"Space capabilities for tackling extreme precipitation events"

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ICHARM
International Centre for Water
Hazard and Risk Management
under the auspices of UNESCO

Satellite Data For Integrated Water Resources & Disaster Managements

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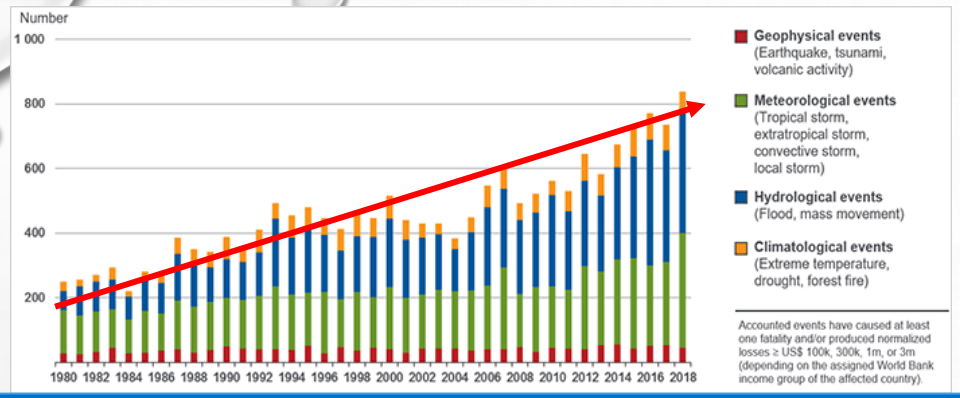
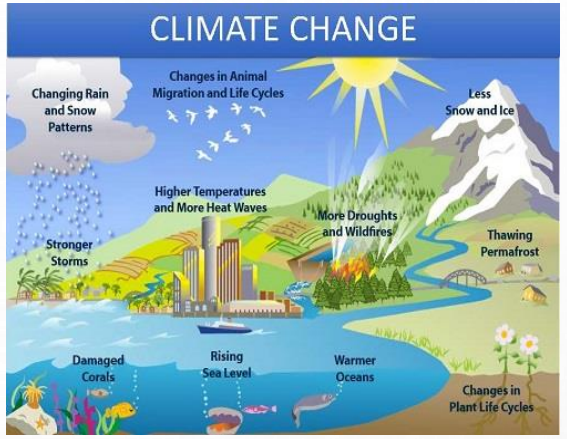
PUBLIC WORK RESEARCH INSTITUTE (PWRI)

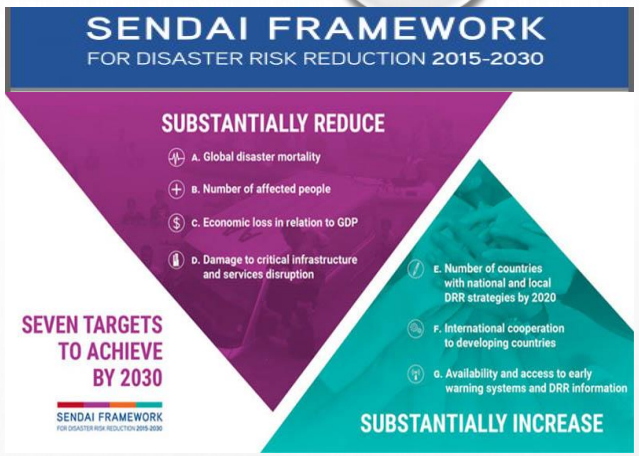
TSUKUBA, JAPAN

Importance of satellite data



Observed records show that water related disasters (i.e. floods and droughts) are on an increasing trend, particularly the lower-middle-income countries becoming more vulnerable

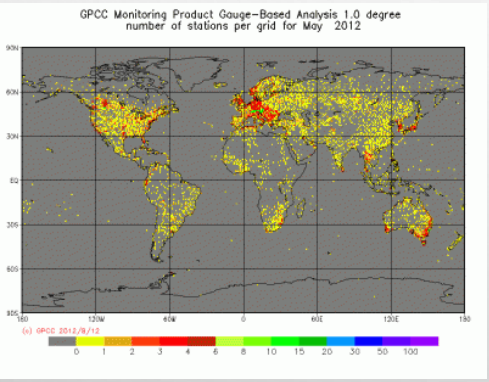




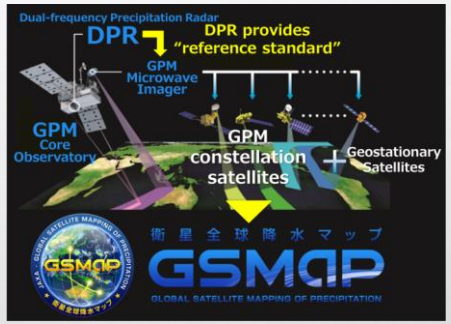
Climate change is sensed most directly through water, thus imposing threats on sustainable development. Sendai Framework for Disaster Risk Reduction was developed to guide DDR efforts.

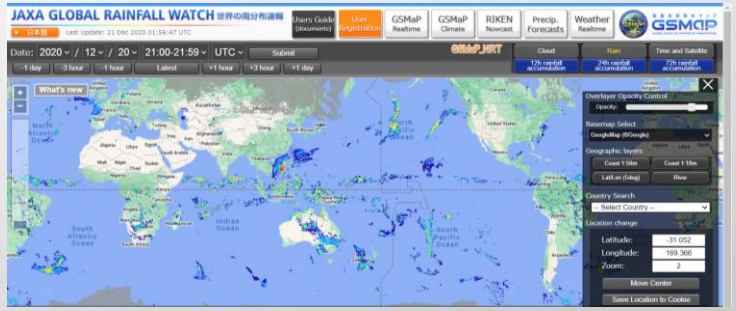
Conventional methods

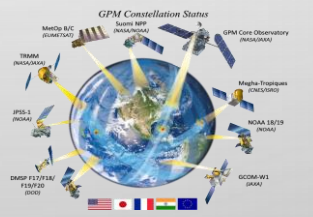
Limited observations

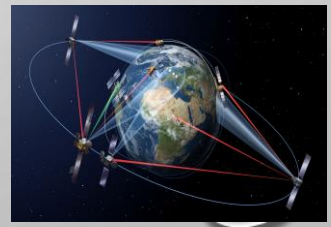


The most of the places have limited data to monitor and forecast the information on water thereby hampering the efforts for implementing DRR and sustainable development goals.





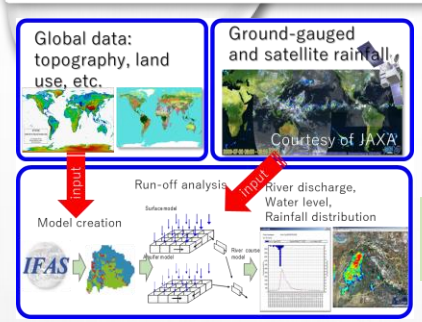




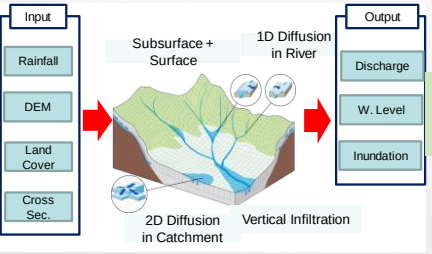
The exploitation of global satellite-based data is a promising and viable solution to develop an affordable and proactive IWRM plans and disaster early warning system.

