

The 10th 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



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”;

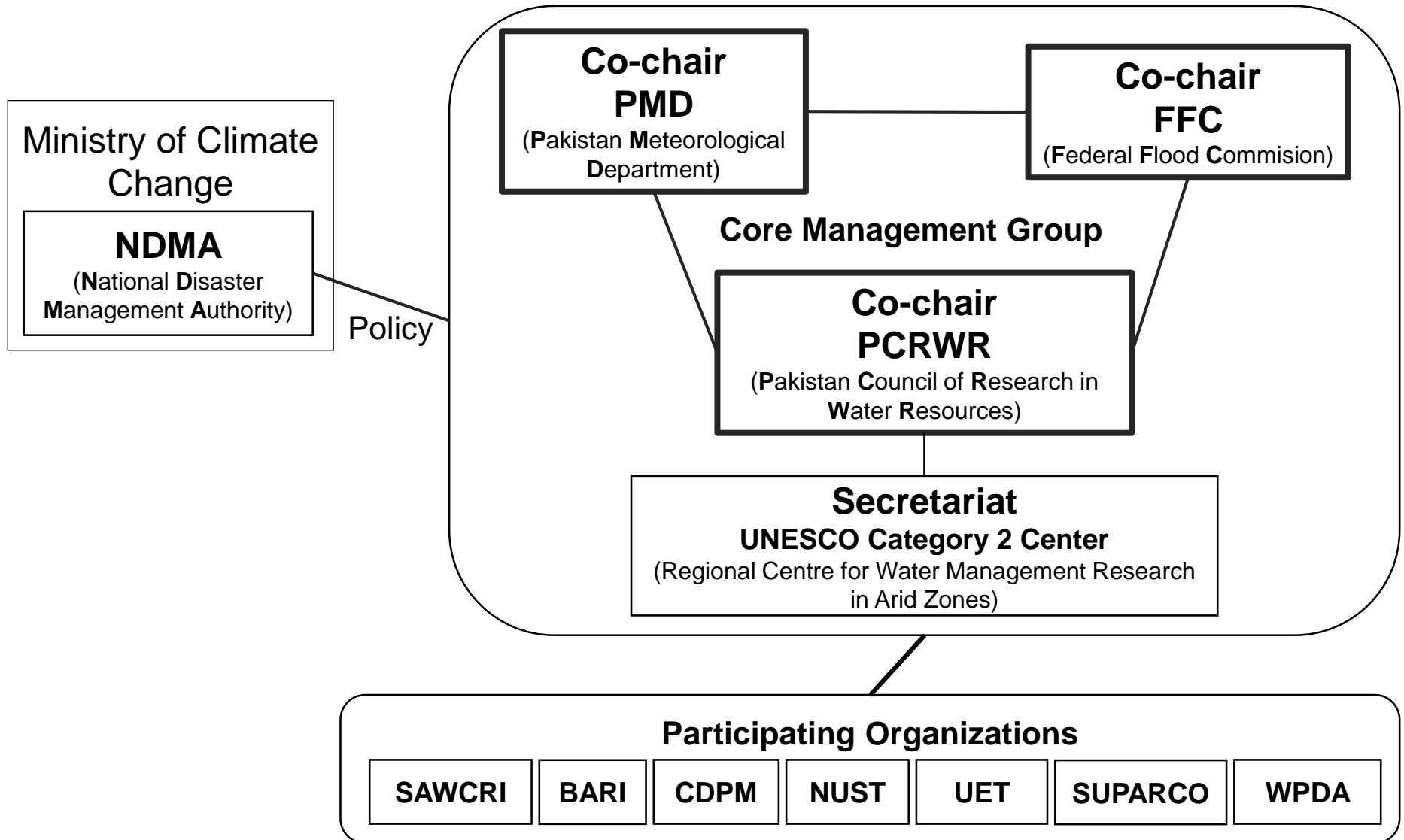
- 2-3 March at PMD Headquarter, Islamabad



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”



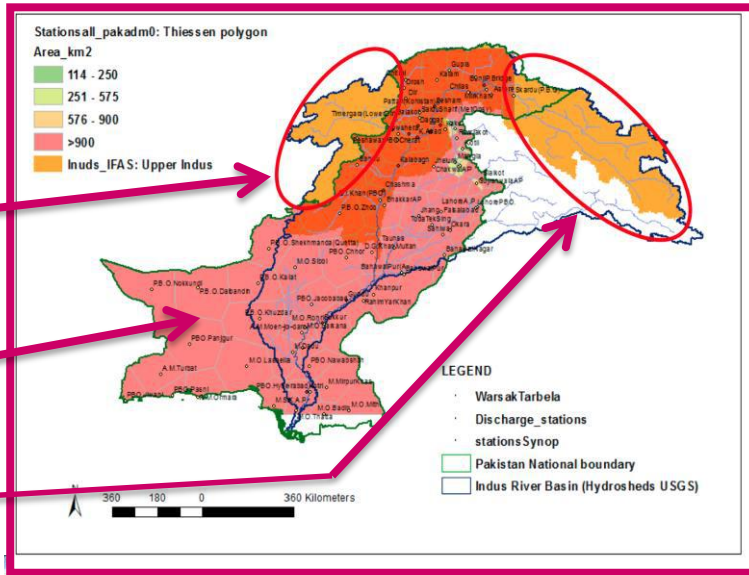
Pakistan

Activities (UNESCO Project)

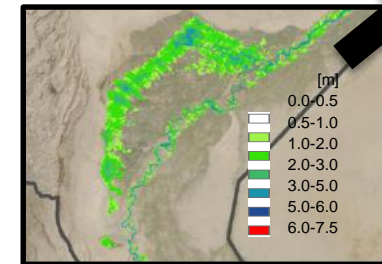
Indus-IFAS: flood forecasting system based on IFAS/RII

INPUT DATA CHALLENGES:

- Lack of trans-boundary data
- Null-Low rain gauges network density
- Uncertainty on snowmelt



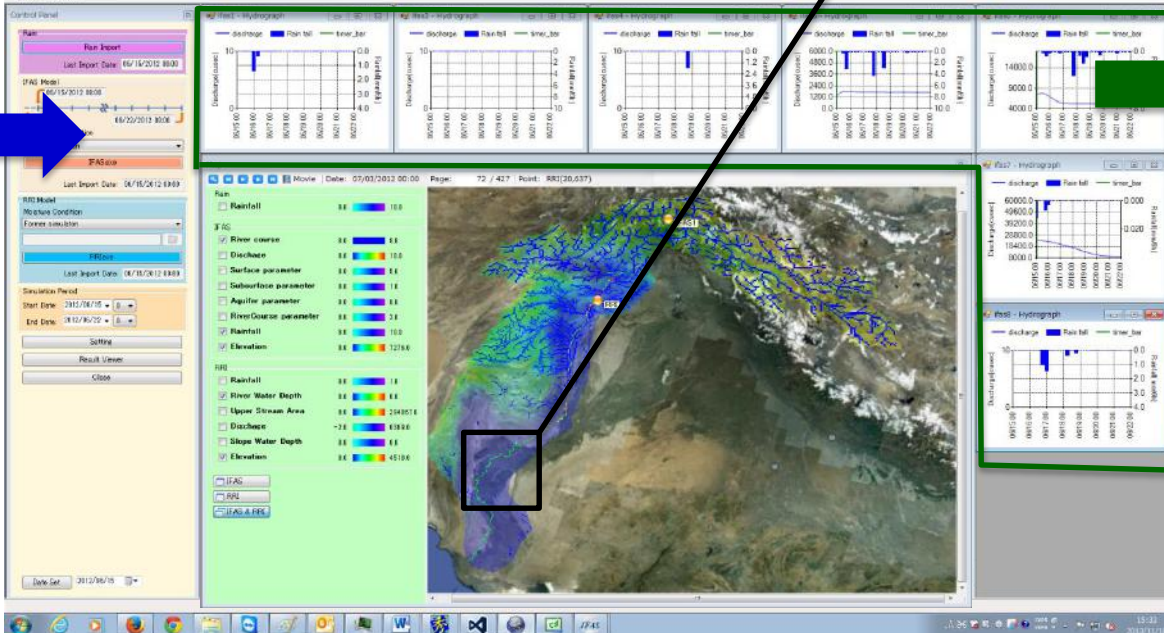
Inundation area by RRI



FLOOD HAZARD MAPPING

INPUT DATA :

- Rainfall data (PMD ground-gauges, GSMaP and forecasted)
- **Real-time observed discharges**



OUTPUT DATA:

- Rainfall distribution maps
- Hydrographs at specified locations
- Inundation extents in mid-low Indus

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)

