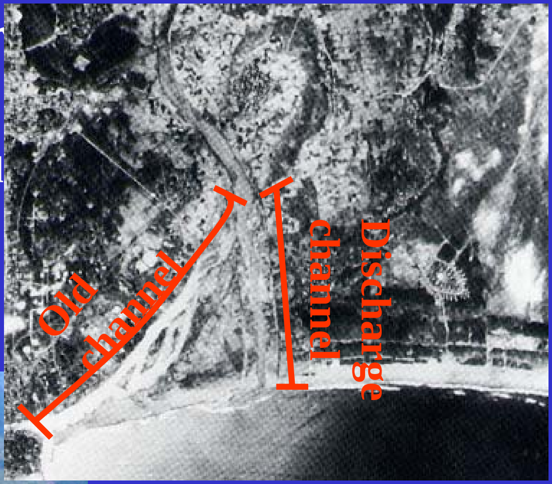
(Kitakami River, Omono River, Aka River, Mabechi River)

- ◆ **1927 Discharge in Aka River discharge channel**
- ◆ **1932 Discharge in Kitakami River discharge chann**
- ◆ **1938 Discharge in Omono River discharge channel**




## ◆Mabuchi River dischar

**1950 Discharge in discharge channel**
**1955 Completion of discharge channel**
**1964 Specification of Hachinohe New Industrial City**
**1967 Specification as Class 1 river**




**Mabechi River discharge channel (before discharge)**


**Mabechi River discharge channel (present)**

# Flood Control Basin Establishment Project

## Flood control basin in Tohoku region

(Ohkubo flood control basin, Hamao flood control basin, Ichinoseki flood control basin)

- **1997 Completion of Ohkubo Flood Control Basin (Mogami River)**
- **2005 Completion of Hamao Flood Control Basin (Abukuma River)**

## ◆Ichinoseki Flood Control Basin◆

**1972 Kitakami River Flood Control Project**

**1980 Groundbreaking Ceremony for Ichinoseki Flood Control Basin**

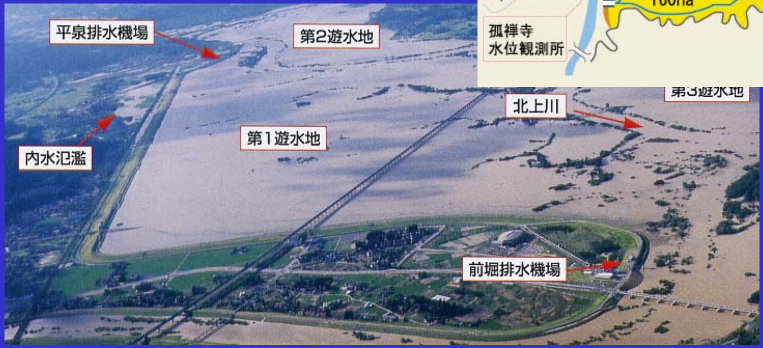
**2002 Overall completion of surrounding bank**

**Present**

**Project in implementation**


**Ichinoseki Flood Control Basin Plan Drawing**

**Photograph of Flood in July 2002**




# TVA Project of KVA-Japan (5 Great Dams of Kitakami River)

1945 – Reconstruction after war

## 1947 Typhoon Kathleen

◆Damages of Typhoon Kathleen◆

| | | |
|---|---|---|
| Deaths/missing | about 170 | |
| Injuries | about 3,500 | |
| Totally/partially collapsed houses or runoff houses | | 3,096 |

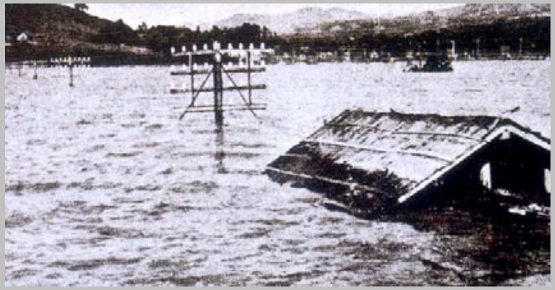
Photo: Ichinoseki City, Iwate Pref.

## 1948 Typhoon Ione

◆Damages of Typhoon Ione◆

| | | |
|---|---|---|
| Deaths/missing | about 710 | |
| Injuries | about 500 | |
| Totally/partially collapsed houses or runoff houses | | 3,700 |

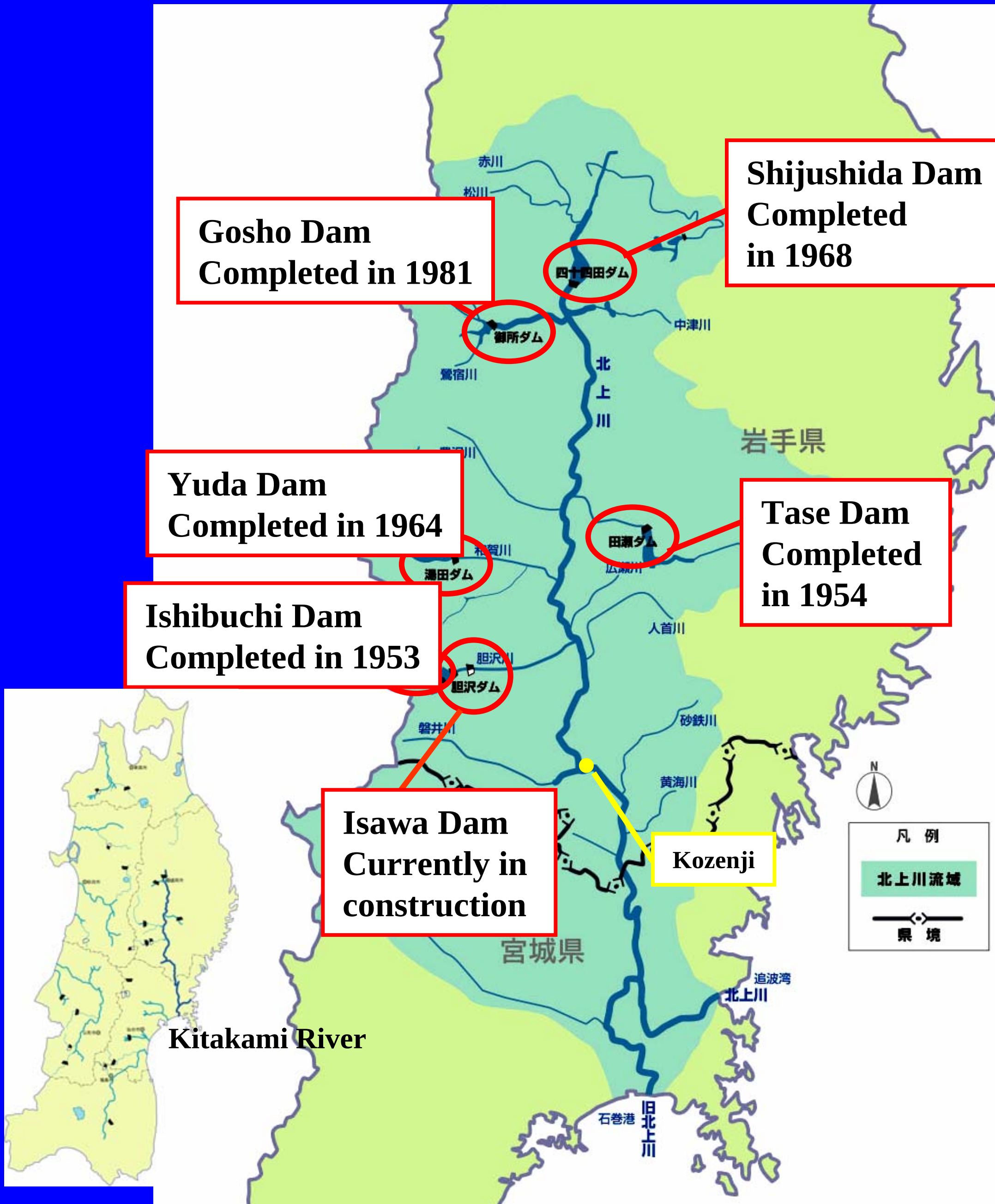
Photo: Ichinoseki City, Iwate Pref.