Three Pillars of ICHARM Activities

The mission is to serve as the Global Centre of Excellence for Water Hazard and Risk Management

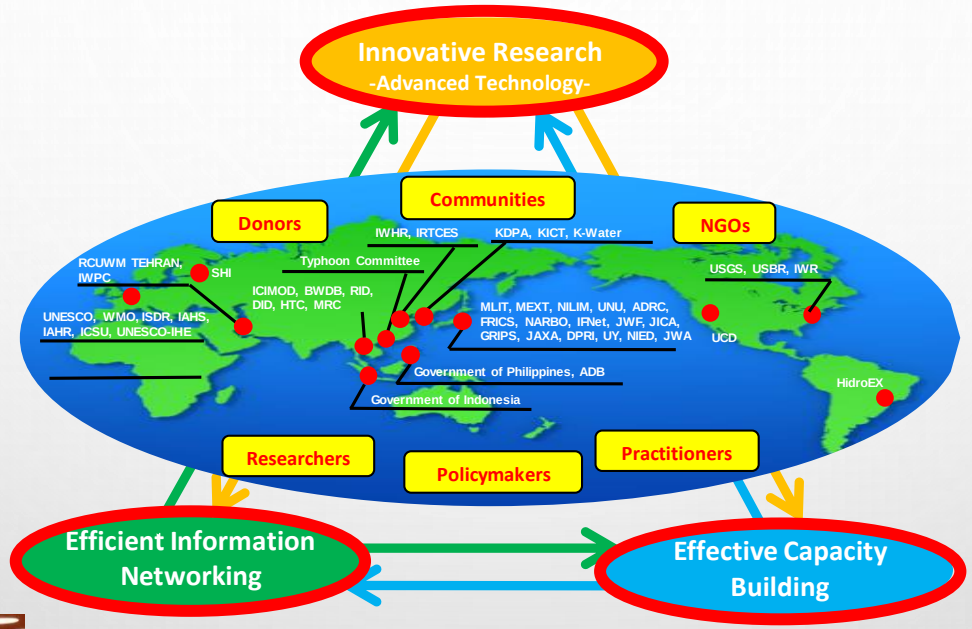


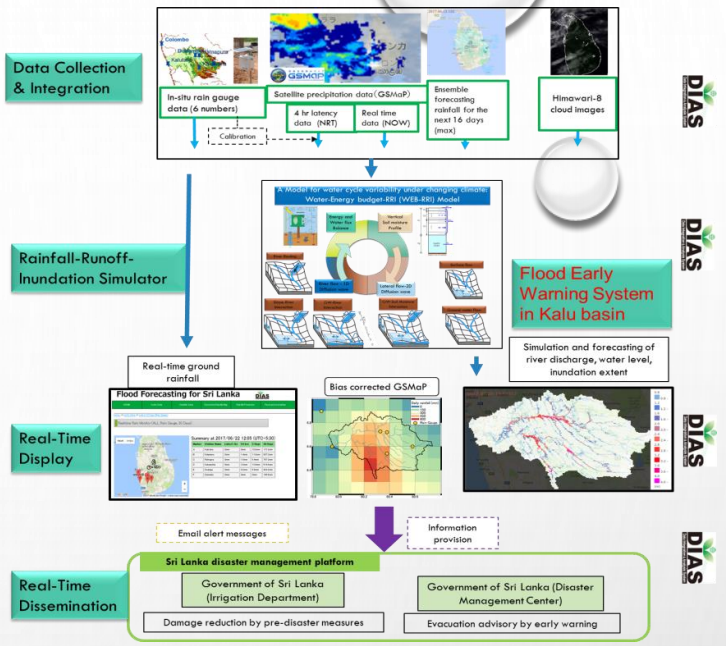
Integrated Flood Analysis System (IFAS)



Rainfall Runoff Inundation (RRI) model

Hydro-meteorological models & System for early warning & hazard mapping utilizing satellite data





System for early warning & hazard mapping

- UNESCO-IHP
- **International Flood Initiative (IFI)**
- UN agencies (WMO, UNISDR….)
- Typhoon Committee
- Governments, NGOs, Academia etc.

- Short-term training
- Master Course
- Ph.D. Course
- Local training & workshop (IFAS

A System for Integrated Water Resources and Disaster Management

Rain gauge

- Quantitative
- expensive

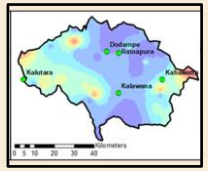
+

GSMaP data

Reliable distribution
Qualitative amount

→

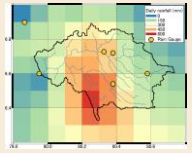
Min. required no. of gauges ?



Based on satellite distribution

→

Bias-corrected GSMaP

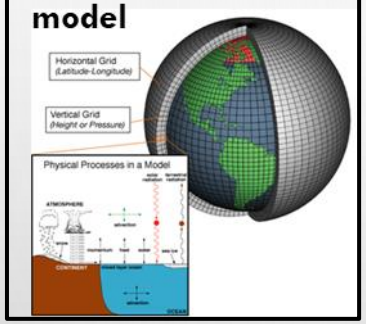


Real-time
NRT

Reliable distribution
Qualitative amount

↓

Weather & climate model



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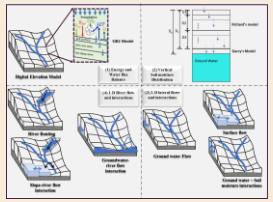
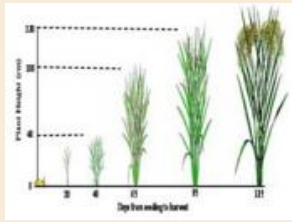
Flow Simulator

IFAS
RRI
WEB-RRI



+

Crop Simulator

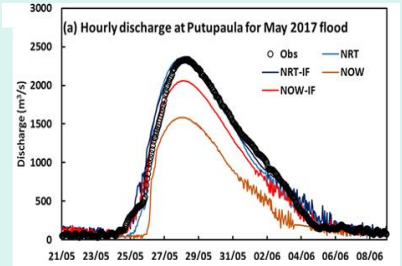


SIMRIW
Dynamic veg.

