

The 10<sup>th</sup> GEOSS-AP, WG1 AWCI,  
19 Sep. 2017, Hanoi, Vietnam

# International Flood Initiative - Needs and activities in Asia-Pacific -

**Mamoru Miyamoto**

Executive Manager of IFI secretariat

ICHARM

(International Centre for Water Hazard and Risk Management)



## International Flood Initiative(IFI)

International Flood Initiative (IFI) is a joint initiative in collaboration with **UNESCO (IHP), WMO, UNISDR, UNU, IAHS** and **IAHR**. ICHARM is the secretariat of IFI.

*In Close Collaboration with:*



# HELP-IFI Jakarta Statement (drafted Oct.31, 2016)

-Towards an interdisciplinary and transdisciplinary partnership to consolidate flood risk reduction and sustainable development -

## 1. Present Status

- increasing losses
- human factors + climate change
- globalized and interconnected 21C
- gap between science and society
- lack of effective inter-agency coordination

## 2. Key Directions

- Sendai+SDGs+Paris
- budgetary imitations and capabilities
- spiral-up approach
- interdisciplinary and transdisciplinary
- quantifying and minimizing the uncertainty
  - data
  - assessment
  - change identification
  - awareness
  - preventive investment
  - response-recovery

## 3. Actions

### Each country:

- platform on water and disaster (<national platform)

### IFI Partners:

- assist the platform

### Donors:

- incremental support

Asia and Pacific → World

# Implementation Planning Workshop on International Flood Initiative (IFI) in Asia-Pacific

January 10, 2017 in Tokyo, Japan

[http://www.ifi-home.info/20170110\\_event.html](http://www.ifi-home.info/20170110_event.html)



## Participated Countries (6)

**Indonesia, Malaysia, Myanmar, Pakistan, Philippines, Sri Lanka**

# Activities in Asia-Pacific Region

- **Pakistan**

- **Platform on Water and Disaster**
- Activity: Meeting among related stakeholders in **March**, 2017
- Initial Target(s): The Indus River basin

- **Myanmar**

- **Platform on Water and Disaster**
- Activity: Meeting among related stakeholders in **May** and **November**, 2017
- Initial Target(s): The Bago River & The Sittaung River basin

- **Philippine**

- **Platform on Water-related Disasters (PLATFORM)**
- Activity: Meeting among related stakeholders in **March** and **June**, 2017
- Initial Target(s): The Pampanga River & The Davao River basin

- **Sri Lanka**

- **Platform on Water and Disasters**
- Activity: Meeting among related stakeholders in **August**, 2017
- Initial Target(s): The Kalu River basin

- **Indonesia**



## Activities for “Platform on Water and Disaster”

A meeting for establishment of “Platform on Water and Disaster”;

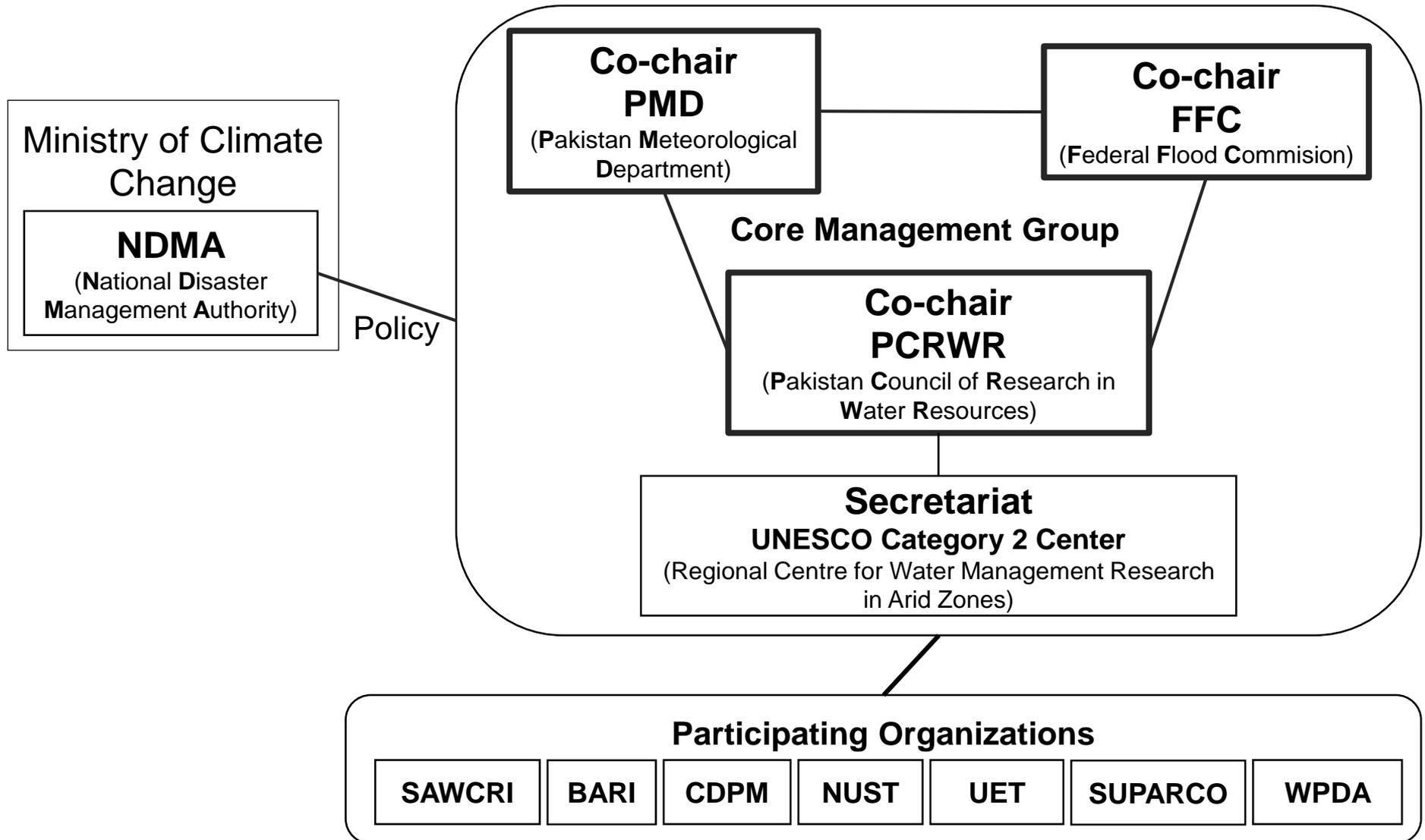
- 2-3 March at PMD Headquarter, Islamabad



### Participated Stakeholders

- **PMD** : Pakistan Meteorological Department
- **PCRWR** : Pakistan Council of Research in Water Resources
- **GCISC** : Global Change Impact Studies Center
- **NARC** : National Agriculture Research Centre
- **NDMA** : National Disaster Management Authority
- **UNESCO**
- **ICHARM**

# Institutional Structure of “Platform on Water and Disaster”





# Myanmar

## Activities for “Platform on Water and Disaster”



Meetings on “Platform on Water and Disaster”;

- 9 May at Nay Pyi Taw
- 1 November at Nay Pyi Taw (arranging)

