Flood Management in Japan

1. Comprehensive Flood Control Measures

2. Provision of River information

3. Responses to the Niigata Torrential Rain Disaster

4. About ICHARM

5. Responses to 2011 Thailand Floods

6. Outline of the Tsunami-Resilient City

ICHARM

International Centre for Water Hazard
and Risk Management

Institute on 6 March 2006

What Is ICHARM?

- A UNESCO Category II* centre established in March 2006 at the Public Works Research Institute (Tsukuba). Its mission is to be the world centre of excellence to provide and assist implementation of best practicable strategies to localities, nations, regions and the globe to manage the risk of water related disasters.

- As a UNESCO Water Centre under the International Hydrological Programme (IHP), it contributes to ensuring safety from water hazards around the world.

【March 6, 2006】 Establishment of ICHARM as an integral part of the Public Works Research Institute, with Dr. Kuniyoshi Takeuchi, then University of Yamanashi professor (now emeritus) and former Chairman of the UNESCO IHP Inter-Governmental Council, as founding Director.

*Category II Centre: An organization that, while not legally part of the UNESCO organization, is certified by UNESCO (33C/Resolution 90) as serving to boost UNESCO's worldwide activities.

Three Pillars of ICHARM Activities
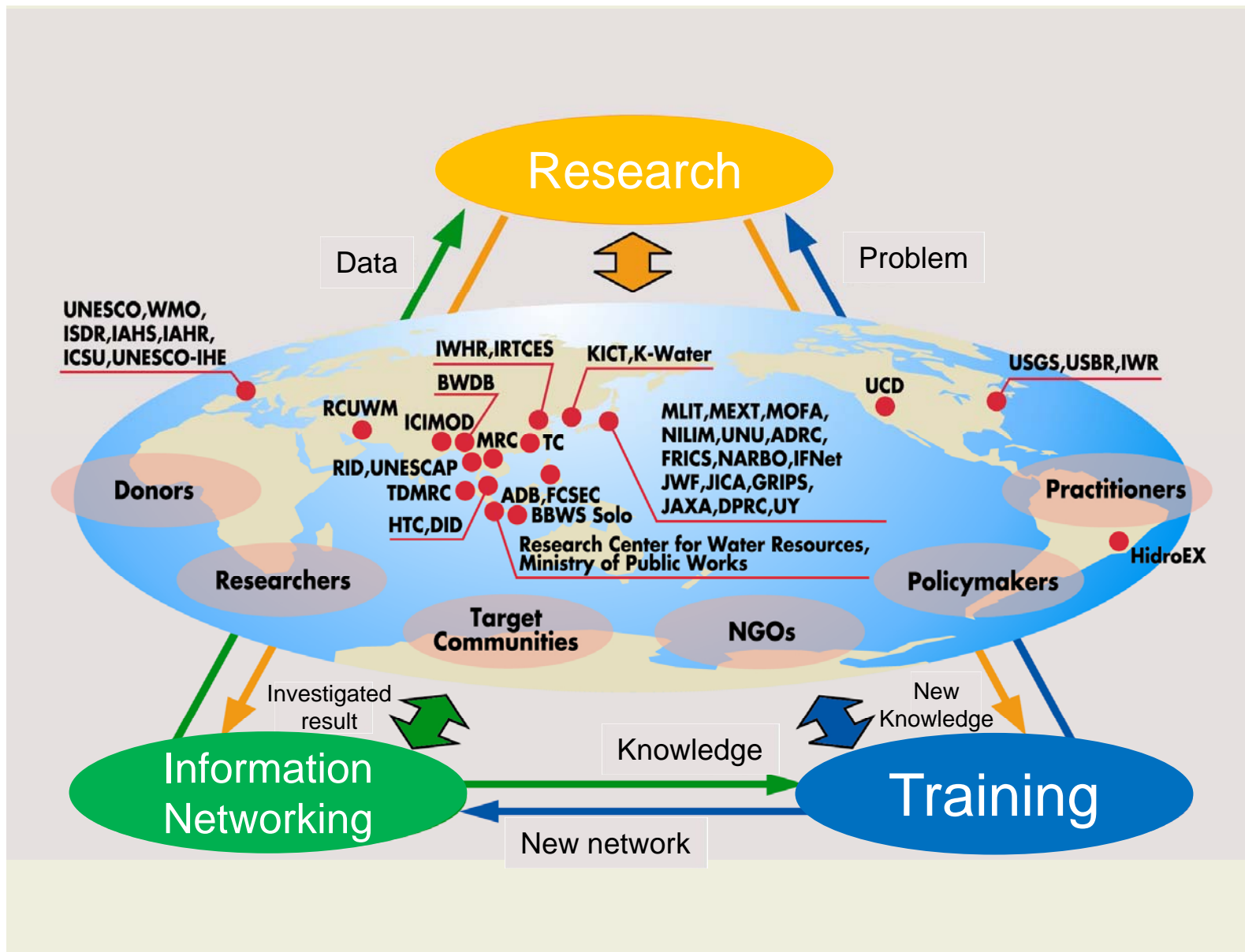
What Is IFAS (Integrated Flood Analysis System)?

