Tonkin+Taylor

Coastal Inundation Forecasting System for Community Resilience (CIFDP-Bangladesh)

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Integrated Research on Disaster Risk (IRDR)

Japan Meteorological Agency (JMA), Japan
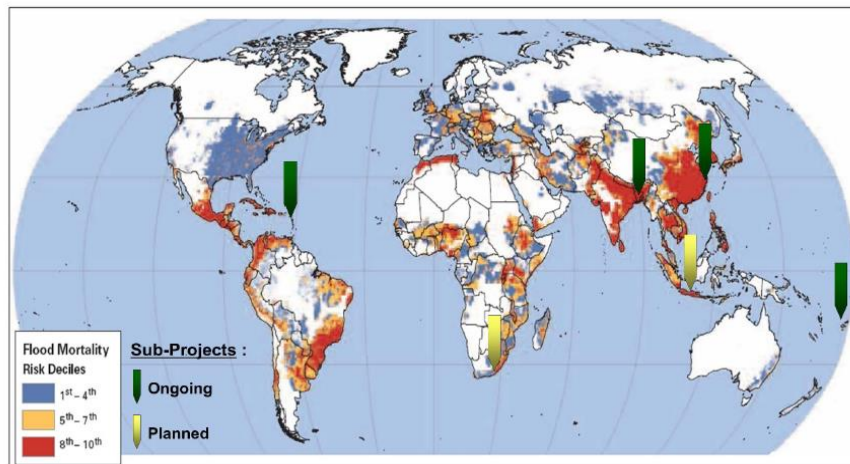
Bangladesh Meteorological Department (BMD), Bangladesh

2nd International Workshop on Waves, Storm Surges and Coastal Hazards

WMO Coastal Inundation Forecast Demonstration Project (CIFDP)

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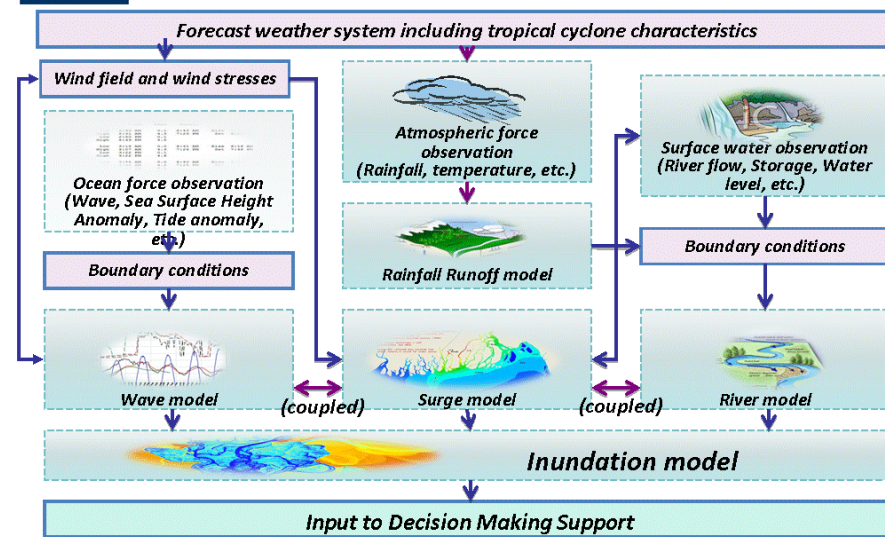## Applying available techniques for integrated operational forecasting/warning

- ✓ Assessment of the regional coastal inundation forecasting/warning **capacities**

- ✓ Identify **gaps**

- ✓ Provide an **overview on the technical aspects** for definition

CIFDP: Technical Development for Coastal Inundation Forecasting/Warning

Forecast weather system including tropical cyclone characteristics

Wind field and wind stresses

Ocean force observation (Wave, Sea Surface Height Anomaly, Tide anomaly, etc.)

Atmospheric force observation (Rainfall, temperature, etc.)

Surface water observation (River flow, Storage, Water level, etc.)