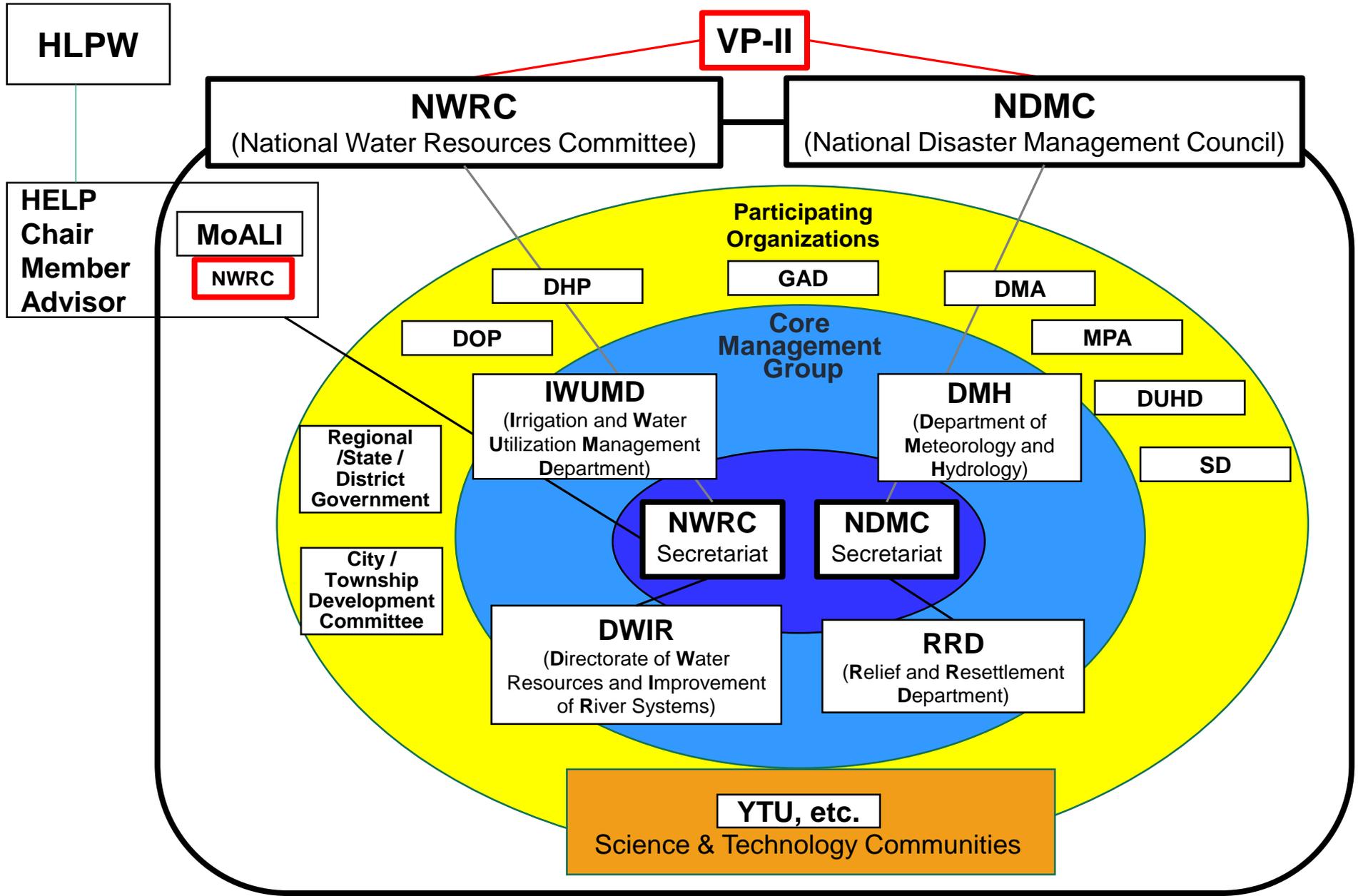


### Participated Stakeholders

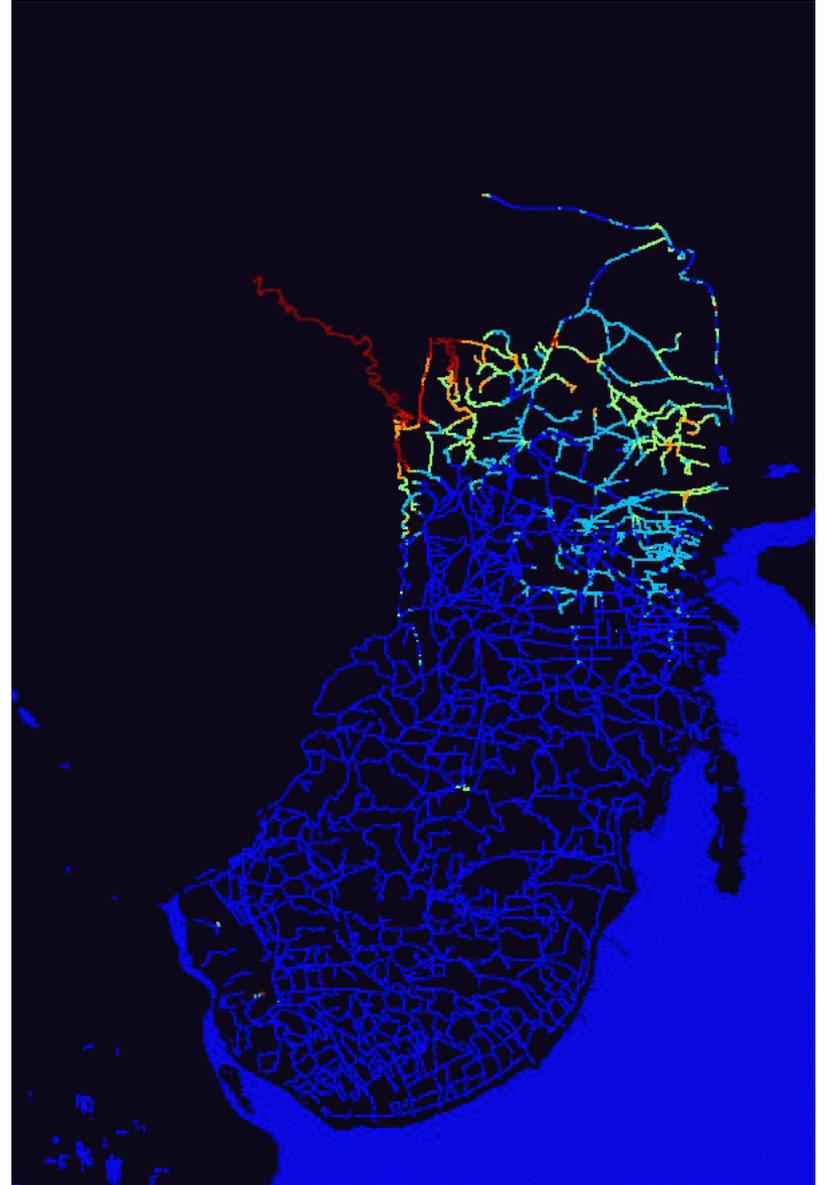
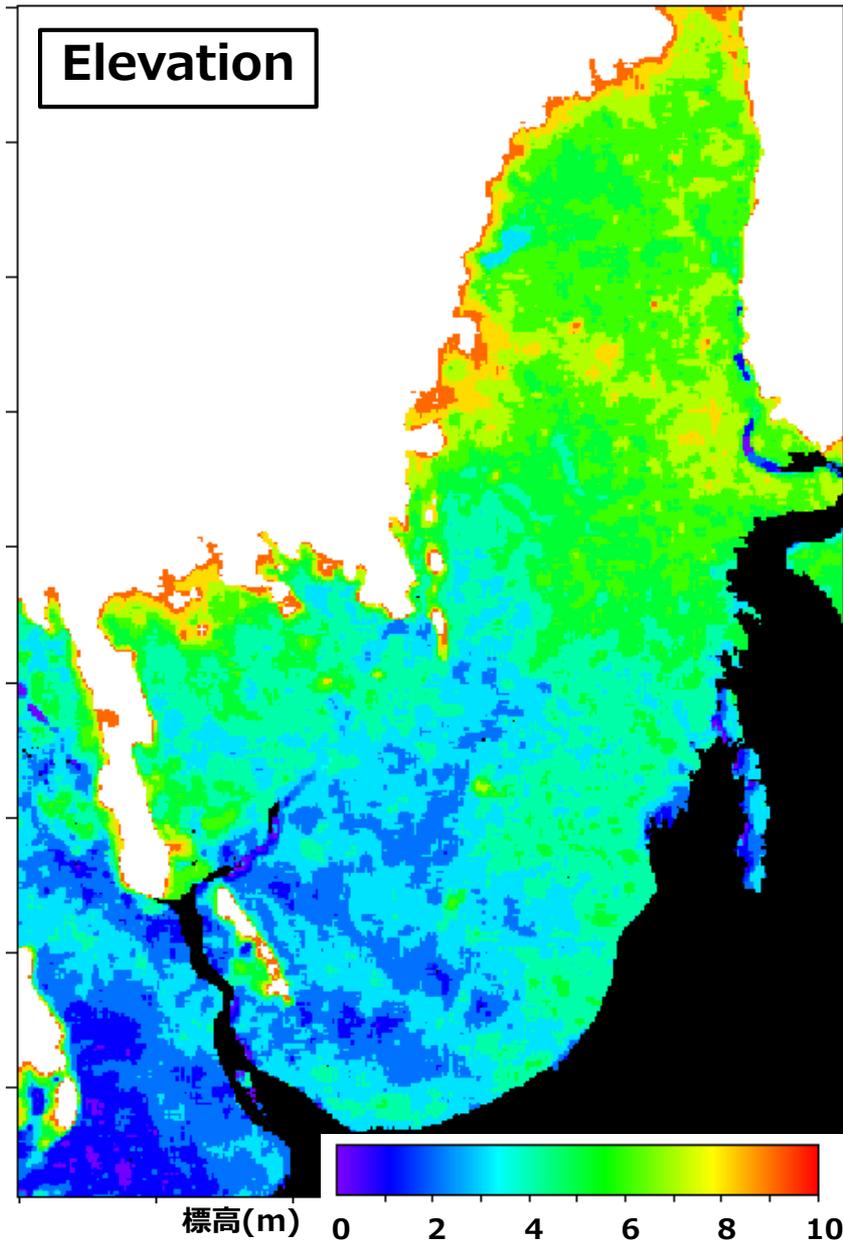
- **DWRI, Ministry of Transport and Communications**
- **DMH, Ministry of Transport and Communications**
- **RRD, Ministry of Social Welfare, Relief and Resettlement**
- **IWUMD, Ministry of Agriculture, Livestock and Irrigation**
- **Yangon Technical university**
- **ICHARM**
- **University of Tokyo**
- **Japan Water Forum**
- **JICA**

# Myanmar

# Institutional Structure of “Platform on Water and Disaster”



# Canal model in deltaic area (Achievements of JICA-SATREPS Project)



# Philippines

## Activities for “Platform on Water-related Disasters”



Meetings on “Platform on Water and Disaster”;

- 13 March at Metro Manila
- 15 June at Metro Manila



### Participated Stakeholders

- **DOST** : Department of Science and Technology
- **PAGASA** : Philippine Atmospheric, Geophysical and Astronomical Services Administration
- **DPWH** : Department of Public Works and Highways
- **OCD** : Office of Civil Defense
- **NEDA** : National Economic and Development Authority
- **PSA** : Philippine Statistics Authority
- **NAMRIA** : National Mapping and Resource Information Authority
- **UP** : University of Philippines
- **JICA**
- **ICHARM**

Hydro-Met

River Bureau

Disaster

Economy

Statistics

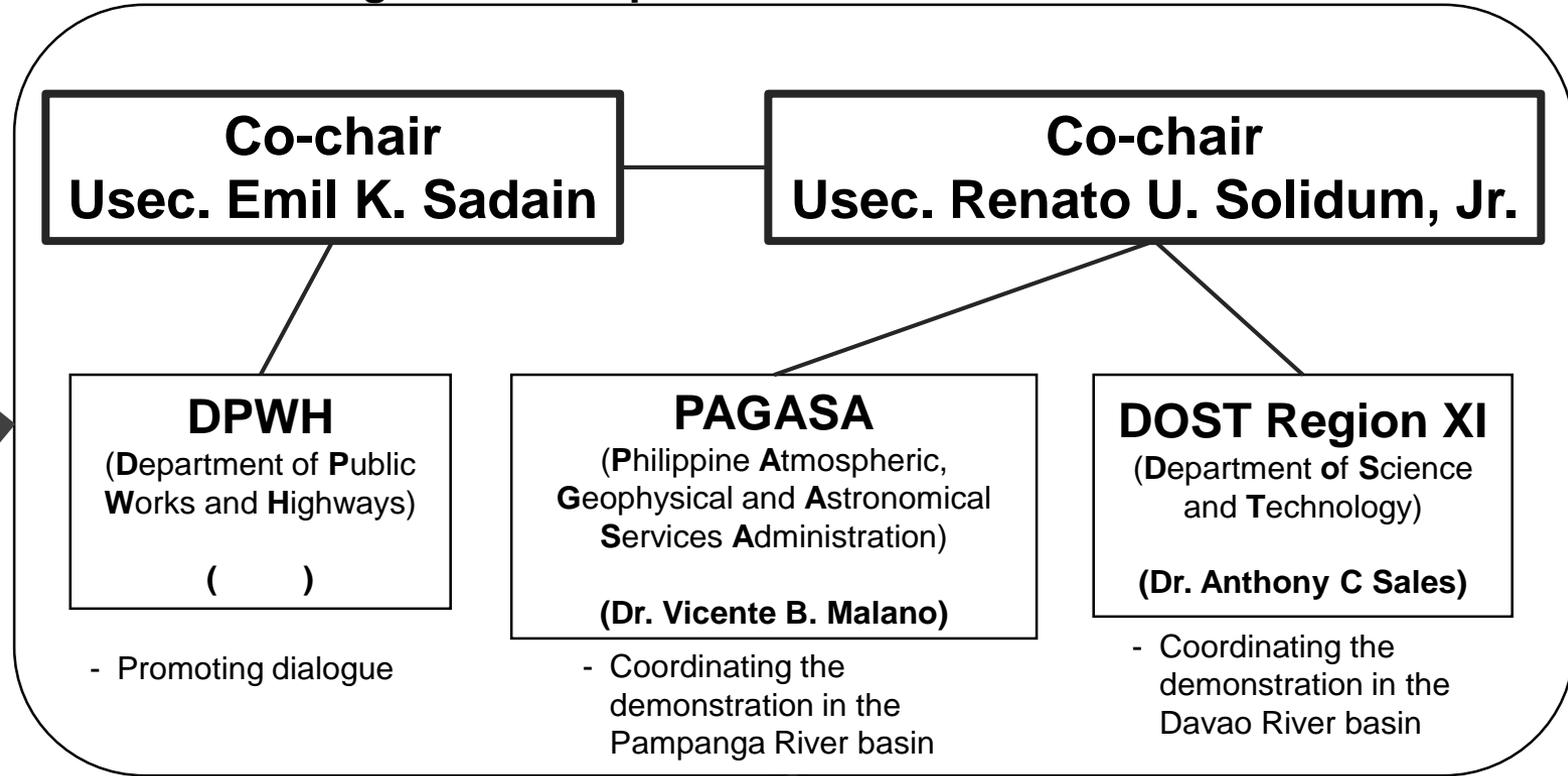
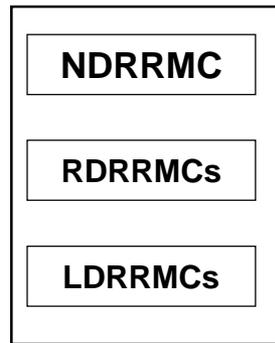
Geology

Academia

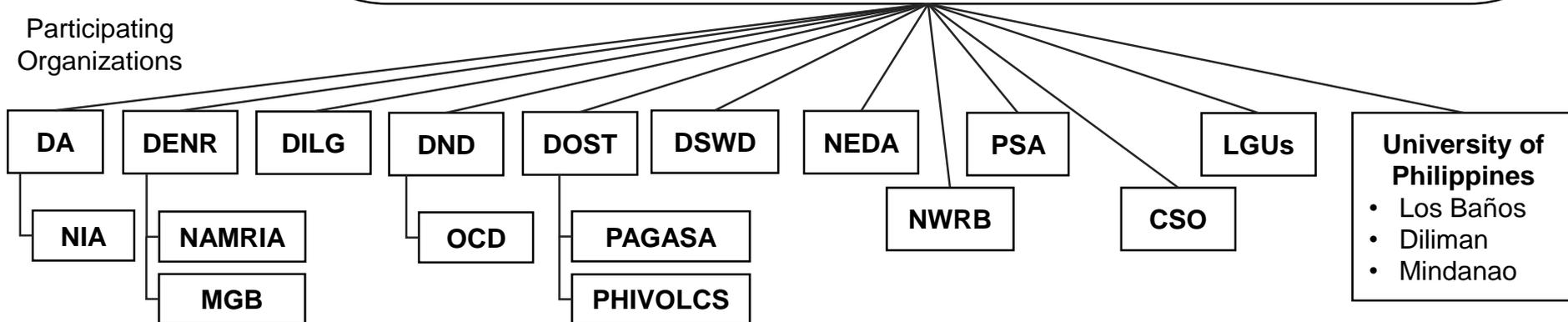
# Philippines

## Institutional Structure of “Platform on Water-related Disasters”

### Core Management Group



### Participating Organizations



# Philippines

# Activities

1. Data Set Creation
2. Climate Change Impact Assessment and Adaptation Planning
3. Early Warning
4. Economical Assessment
5. Contingency Planning