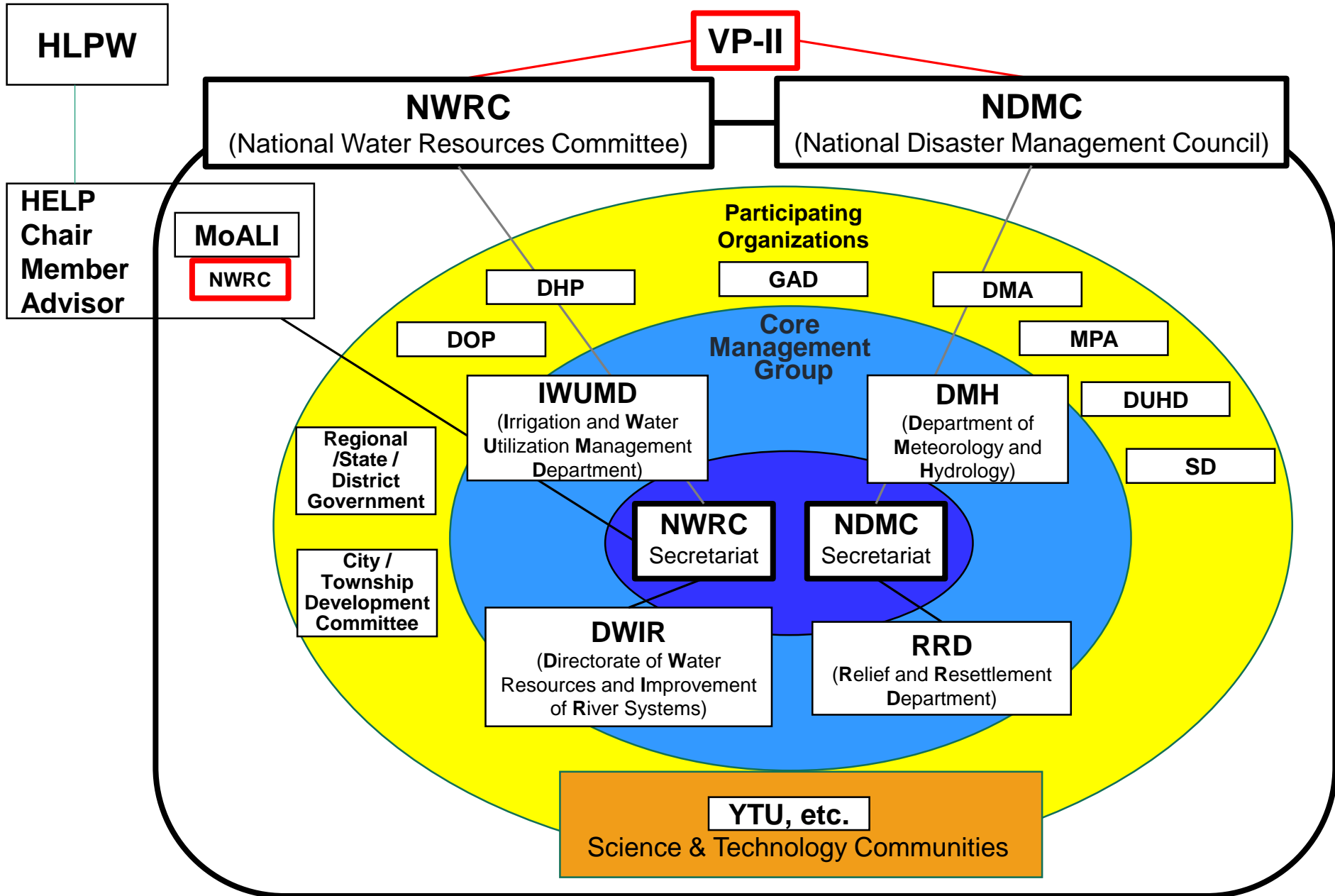


Participated Stakeholders

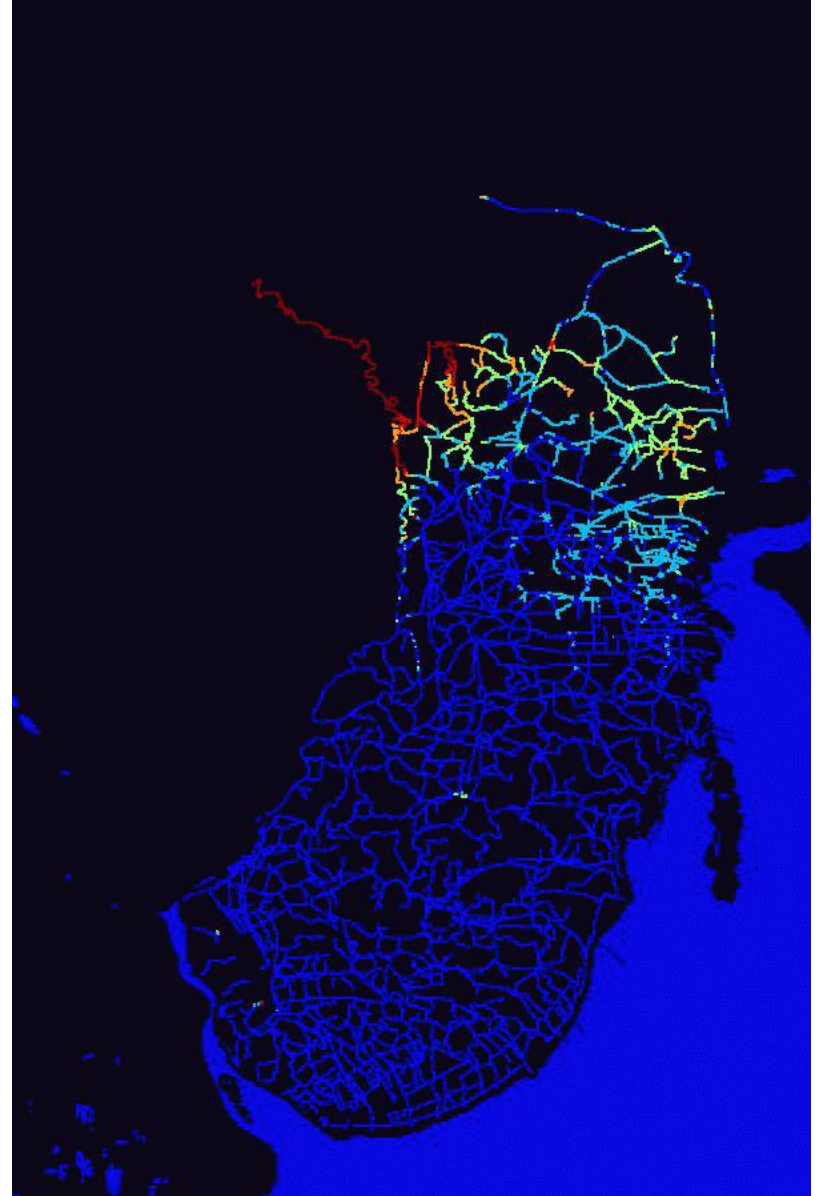
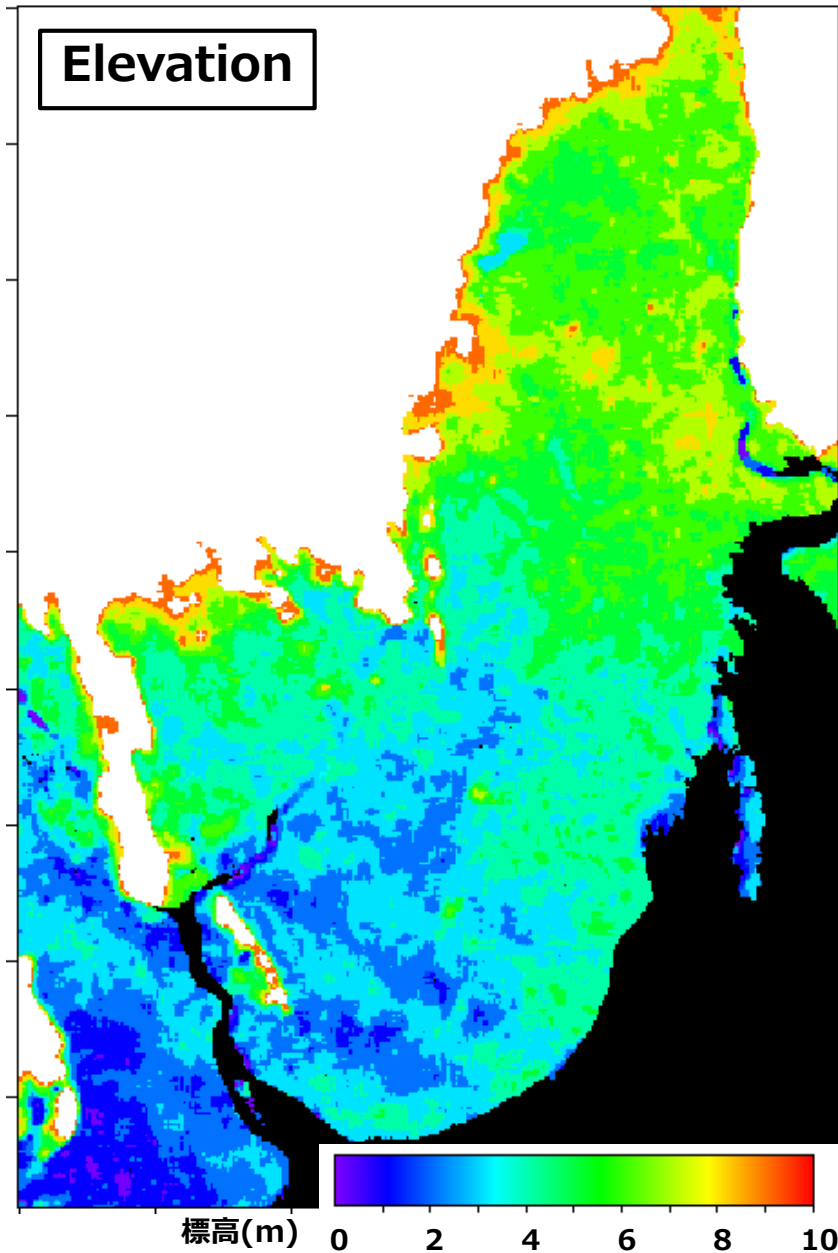
- **DWRI, Ministry of Transport and Communications**
- **DMH, Ministry of Transport and Communications**
- **RRD, Ministry of Social Welfare, Relief and Resettlement**
- **IWUMD, Ministry of Agriculture, Livestock and Irrigation**
- **Yangon Technical university**
- **ICHARM**
- **University of Tokyo**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

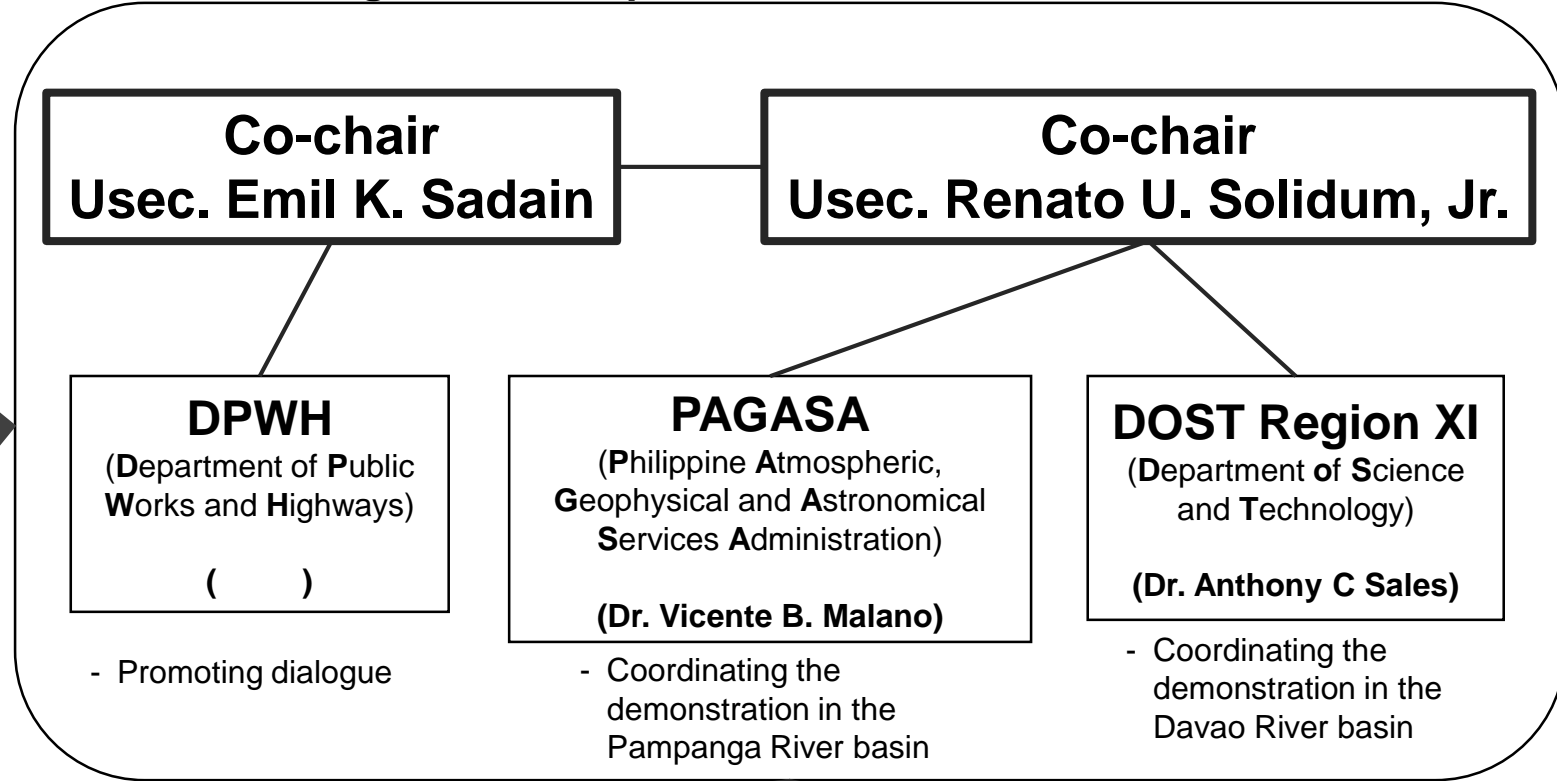
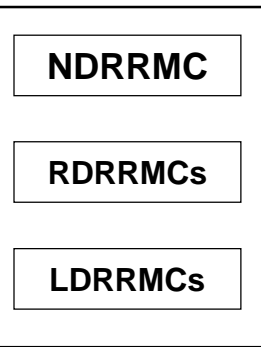
Geology