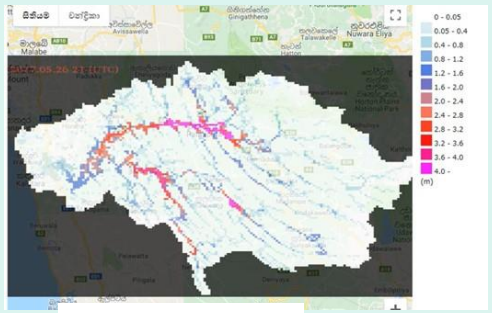
←

↓

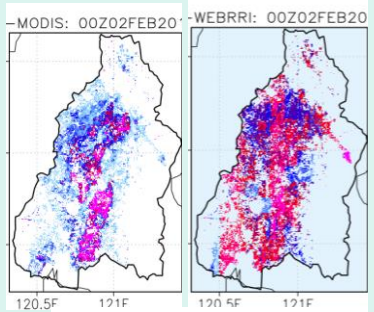
Monitoring, Forecasting, projections



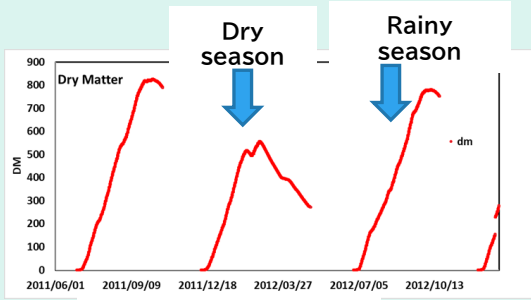
Discharge



Inundation



Leaf-Area-Index



Dry matter

↓

Socio-economic Benefits

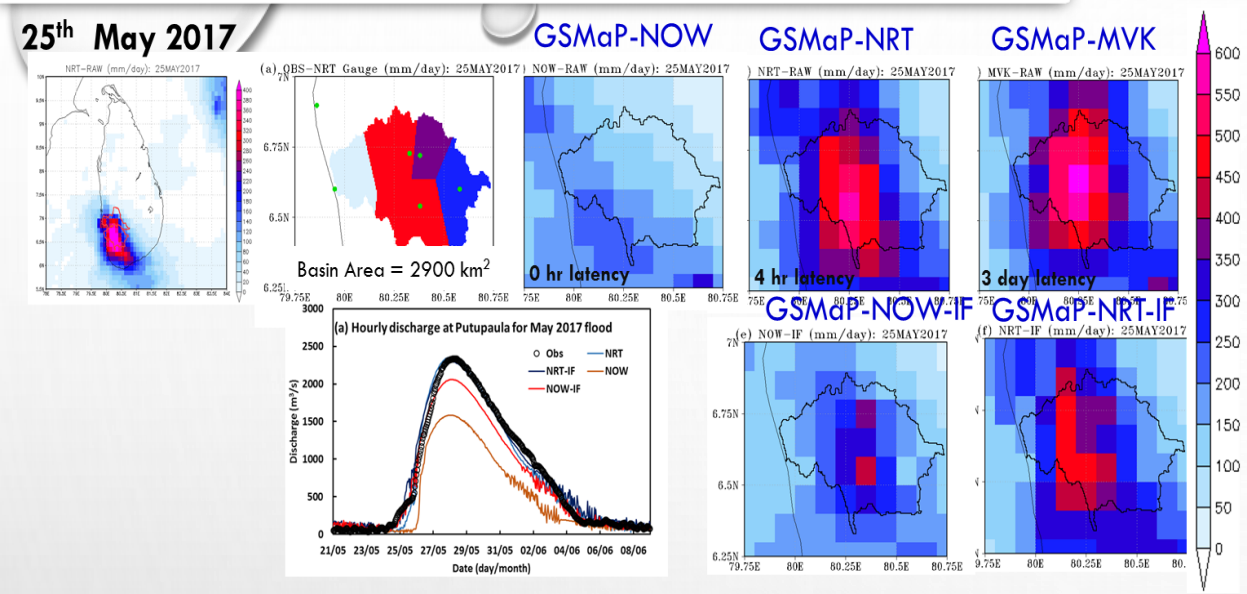
Hazard maps, Disaster Early warning, Assessment of Risk and Damages

Review of irrigation practices, adaptability measures, and impacts on economy

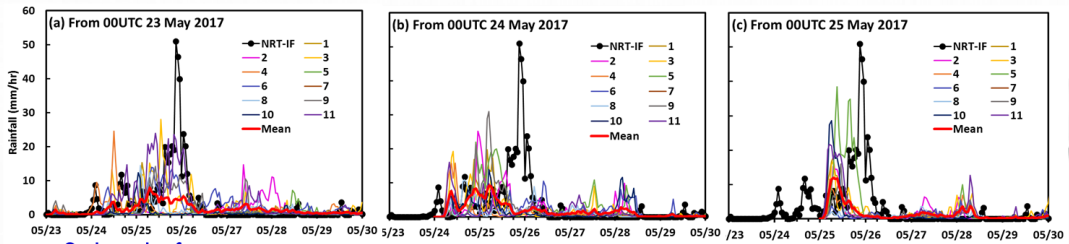
- Sendai Framework
- Paris agreement
- SDGs

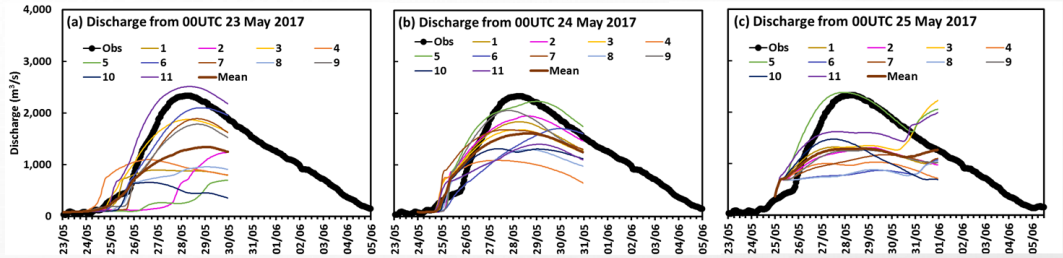
Flood Hazard Forecasting System in Sri Lanka