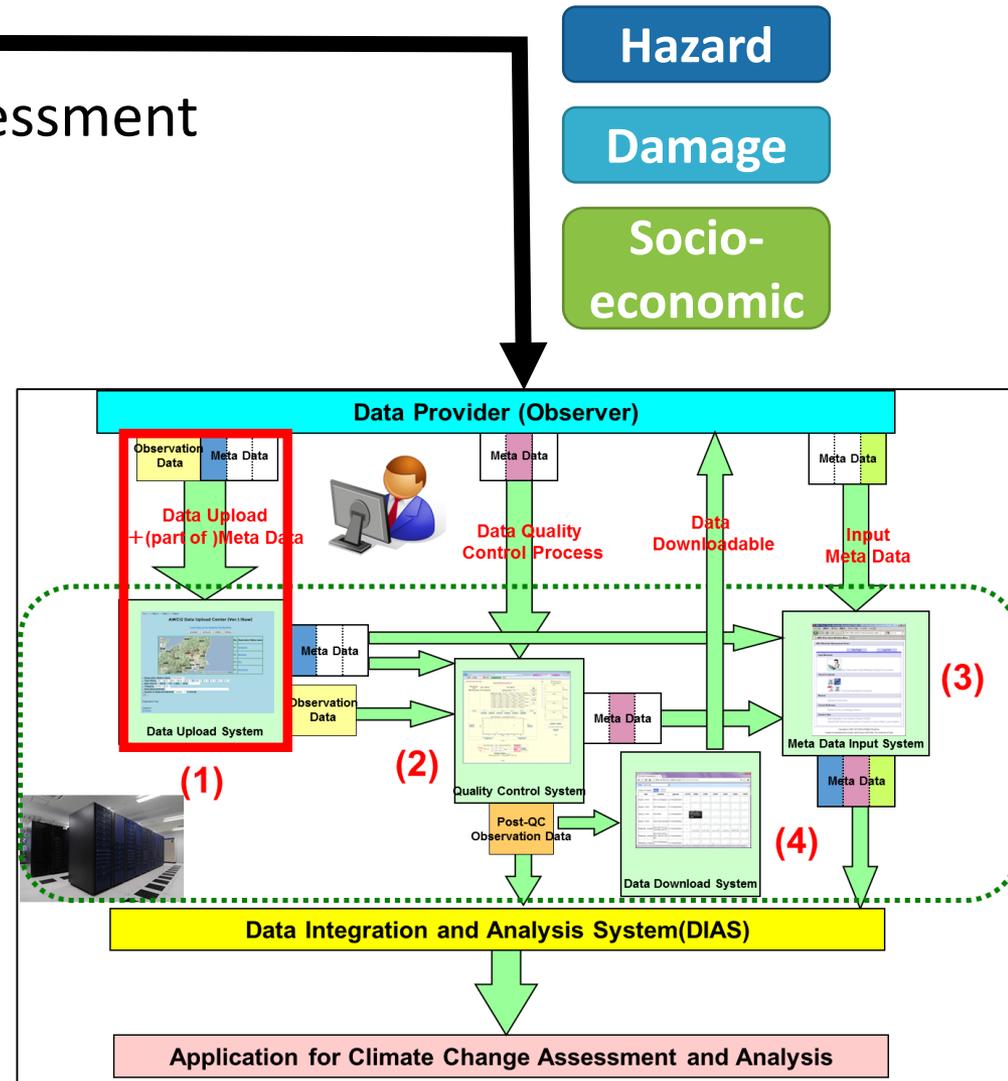
Hazard

Damage

Socio-economic

## Data Archiving Schedule

- **Sep. 2017:** Make a list of meta-data and responsible person
- **Dec. 2017:** Start uploading



Data Uploading System by DIAS  
(DIAS: Data Integration and Analysis System)



A meeting for establishment of “Platform on Water and Disaster”;  
● 24 August at Irrigation Department, Colombo



Flood and landslide  
disaster occurred in late  
May this year.



**Post-Disaster Activities**

### Participated Stakeholders

- Department of Meteorology, Ministry of Disaster Management
- Irrigation Department, Ministry of Irrigation & Water Resources Management
- Ministry of Megapolis and Western Province Development
- JICA
- ICHARM

## **Platform Participating Organizations:**

- Irrigation Department (ID)
- Meteorology Department (MD)
- Survey Department (SD)
- Disaster Management Center (DMC)
- National Building Research Organization (NBRO)
- Ministry of Magapolis and Western Department (MMWD)
- Ministry of Mahaweli Development & Environment (TBD, MMDE)

## **Platform Target Actions and Coordinating Bodies**

1. Early Warning: rainfall, flooding, landslide:

ID, MD, NBRO

2. Adaptation Planning: Climate Change, Urbanization:

ID, MMDE, MMWD

3. Economic Effect of Disasters:

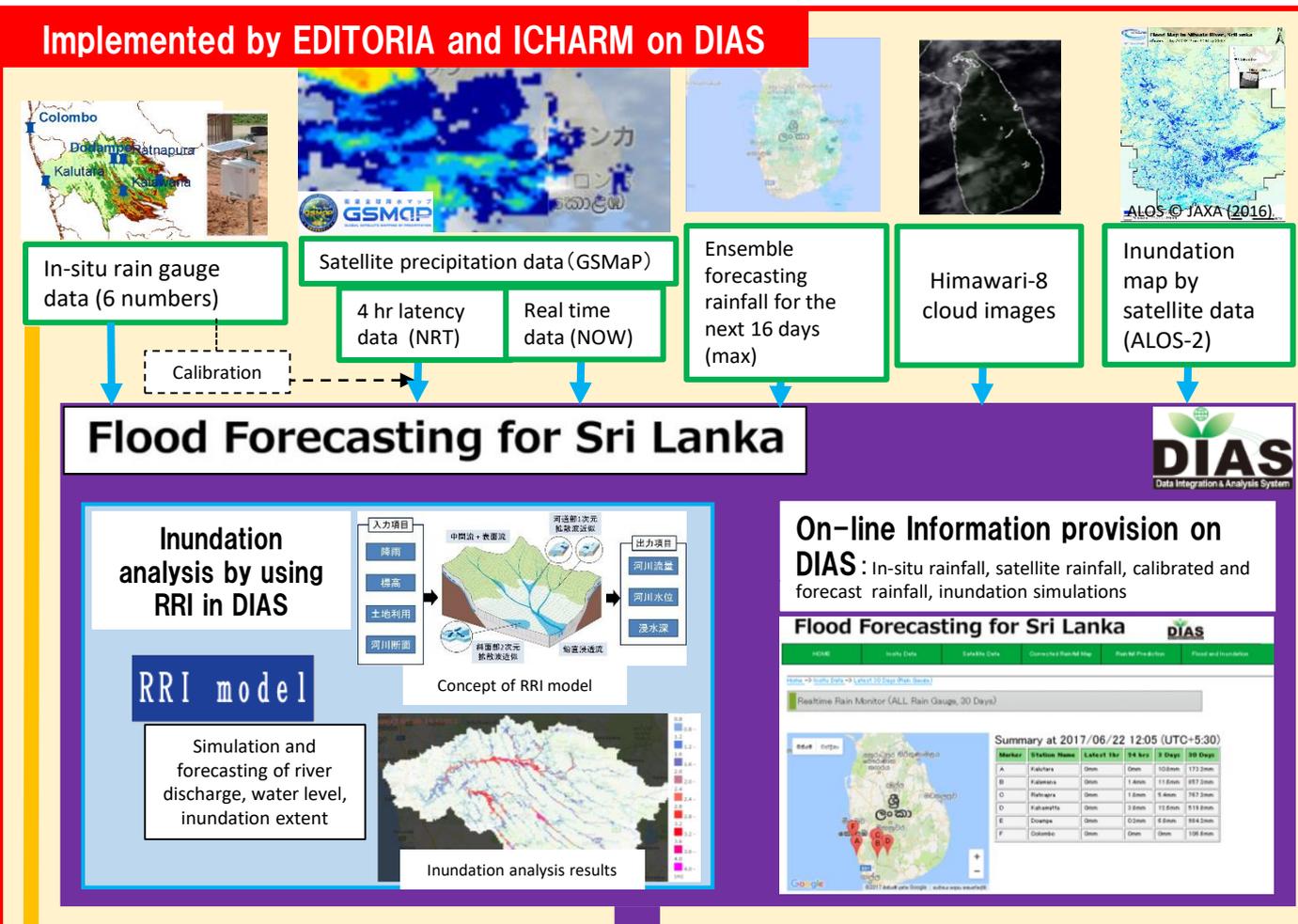
MMDE, DMC

4. Contingency Planning:

DMC

# Present situation: Test operation for rainy season

Implemented by EDITORIA and ICHARM on DIAS



## Mid-term framework



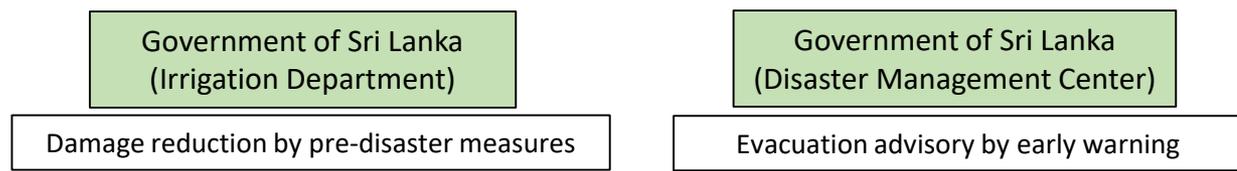
Collaboration with member organizations of disaster management platform

- Member organizations of national platform
- Meteorology Department
  - Irrigation Department
  - Disaster Management Center
  - Universities and others

Capacity building for operation

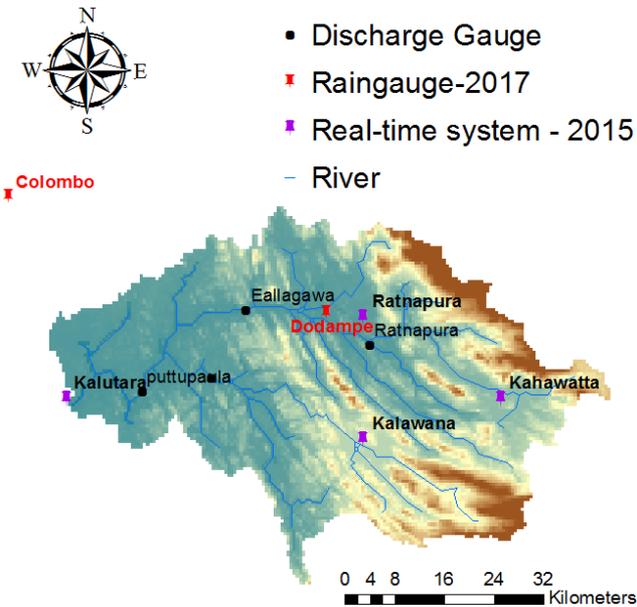
- Promotion of research
- Damage reduction through implementation