1951 – Specification as area applicable to
"Act for Comprehensive Development of the National Land"

1953 – Launch of Comprehensive Development Project
in Kitakami Specific Region (KVA)

# Comprehensive Development Project in Kitakami Specific Region (KVA)




## 1. Flood adjustment

◆ Reduction of floods in downstream Kitakami River area by 5 great dams at upstream Kitakami River and Ichinoseki Flood Control Basin

◆ Effect of dams

Basic high level flow rate 13,000 m3/s
→ Approx. 11,000 m3/s
(Reference point:
Approx. 2,000 m3/s reduction at Kozenji)

## 2. Irrigation project

◆ Irrigation water supply to rice paddies/fields

* Supply to 86,000 ha and reclamation project of approx. 13,000 ha. Irrigation capacity of approx. 170 million m3

## 3. Power generation project

◆ Hydroelectric power generation

* Power of 113,500kw generated at maximum

Total power generation capacity of approx. 340 million m3

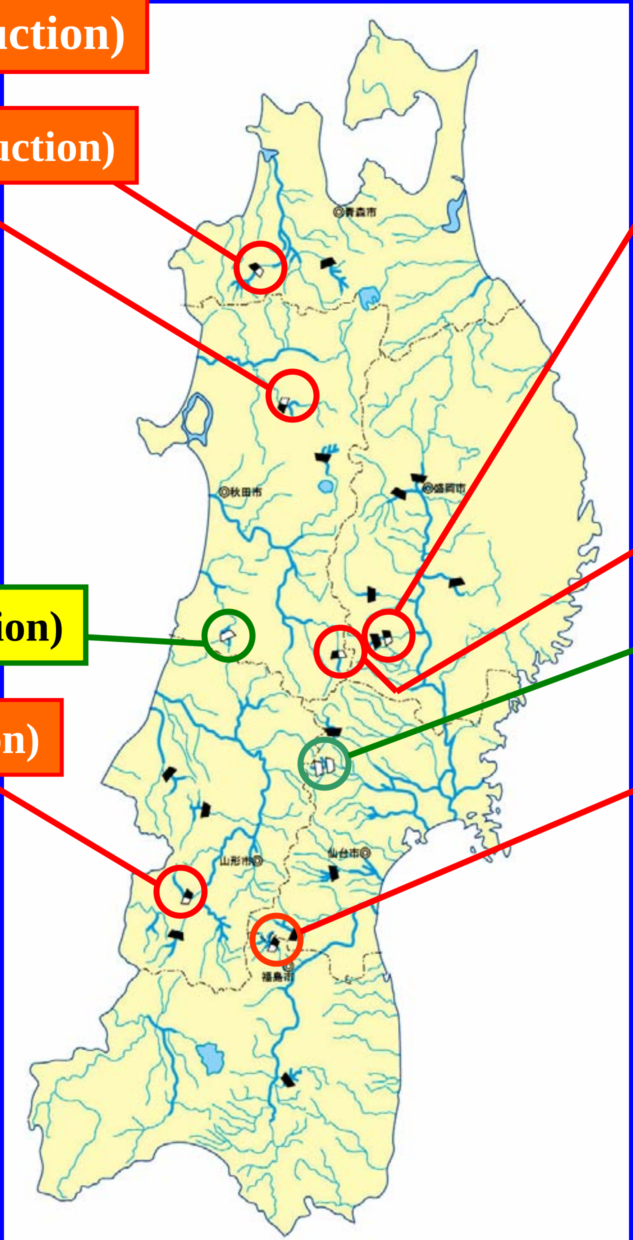
# Dams in Construction/Investigation in Tohoku Region

Tsugaru Dam (in construction)

Moriyoshizan Dam (in construction)

Chokai Dam (in investigation)

Nagai Dam (in construction)



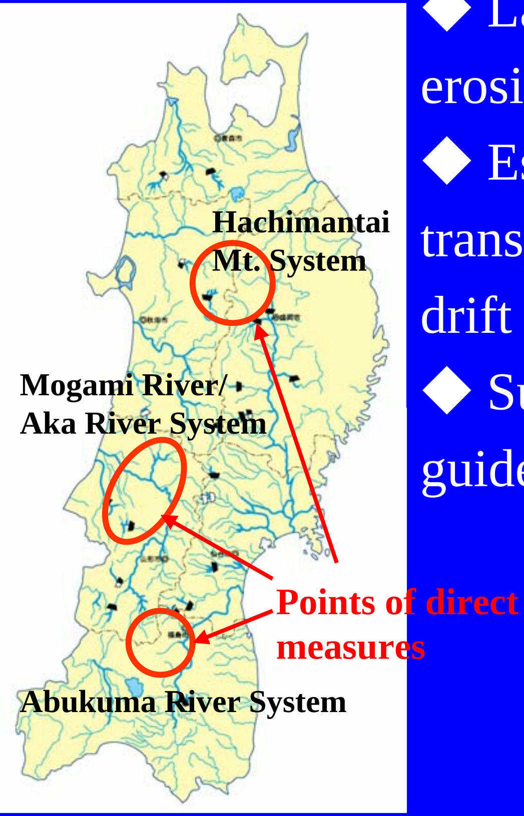

Isawa Dam (in construction)

Naruse Dam (in construction)

Tagawa 1st/2nd Dams (in investigation)

Surikami River Dam
(in construction)
Control planned to be shifted in April 2006

# Landslide Disaster Measures




- Landslide disasters by earth, driftwood runoff are prevented by erosion control weir, etc.
- Establishment of fish pass with consideration of continuance of transmissive erosion control weir and environment for ensuring the drift sand system
- Support for preparation of volcano disaster prevention map, guideline, etc.

Erosion control weir on Kosendatsu River (Akita Prefecture)

Masudama 2nd erosion control weir <transmissive> (Yamagata Pref.)

Fish pass establishment status

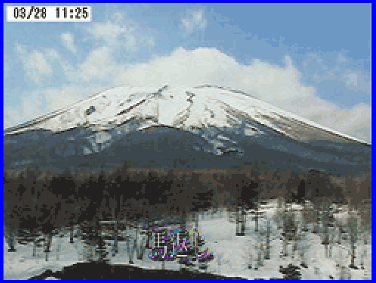
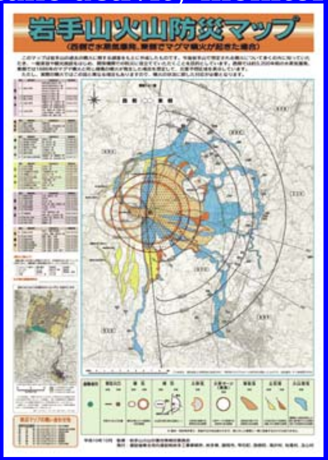