Academia

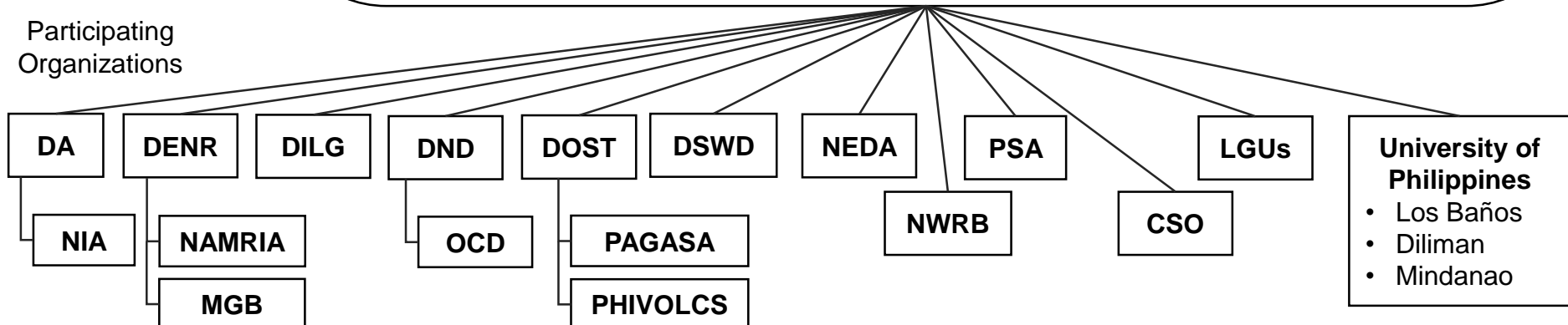
Philippines

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

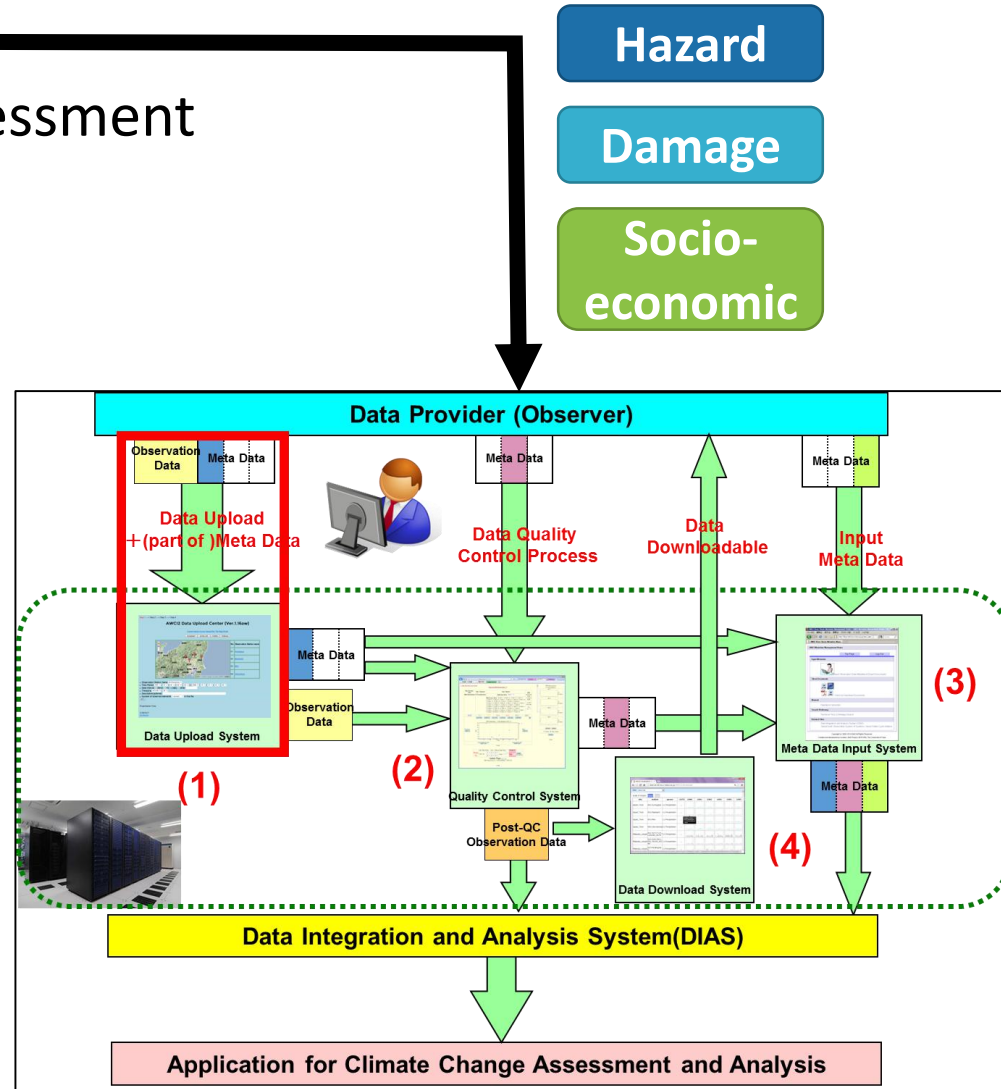
Hazard

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

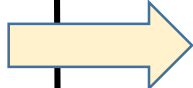


Mid-term framework



Collaboration with member organizations of disaster management platform

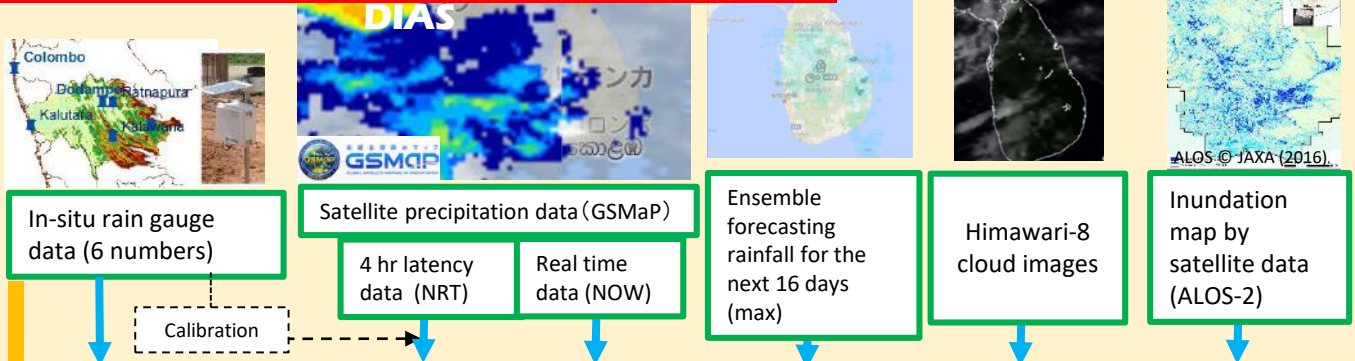
- Member organizations of national platform
- Meteorology Department
 - Irrigation Department
 - Disaster Management Center
 - Universities and others



Capacity building for operation

- Promotion of research
- Damage reduction through implementation

Implemented by EDITORIA and ICHARM on



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

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)

Marker	Station Name	Latest 1hr	3 Days	30 Days
A	Fukurua	0mm	0.0mm	173.2mm
B	Kalutara	1.0mm	13.0mm	457.2mm
C	Ratnapura	1.0mm	9.0mm	267.2mm
D	Fukurua	3.0mm	12.0mm	519.2mm
E	Dumpe	0.0mm	0.0mm	854.2mm
F	Colombo	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)

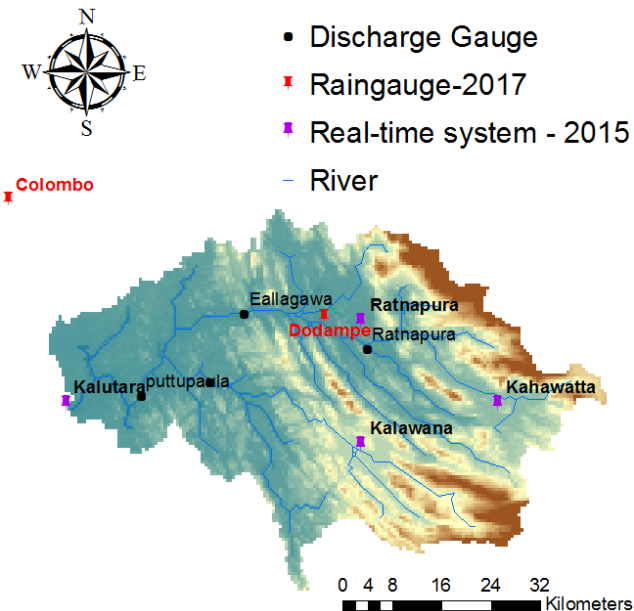
Damage reduction by pre-disaster measures

Evacuation advisory by early warning

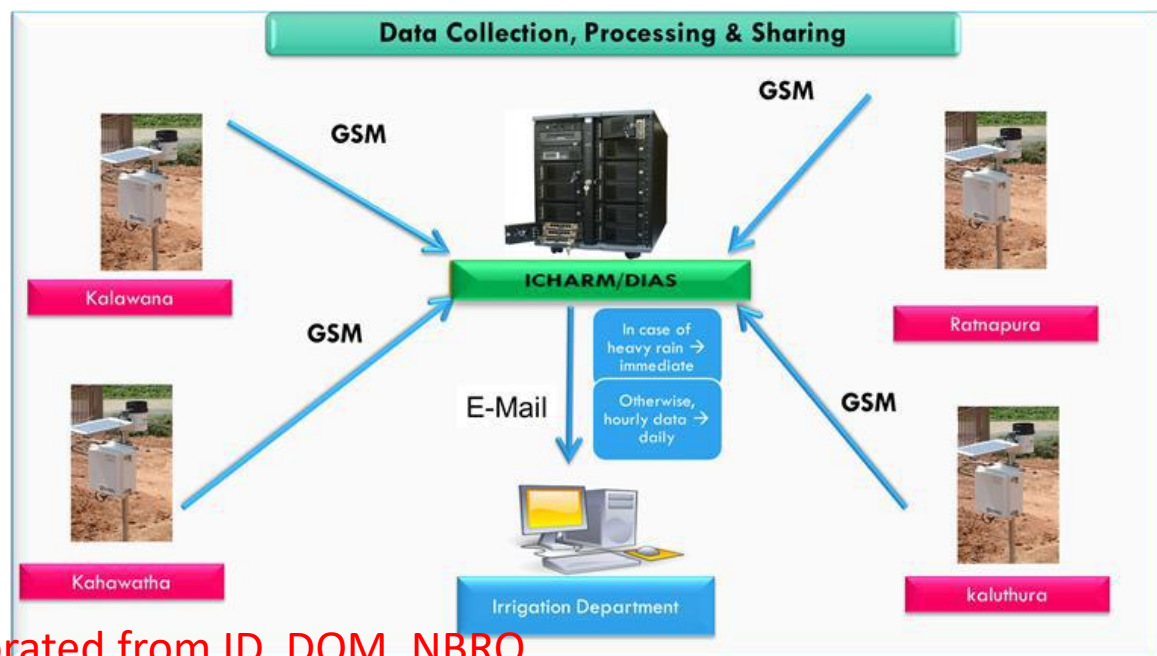


Kalu River Basin: Real-time rainfall monitoring & Modeling

Real-Time Data Transfer System in the Kalu River Basin



- ✓ Catchment area 2839km²
- ✓ 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

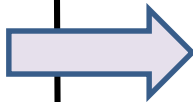


Mid-term framework



Collaboration with member organizations of disaster management platform

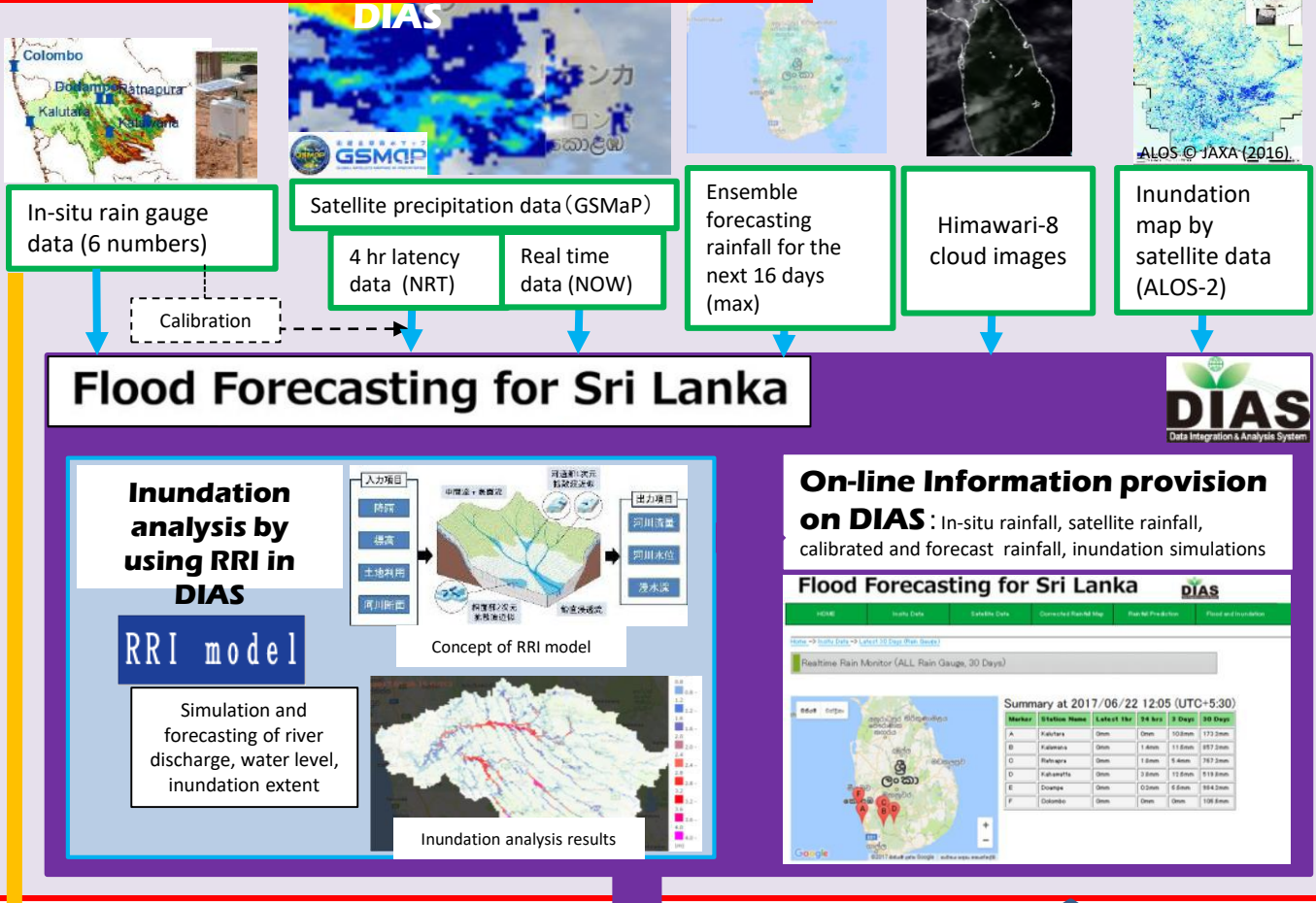
- Member organizations of national platform
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Capacity building for operation

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- Damage reduction through implementation

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Email alert messages

Information provision



Collaboration

Sri Lanka disaster management platform

Government of Sri Lanka (Irrigation Department)

Government of Sri Lanka (Disaster Management Center)