### Sri Lanka disaster management platform

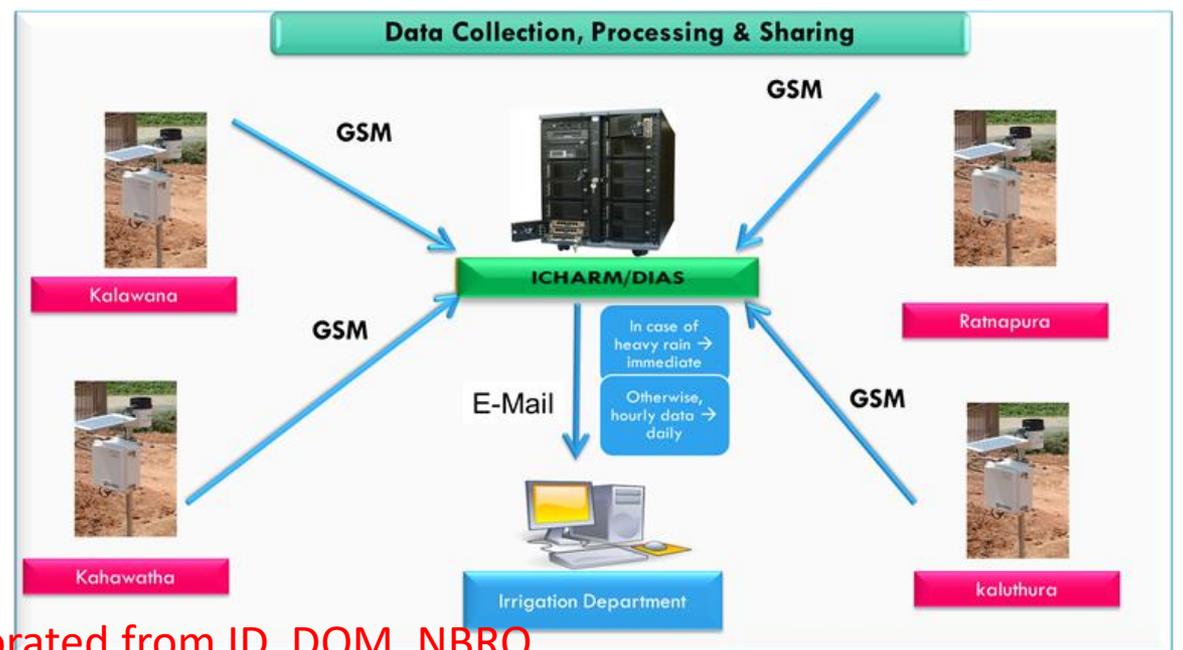


# Kalu River Basin: Real-time rainfall monitoring & Modeling

## Real-Time Data Transfer System in the Kalu River Basin



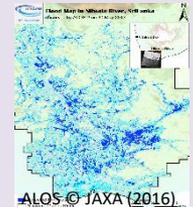
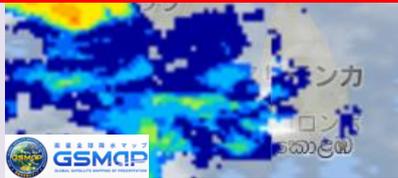
- ✓ Catchment area 2839km<sup>2</sup>
- ✓ Largest Discharge to sea 4035MCM annually
- ✓ Highest Rainfall
- ✓ Length 129km



More real-time data can be incorporated from ID, DOM, NBRO

# Present situation: Test operation for rainy season

Implemented by EDITORIA and ICHARM on DIAS



In-situ rain gauge data (6 numbers)

Satellite precipitation data (GSMaP)  
4 hr latency data (NRT) | Real time data (NOW)

Ensemble forecasting rainfall for the next 16 days (max)

Himawari-8 cloud images

Inundation map by satellite data (ALOS-2)

Calibration

## Flood Forecasting for Sri Lanka



### Inundation analysis by using RRI in DIAS

**RRI model**

Simulation and forecasting of river discharge, water level, inundation extent

**Concept of RRI model**

Input items: Rainfall, Elevation, Land use, River cross-section, 2D/3D terrain data, River network data.

Output items: River discharge, River water level, Flood depth.

**Inundation analysis results**

### On-line Information provision on DIAS

In-situ rainfall, satellite rainfall, calibrated and forecast rainfall, inundation simulations

#### Flood Forecasting for Sri Lanka

RealTime Rain Monitor (ALL Rain Gauge, 30 Days)

Summary at 2017/06/22 12:05 (UTC+5:30)

Marker	Station Name	Latest 1hr	24 hrs	3 Days	30 Days
A	Falhera	0mm	0.0mm	173.2mm	
B	Kalutara	0mm	1.0mm	11.6mm	257.2mm
C	Ratnapura	1.0mm	9.0mm	767.2mm	
D	Falhera	0mm	3.0mm	12.0mm	519.0mm
E	Dowlaba	0.0mm	0.0mm	0.0mm	854.0mm
F	Colombo	0mm	0mm	0mm	108.0mm

Email alert messages

Information provision

Collaboration

## Sri Lanka disaster management platform

Government of Sri Lanka (Irrigation Department)

Government of Sri Lanka (Disaster Management Center)

Damage reduction by pre-disaster measures

Evacuation advisory by early warning

## Mid-term framework



Collaboration with member organizations of disaster management platform

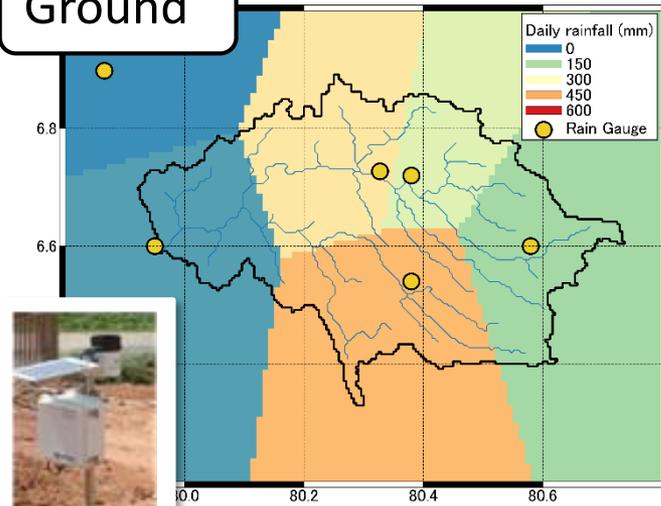
- Member organizations of national platform
- Meteorology Department
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  - Universities and others

Capacity building for operation

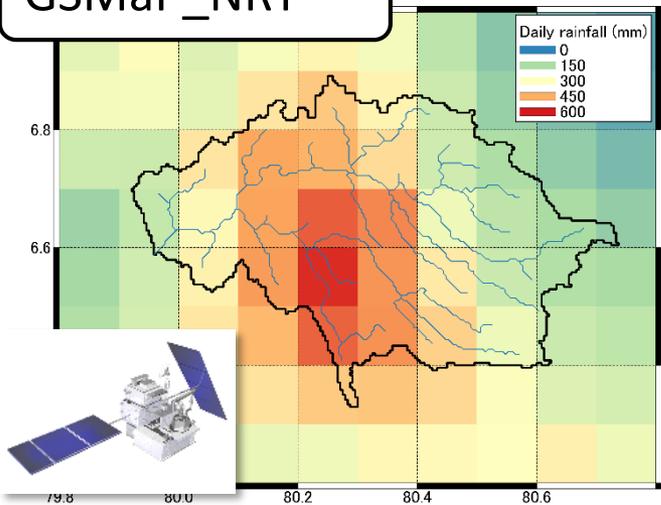
- Promotion of research
- Damage reduction through implementation

# Bias correction of satellite rainfall by ground observation

Ground

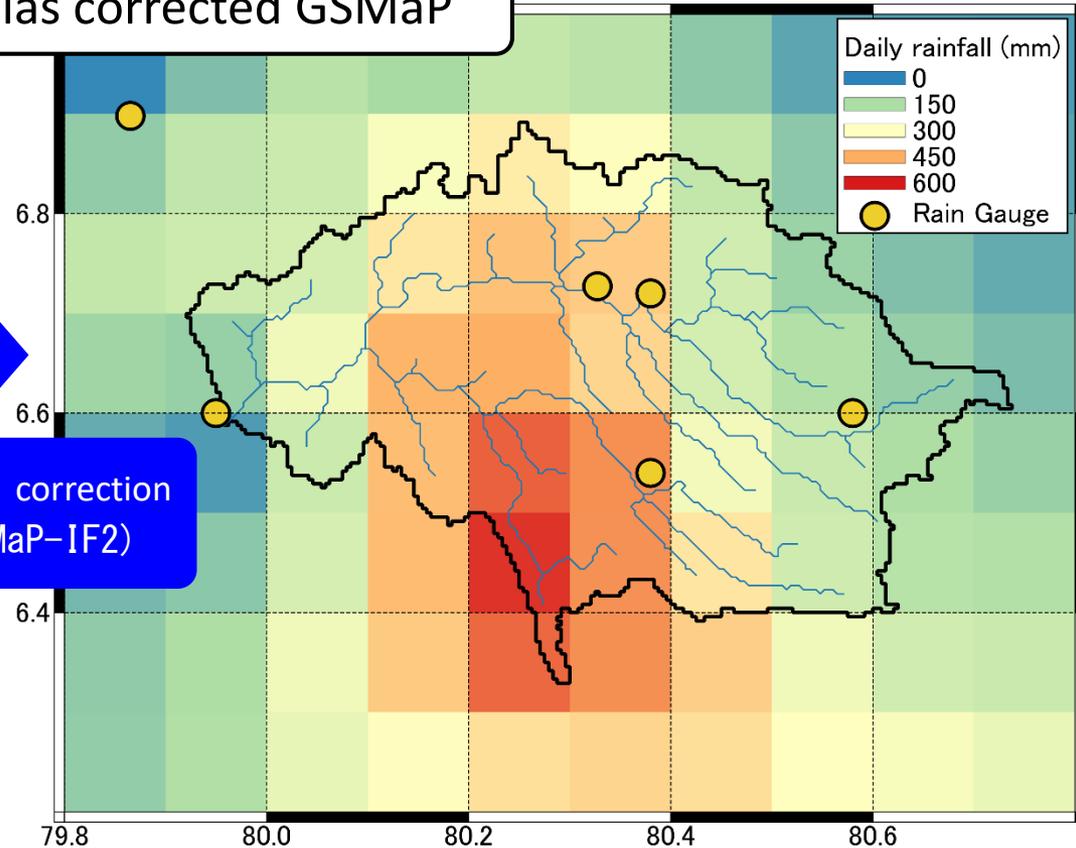


GSMaP\_NRT



Spatial & Quantitative

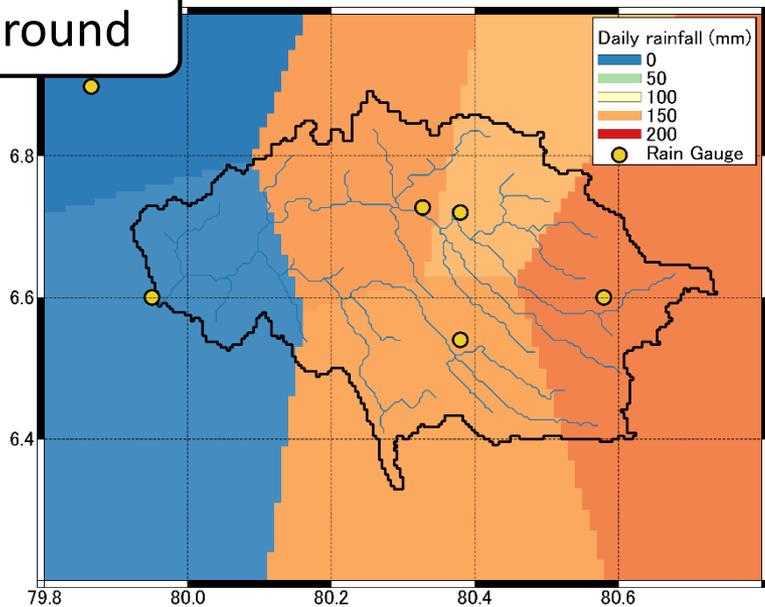
Bias corrected GSMaP



25 May 2017, The Kalu River basin

# Geolocation error correction

Ground

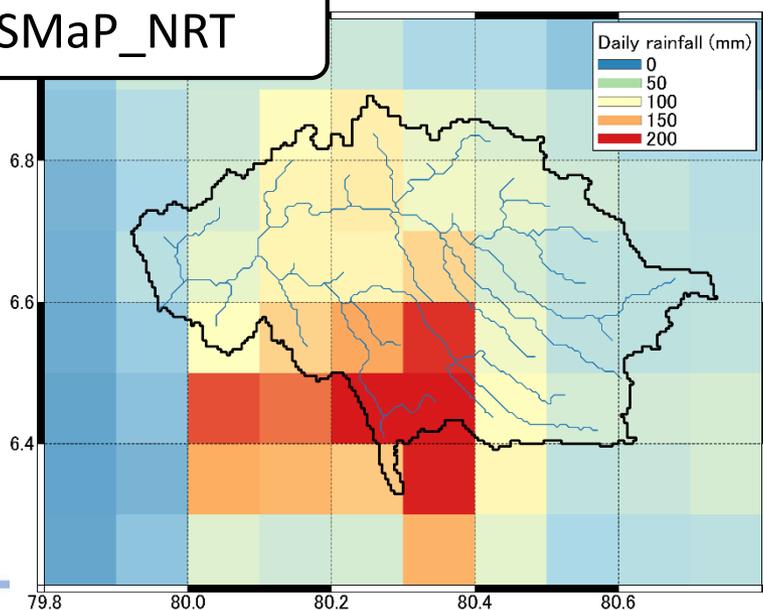


Error of rainfall area location  
(Geolocation error)