Image from Iwate volcano activity monitoring




Iwate volcano disaster prevention map

# Earthquake Measures

## ～Naruse River earthquake measures～

North Miyagi Earthquake on July 26, 2003

◆ Earthquakes occurred 3 times in intensities of 6 or larger.◆

**Damges**

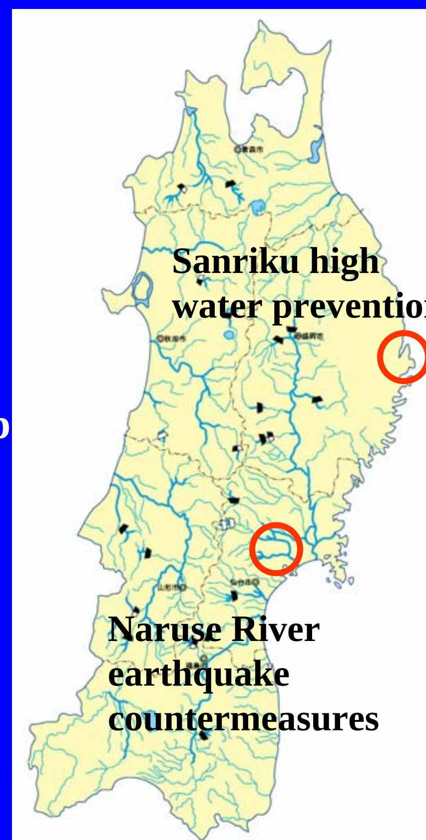
**Injuries: 675**

**Totally/partially collapsed houses: 4,966**

**Vertical crack at the edge of weir top**

**Emergency recovery construction**

**Completion of full recovery construction**

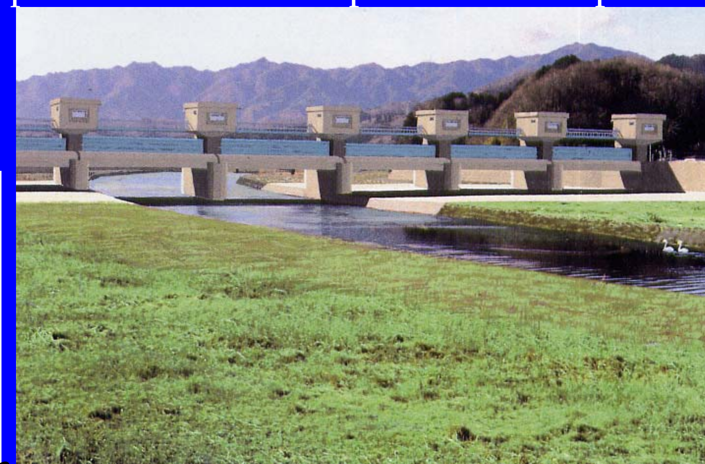



## ～Sanriku high water prevention Tsugaruishi Water Gate construction～

◆ Bank raising for tide enbankment

◆ Gate installation near Tsugaru Ishikawa estuary

◆ Preparation of disaster prevention map



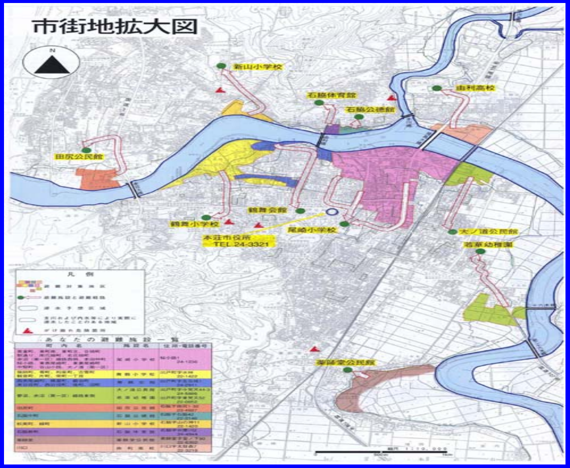
**Tsugaruishi water gate**


**Kesennuma City disaster prevention map**

# Software Measures

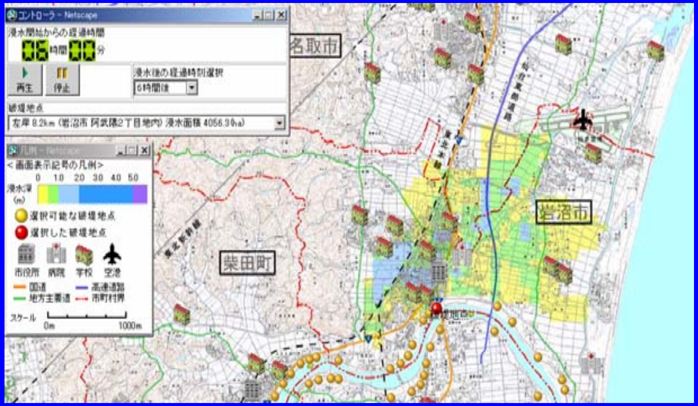
## ～Integration of hardware establishment and software measures～

- ◆ Provision of river disaster prevention information on the Internet or mobile phone sites (water level, rainfall, flood forecast, flood warning, etc.)
- ◆ Information provided in real time for 24 hours
- ◆ Flood images in rivers provided to public broadcast
- ◆ Support for hazard map preparation




**Flood hazard map (Yurihonjo City, Akita Pref.)**


**Information provided by utilization of the Internet**




**Flood simulation**


**Information provided by live broadcast**

Typhoon Rusa and Super Typhoon Maemi: Impacts and Aftermath

The 14th International Symposium
on National Land Development and Civil Engineering in Asia

Prepared by Chang Wan KIM
Water Resource Research Department
Research Fellow, Korea Institute of Construction Technology
Korea

## 1. Introduction

Two recent major typhoons, Typhoon Rusa in 2002 and Super Typhoon Maemi in 2003, imposed a heavy toll on Korean society. Typhoon Rusa was labeled as one of the worst tropical storms of the last 45 years. Super Typhoon Maemi was the strongest typhoon since records began almost 100 years ago. Characteristics of Typhoon Rusa and Maemi are analyzed using the typhoon tracks, hydrologic data, and flood damages.

**Figure 1. Satellite image of Typhoon Rusa**

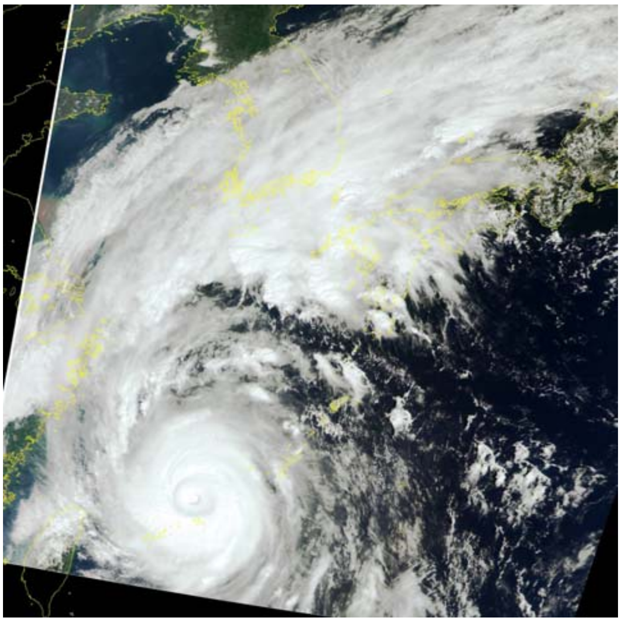
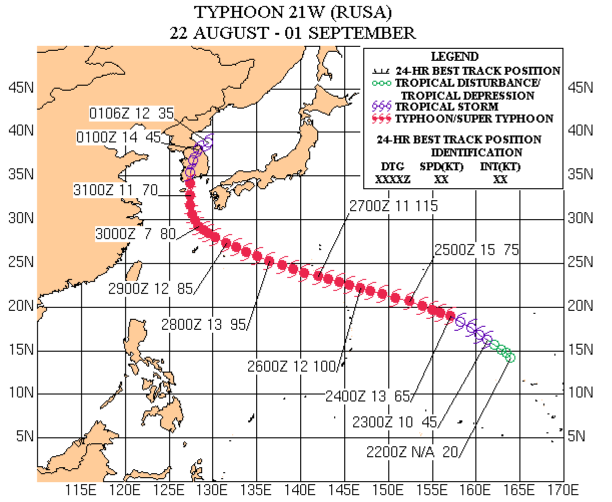


**Figure 2. Satellite image of Typhoon Maemi**

## 2. Typhoon Tracks

'Rusa' is the Malaysian word for deer. Typhoon Rusa developed southwest of Wake Island at the eastern periphery of the monsoon trough. The cyclone tracked northwest toward Okinawa for approximately 8 days before turning toward the Korean Peninsula and subsequently made landfall at approximately at 06:30 UTC on 31 August 2002 near Goheung-gun, Korea, with maximum sustained winds of 120 km/hr (65 knots), gusting to 150 km/hr (80 knots). Typhoon Rusa reached a peak intensity of 215 km/hr (115 knots) on 26 August near the Bonin Islands and maintained this intensity for 24 hours before beginning a slow weakening trend until landfall in Korea.



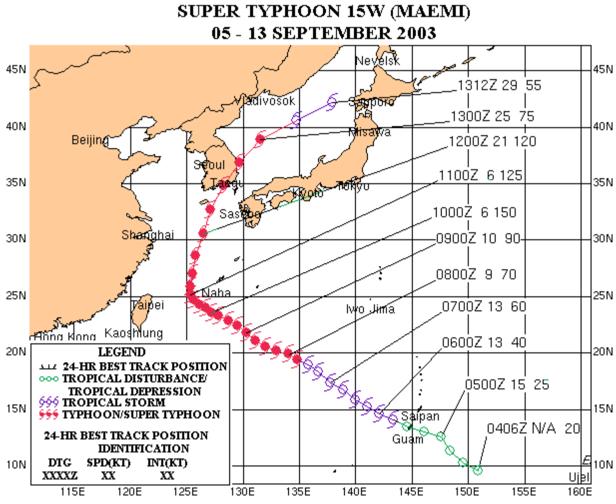




**Figure 3. Track map of Typhoon Rusa** **Figure 4. Track map of Typhoon Maemi**

'Maemi' is the Korean word for cicada. Super Typhoon Maemi formed in the monsoon trough approximately 110 km east-southeast of Guam. As the typhoon approached Okinawa, it developed into a super typhoon (category-5) by 12:00 UTC on 9 September and attained maximum intensity of 280 km (150 knots) 12 hours later. Typhoon Maemi made landfall at 13:00 UTC on 12 September near Goseong-gun, Korea, with maximum sustained winds of 140 km/hr (75 knots), gusting to 175 km/hr (95 knots) and, subsequently, tracked along the southeastern coast of Korea.