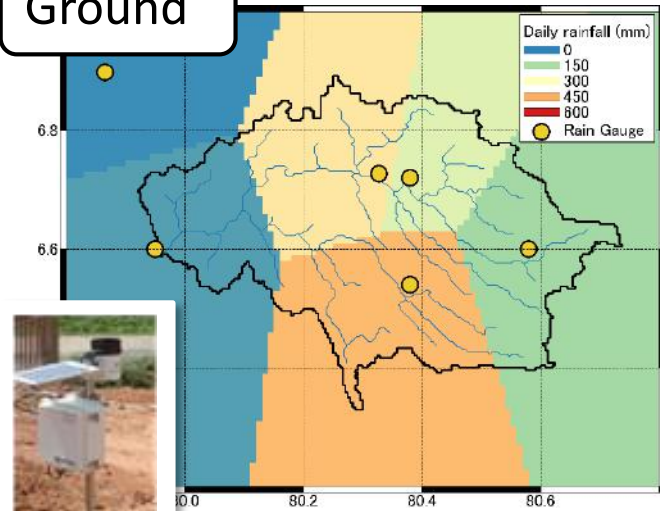
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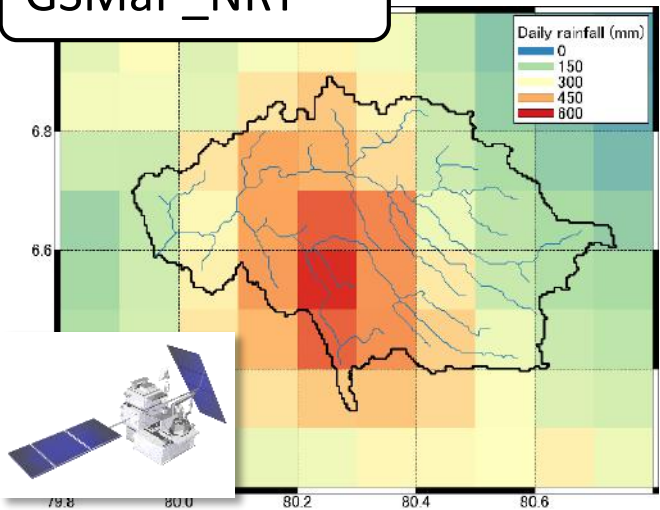


Bias correction of satellite rainfall by ground observation

Ground

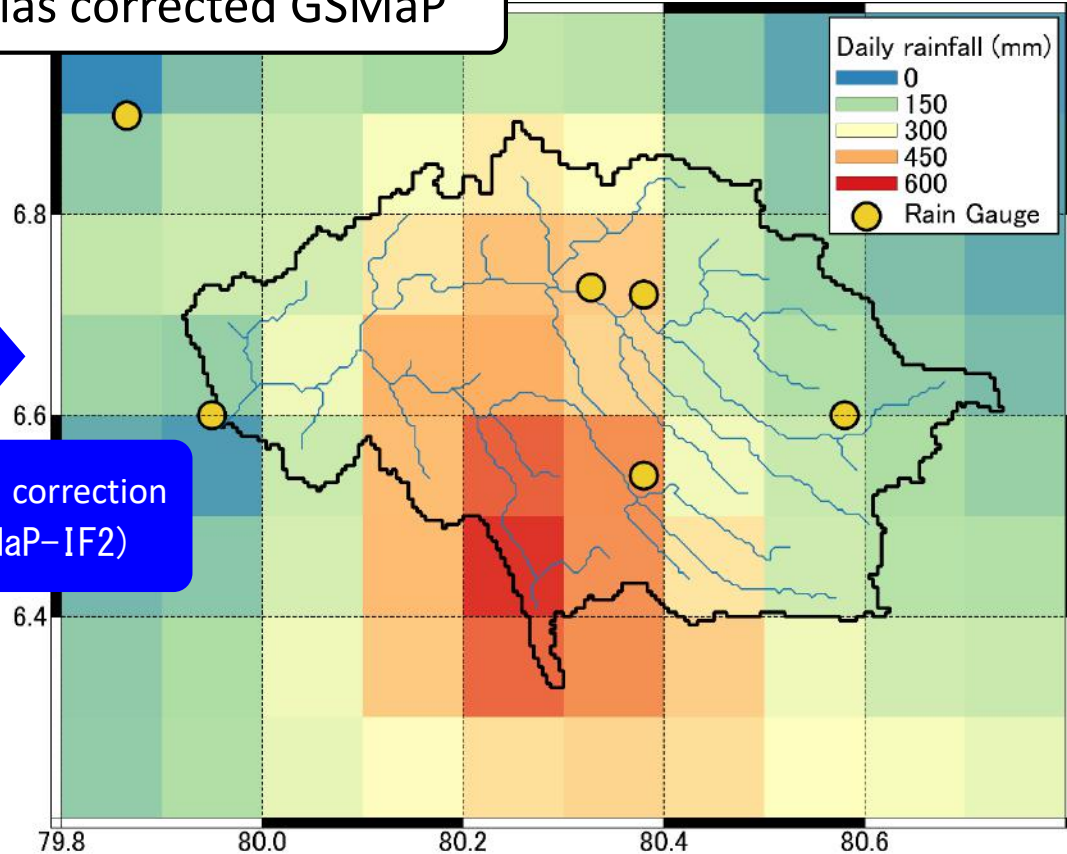


GSMaP_NRT



Spatial & Quantitative

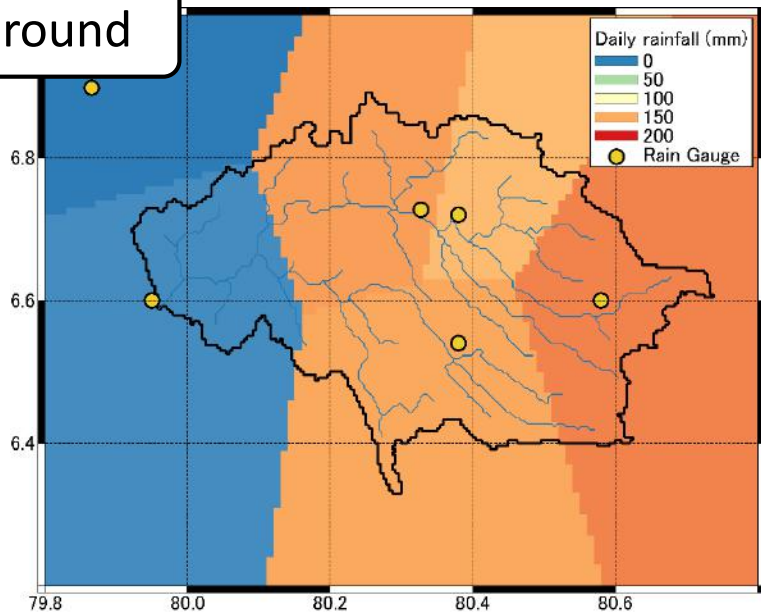
Bias corrected GSMaP



25 May 2017, The Kalu River basin

Geolocation error correction

Ground

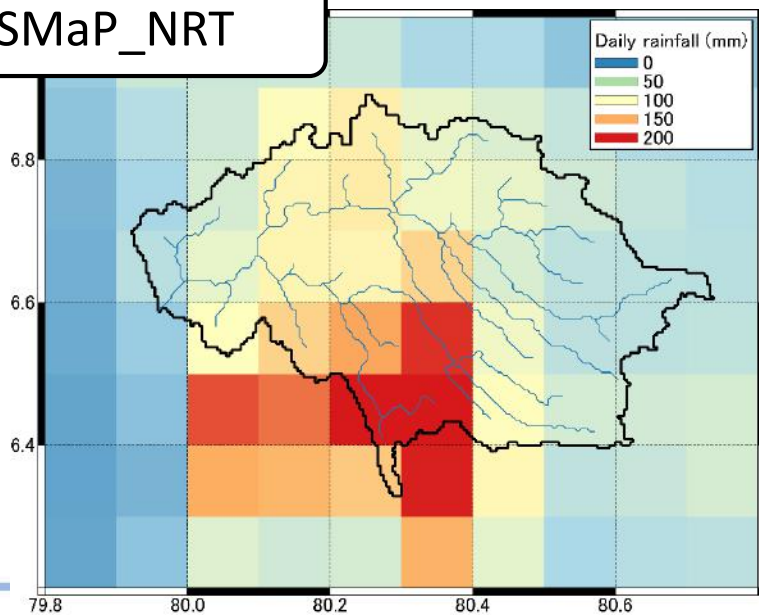


Error of rainfall area location
(Geolocation error)