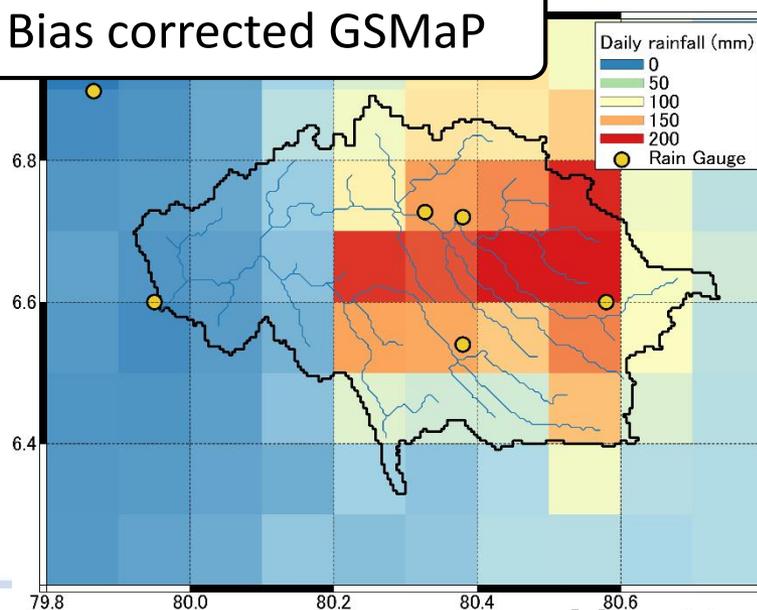


Geolocation error is corrected by  
comparison of rainfall pattern

GSMaP\_NRT

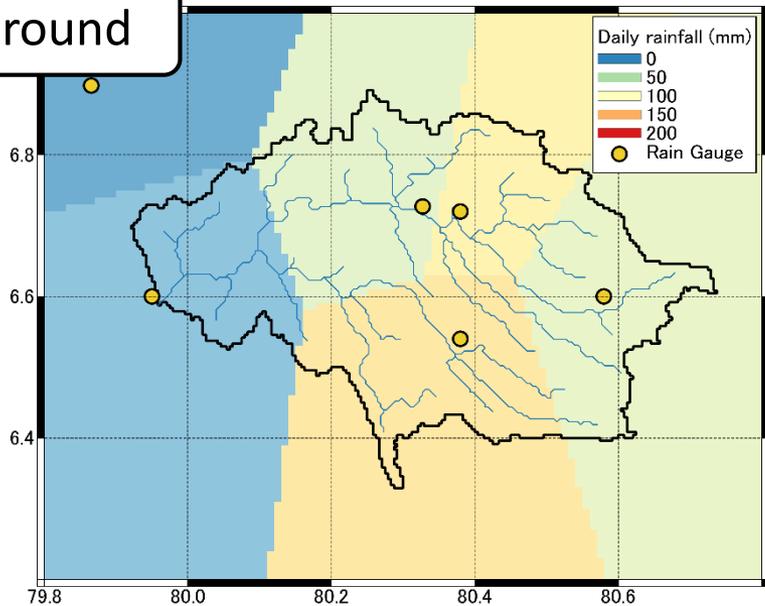


Bias corrected GSMaP



# Rainfall intensity correction

Ground

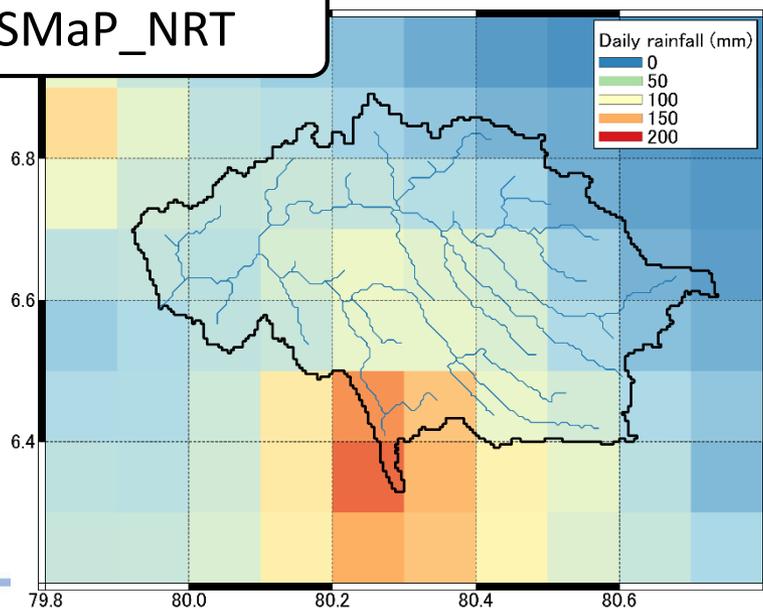


Bias of rainfall intensity

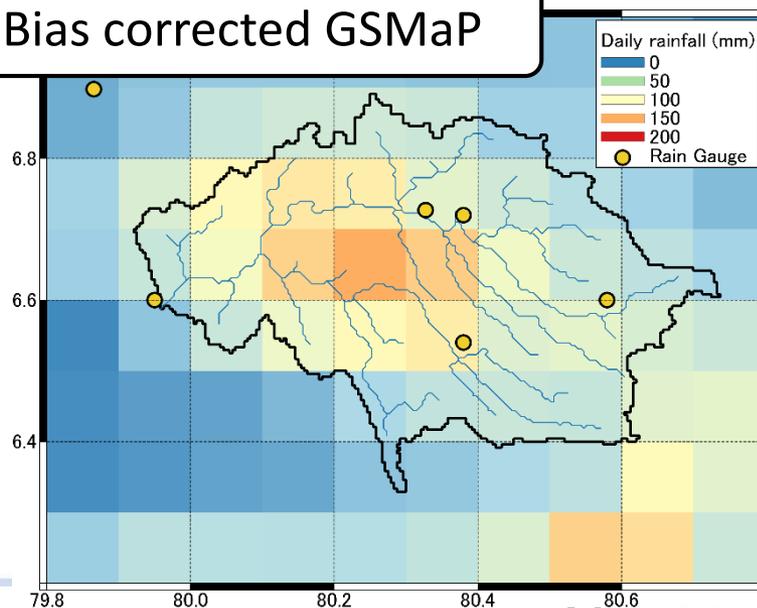


Rainfall intensity is adjusted using information of ground observation

GSMaP\_NRT

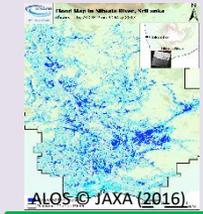
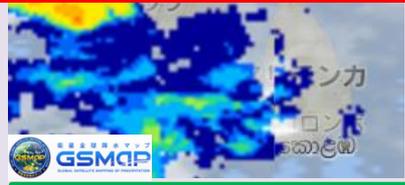


Bias corrected GSMaP



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Satellite precipitation data (GSMaP)  
4 hr latency data (NRT) | Real time data (NOW)

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Calibration

## Flood Forecasting for Sri Lanka



### Inundation analysis by using RRI in DIAS

**RRI model**

Simulation and forecasting of river discharge, water level, inundation extent

**Concept of RRI model**

Input items: 降雨 (Rainfall), 標高 (Elevation), 土地利用 (Land Use), 河川断面 (River Cross-section)

Intermediate/Output items: 中間流・表面流 (Intermediate/Surface flow), 河川流量 (River discharge), 河川水位 (River water level), 浸水深 (Inundation depth)

Process: 河川断面 (River Cross-section) → 河道断面 (River cross-section) → 河道流量 (River discharge) → 河道水位 (River water level) → 河道浸水深 (River inundation depth)

**Inundation analysis results**

### On-line Information provision on DIAS

In-situ rainfall, satellite rainfall, calibrated and forecast rainfall, inundation simulations

### Flood Forecasting for Sri Lanka

DIAS

RealTime Rain Monitor (ALL Rain Gauge, 30 Days)

Summary at 2017/06/22 12:05 (UTC+5:30)

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C	Ratnapura	1.0mm	9.0mm	267.2mm	267.2mm
D	Kalutara	3.0mm	12.0mm	519.2mm	519.2mm
E	Dombaya	0.0mm	0.0mm	854.2mm	854.2mm
F	Colombo	0mm	0mm	108.0mm	108.0mm

Email alert messages

Information provision

Collaboration

## Sri Lanka disaster management platform

Government of Sri Lanka (Irrigation Department)

Damage reduction by pre-disaster measures

Government of Sri Lanka (Disaster Management Center)

Evacuation advisory by early warning

## Mid-term framework



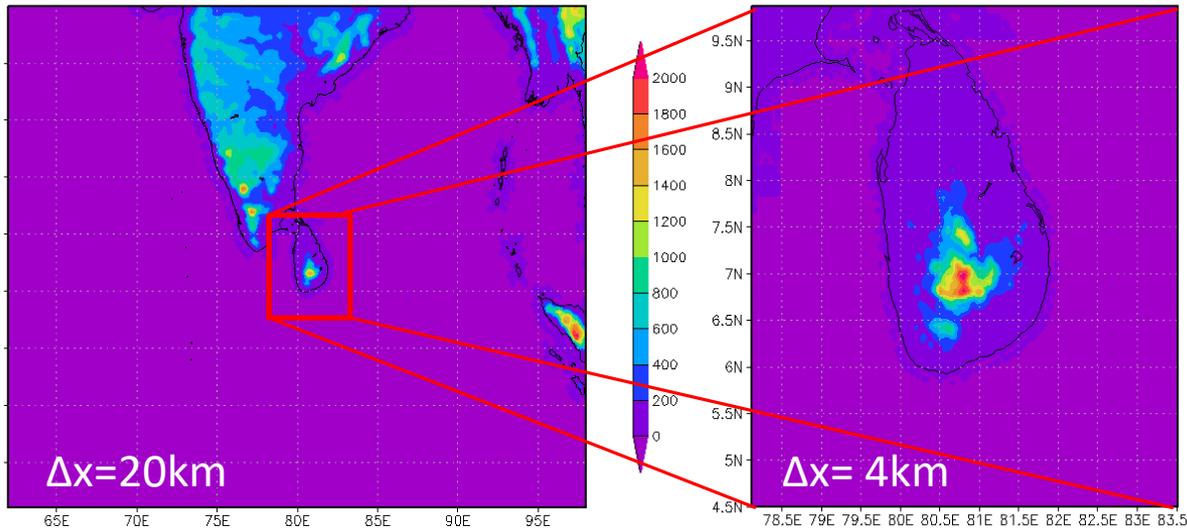
Collaboration with member organizations of disaster management platform

- Member organizations of national platform
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  - Universities and others

Capacity building for operation

- Promotion of research
- Damage reduction through implementation

# Forecast model and prediction method



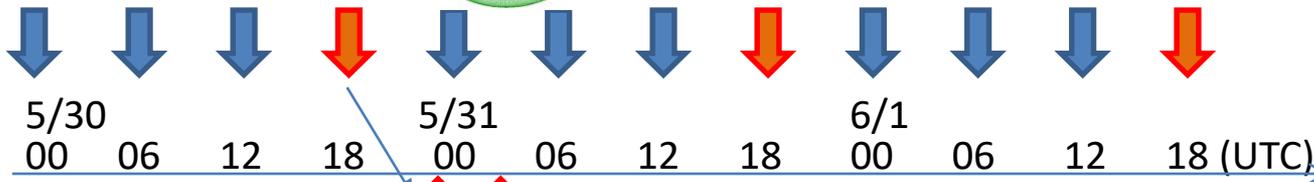
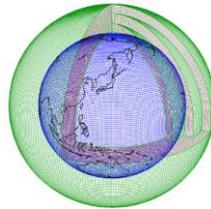
WRF model:

Resolution: 20km/4km

Grids: 200 × 150 × 40 (outer),  
151 × 151 × 40 (inner)

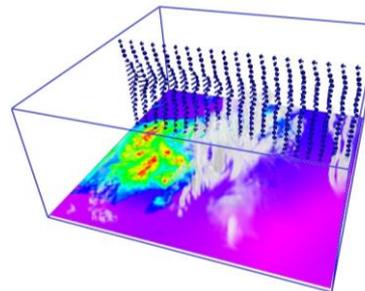
Cumulus parameterization:  
Newer Tiedtke in outer frame  
Cloud microphysics: Lin (water  
cloud, ice cloud, rain, graupel,  
snow, single moment)

Forecast initial time  
(NCEP GFS)



Global  
forecasts  
available

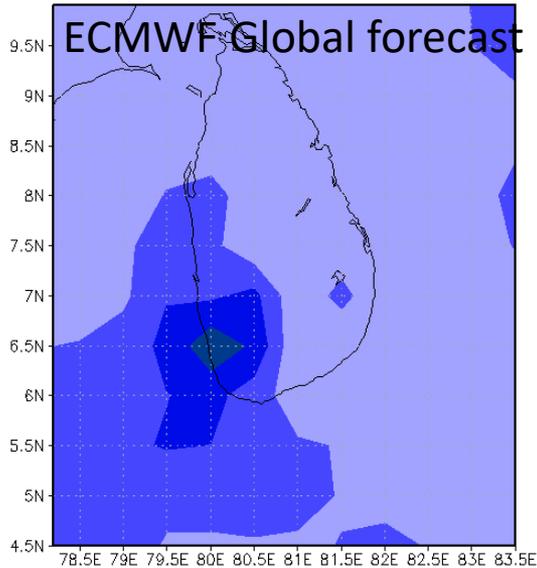
Downscaled  
forecast (3days)  
is available.