### 3. Renewal of Rainfall and Wind Speed Record

Typhoon Rusa caused a historical precipitation in northeastern part of Korea. Table 1 shows rainfall depths measured at two gauging stations. As shown in Table 1, all the recorded data exceed the probable precipitation of 200-year return period at every duration time both in the two stations. A PMP (Probable Maximum Precipitation) analysis shows that for the duration time of 24 hours the recorded amount of rainfall exceeds the existing PMP in the basin area of up to 2,000 $km^2$. It shows also that for the duration times of 12 and 48 hours, the recorded ones exceed the existing PMP in the basin area of up to 200 $km^2$.

**Table 1. Rainfall depths recorded at two stations in northeastern part of Korea**

| Stations | Item | Duration(hr) | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 6 | 12 | 24 | 48 |
| Gangneung | Return period (yr) | Over 200 | Over 200 | Over 200 | Over 200 | Over 200 |
| | Rainfall depth (mm) | 98.0 | 399.5 | 576.0 | 880.0 | 897.5 |
| Yangyang | Return period (yr) | Over 200 | Over 200 | Over 200 | Over 200 | Over 200 |
| | Rainfall depth (mm) | 83.0 | 403.0 | 560.0 | 664.0 | 679.0 |

Super Typhoon Maemi caused a historical wind gust in Jeju Island and southeastern part of Korea. The typhoon struck the south coast of Korea during the night of September 12 as a category-3 typhoon, with wind gusts reaching 216 km/hr and rainfall of up to 450 mm before it made landfall. The maximum wind speed of 60 m/s (216 km/hr) at Jeju gauging station is the national record of Korea. This fact indicates that the characteristics of Super Typhoon Maemi is the very strong wind around the center of typhoon.

Figure 5 shows the gauging stations which made new records among eighty-seven stations. While Typhoon Rusa made the new records of one-day maximum rainfall at eight stations, Super Typhoon Maemi made the new records of maximum instantaneous wind speed at twenty stations. From this fact, it can be noticeable that Typhoon Rusa was a wet typhoon but Super Typhoon was a dry typhoon.

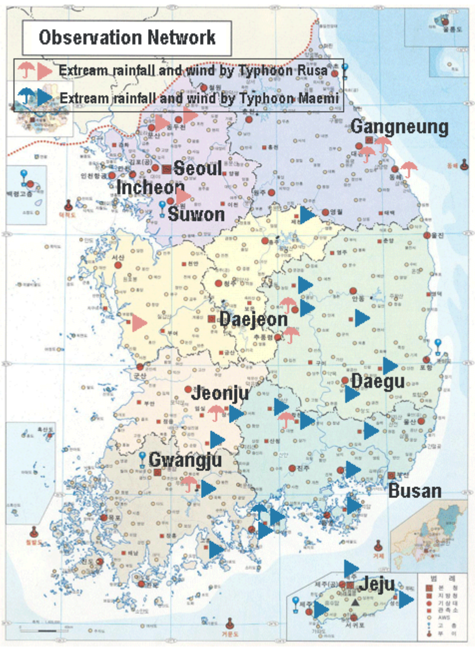



**Figure 5. Meteorological observation stations**

## 4. Rainfall and Floods

As shown in Figure 6 and 7, the amount of precipitation caused by Typhoon Rusa in the northeastern part of Korea was almost twice of that caused by Super Typhoon Maemi . Figure 8 shows the stage hydrograph and the spatially averaged-rainfall hyetograph at Gangneung stage-gauging station located at the downstream in the basin. The design water level of 100-year return period at this station is 3.54m and the flood level exceeded it by 1.8m. In this figure, too, the peak flood coincides the peak rainfall, which implies the flood is a type of flash flood.

Figure 8 shows the stage hydrograph and the spatially averaged-rainfall hyetograph at Gupo stage-gauging station located at the downstream of the Nakdong River while Super Typhoon Maemi made landfall at 21:00 KST (13:00 UTC) on September 12 near Goseong-gun. The typhoon kept its strength over category-1 typhoon for 12 hours after the landfall. The stage-gauging stations near the sea experienced the storm surge of about 1.4 m during this period.