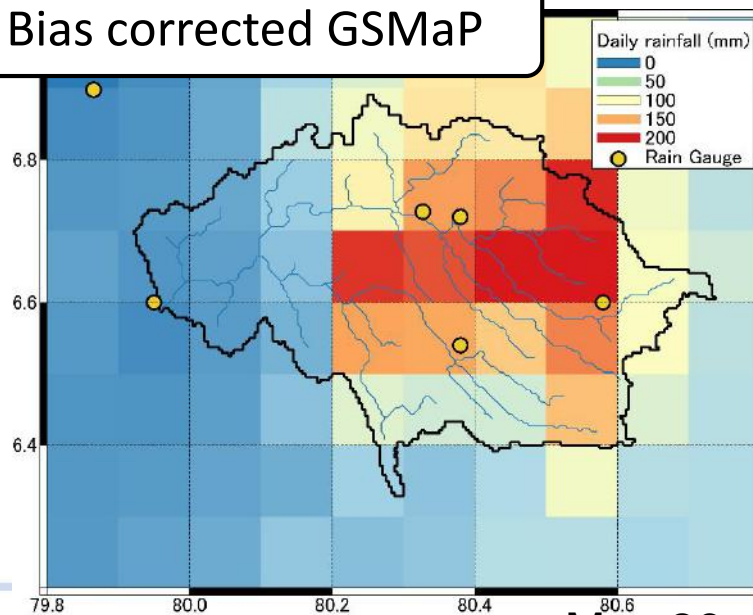


Geolocation error is corrected by
comparison of rainfall pattern

GSMaP_NRT

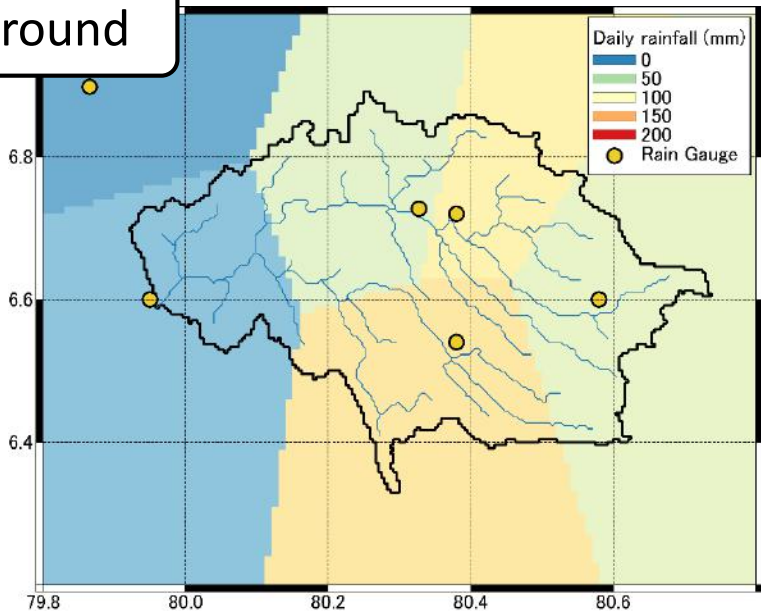


Bias corrected GSMaP



Rainfall intensity correction

Ground

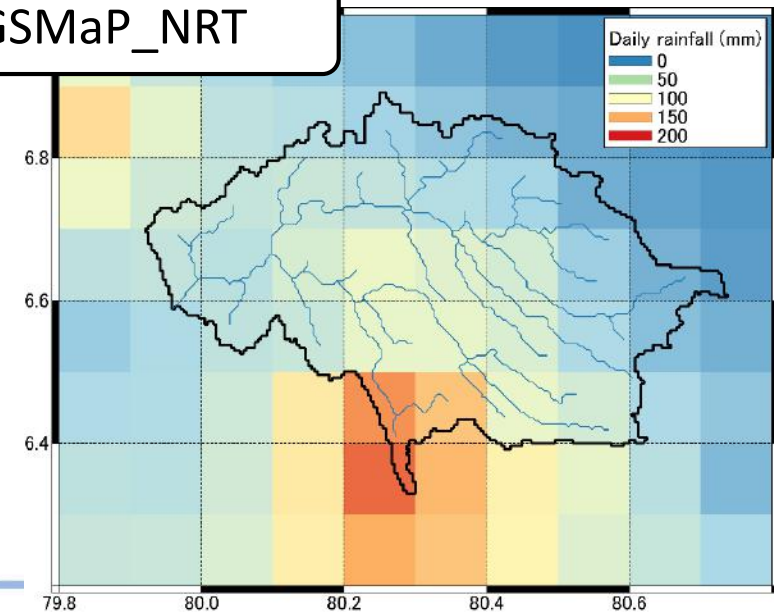


Bias of rainfall intensity

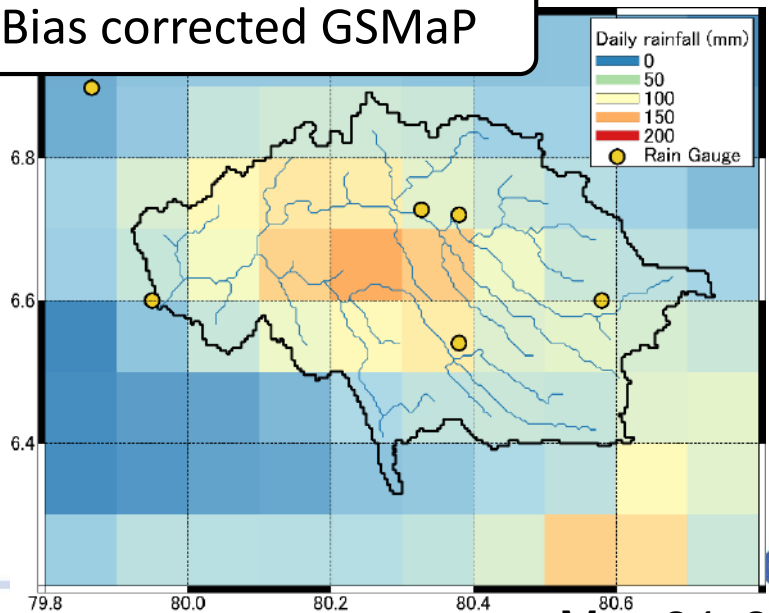


Rainfall intensity is adjusted using information of ground observation

GSMaP_NRT



Bias corrected GSMaP



Present situation: Test operation for rainy season

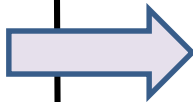


Mid-term framework



Collaboration with member organizations of disaster management platform

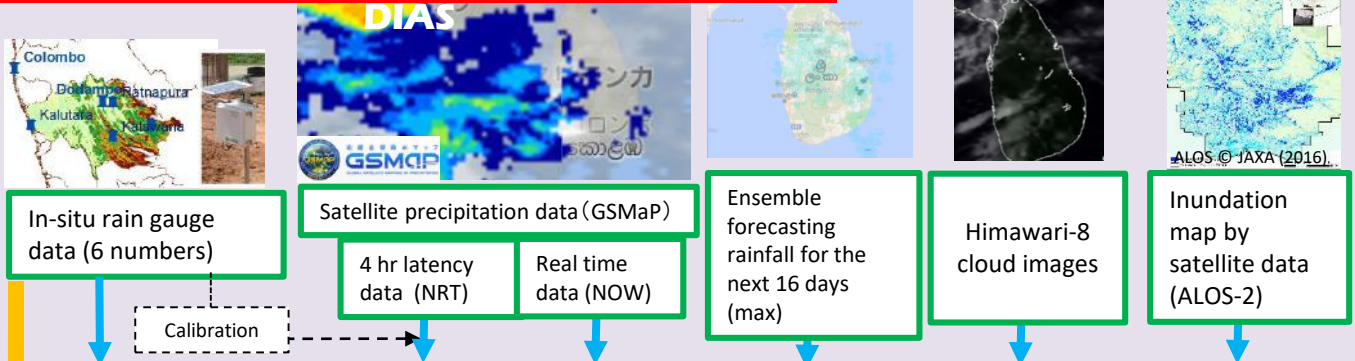
- Member organizations of national platform
- Meteorology Department
 - Irrigation Department
 - Disaster Management Center
 - Universities and others



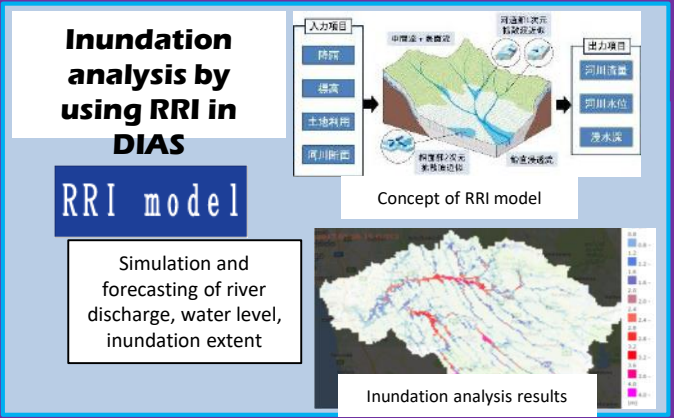
Capacity building for operation

- Promotion of research
- Damage reduction through implementation

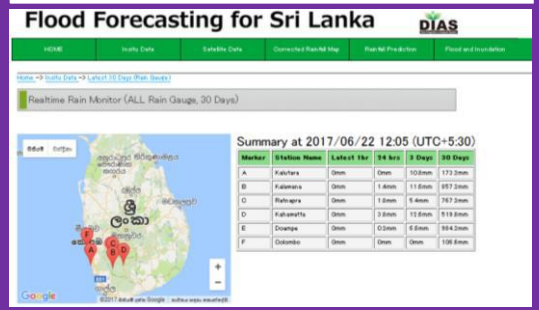
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Flood Forecasting for Sri Lanka



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



Email alert messages

Information provision



Collaboration

Sri Lanka disaster management platform

Government of Sri Lanka (Irrigation Department)

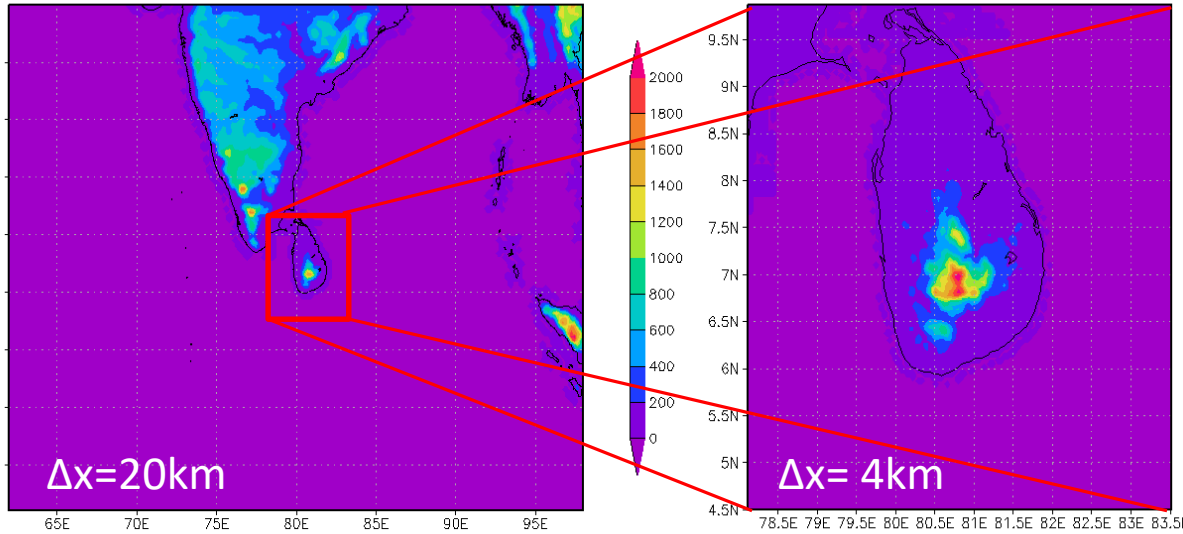
Government of Sri Lanka (Disaster Management Center)

Damage reduction by pre-disaster measures

Evacuation advisory by early warning



Forecast model and prediction method



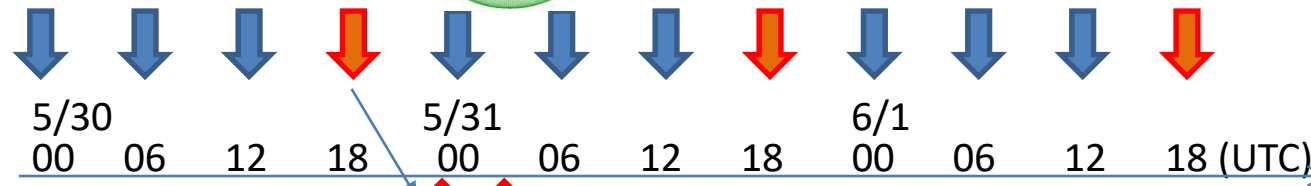
WRF model:

Resolution: 20km/4km

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

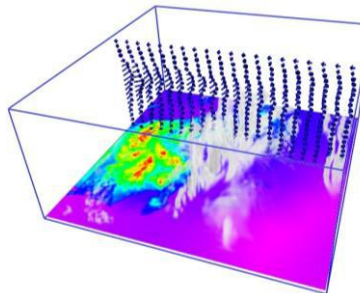
Cumulus parameterization:
Newer Tiedtke in outer frame
Cloud microphysics: Lin (water
cloud, ice cloud, rain, graupel,
snow, single moment)

Forecast initial time
(NCEP GFS)



Global
forecasts
available

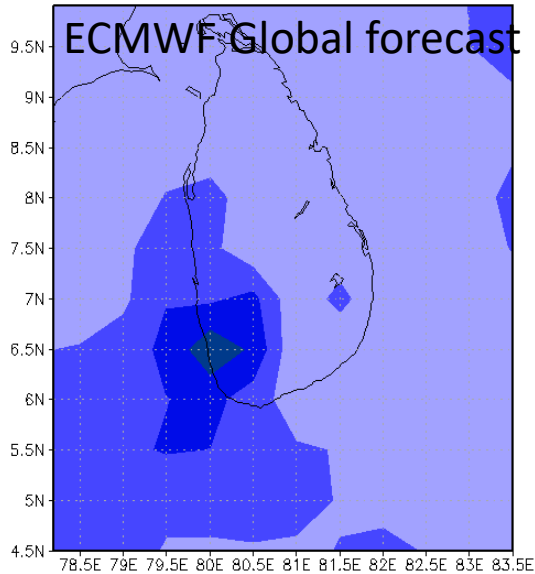
Downscaled
forecast (3days)
is available.



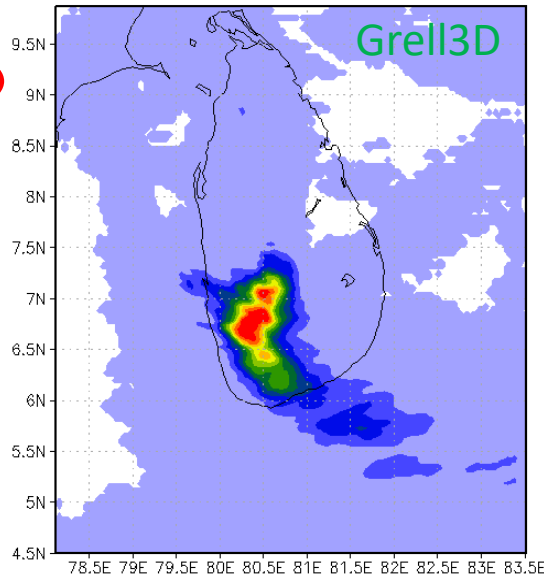
Forecast from 18UTC is
available at around
01UTC next day.

Forecast Rainfall in 25May2017

Rainfall 25May2017 ECMWF

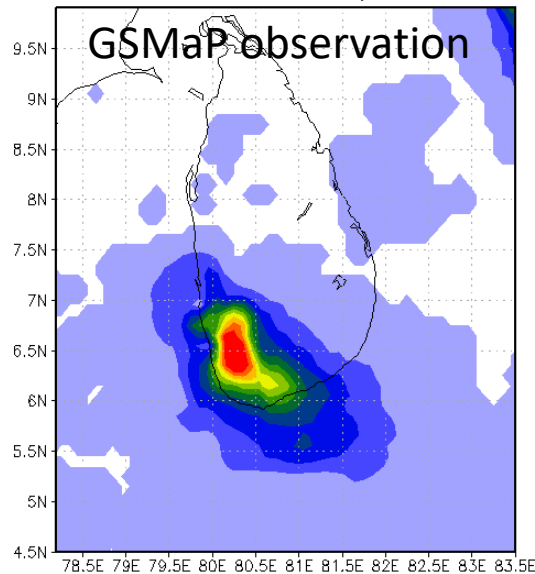


Rainfall 25May2017 5,0

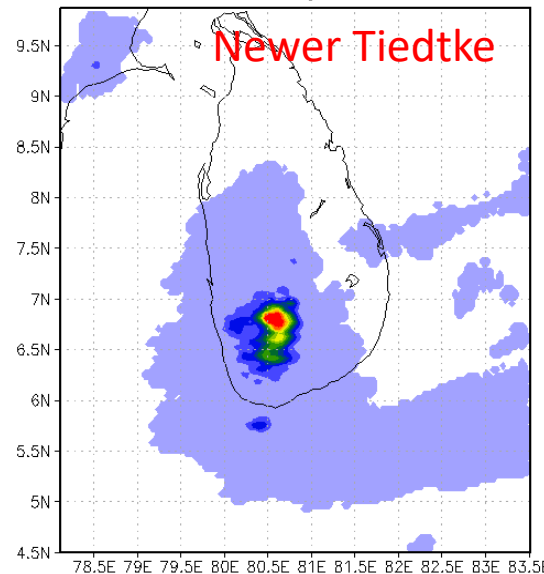


The location of precipitation is well predicted, but is overestimated or underestimated depend on the choice of cumulus scheme.