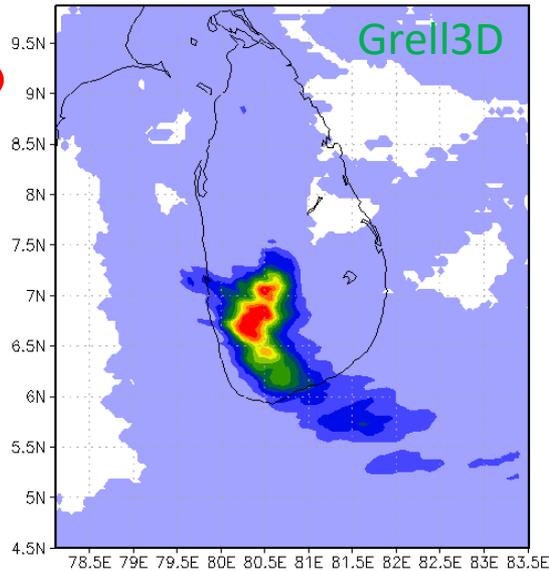
Forecast from 18UTC is  
available at around  
01UTC next day.

# Forecast Rainfall in 25May2017

Rainfall 25May2017 ECMWF

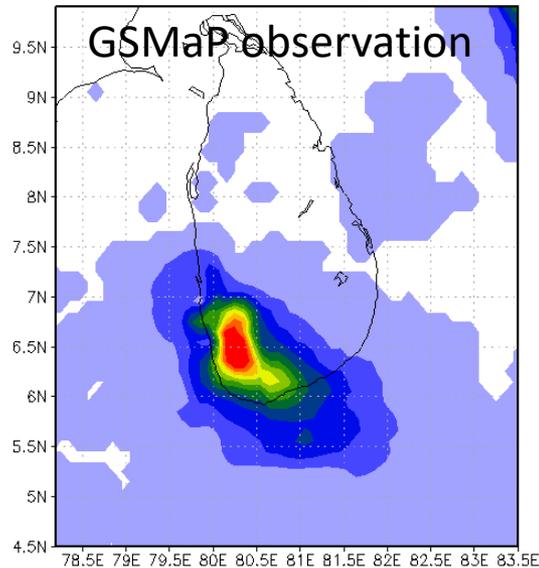


Rainfall 25May2017 5,0

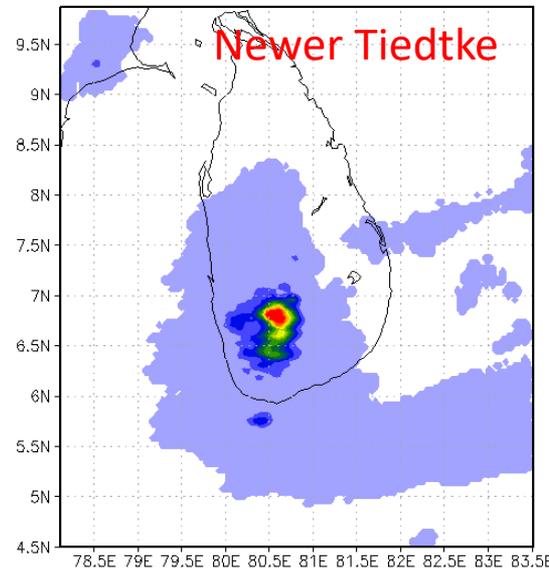


The location of precipitation is well predicted, but is overestimated or underestimated depend on the choice of cumulus scheme.

GSMaP NRT 25May2017

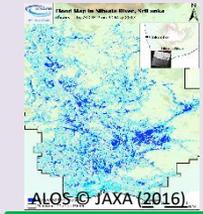
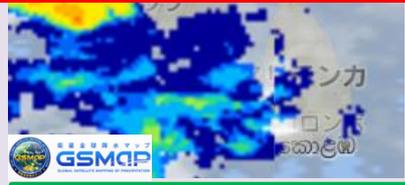


Rainfall 25May2017 16,0



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## Mid-term framework



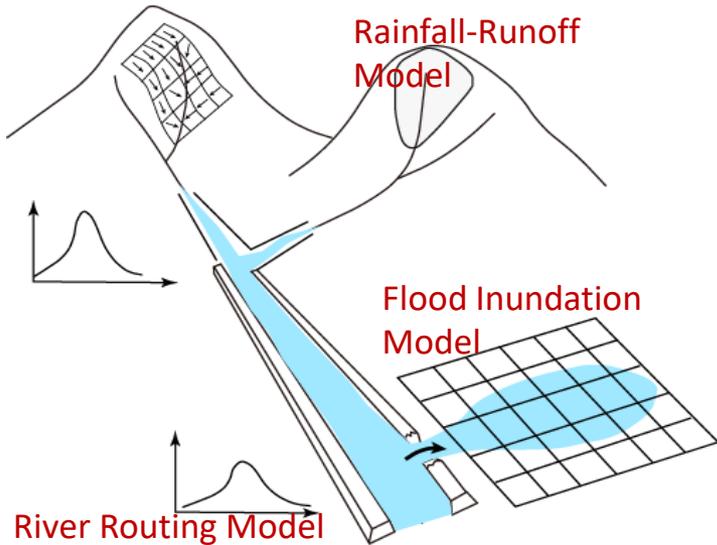
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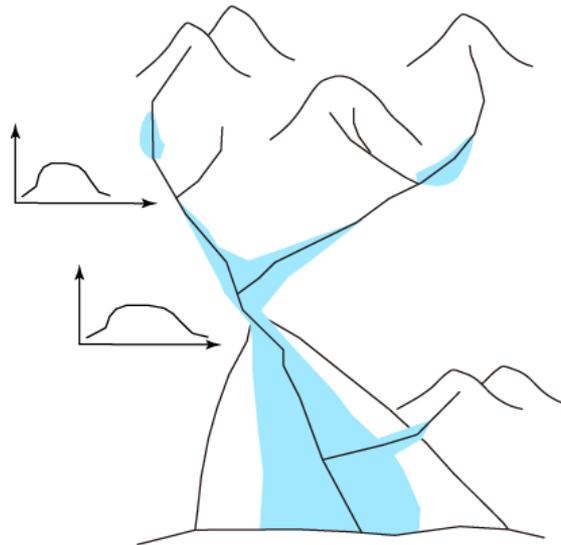
Capacity building for operation

- Promotion of research
- Damage reduction through implementation

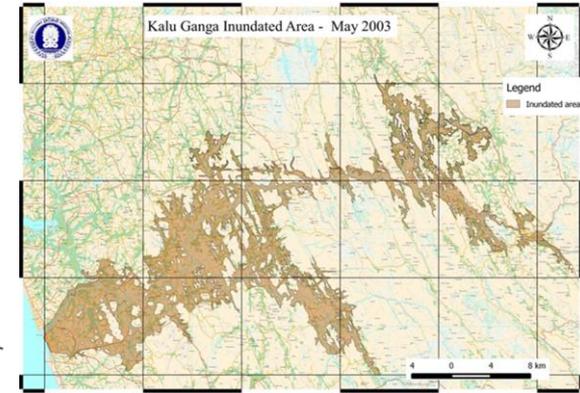
# RRI: Rainfall-Runoff-Inundation Model



e.g. Japanese River Case



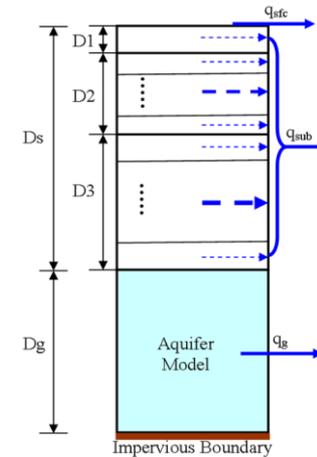
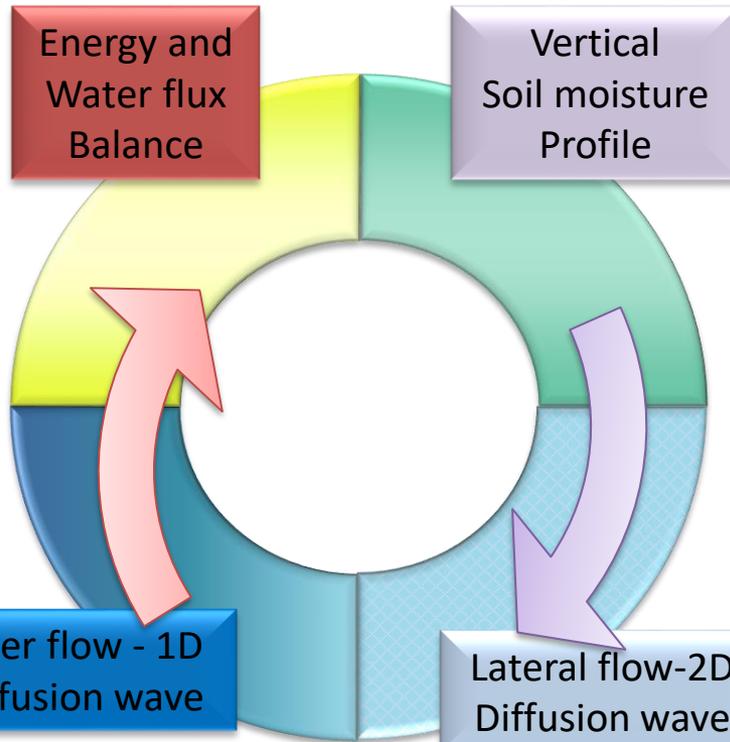
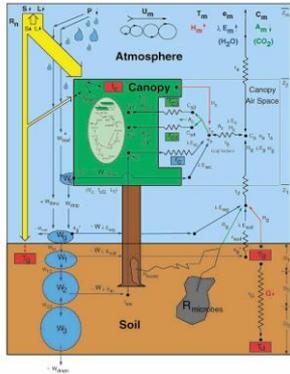
e.g. Chao Phraya River Case



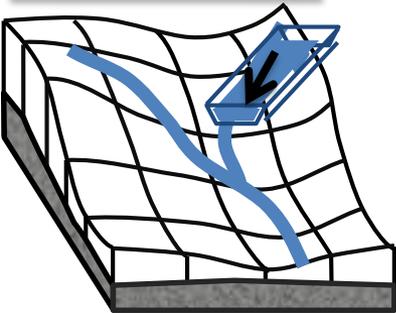
Kalu River - Inundation

- ✓ Ordinary Rainfall-Runoff models are incapable of simulating inundation effects due to kinematic wave
- ✓ Flood inundation models are typically designed for floodplains with boundary conditions from a breaching point (not suitable for large scale flooding).
- ✓ Rainfall-runoff and inundation processes should be simulated simultaneously for some cases e.g. evacuation, risk assessment