IFAS

Integrated Flood Analysis System

A system for calculating time and extent of river flow increase in heavy rain

Background

In developing nations that lack adequate provision and maintenance of hydrometric stations for measuring rainfall, river water level, and flow rate, it is difficult to set up evacuation warning systems, including flood warnings, for mitigating risks.

A system was developed mainly in ICHARM enabling data provision for flood forecasting and flood control planning even in areas without adequate hydrological data.

Features

Can **automatically collect** geographical data, land use data, and satellite rainfall data and use these to calculate river flow rate, etc.
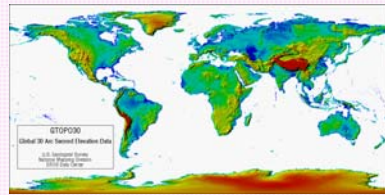
Analysis is possible from any Windows PC connected to the Internet.

IFAS can be downloaded from the ICHARM website.
http://www.icharm.pwri.go.jp/index.html

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IFAS

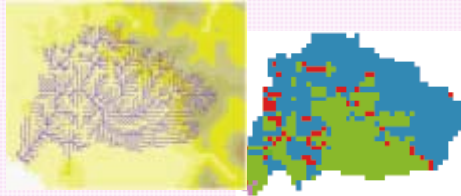**Altitude data**   **Land use data**
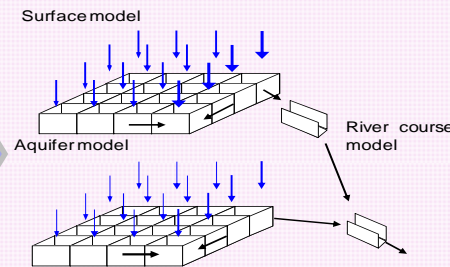
GSMaP_NRT (JAXA)
3B42RT (NASA), etc.

Rainfall data from satellite or ground observations

Input

Input

Runoff analysis

Calculation of river water flow rate and level, etc.

Model creation

Surface model

Aquifer model

River course model

Decision by risk manager

AutoIFAS

Dangerous flooding expected!
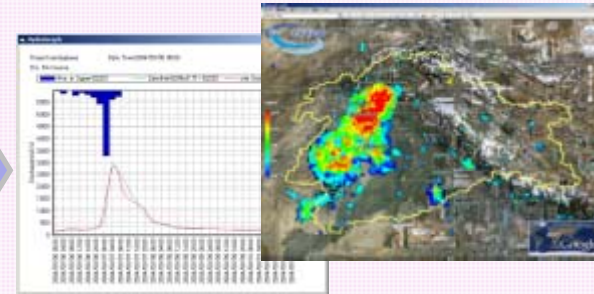
Alert displayed