Boundary conditions

Rainfall Runoff model

Boundary conditions

Wave model — (coupled) — Surge model — (coupled) — River model

Inundation model

Input to Decision Making Support

Flood Mortality Risk Deciles
- 1st–4th
- 5th–7th
- 8th–10th

Sub-Projects:
- Ongoing
- Planned

Natural Disaster Hotspots: A Global Risk Analysis. World Bank, 2005
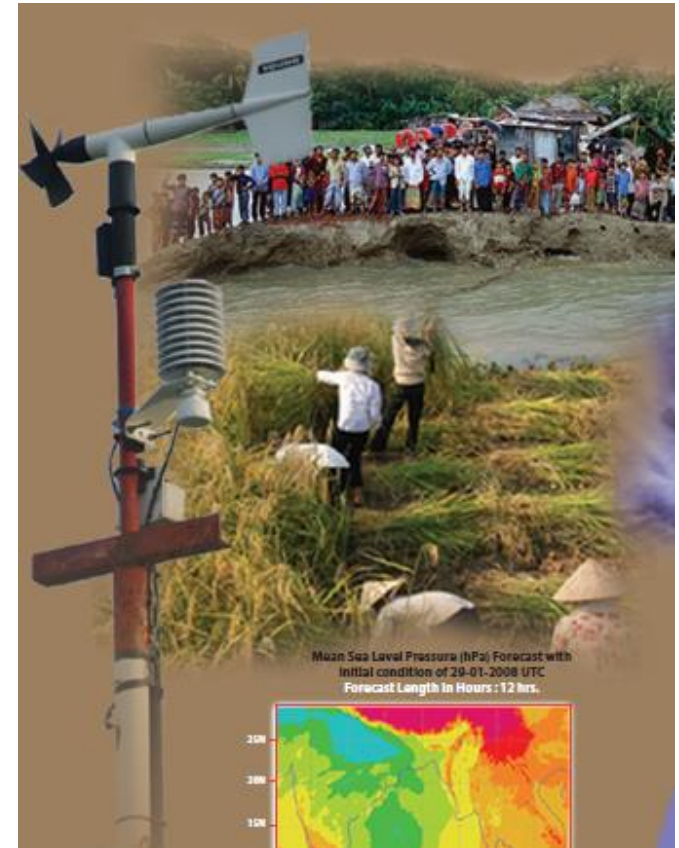
Sub-project：
Bangladesh, Caribbean(Dominica),
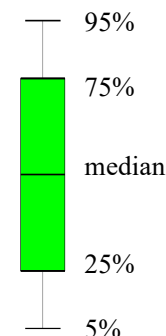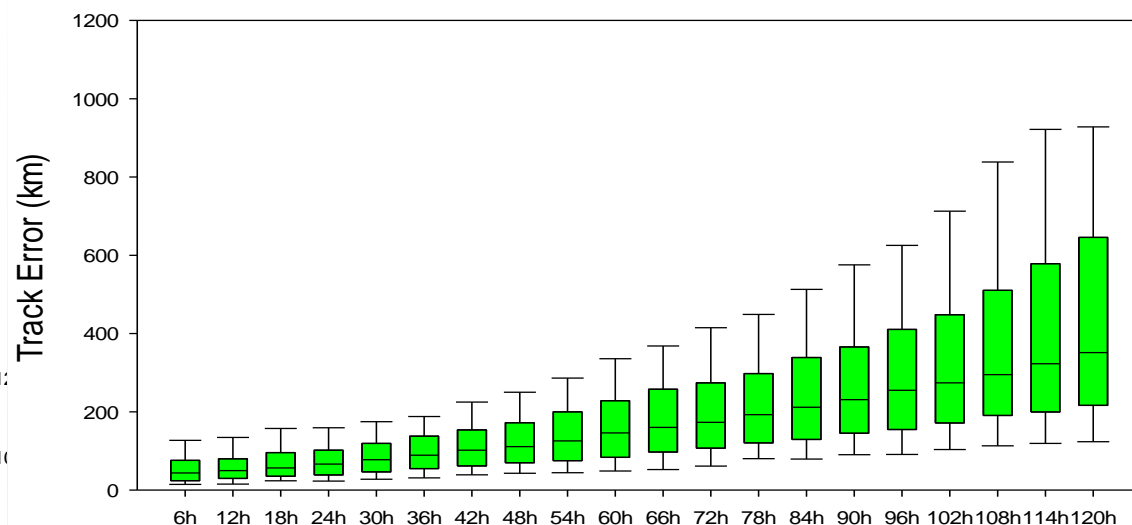Fiji, Indonesia, Shanghai(China)

TC - Information Needs

Warning/forecast information that:

- is localized
- timely
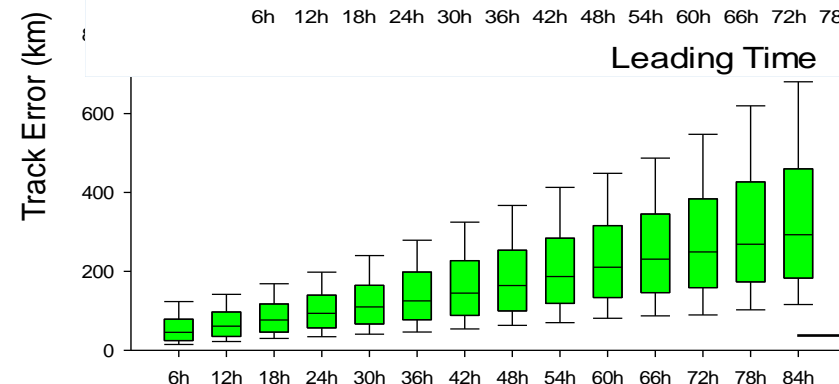- in easily understandable language
- meets end user needs

Uncertainties- Track Forecast

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ECMWF Track Error

Note: The bars at the top (bottom) of the lines signal the 95th (5th) percentile of track errors. The upper (lower) bounds of the quadrate boxes signal the 75th (25th) percentile of track errors. The bars inside the boxes are the median track errors.

JMA-GSM

	24h	48h	72h	96h	120h
ECMWF-IFS	80.8	137.5	215.9	322.6	478.2
JMA-GSM	109.0	194.6	315.3		

Challenges

- ✓ **Capacity to generate the localized and reliable operational science information**

- ✓ **Advances in generating hazard risk information have not been incorporated into operational forecast systems**

- ✓ **similarly the operational forecasts have not been integrated into decision making processes in order to reduce disaster risks.**

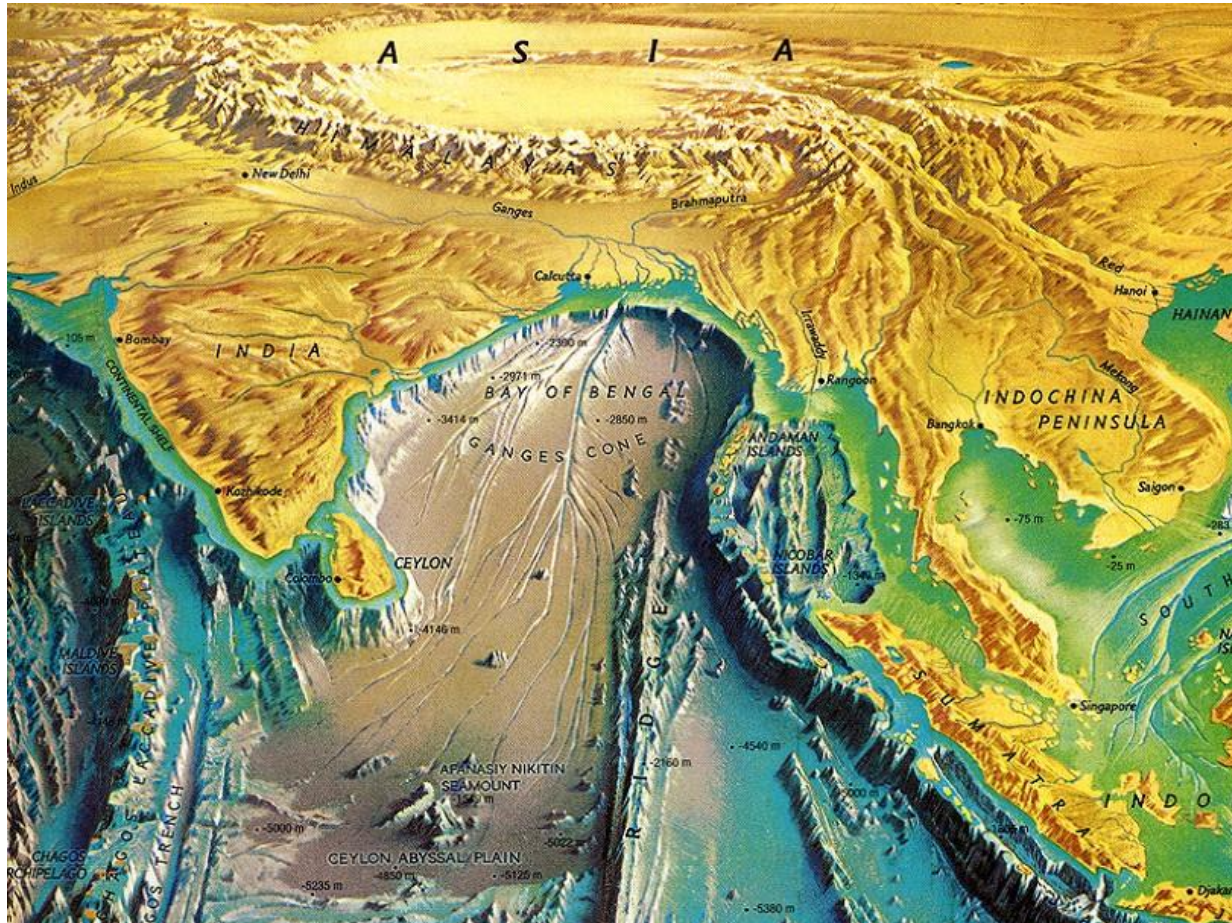- ✓ **Experience in communicating probabilistic scientific information for practical use by end users**