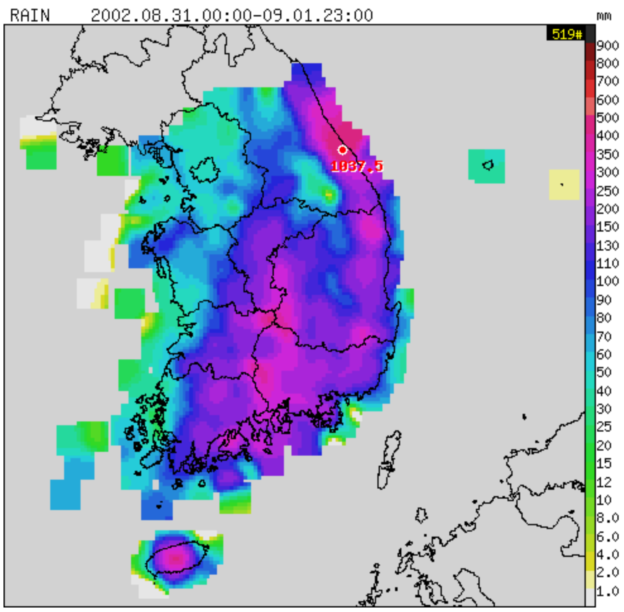



**Figure 6. Rainfall by Typhoon Rusa**

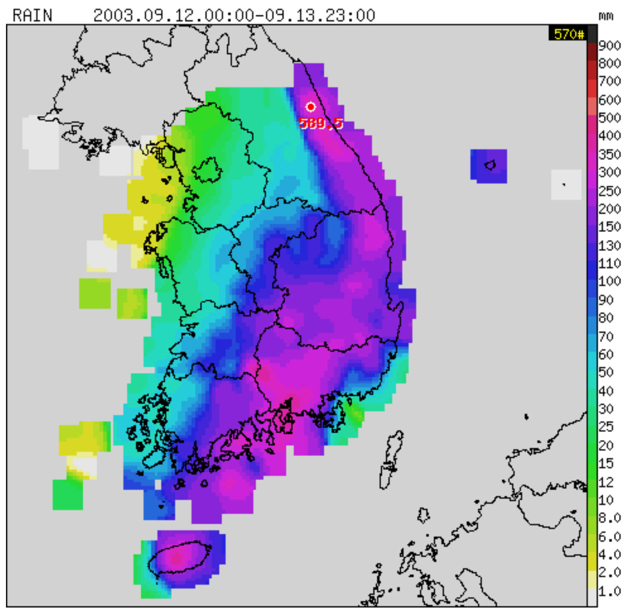



**Figure 7. Rainfall by Typhoon Maemi**

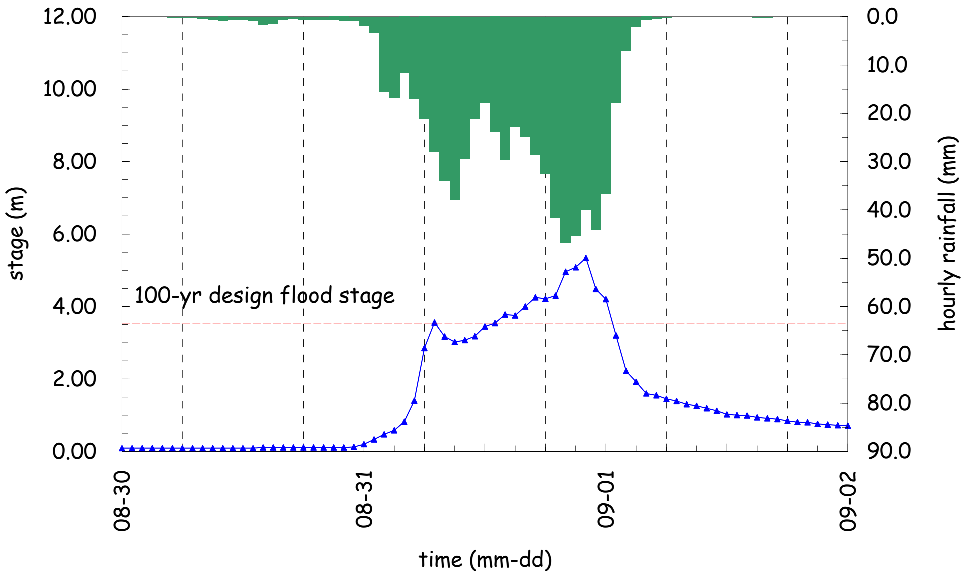



**Figure 8. Hydrograph at Gangneung stage-gauging station**

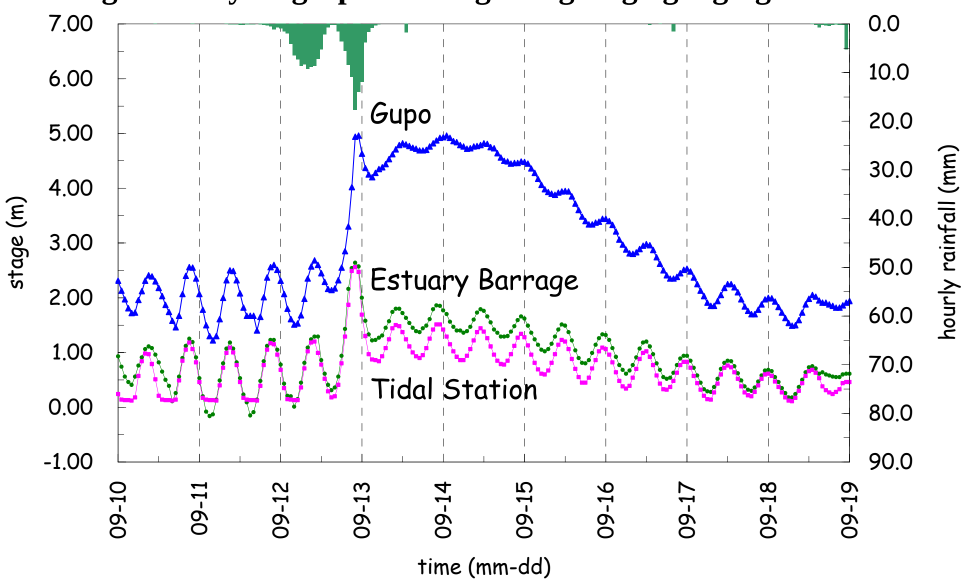



**Figure 9. Hydrograph at Gupo stage-gauging station**

### 5. Flood Damages

The resulting floods of Typhoon Rusa left 213 dead and another 33 missing in the whole country. Heavy storms accompanied with the typhoon destroyed more than 45,000 houses, washed away 850 $km^2$ of farmland, swept 202 bridges, destroyed several sections of roadway and railway, and cut off fresh water to 400,000 people. Besides, they destroyed completely and nearly hundreds of stream channels in the regions. Altogether, the damage caused by the typhoon was as much as $ 5.4 billion.

During the floods, morphologies of many streams flowing especially to the East Coast from the mountainous regions were dramatically changed by the high-speed and highly concentrated flows. Channel response to such extreme flood clearly shows the inertia-dominant behavior of channel straitening, widening, and steepening. Re-channelization is to restore the stream channel with new channel forms and new floodplain management practices after a stream channel and surrounding floodplain are completely or near-completely altered by the extreme flood. It would usually follow, in case that the channel and socio-economic conditions allow, the channel forms newly shaped by the extreme flood.

Super Typhoon Maemi damaged 774 roads, 27 bridges, and submerged 174 $km^2$ of farmland. More than 25,000 were left homeless and at least 117 fatalities were reported. The storm destroyed more than 5,000 houses and damaged a further 13,000 homes and businesses. Almost 40,000 cars were damaged in the storm. A total of 465 vessels were destroyed or marooned. The most severe damage caused by this typhoon was that Korea's main port of Busan and the industrial areas in Yecheon, Ulsan and Daegu were heavily affected. Altogether, the damage caused by the typhoon was as much as $ 4.8 billion.

Up to 453 mm of rainfall fell across the Nakdong River basin. The Nakdong River Flood Control Center issued flood warnings along the Nakdong River, which runs through the center and south of Korea, as overflowing dams had to open floodgates. About 25,000 people had to be evacuated and several thousand were camped out in public buildings on Sunday 14th September, two days after the event.

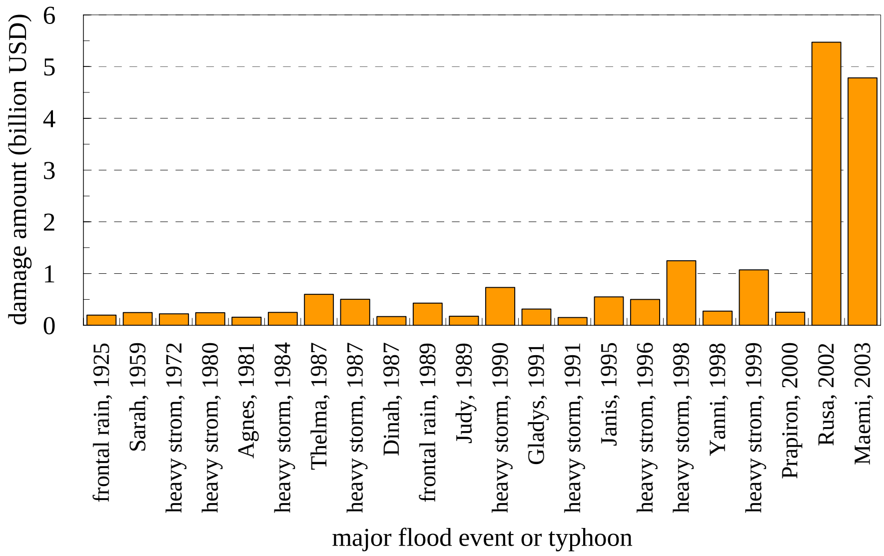



**Figure 10. Flood damage amount by major flood event or typhoon**

Figure 10 shows the damage of past twenty-two flood events or typhoons. From this figure, damage amount by Typhoon Rusa is about ten times as large as the average. It is also about 5 times as large as the previous maximum damage amount. Damage amount by Super Typhoon Maemi is as large as that by Typhoon. So, damage amount by both typhoons exceeds the rest damage amount.

Flood damages caused by the typhoon Rusa show a very different characteristic as compared with the previous ones in terms of the scale and type of damage. In a word, almost all of the river channels were changed and the most levees along those channels were washed away. Moreover, two small dams were overtopped in the Gangneungnamdae River running through Gangneung city causing losses of lives and property. The flood damages in the region can be categorized into several types as follows:

Type 1 is the levee failure and channel re-coursing. During the floods, morphologies of the many channels in the region were dramatically changed by the high-speed flows as well as highly concentrated debris flows. These streams affected by the floods had been channelized during the 1970's - 90's by the river regulation works, including levee construction along the both sides of the channel and bridges crossing the streams. Figure 11 shows a typical one of such type.

Type 2 is the debris flow caused by the torrential water along the narrow river valley and landslides from the slopes of mountain. Debris flow is not common in Korea because the basins are geologically mature and have relatively thin soil layers over the mother rocks. This time, the catastrophic rainstorms and floods by the typhoon caused numerous landslides and debris flows especially in the steep and narrow river valleys. Figure 12 shows a remnant of debris flow burying houses and lands.

Type 3 is the dam overtopping and resulting downstream floods. This was caused probably by the near-PMP condition. Figure 13 shows the Dongmak dam site, one of the two dam-overtopping cases during the flood.

**Figure 11. Levee failure, channel widening and recoursing (flow from center-left to lower-left)**

**Figure 12. Houses buried by debris flow**

**Figure 13. Dam collapse (Dongmak Reservoir; view from upstream to downstream)**

**Figure 14. Container cranes destroyed in Busan Port**

The damage due to Typhoon Maemi was mostly dominated by wind and occurred in private property. Busan, as Korea's largest port, normally handles 80 percent of the country's container shipping. Typhoon Maemi blew into Busan with such intensity that not only tossed shipping containers and fishing boats into the air but also toppled eleven giant container-lifting cranes, each weighing around 900 tons. Figure 14 shows container cranes destroyed in Busan Port.

## 6. Lessons Learned

There are lessons which can be learned from Typhoon Rusa in 2002 and again Super Typhoon Maemi in 2003.

Although Typhoon Rusa and Super Typhoon Maemi were both closely monitored and categorized in meteorological term, the significant differences in their physical characteristics led to different damages to the society. The forecasts and severe weather warnings were also too later for disaster management teams to react.

The climate is changing but policy for dealing with it has not changed. Korea is carrying out the first Korean geosynchronous multi-functional satellite (COMeS) development program to improve the capability of obtaining real-time meteorological observation data that provides higher time, spatial and spectral resolution data than currently available. For more rapid and precise forecast of rainfall and streamflow, Korea is installing hydrological radars and the automated flow measurements.

As many people complained about the slow relief measures after Typhoon Rusa, the new administration had not carried out effective evacuation actions when Super Typhoon Maemi hit again one year later. The Korean government is now pursuing several improvements to its disaster management system. These improvements would cover the entire country simultaneously through the use of advanced information and communication technologies.