Evacuation from areas at risk

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Accuracy of rainfall runoff analysis when satellite-based microwave radiometry observations match timing of torrential rain

Satellite rainfall observations

Corrected satellite rainfall observations

Flow rate calculated from corrected satellite rainfall observations

Actual flow rate

Time of observation by microwave radiometers

Flow rate calculated from satellite rainfall observations
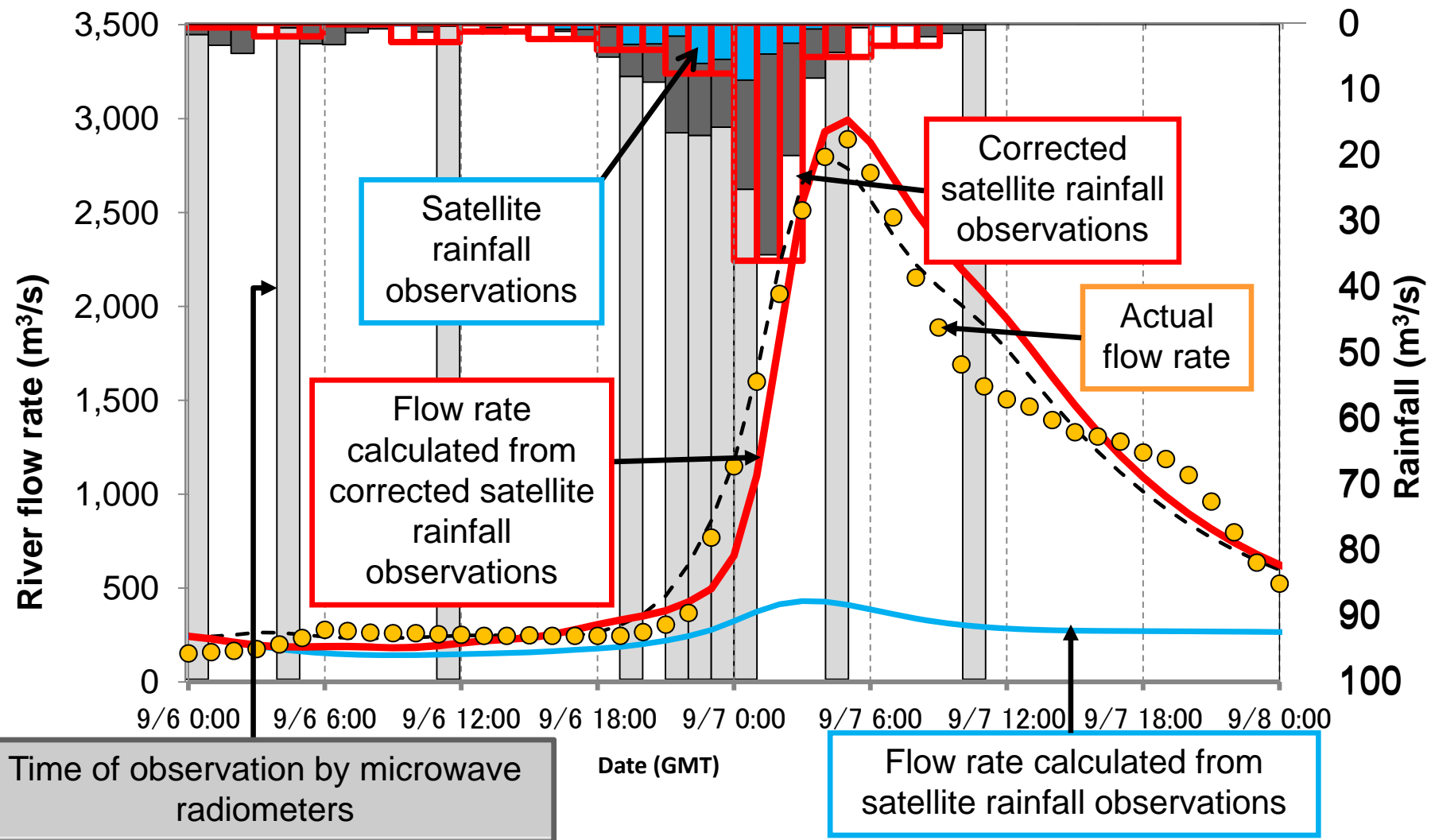
Thanks to frequent microwave measurements when storm fronts are developing, rainfall amounts are corrected with high precision enabling accurate calculations of river flow rate.