GSMaP NRT 25May2017

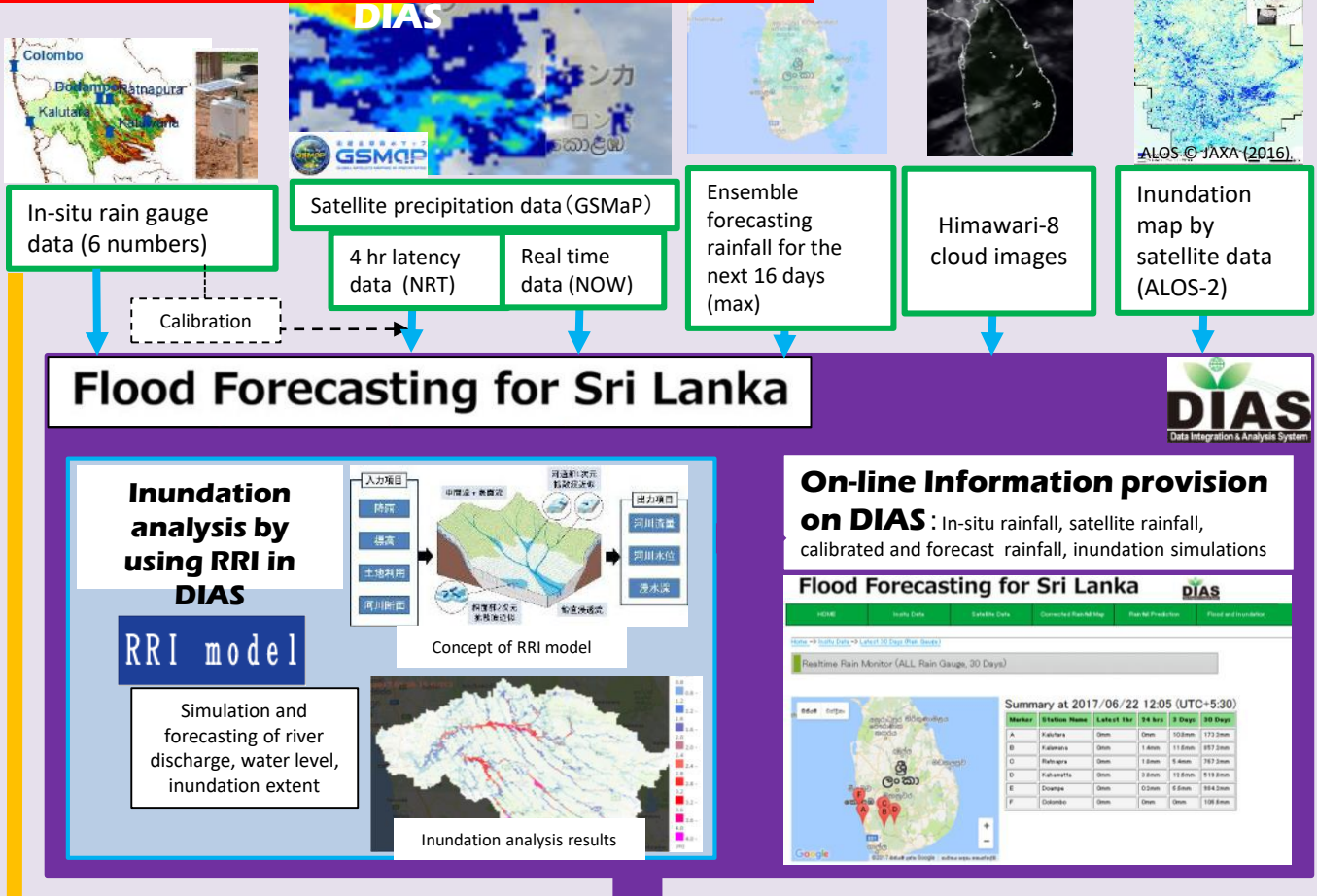


Rainfall 25May2017 16,0



Present situation: Test operation for rainy season

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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

Email alert messages

Information provision

Collaboration

Sri Lanka disaster management platform

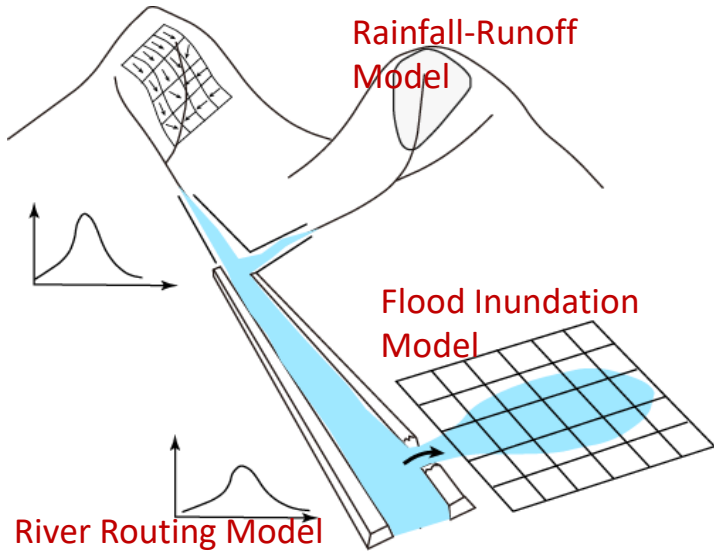
Government of Sri Lanka (Irrigation Department)

Damage reduction by pre-disaster measures

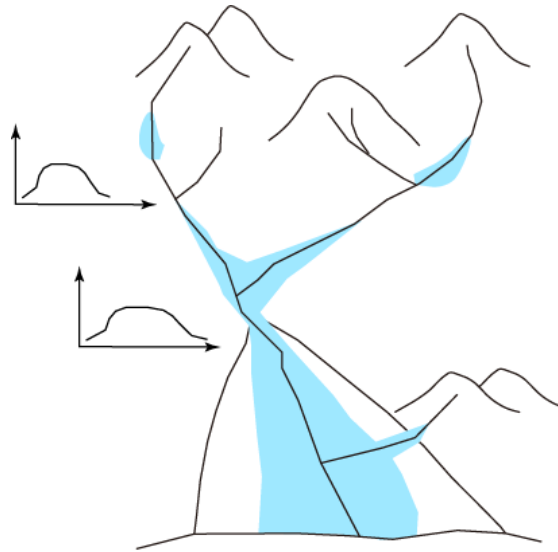
Government of Sri Lanka (Disaster Management Center)

Evacuation advisory by early warning

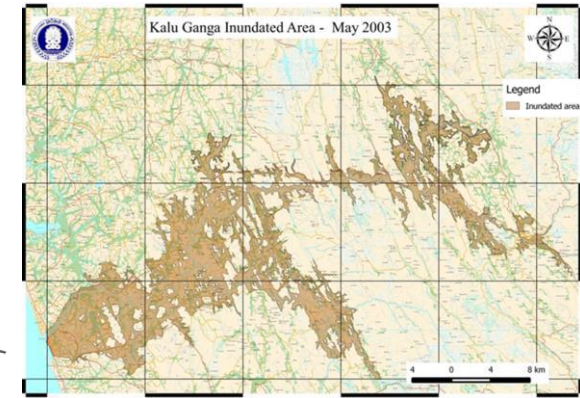
RRI: Rainfall-Runoff-Inundation Model



e.g. Japanese River Case



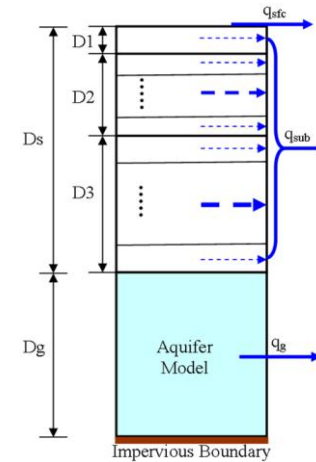
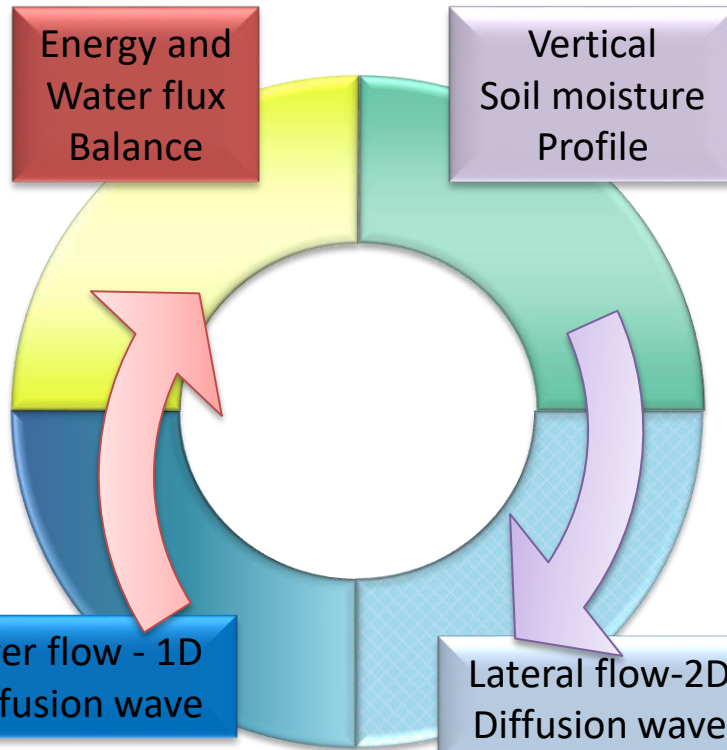
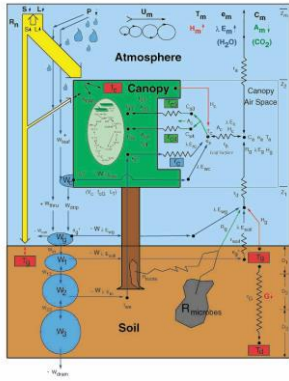
e.g. Chao Phraya River Case