25th May 2017

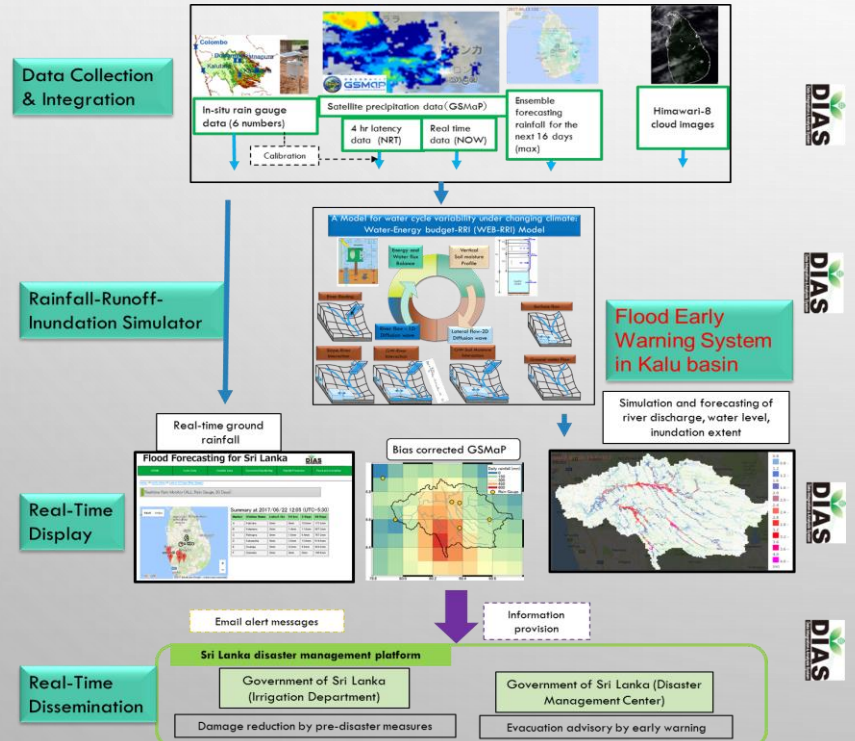


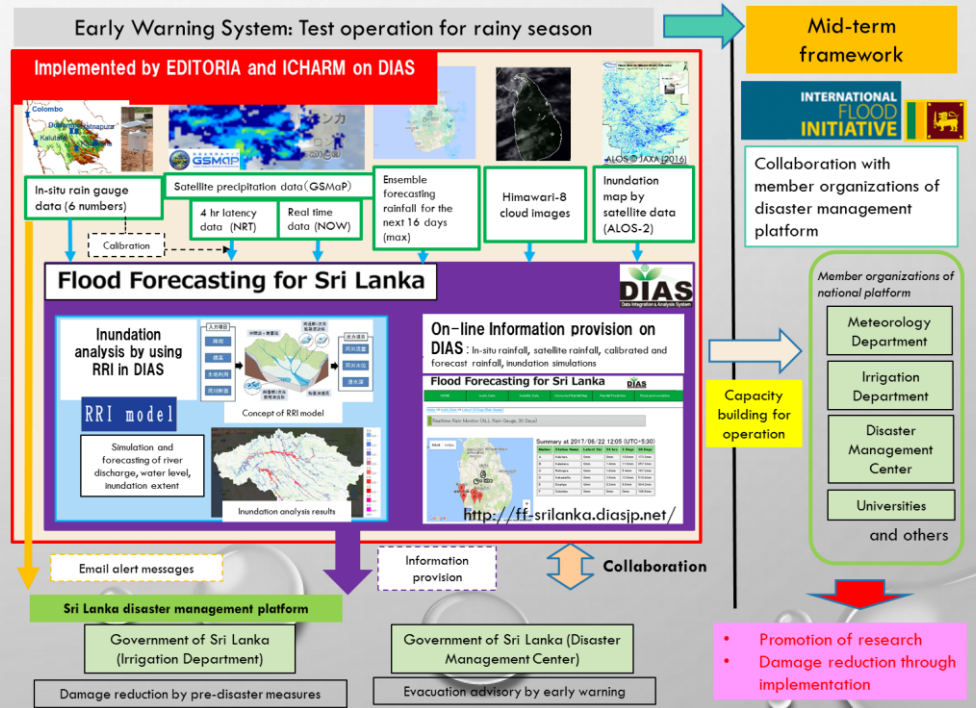
Forecasted Rainfall Vs GSMaP-NRT-IF





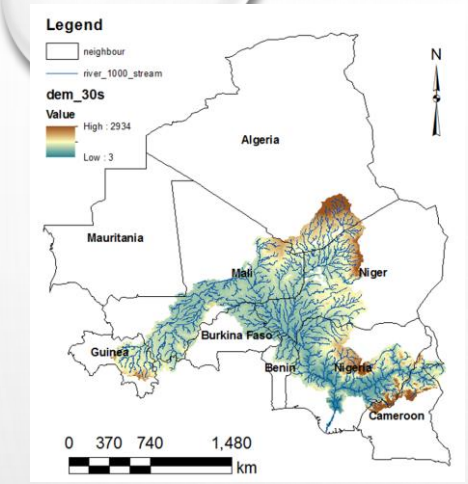
Integrated Flood Information System (IFIS)



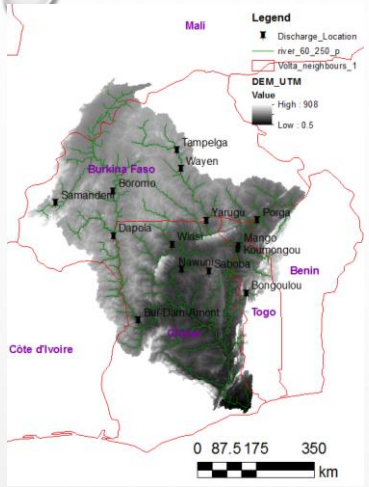


http://ff-srilanka.diasjp.net/

Flood Hazard Monitoring System in Niger and Volta River Basin in West-Africa

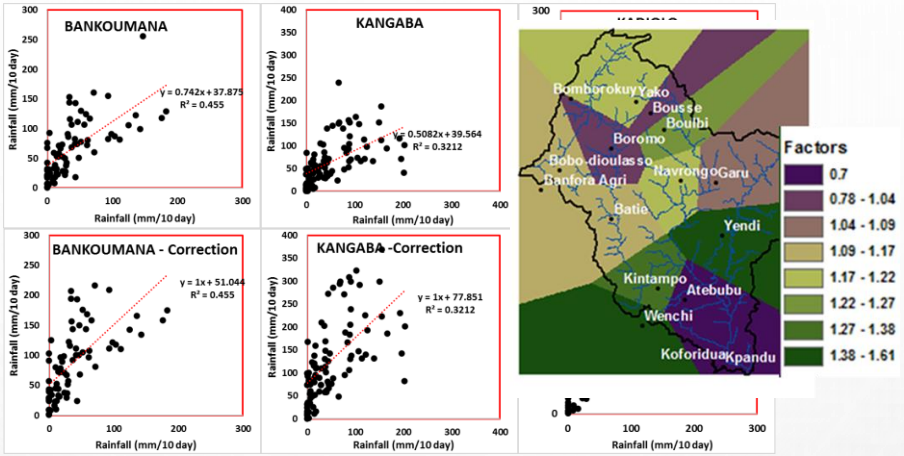


Catchment: 2.2 Million km²

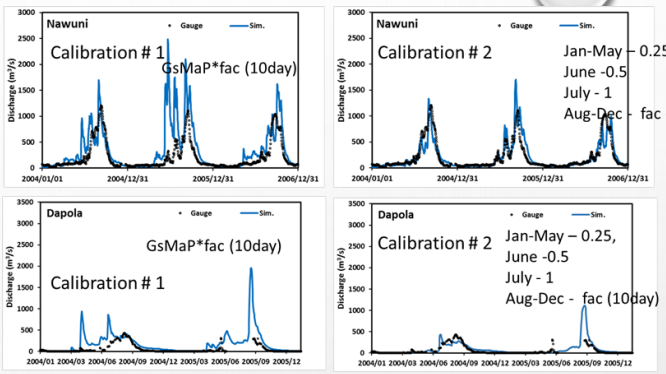


Catchment: 0.4Million km²

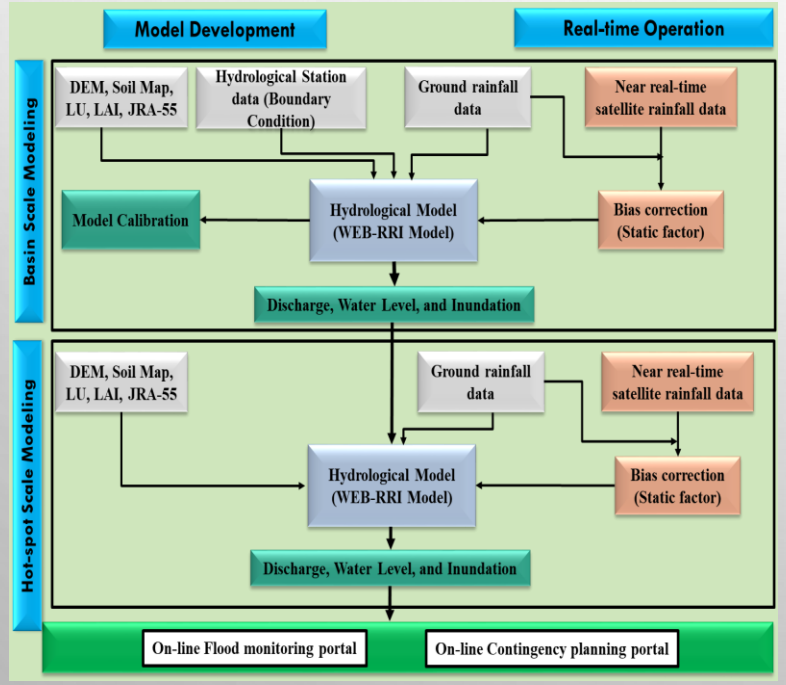
Gauge Vs NRT



Nawuni & Dapola gauging point

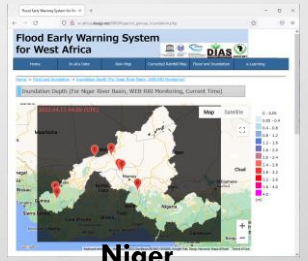


Integrated Flood Information System (IFIS)