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Issues for Obtaining Good Analysis Results with IFAS

Accuracy of satellite rainfall observations and of corrections depends on frequency of microwave radiometry observations.

(Because satellites circle the earth, they cannot measure at all times.)
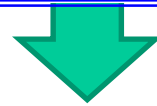
If satellite microwave radiometry observations are not timed to rainfall peak, deviation between analysis results and actual flow rate is large.
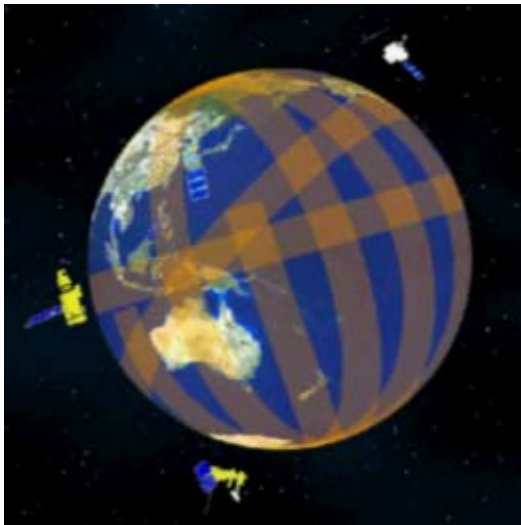
Courtesy of JAXA

Microwave measurement from satellites

How to realize improvements:

- Have the world's aerospace organizations increase the number of satellites equipped with microwave radiometers to enable more frequent observations.

- Make maximum use of available rainfall data from ground observations (obtain data not dependent on satellites such as ground rain gauges and radar rain measurements).

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IFAS Use Overseas

- Seminar held on IFAS use in six Asian nations (Indonesia, Thailand, Vietnam, Myanmar, Pakistan, India)
- Flood warning system using IFAS being built for Solo River in central Java, Indonesia in cooperation with Asian Development Bank (ADB) Solo River (scheduled for completion in March 2012)
- UNESCO project to provide flood warning system using IFAS for Indus River
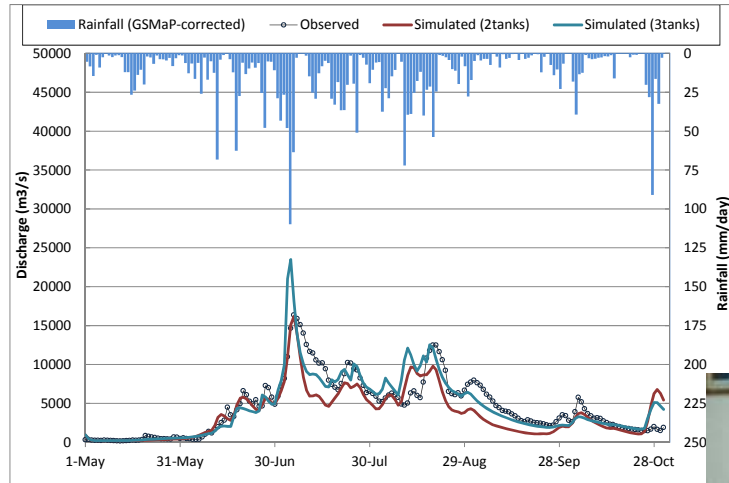
Case study of IFAS use for rainfall/discharge analysis at IFAS seminar in Myanmar (June 2010)
Chindwin River, tributary of Irrawaddy River

RAINFALL-RUNOFF-INUNDATION PREDICTION IN THE CHAO PHRAYA RIVER BASIN

2011 Chao Phraya flood in Thailand

Rainfall-Runoff-Inundation Prediction in the Chao Phraya

> **Rainfall-Runoff-Inundation Model (RRI Model)**
> RRI model is designed to analyze the entire process from river discharge to inundation by using rainfall as the input data.