Rapid urbanization and industrialization but lacking sufficient infrastructure for disaster management contributed more in property damage and life loss. Moreover, construction standards are still based on flood frequencies from decades past. The Korean government has established a new concept in measures for flood damage such as the Comprehensive River Basin Flood Control Plan. The focus of this plan is that the whole basin can be protected from flooding through effective combination of embankments, dams, retention and flood control pond. Besides, the Korean government checked the safety of dams to implement proper adjustments for better flood control by dams.

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# Outline of ICHARM


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*Public Works Research Institute (PWRI)*

*Tsukuba, Japan*

# the International Centre for Water Hazard and Risk Management

# (ICHARM)

## under the auspices of UNESCO

# I am going to talk about

- 世界の水災害の動向

  (Trend of water related disasters in the world)

- 土木研究所の概要

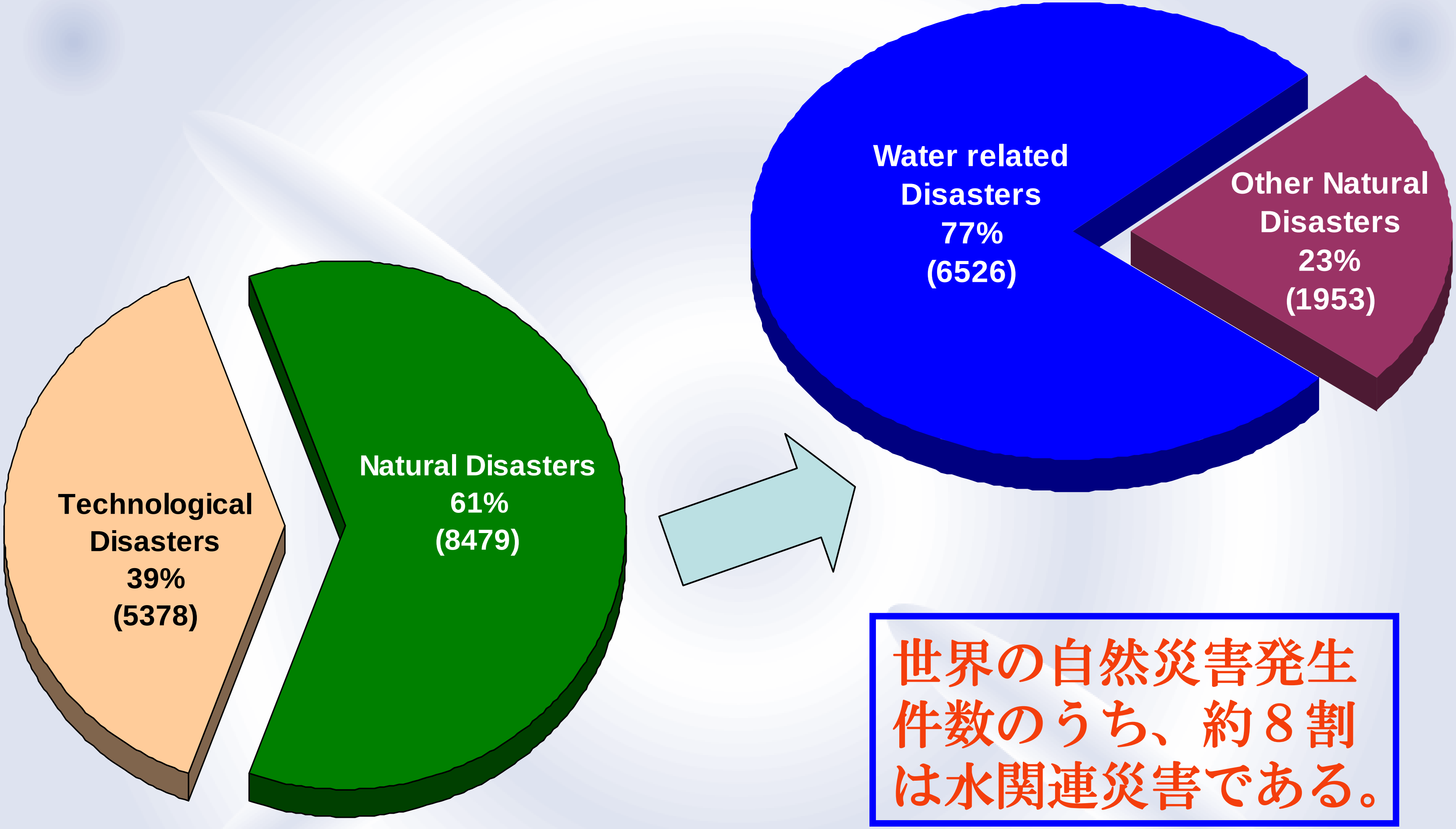
  (Outline of PWRI)

- ICHARMの活動予定

  (Planned activities of ICHARM)

- ICHARMの設立準備状況

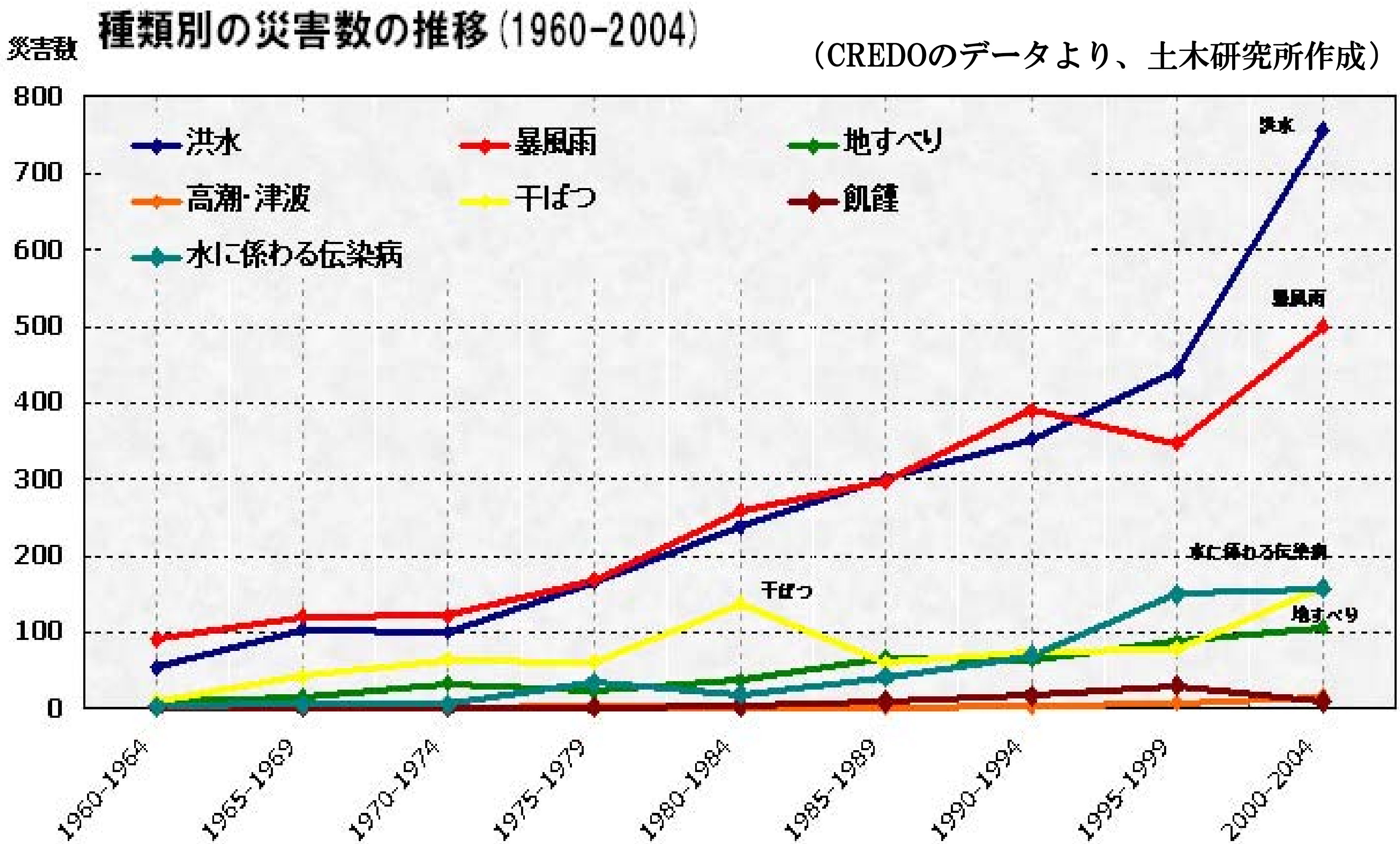
  (Preparatory activities of ICHARM)