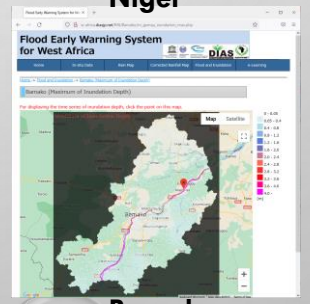
Realtime GSMaP

Inundation Monitoring

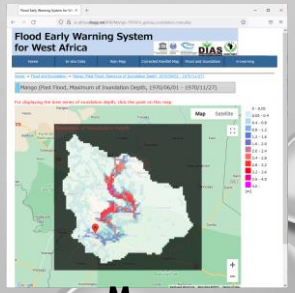


Niger

Volta



Bamako

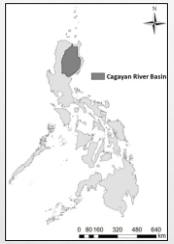


Mango

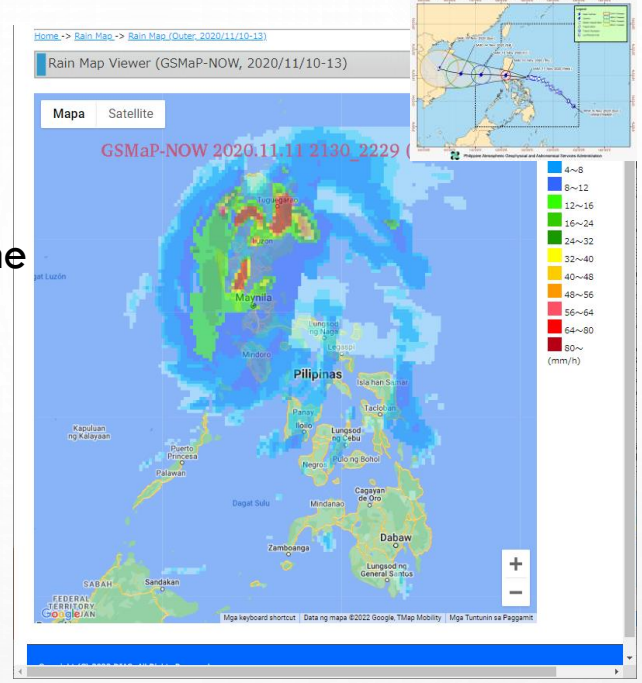
http://w-africa.diasjp.net/rainmap/gsmap_current.php

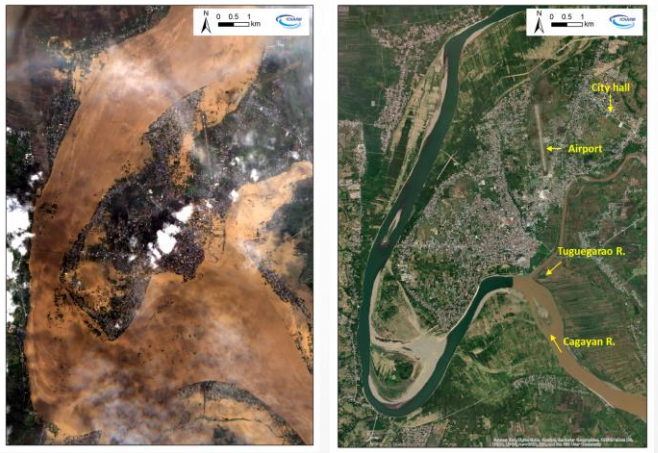
Philippines: Typhoon Vamco or Ulysses

- A powerful and deadly Category 4-equivalent typhoon the second-costliest Philippine typhoon of all time
- The typhoon brought heavy rains in Central Luzon, and the nearby provinces, including Metro Manila, the national capital (Cagayan, Isabella, Marikina flooded)



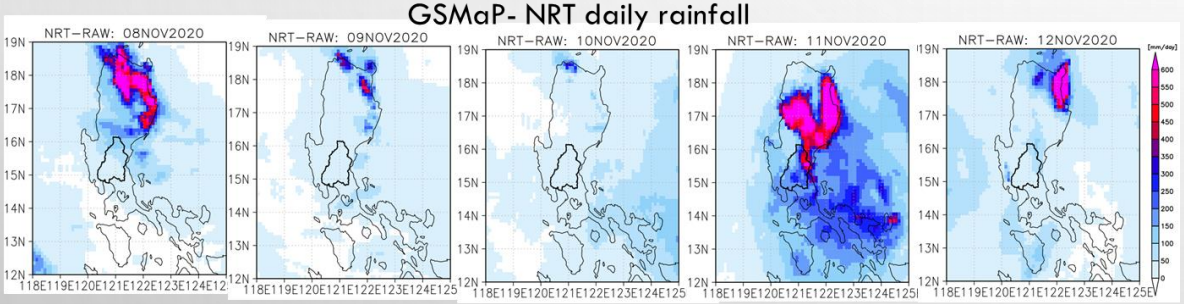
08/11 - 18/11/2020





Copernicus Sentinel Data 2020: Sentinel-2 (13/Nov/2020)

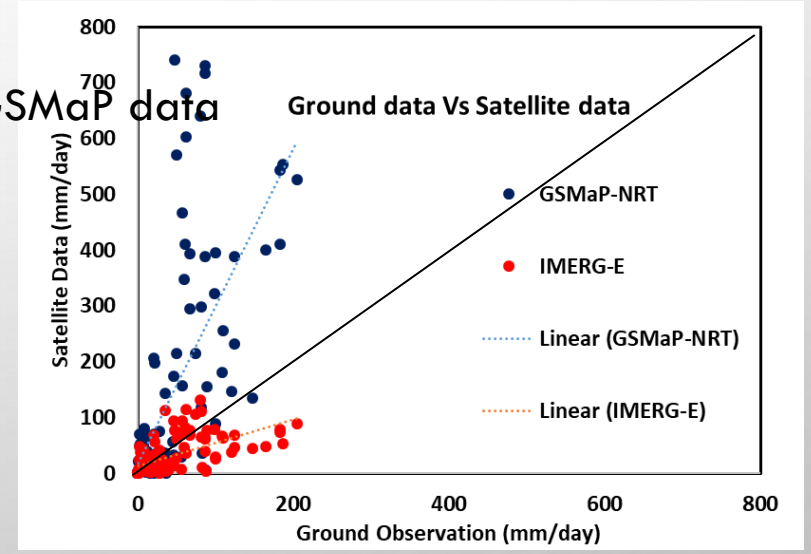
GSMaP- NRT daily rainfall



IMERG-EARLY daily rainfall

08/11 - 18/11/2020

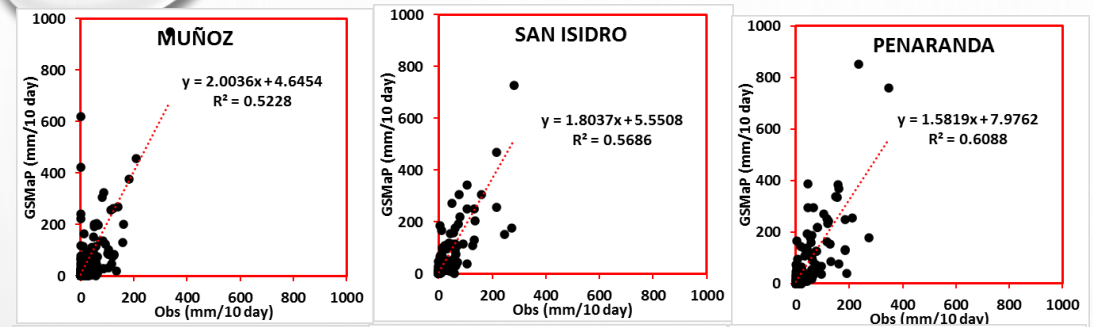
GSMaP data

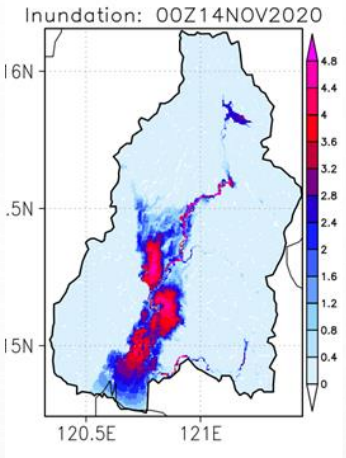


GSMaP	IMERGE
Corr. = 0.66 RMSE = 150.15 MBE = 95.32	Corr. = 0.6 RMSE = 26.39 MBE = -12.1