(m)
- 1 – 5
- 5. – 10
- 10. – 15
- 15. – 20
- 20. – 30
- 30. – 50
- 50. – 100
- 100. – 250
- 250. – 500
- 500. – 1,892
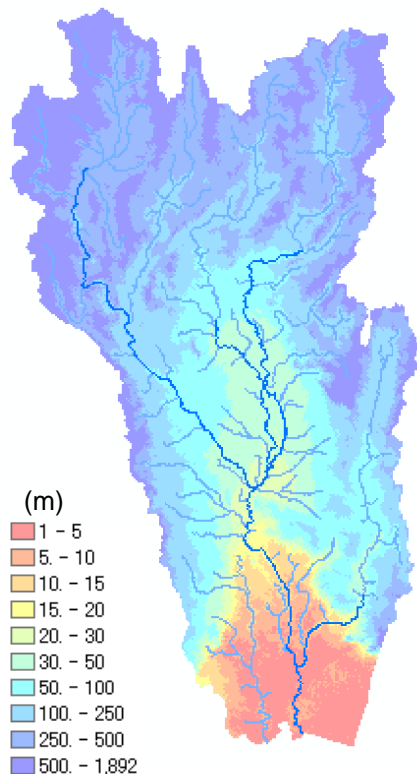
Satellite topographic data
& HydroSHEDS for river channels

- Damage status must be assessed based on limited information during a large-scale flooding event like the Thai flood.
- ICHARM is working on a new technology capable of flood simulation even in the middle of flooding to provide more information on inundation in addition to satellite remote sensing information.
- Flood data collection and analysis started last mid-October before the flood peak, and the results were released for governmental offices and the media.

- RRI was introduced to analyze this flood event, specifically designed to forecast flood discharge and water level, **because RRI can holistically analyze river discharge and inundation by using rainfall as input**.
- Analysis was done based on satellite topographic and rainfall information.
- ICHARM is working to provide more detailed reproduction simulation that can reflect the effects of artificial structures and other relevant factors.
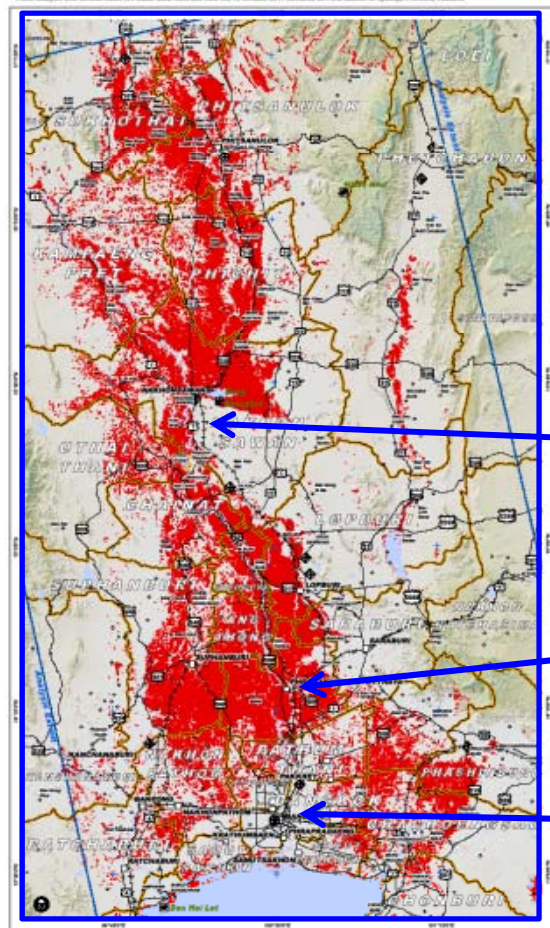
Simulation area: 163,293 km^2
Simulation period: 0:00, 1st July 2011 – 0:00, 30 Nov. 2011 (UTC)
Input rainfall: satellite rainfall, forecasted rainfall