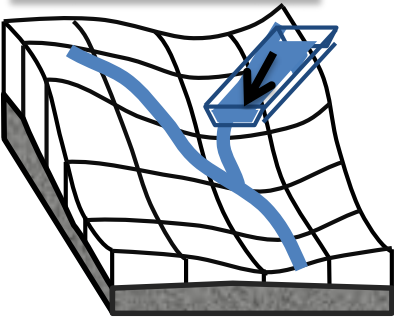
Kalu River - Inundation

- ✓ 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



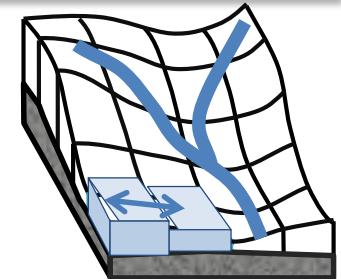
River Routing



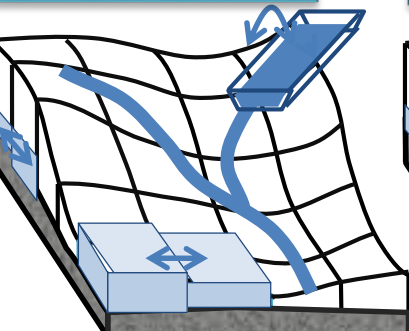
River flow - 1D Diffusion wave

Lateral flow-2D Diffusion wave

Surface flow



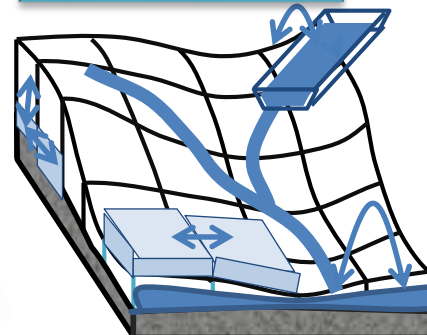
Slope-River Interaction



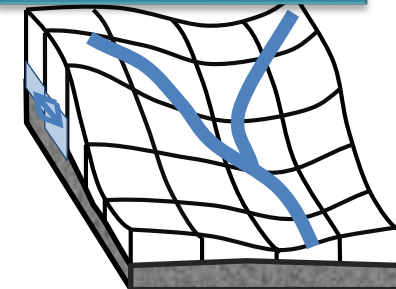
GW-River Interaction



GW-Soil Moisture Interaction

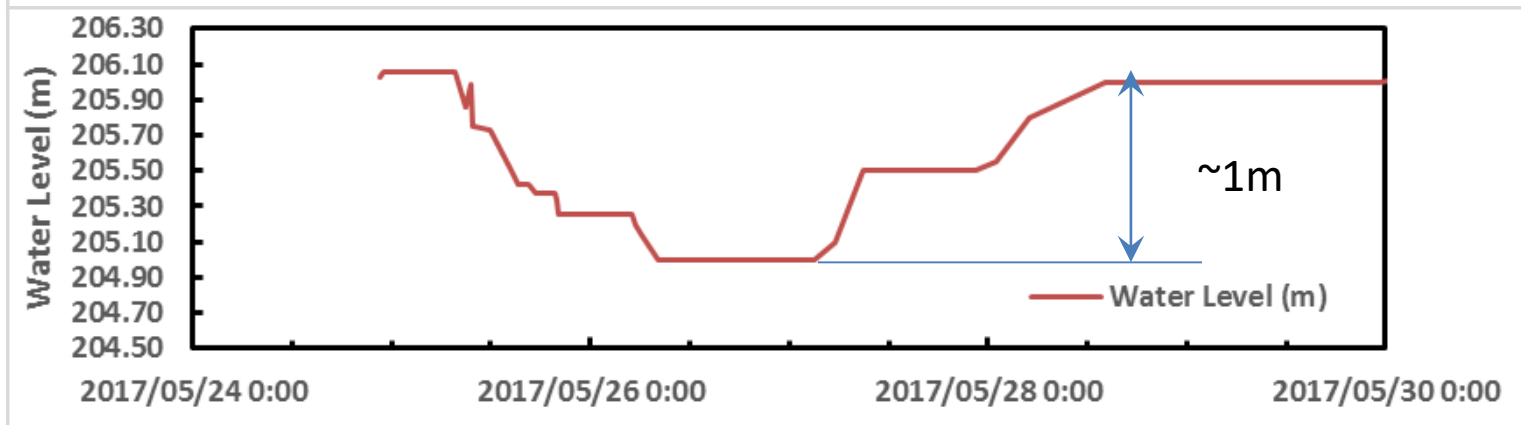
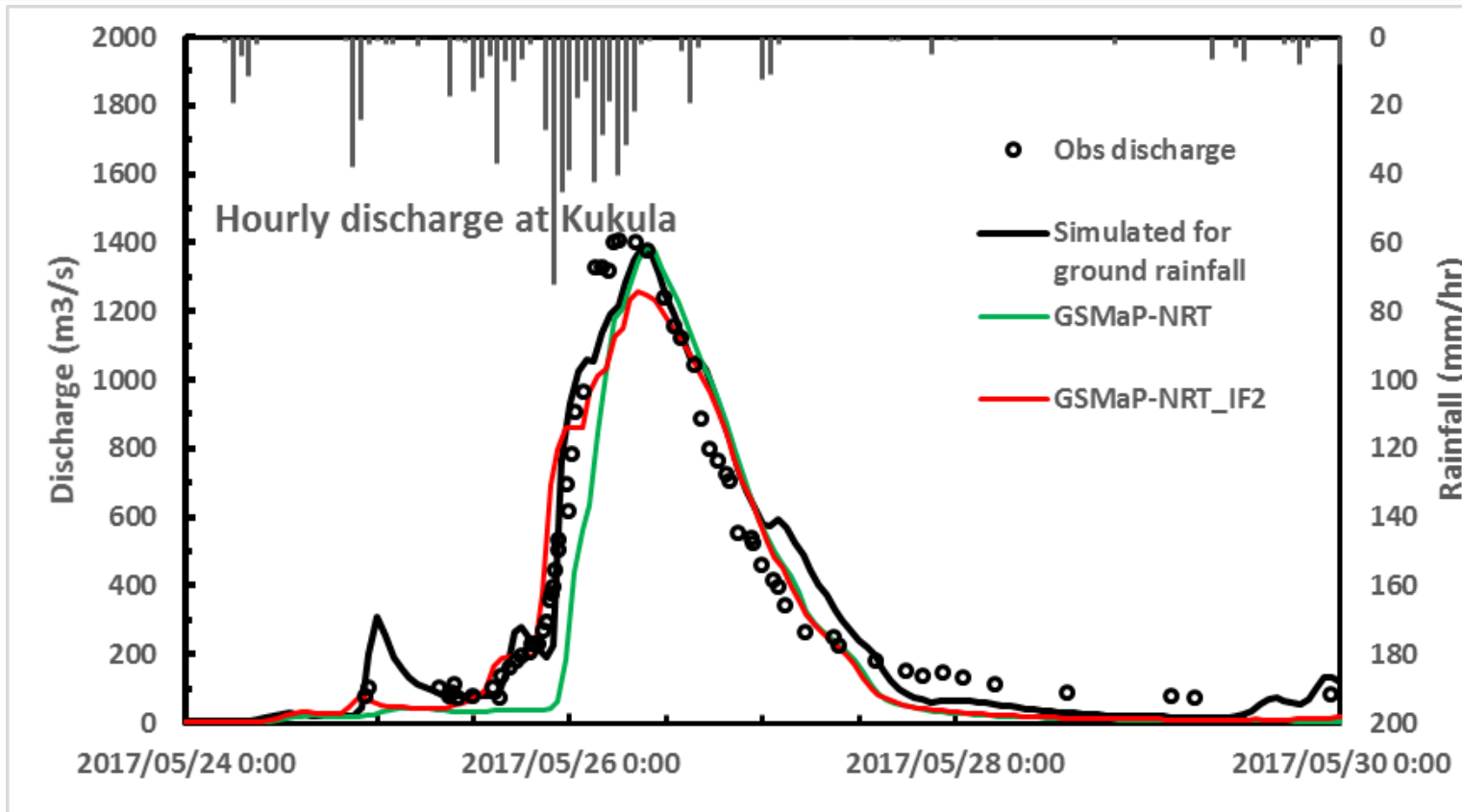


Ground water Flow

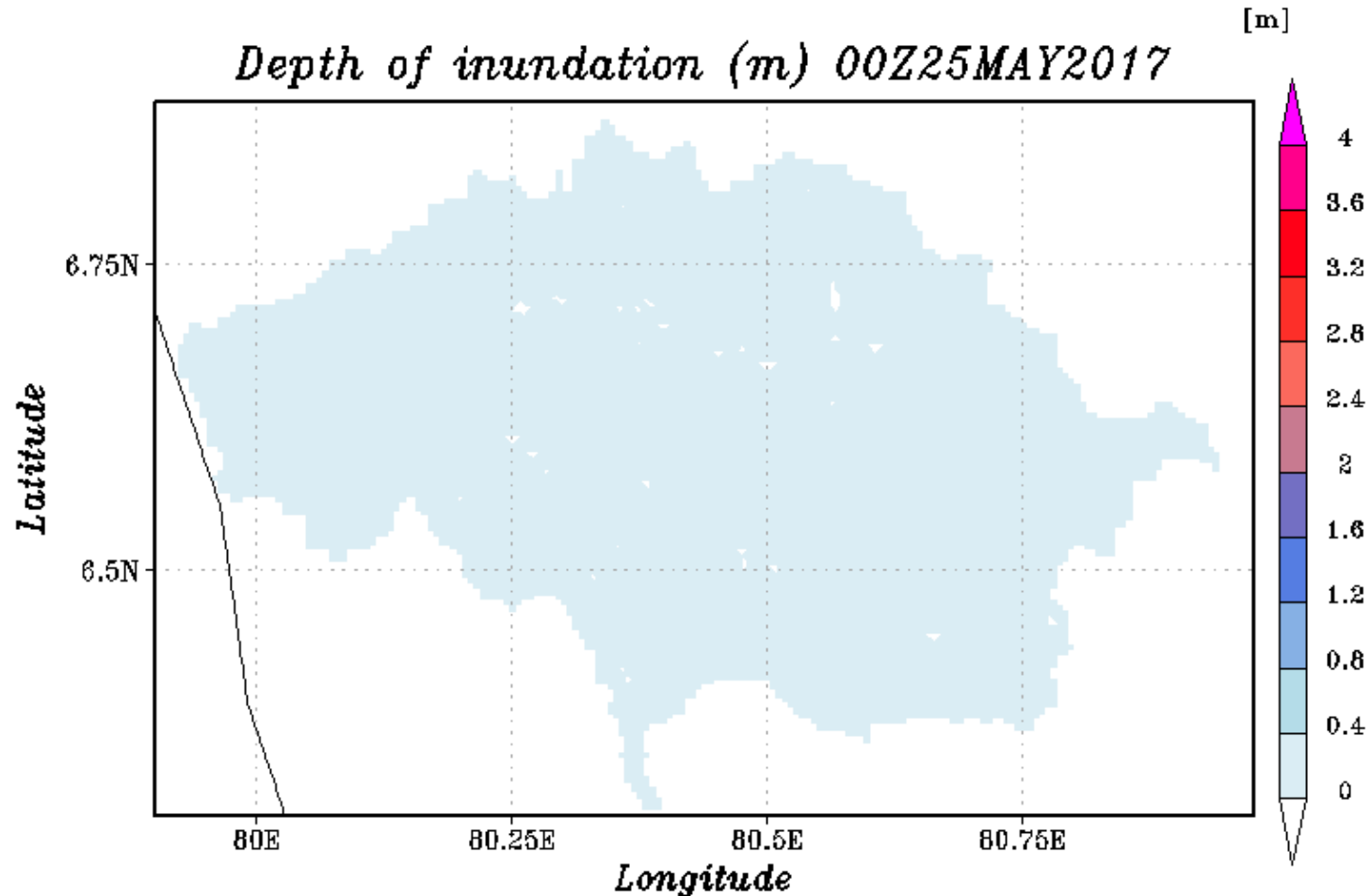


$$Q_{RF} = \frac{K \cdot L_w}{h_c} (h_{rw} - h) = c_{gw} (h_{rw} - h)$$

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

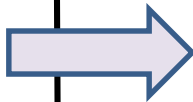


Mid-term framework



Collaboration with member organizations of disaster management platform

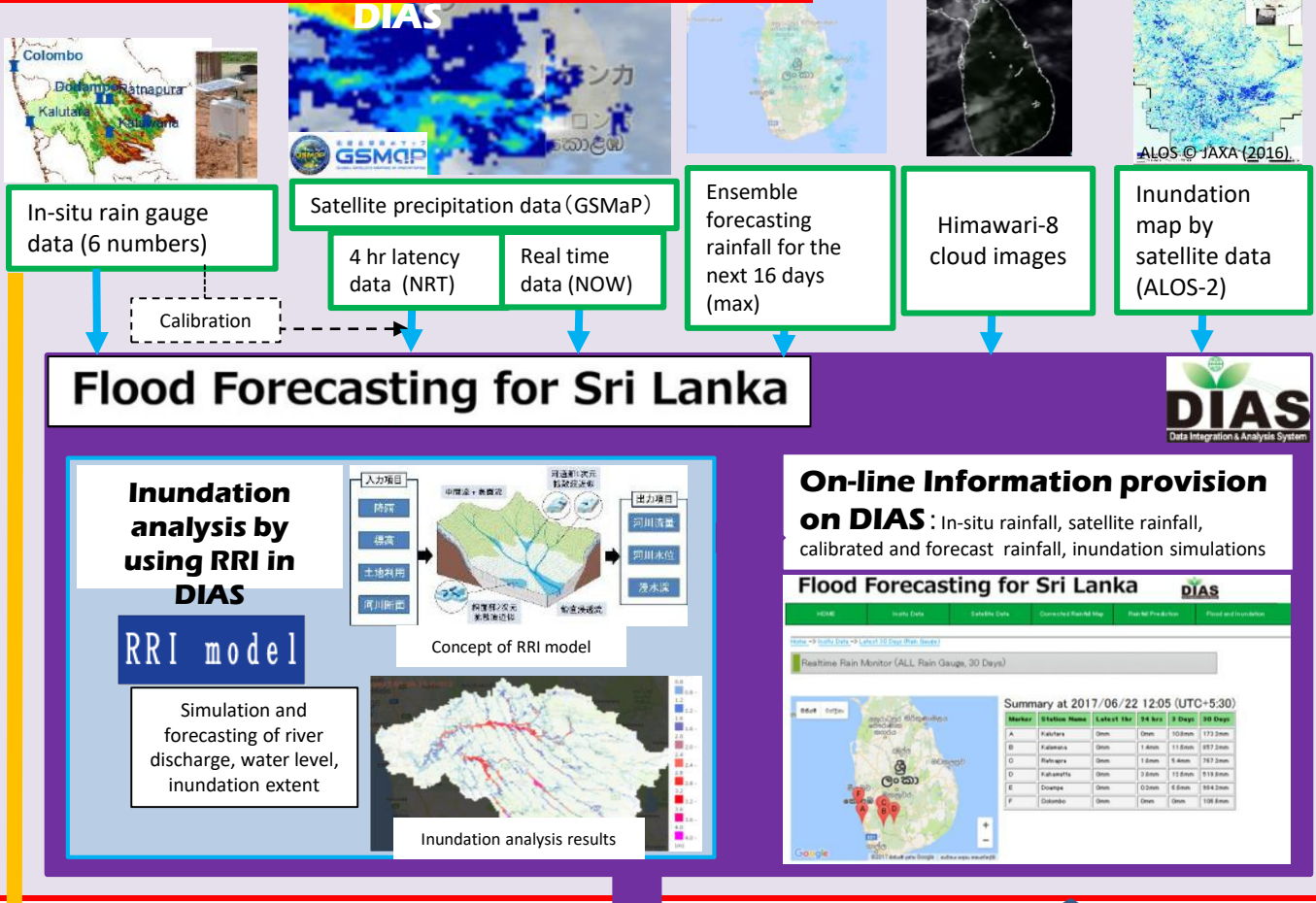
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Capacity building for operation

- Promotion of research
- Damage reduction through implementation

Implemented by EDITORIA and ICHARM on



In-situ rain gauge data (6 numbers)

DIAS
Satellite precipitation data (GSMaP)

Ensemble forecasting rainfall for the next 16 days (max)

Himawari-8 cloud images

Inundation map by satellite data (ALOS-2)

4 hr latency data (NRT) | Real time data (NOW)

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

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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	1.0mm	13.6mm	457.2mm	
C	Raharaha	1.0mm	9.0mm	267.2mm	
D	Falhera	3.0mm	12.0mm	519.2mm	
E	Dumpe	0.0mm	0.0mm	854.2mm	
F	Colombo	0mm	0mm	108.0mm	