OBS Vs GSMAP (Pampanga 2009-2012)

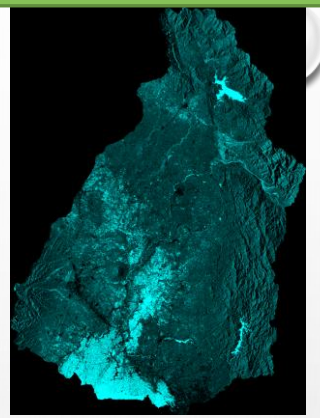
Statistical Bias Correction factor



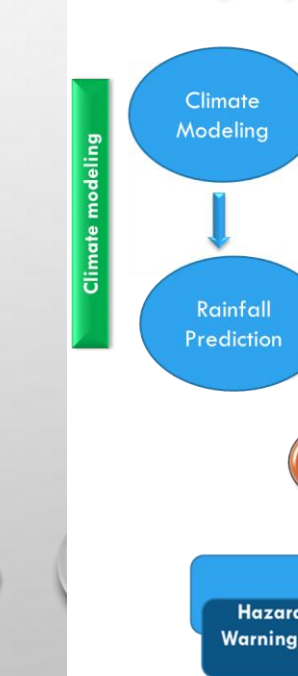


Sentinel-2 Optical image Nov. 13

Sentinel-1 SAR image on Nov-16,



Inundation map: Typhoon Ullysses

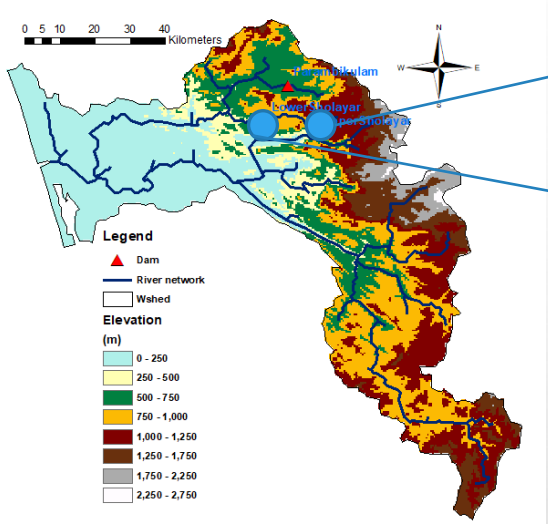


Hybrid Modeling Approach : IWRM under changing climat

Flood Hazard Monitoring System in Kerala/India

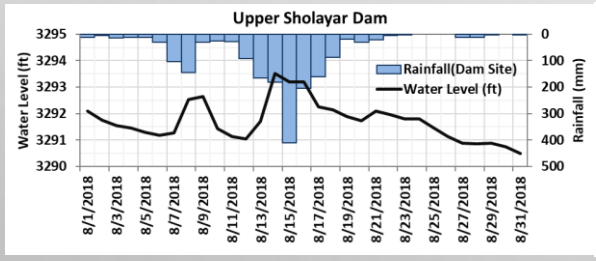
- On 16 August 2018, severe floods affected Kerala
- Over 483 people died, and 15 are missing.
- About a million people were evacuated

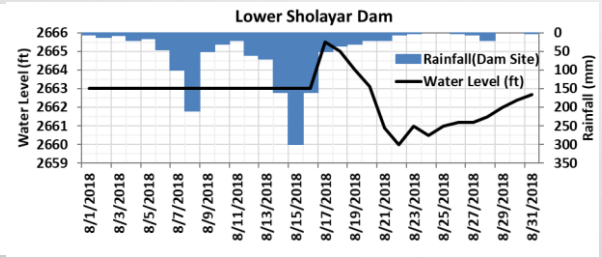
Model Domain: Periyar-Chalakudy River Basin

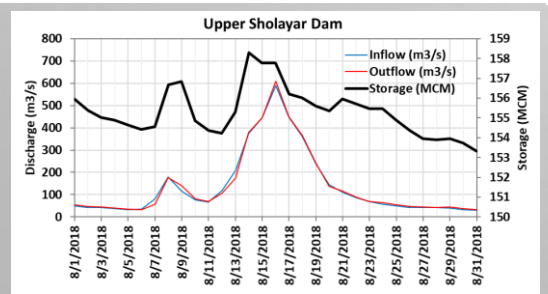


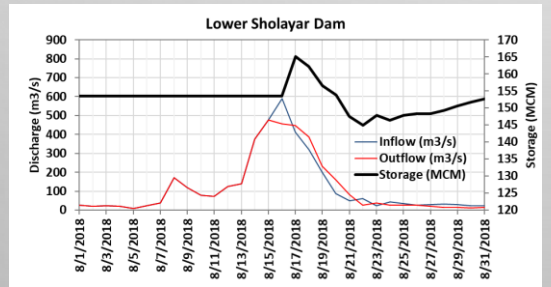
Upper Sholayar dam

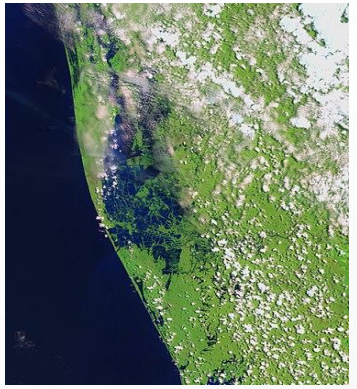
Lower Sholayar dam





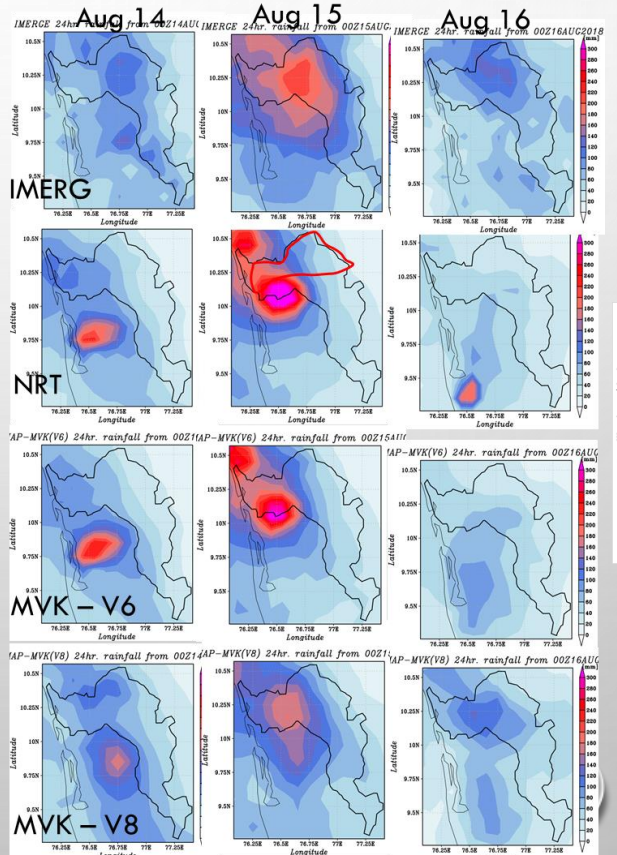




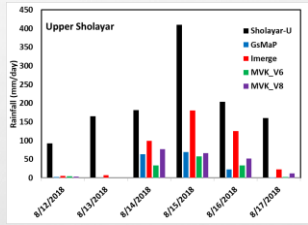


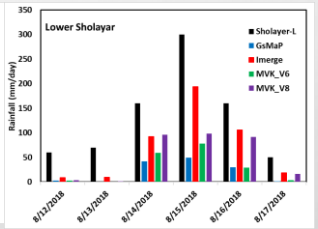
Wikipedia

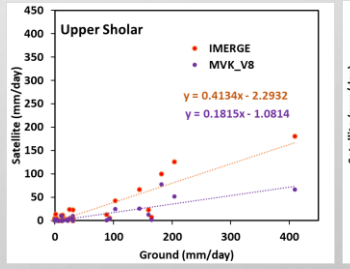
SATELLITE RAINFALL PRODUCTS:

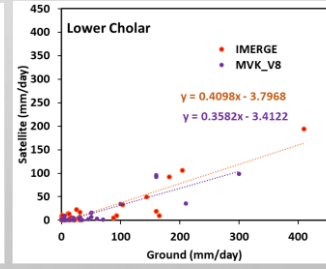


GSMAP VS GAUGE







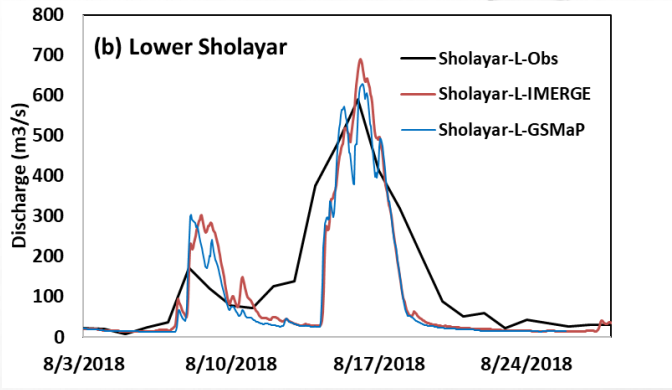


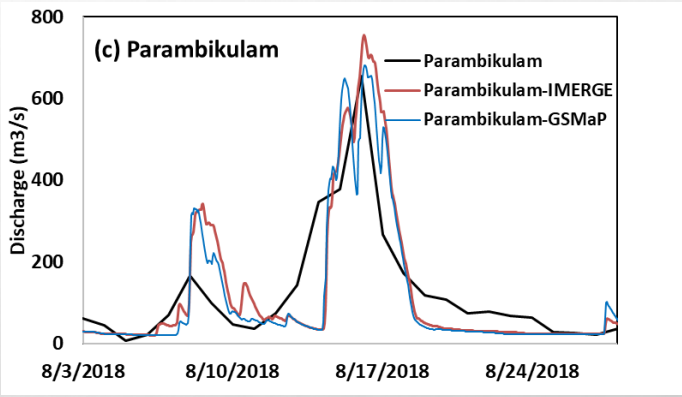
Corr. Factor	Upper	Lower
IMERGE	2.42	2.44
MVK	5.56	2.86

SCENARIOS: WATER BUDGET - AUG. 12 – AUG 22 2018

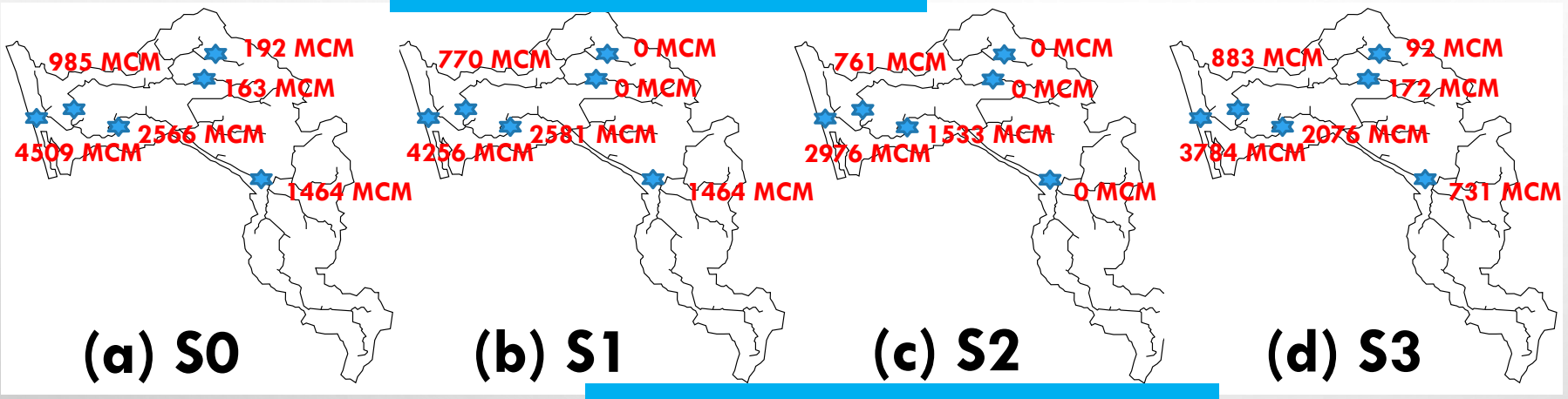
S0 – Default
S1 – No outflow from Chalakudy river
S2 – No outflow from the Chalakudy & Periyar
S3 – Release half & store half

Calibration

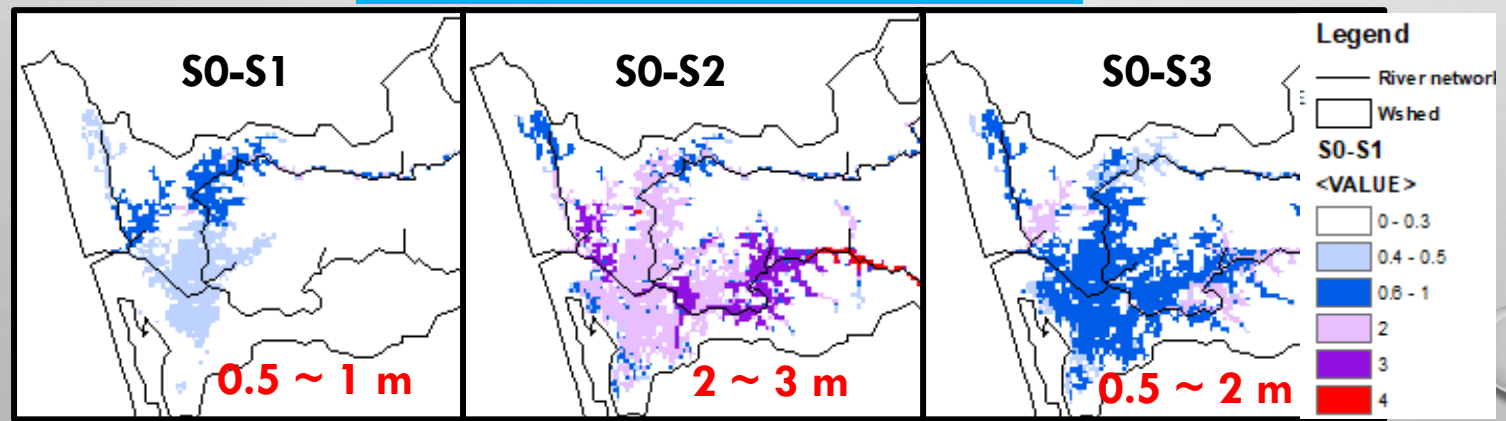




Discharge Volume



Flood Inundation Reduction



Operational Flood Monitoring System: Present Situation and Challenges to be addressed

To further improve the system

- Need to collect rainfall data at real time from several location to develop a dynamic correction factor on hourly or daily basin
- Need to collect dam release data and operation rule to in cooperate dam effect in flood forecast and estimation
- Need capacity building programs to train the trainers & experts

- Satellite rainfall amount and distributions need further improvements
- ACCP Mission - Aerosol and Cloud, Convection and Precipitation – Very important and timely
  - Understanding the process of clouds and rainfall can help to improve accuracy of rainfall estimates.

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Hazard and Risk Management
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Thank you for your kind attention !!!