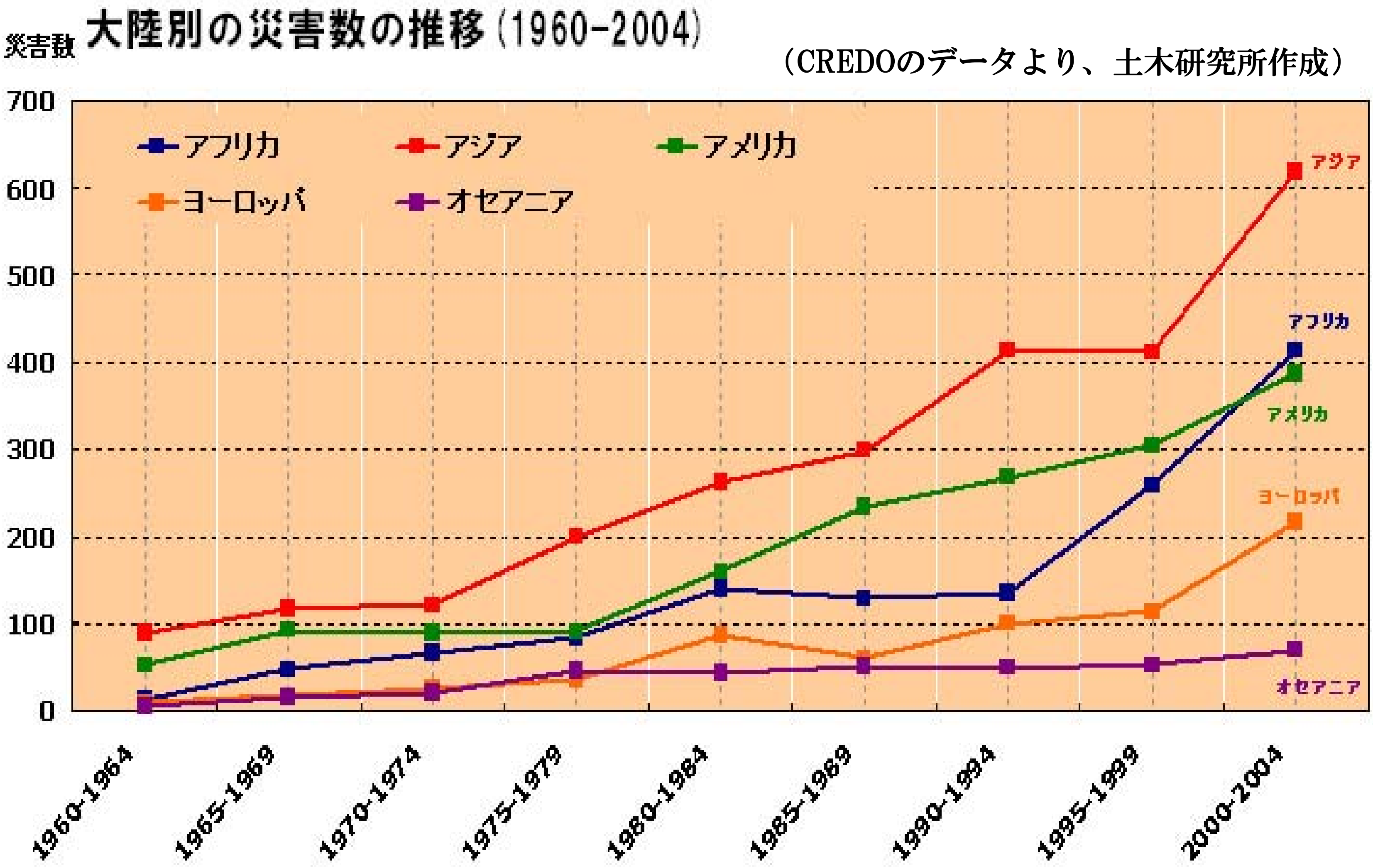

世界の自然災害発生件数のうち、約８割は水関連災害である。

Disasters in the World（1960－2004）

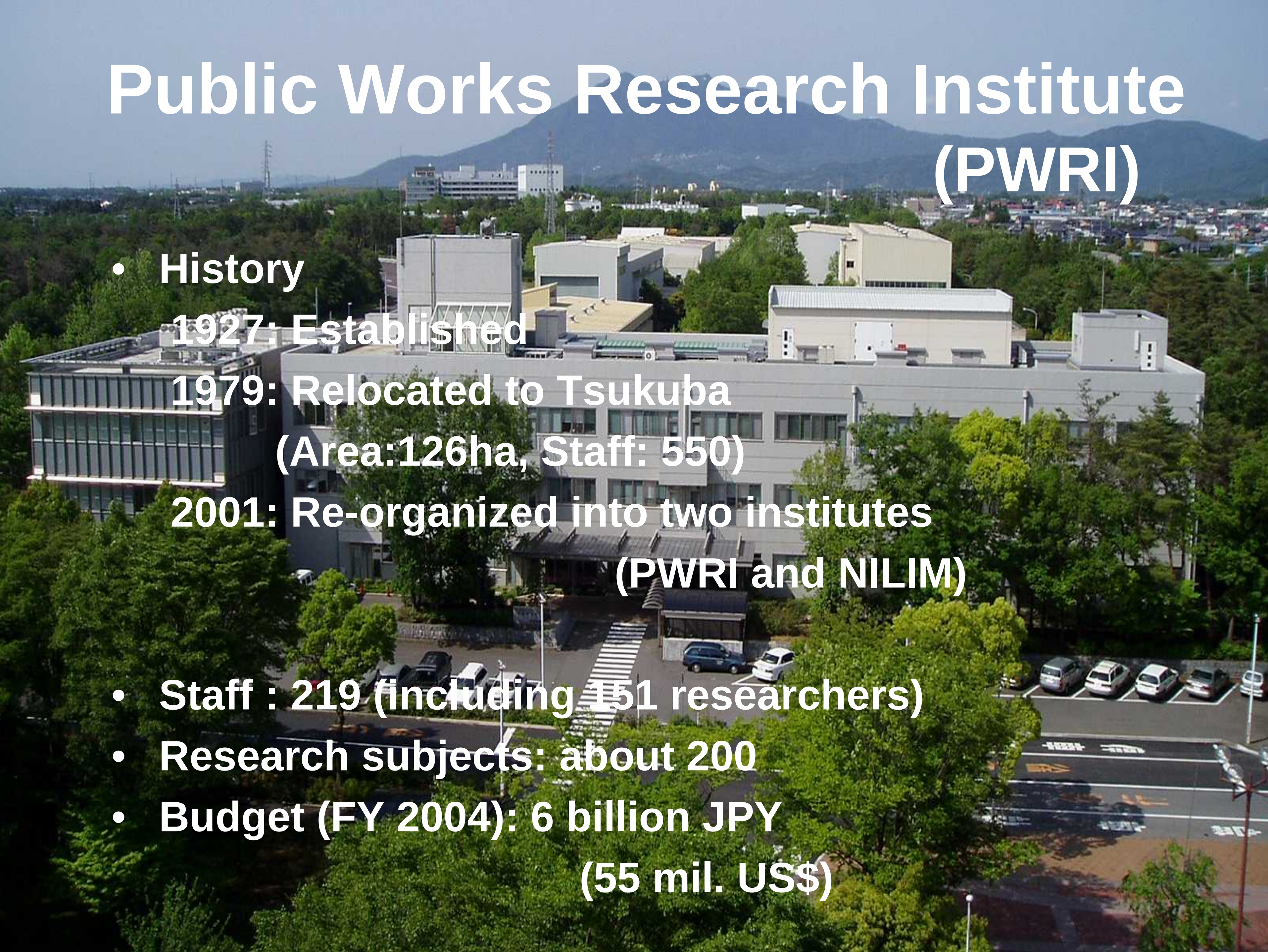
※ CREDOのデータより、土木研究所作成




死者１０名以上もしくは被災者１００名以上等の要件を満たす災害のうち、洪水や暴風雨によるものが圧倒的な比率を占めており、近年増加傾向にある。




アジア地域の水災害発生件数は、世界の1/３以上を占めており、
これも近年増加傾向にある。



# Public Works Research Institute (PWRI)

- History
  - 1927: Established
  - 1979: Relocated to Tsukuba (Area:126ha, Staff: 550)
  - 2001: Re-organized into two institutes (PWRI and NILIM)

- Staff : 219 (including 151 researchers)
- Research subjects: about 200
- Budget (FY 2004): 6 billion JPY (55 mil. US$)