Email alert messages

Information provision



Collaboration

Sri Lanka disaster management platform

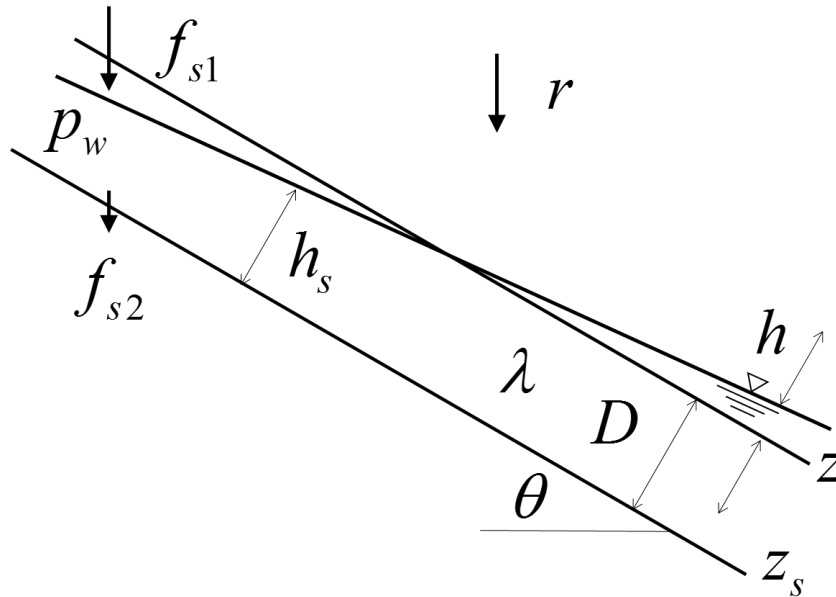
Government of Sri Lanka (Irrigation Department)

Government of Sri Lanka (Disaster Management Center)

Damage reduction by pre-disaster measures

Evacuation advisory by early warning

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

λ : porosity of surface layer

p_w : water content of surface layer

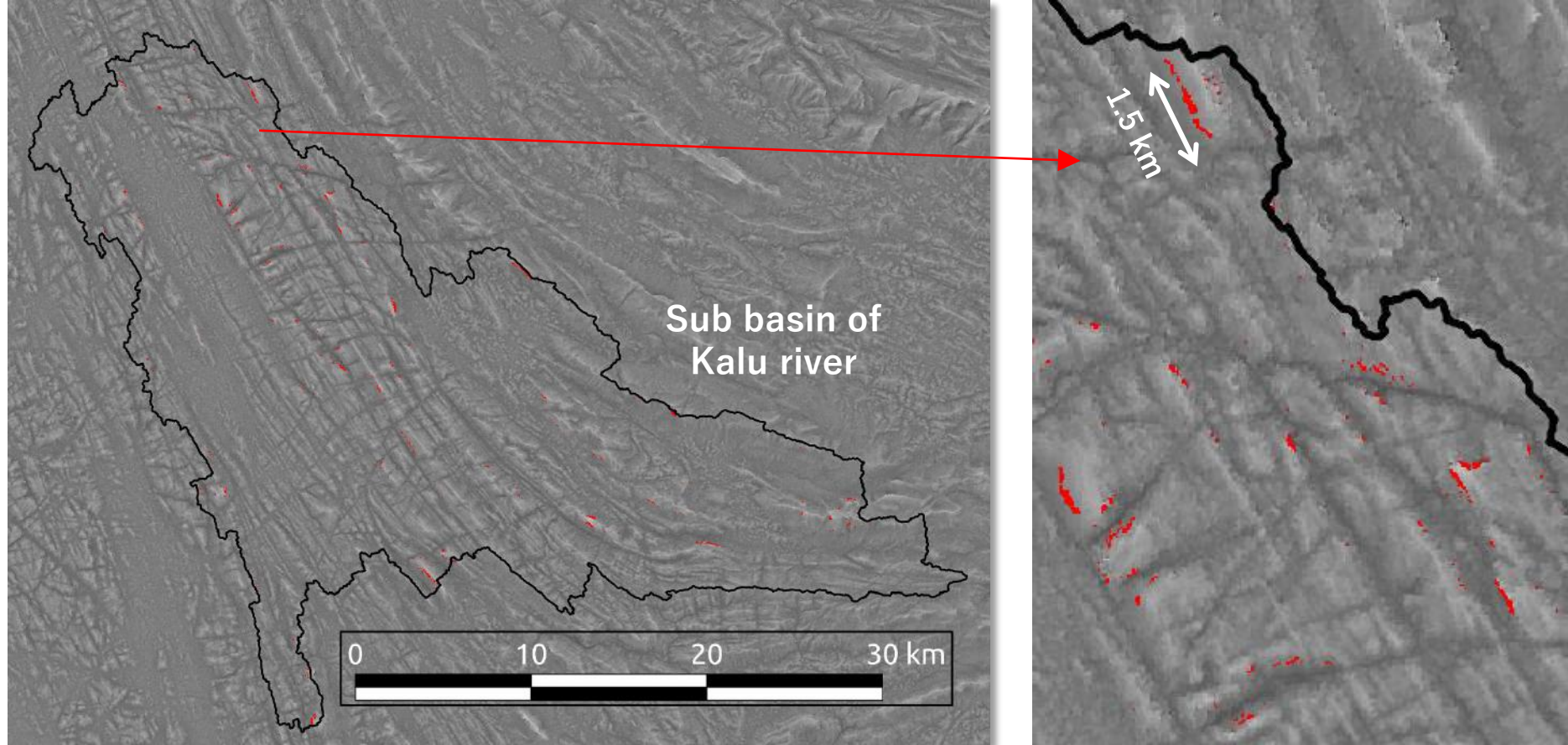
Landslide occur when $\theta_c < \theta$

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

σ : mass density of soil particles ρ : mass density of water c_* : sediment concentration

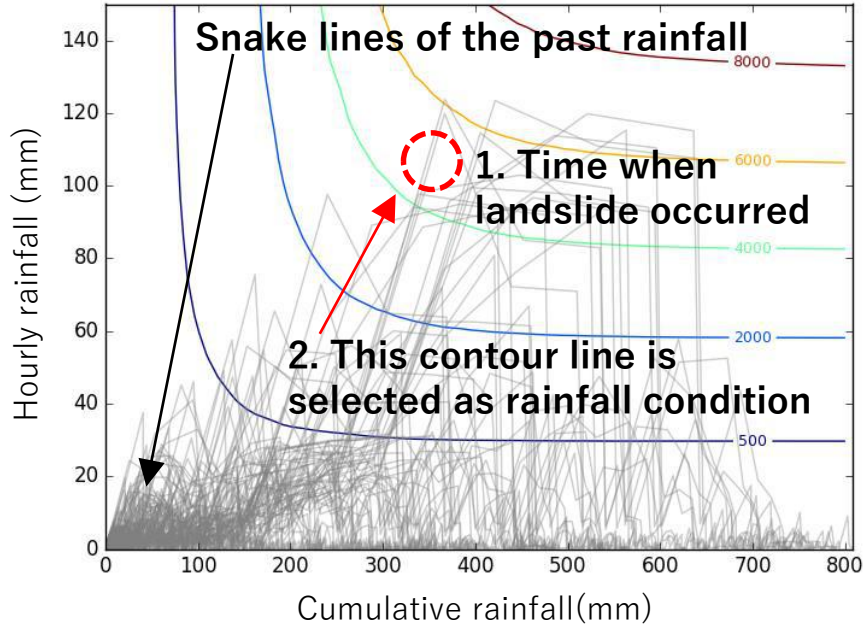
c : cohesion ϕ : interparticle friction angle

Simulation of shallow landslide occurrence

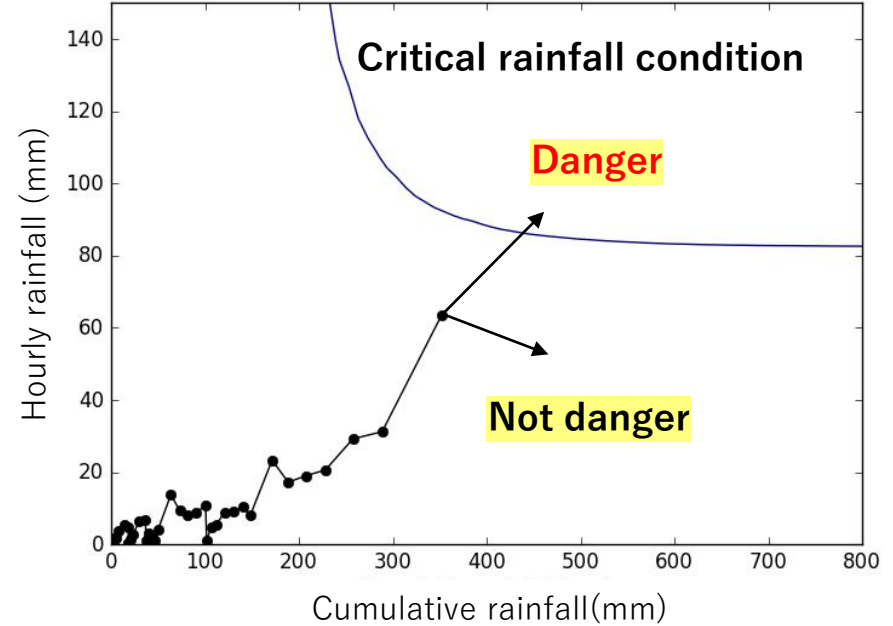


Spatial distribution of meshes estimated to occur landslides with 30m x 30m grid cells, GSMaP and general parameters

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.

Present situation: Test operation for rainy season

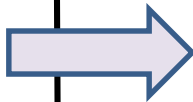


Mid-term framework



Collaboration with member organizations of disaster management platform

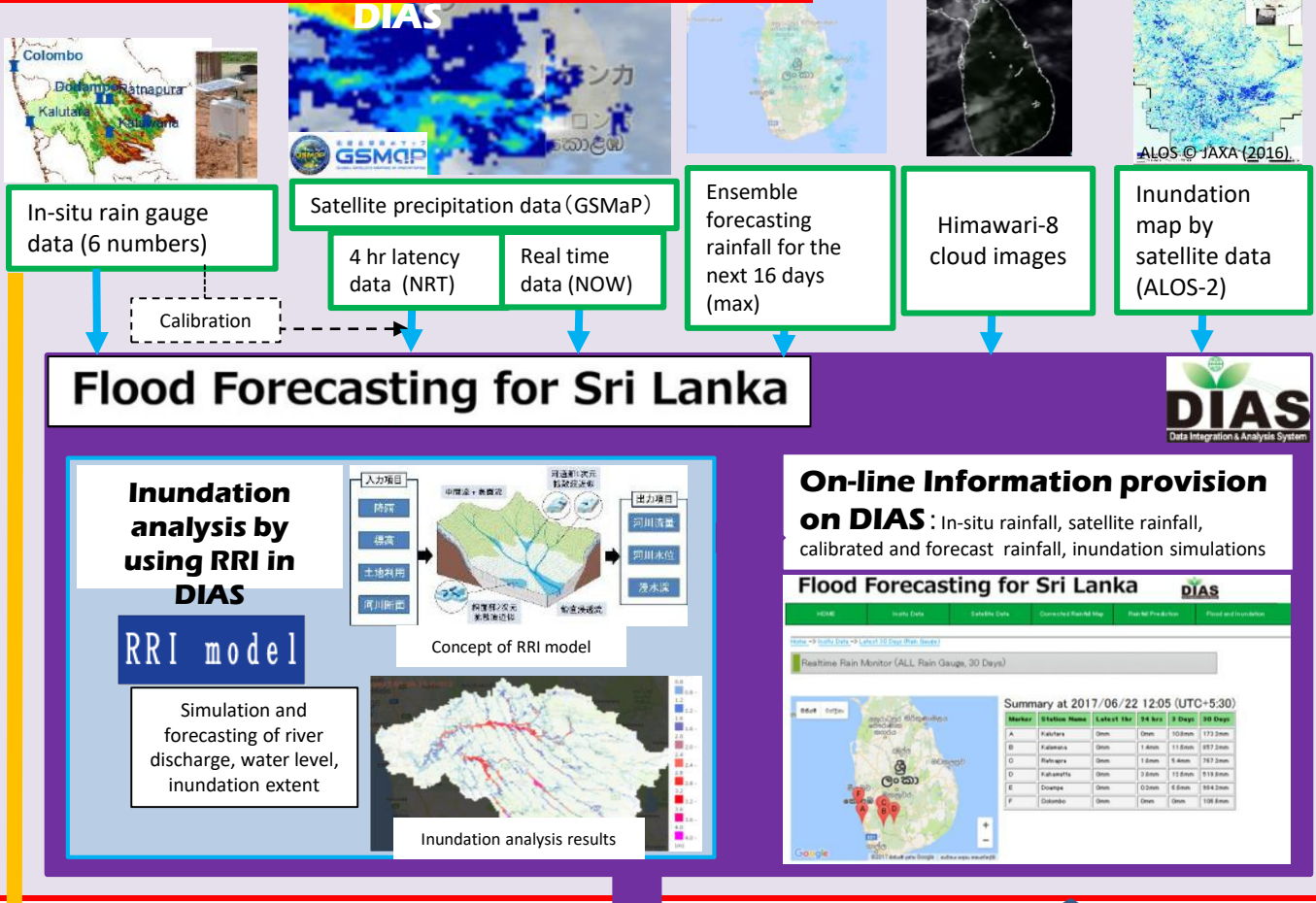
- Member organizations of national platform
- Meteorology Department
 - Irrigation Department
 - Disaster Management Center
 - Universities and others



Capacity building for operation

- Promotion of research
- Damage reduction through implementation

Implemented by EDITORIA and ICHARM on



In-situ rain gauge data (6 numbers)

DIAS
Satellite precipitation data (GSMaP)

Ensemble forecasting rainfall for the next 16 days (max)

Himawari-8 cloud images

Inundation map by satellite data (ALOS-2)

4 hr latency data (NRT) | Real time data (NOW)

Calibration

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