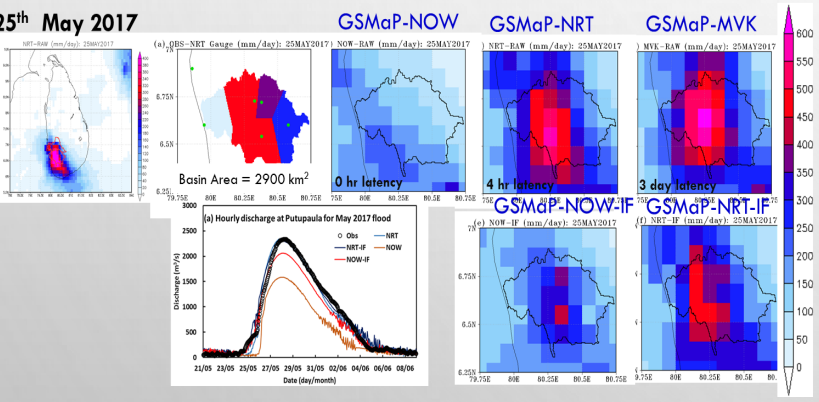
abdul@pwri.go.jp

Discussion

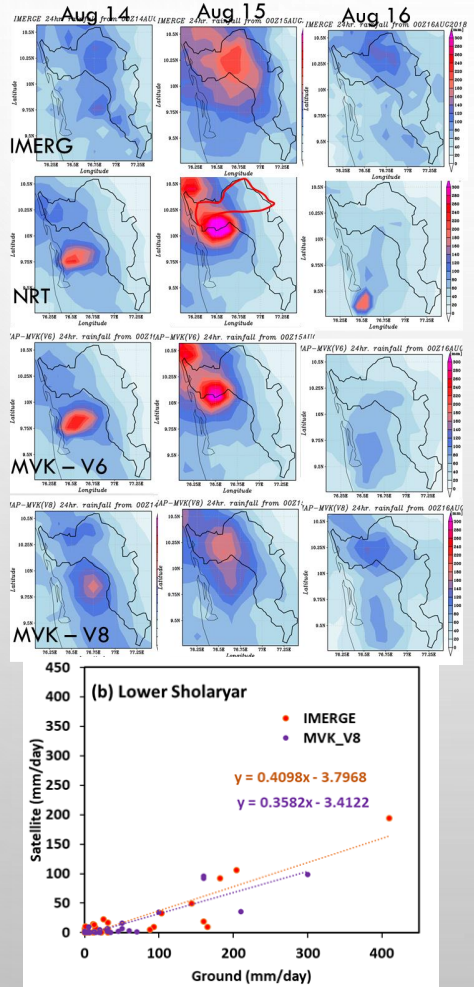
- Reliable and timely precipitation information is crucial for DRR activities and risk informed development
- Satellite precipitation estimation is very valuable and have the advantage of high spatial resolution and global coverage, but these estimates have bias in quantity → indirect measurements
- Remarkable progress was made in improving the quality and quantity of satellite estimates – Bias correction needs to be customized using real-time or near-real time ground data

SATELLITE RAINFALL PRODUCTS:

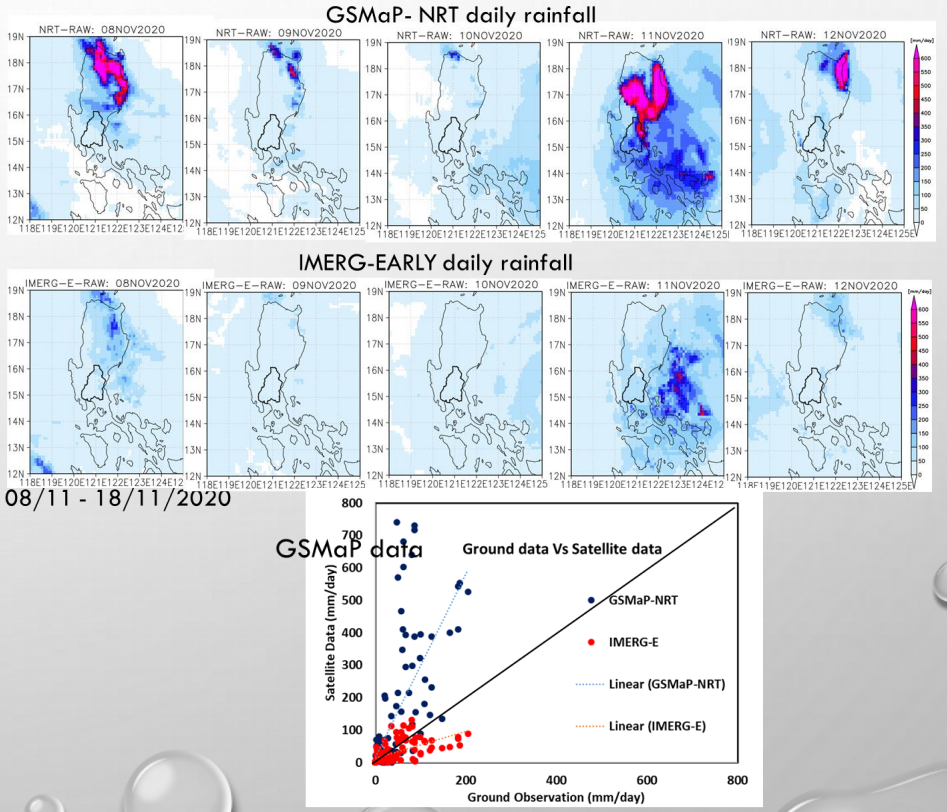
Sri Lanka



India



Philippines



Capacity Building & Training

❑ **Strengthen capacity & Enabling trust-based relationship**

MISSION STATEMENT:
The International Flood Initiative (IFI) promotes an integrated approach to flood management to take advantage of floods and use of flood plains while reducing the social, environmental and economic risks.

OVERALL OBJECTIVE:
To build the capacity necessary to understand and better respond to flood hazards, vulnerabilities and benefits.

In Close Collaboration with:

On-Site Training & Capacity building

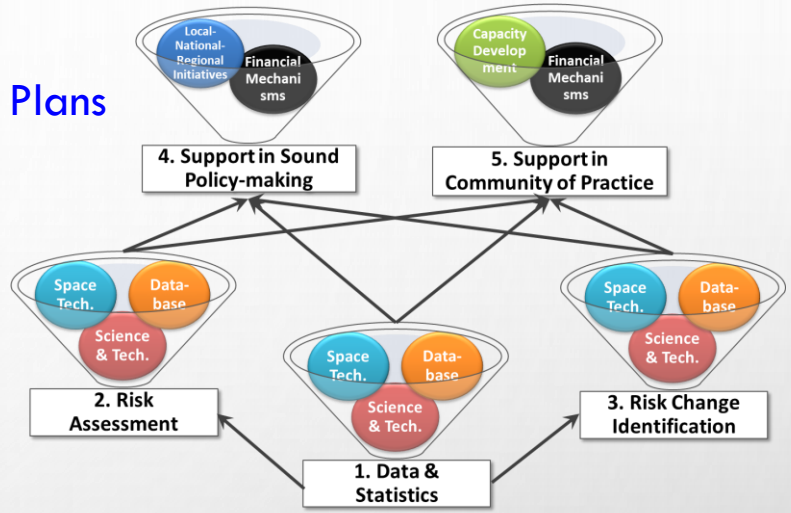
IFI Strategic Structure

Integrated Water Resources Management (IWRM)

Sendai Framework
SDGs
Paris Agreement

Integrated Flood Management (IFM)
- Minimizing social, environmental and economic risks
- Maximizing net benefits from the use of flood plains

IFI Implementation Plans



✓ **Lectures & Hands-on traning**
- **Hydrological modeling & application**
- **Satellite remote sensing & data processing**

E-Learning & Capacity building