# 200 Research topics focusing on 14 priority research projects

- to ensure **safety**
- to conserve and restore the **environment**
- for **efficient management** of infrastructure

# 9 Research Groups with 20 teams

- Construction Technology Research Dept.
- Material and Geotechnical Engineering
- Earthquake Disaster Prevention
- Water Environment　(水循環G)
- Hydraulic Engineering（水工G)
- Erosion and Sediment Control（土砂管理G)
- Road Technology
- Structure
- Niigata Experimental Laboratory

# International Research Cooperation


**Implementation arrangements with overseas organization**

# Objective of ICHARM

- **Accumulated knowledge and experience** trying to overcome water-related disasters
- **Global network of UNESCO-IHP** for internationally sharing valuable information

→ **Contribution to prevent or mitigate water-related disasters in the world**


# Research, Training and Information networking activities would be promoted in a combined manner

# Activities

## - Research -

- **Contribution to international projects such as WWAP and IFI/P (UNESCO/WMO)**
- **Hydraulic / hydrological prediction, observation, modeling and analysis**
- **Risk assessment and risk management technologies for water-related hazards under various socio-economic, geographic and climatic conditions**

# Activities

## - Training and Capacity building -

Conducts JICA training courses, including

- River and dam engineering
- Flood Hazard Mapping

A new course on comprehensive tsunami disaster prevention is in preparation

Strengthen the follow up activities to link the training course to concrete action for preventing or mitigating water related disasters

# TC on Flood Hazard Mapping

## Objective

- Acquire professional knowledge necessary to produce flood hazard maps
- Enhance understanding of its effectiveness
- Seek application in his/her own country

## Framework

- 4 weeks for 5 years (2004-2008)
- 16 trainees from 8 countries of Asia
- Place: Tsukuba, Japan (PWRI & JICA)

# Activities

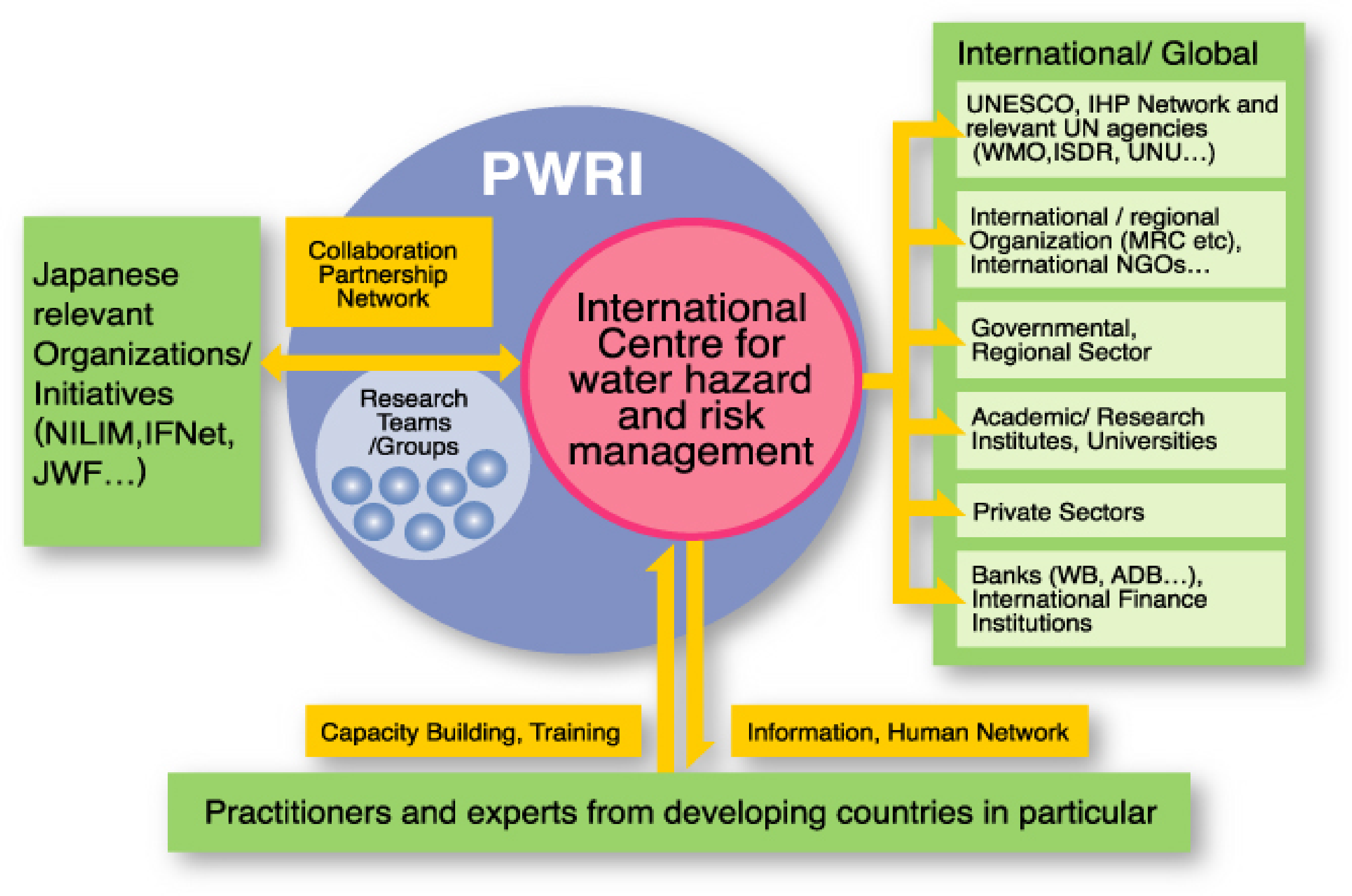
## - Information Networking -

**Information networking will be synergized with research and training activities**

**in order to enhance integration and coordination:**

**Through the information network…**

- Research output will be widely disseminated
- Feedback from countries / regions will be reflected in the research projects
- Trainees will develop domestic links to their own countries/ regions
- Local needs for training items would be clarified




**ICHARM would collaborate with the UNESCO-IHP networks, relevant UN agencies and other key institutes & organizations of the world**

# Preparatory activities

**October 2003**

**32nd UNESCO General Conference**

**→ Announcement of intention to set up the Centre by the representative of Japanese Government**

**October 2003**

**RSC meeting in Southeast Asia & Pacific and in Latin America & Caribbean**

**→ Resolutions strongly supporting the establishment of the Centre**

# Preparatory activities (cont'd)

January 2004

International technical workshop at PWRI

→ Experts from Asia, Africa, East & West Europe, and North & South America

→ Summary Report on directions of the Centre

International Symposium in Tokyo

April 2004

Proposal of the new Center was welcomed at UNESCO IHP Bureau Meeting

July 2004

A preparatory meeting of IFI/P hosted by PWRI

# Preparatory activities (cont'd)

September 2004

UNESCO IHP Intergovernmental Council

→ Resolution to support the proposal

January 2005

World Conference on Disaster Reduction

(Hyogo Japan, organized by ISDR)

→ Recognition of the role of ICHARM

→ Official launch of IFI


International Strategy
ISDR
for Disaster Reduction
Welcome to Hyogo
World Conference
18-22 January 2005, Kobe, Hyogo,


**Dr. Sakamoto, CEO of PWRI, at the opening of the thematic session entitled ‘Research on Floods and Landslides and a new Initiative for Risk Reduction’**

# International Flood Initiative (1/2)

**Mission**

**Promote an integrated approach to flood management**

**by reducing the risk of social, environmental and economic effects that result in and from floods and increasing the benefits from floods and the use of flood plains**

**Implementation**

UNESCO, WMO, UNU, UN-ISDR, IAHS ･･･

Secretariat : ICHARM

# International Flood Initiative (2/2)

**Guiding principles**

- Living with flood
- Equity
- Empowered participation
- Inter-disciplinary and trans-sectorality
- International and regional cooperation

**Strategic Activities**

- Research
- Training and education
- Information networking
- Capacity building
- Technical assistance

# Preparatory activities (cont'd)

**April 2005**

- **UNESCO Executive Board (FA & PX)**

  **→Draft decision was adopted to approve ICHARM at the General Conference in October 2005.**

# Preparatory activities (cont'd)

**October 2005**

**33rd UNESCO General Conference**

**→ Proposal of the Japanese Government was accredited by 191 member countries**

# Office Space of ICHARM

**Research Staff 20**
**(in the initial stage)**

**Office space**
**2,000m²**

# END

**Thank you for your attention**

**http://www.unesco.pwri.go.jp**