Inundation based on satellite information (MODIS) on 13 Oct. 2011

Simulated water depths on 13 Oct. 2011

Nakhon Sawan

Ayutthaya

Bangkok

(m)
- 0.0 – 0.5
- 0.5 – 1.0
- 1.0 – 1.5
- 1.5 – 2.0
- 2.0 – 2.5
- 2.5 – 3.0
- 3.0 – 3.5
- 3.5 – 4.0
- 4.0 – 4.5
- 4.5 – 5.0
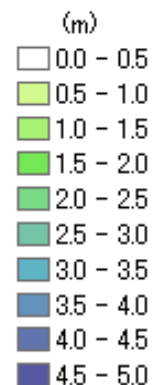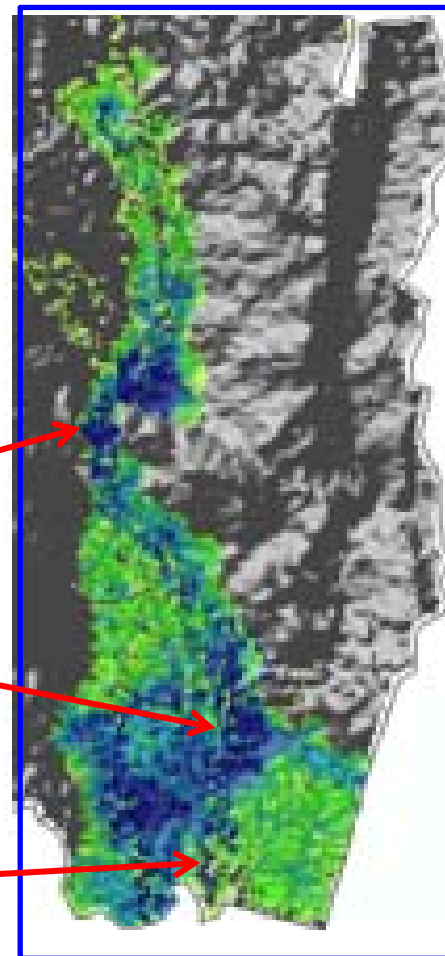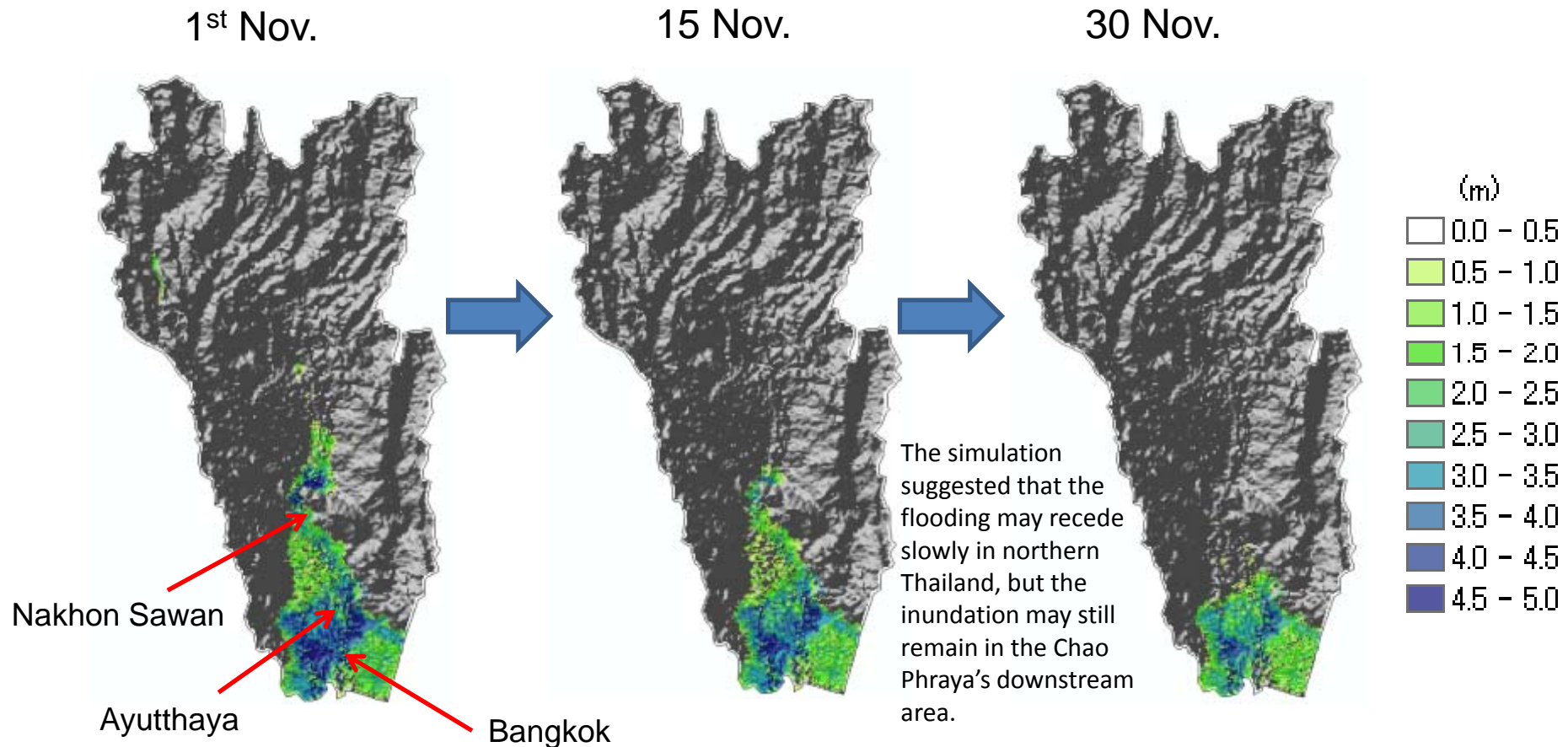
- The simulation largely well reproduced major inundation areas, such as Nakhon Sawan and Ayutthaya, on 13 Oct. 2011.
- Detailed reproduction of the inundation around Bangkok is not possible at this moment due to the difficulty of considering the effects of dykes and other factors.