# Water-Energy budget-RRI (WEB-RRI) Model



River Routing



River flow - 1D Diffusion wave

Lateral flow-2D Diffusion wave

Surface flow



Slope-River Interaction



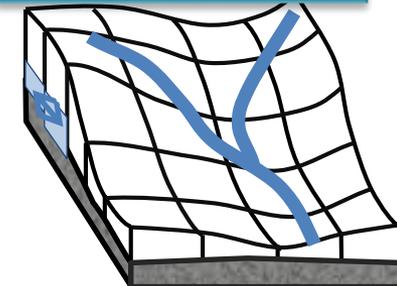
GW-River Interaction



GW-Soil Moisture Interaction

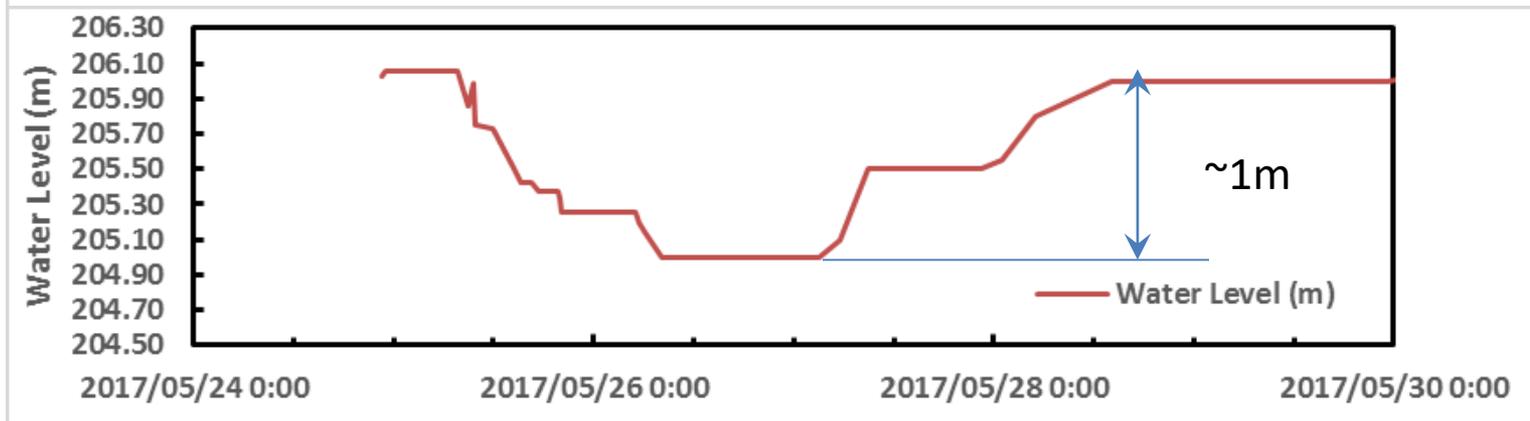
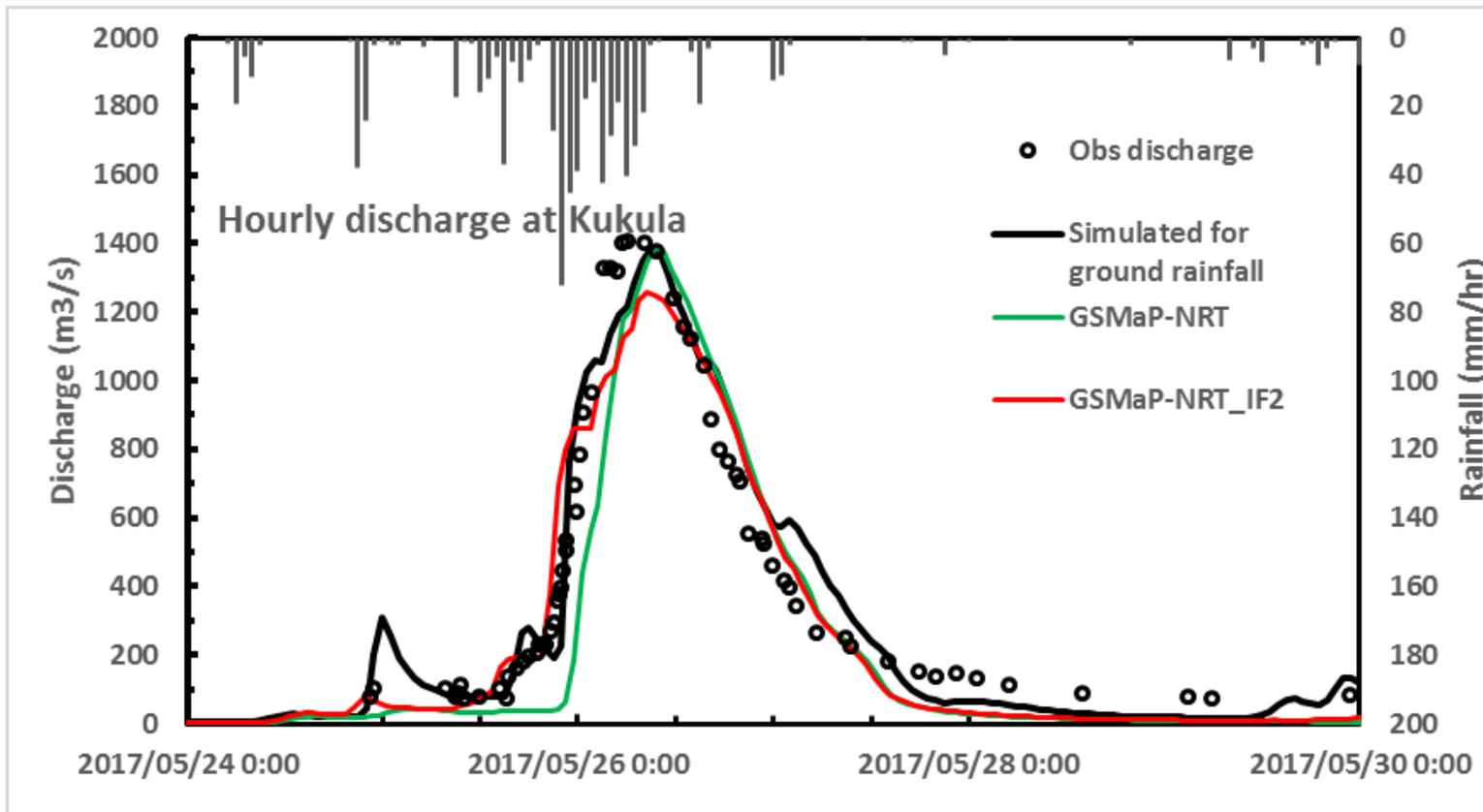


Ground water Flow

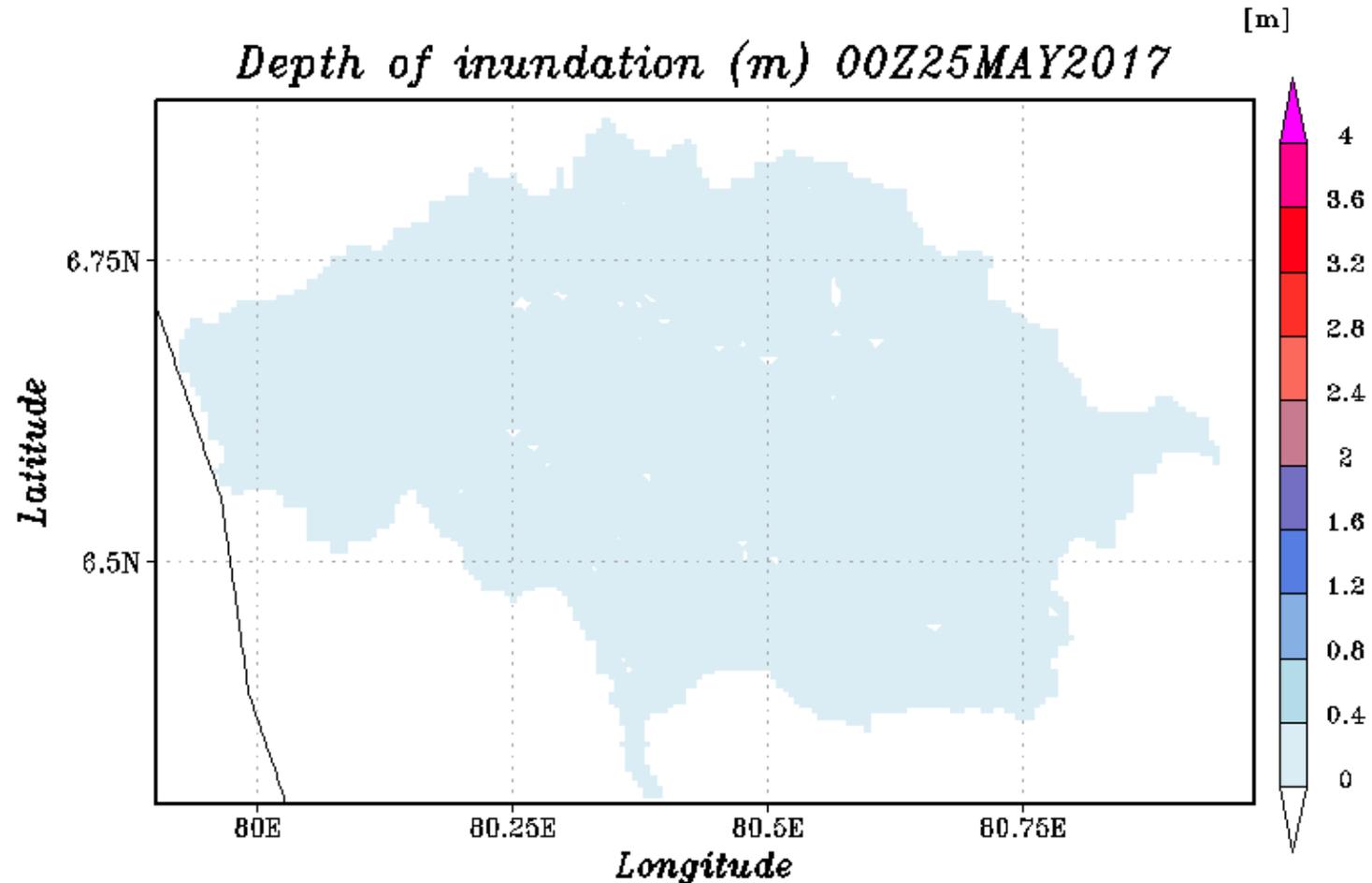


$$Q_{RF} = \frac{K \cdot L_w}{h_c} (h_{rw} - h) = c_{gw} (h_{rw} - h)$$

# Discharge Simulation at Kukula hydro-power Station



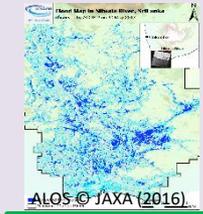
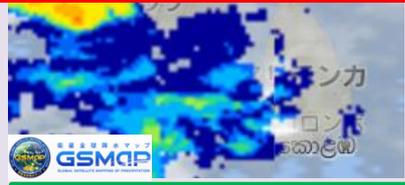
# Inundation in Kalu River simulated by RRI Model



DEM should be updated with better topographical data  
Existing structures should be included for accurate river flow & inundation forecasting

# Present situation: Test operation for rainy season

Implemented by EDITORIA and ICHARM on DIAS



In-situ rain gauge data (6 numbers)

Satellite precipitation data (GSMaP)  
4 hr latency data (NRT) | Real time data (NOW)

Ensemble forecasting rainfall for the next 16 days (max)

Himawari-8 cloud images

Inundation map by satellite data (ALOS-2)

Calibration

## Flood Forecasting for Sri Lanka



### Inundation analysis by using RRI in DIAS

**RRI model**

Simulation and forecasting of river discharge, water level, inundation extent

**Concept of RRI model**

Input items: Rainfall, Elevation, Land use, River cross-section. Intermediate: 2D/3D hydrological data, 2D/3D hydraulic simulation. Output items: River discharge, River water level, Flood depth.

**Inundation analysis results**

**On-line Information provision on DIAS**: In-situ rainfall, satellite rainfall, calibrated and forecast rainfall, inundation simulations

### Flood Forecasting for Sri Lanka

RealTime Rain Monitor (ALL Rain Gauge, 30 Days)

Summary at 2017/06/22 12:05 (UTC+5:30)

Marker	Station Name	Latest 1hr	24 hrs	3 Days	30 Days
A	Palhera	0mm	0.0mm	173.2mm	173.2mm
B	Kalutara	0mm	1.0mm	11.0mm	957.2mm
C	Ratnapura	0mm	1.0mm	9.0mm	767.2mm
D	Kalutara	0mm	3.0mm	12.0mm	519.2mm
E	Dombeya	0mm	0.0mm	0.0mm	854.2mm
F	Colombo	0mm	0mm	0mm	108.0mm

Email alert messages

Information provision

Collaboration

## Sri Lanka disaster management platform

Government of Sri Lanka (Irrigation Department)

Damage reduction by pre-disaster measures

Government of Sri Lanka (Disaster Management Center)

Evacuation advisory by early warning

## Mid-term framework



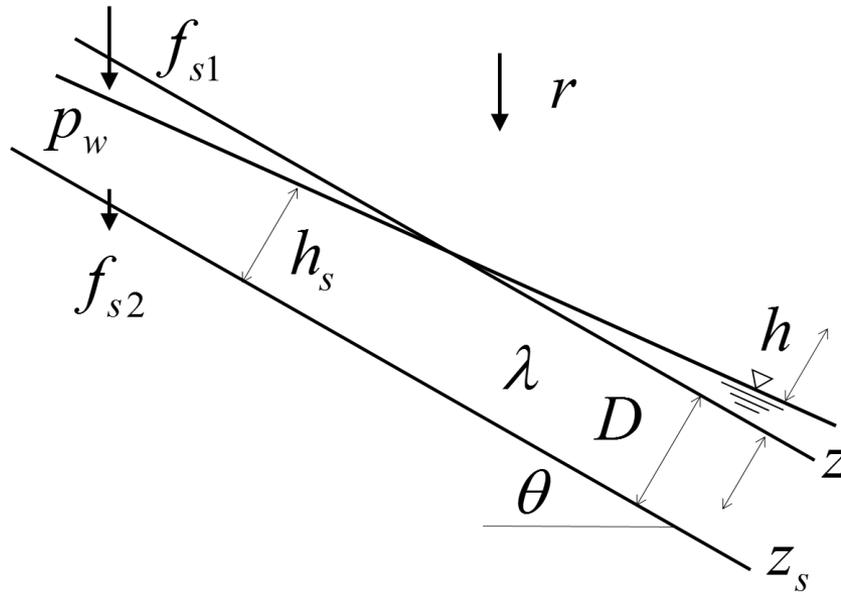
Collaboration with member organizations of disaster management platform

- Member organizations of national platform
- Meteorology Department
  - Irrigation Department
  - Disaster Management Center
  - Universities and others

Capacity building for operation

- Promotion of research
- Damage reduction through implementation

# Schematic explanation and valuables of the model



Schematic explanation for surface soil layer and water surface

$r$ : rainfall

$z$ : elevation of surface layer

$z_s$ : elevation of lower layer

$h$ : depth of surface flow

$h_s$ : depth of saturated lateral flow

$f_{s1}$ : infiltration rate of surface layer

$f_{s2}$ : infiltration rate of lower layer

$D$ : depth of surface layer

$\lambda$ : porosity of surface layer

$p_w$ : water content of surface layer

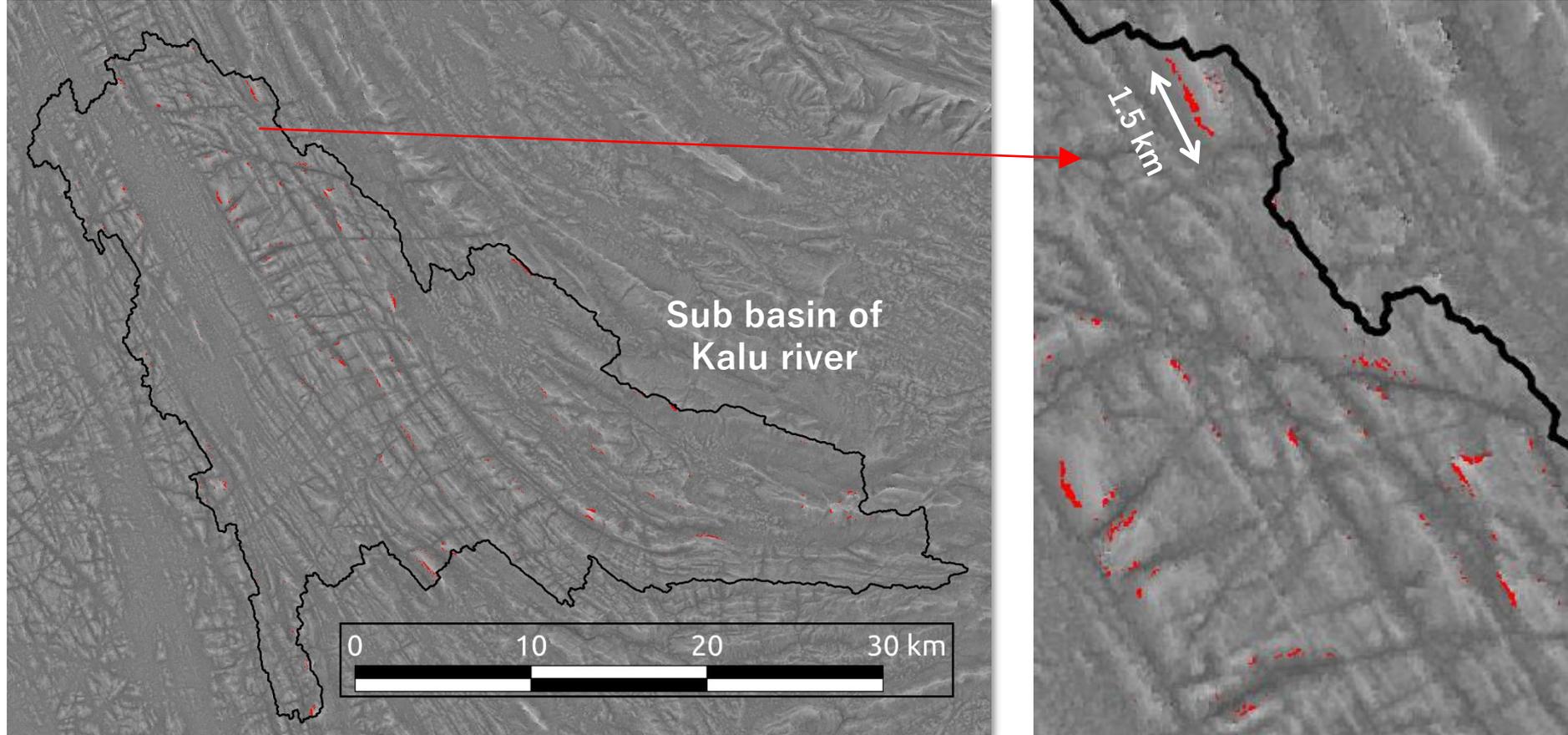
Landslide occur when  $\theta_c < \theta$

$$\tan\theta_c = \frac{\left(\frac{\sigma}{\rho} - \frac{h_s}{D}\right)c_* + \left(1 - \frac{h_s}{D}\right)p_w + c/(\rho g D \cos\theta \tan\phi)}{\left(\frac{\sigma}{\rho} - \frac{h_s}{D}\right)c_* + \left(1 - \frac{h_s}{D}\right)p_w + \frac{(h_s + h)}{D}} \tan\phi$$

$\sigma$ : mass density of soil particles     $\rho$ : mass density of water     $c_*$ : sediment concentration

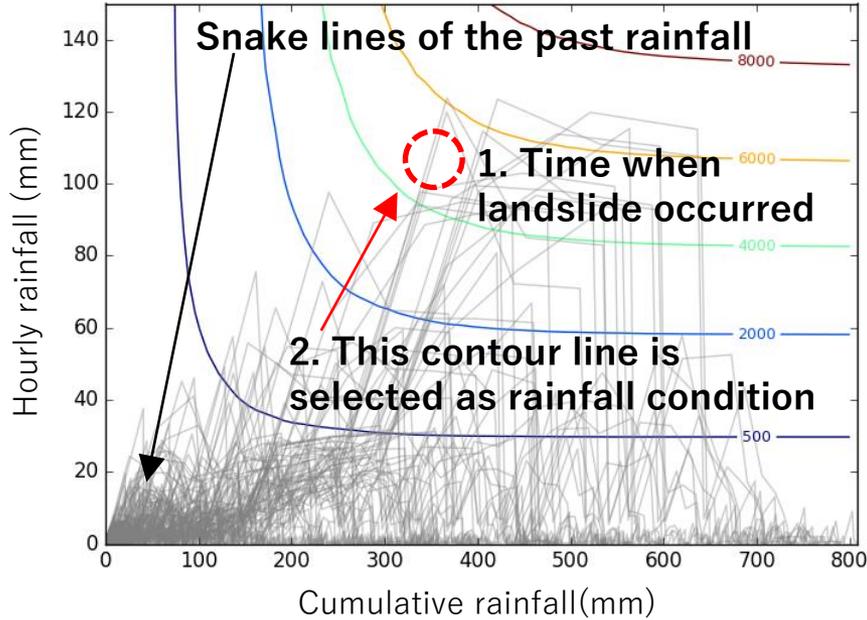
$c$ : cohesion     $\phi$ : interparticle friction angle

# Simulation of shallow landslide occurrence

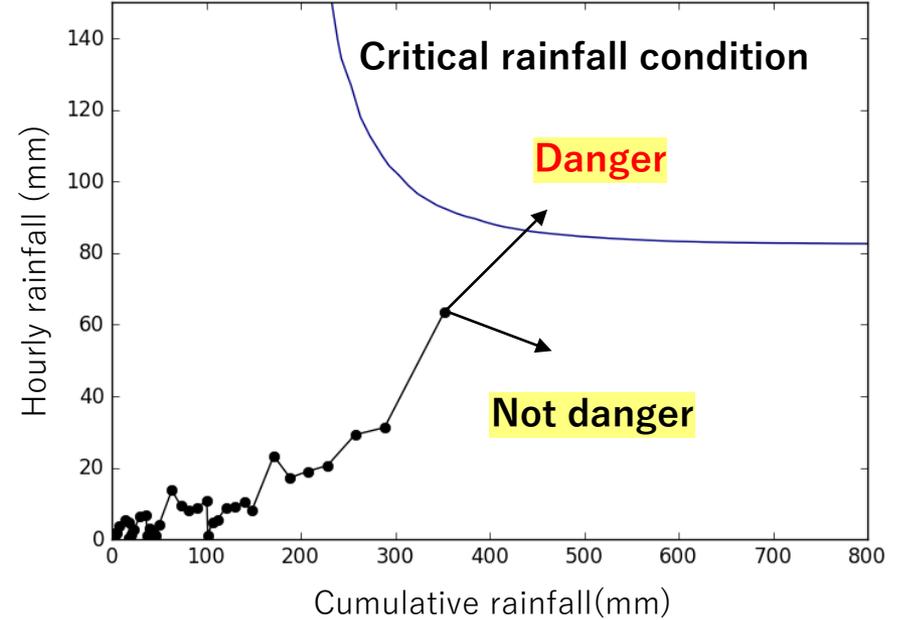


Spatial distribution of meshes estimated to occur landslides with 30m x 30m grid cells, GSMaP and general parameters

# Estimation of critical rainfall condition



Method for setting critical rainfall condition.



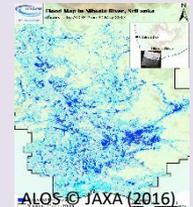
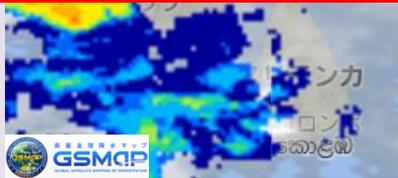
Warning to evacuate based on critical rainfall condition and forecasted rainfall.

One contour line is selected as a critical rainfall condition based on the time of landslide occurrence on the snake line of the past rainfall that caused landslide. The contour lines are generated by the data obtained by simulation with various steady-state rainfall intensity.

**Location, occurrence time and depth of landslide are necessary to improve accuracy of the model.**

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## **Platform Participating Organizations:**

- Irrigation Department (ID)
- Meteorology Department (MD)
- Survey Department (SD)
- Disaster Management Center (DMC)
- National Building Research Organization (NBRO)
- Ministry of Magapolis and Western Department (MMWD)
- Ministry of Mahaweli Development & Environment (TBD, MMDE)

## **Platform Target Actions and Coordinating Bodies**

1. Early Warning: rainfall, flooding, landslide:

ID, MD, NBRO

2. Adaptation Planning: Climate Change, Urbanization:

ID, MMDE, MMWD

3. Economic Effect of Disasters:

MMDE, DMC

4. Contingency Planning:

DMC

# Thank you for your kind attentions!

mamiyamoto@pwri.go.jp



## Future Events of IFI

- Sep. 2017 10<sup>th</sup> HELP Meeting@Gyeongju, Korea
- Sep. 2017 GEOSS-AP@Hanoi, Vietnam (IFI special session)
- Nov. 2017 World BOUSAI Forum@Sendai, Japan (IFI session)