Inundation Prediction up to late Nov. 2011 (as on 21 Oct. 2011)

The simulation results suggested that the inundation may continue to remain in the downstream area up to late Nov. 2011.

1st Nov.　　　　　　15 Nov.　　　　　　30 Nov.

The simulation suggested that the flooding may recede slowly in northern Thailand, but the inundation may still remain in the Chao Phraya's downstream area.

Nakhon Sawan

Ayutthaya

Bangkok

(m)
- 0.0 – 0.5
- 0.5 – 1.0
- 1.0 – 1.5
- 1.5 – 2.0
- 2.0 – 2.5
- 2.5 – 3.0
- 3.0 – 3.5
- 3.5 – 4.0
- 4.0 – 4.5
- 4.5 – 5.0

*The simulation was done by ICHARM using the RRI model. (The inundation depth was simulated based on the satellite rainfall from 1 July to 0:00. 8 Nov. 2011 , JMA-forecasted rainfall from 6:00, 8 Nov. to 12:00, 15 Nov. 2011, and last year rainfall from 15:00, 15 Nov. to 30. Nov. 2010.)
*The degree of uncertainty is especially large in inundation depth around Bangkok located downstream of the Chao Phraya.
*The topographic map used for the simulation was created by ICHARM based on HydroSHEDS (USGS).

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