System Based Thinking- Total Warning Concept (Multi-Hazards Impact Based EWS)

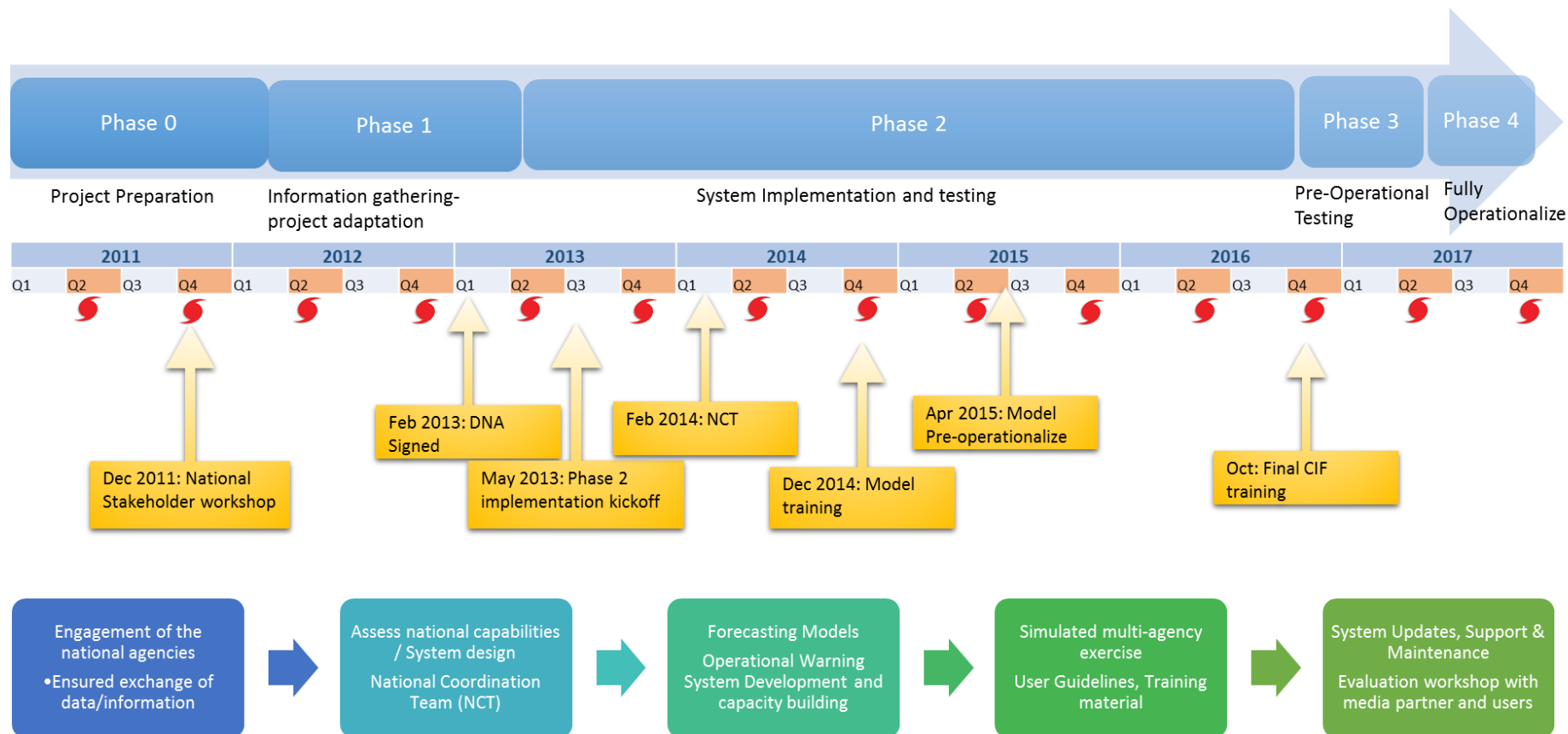Multi-Hazard Impact Based Early Warning System

Case: Bangladesh

CIFDP-B Timelines

Overview of Storm Surge Model

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- Storm Surge Model: 2 dimensional ocean model, vertically integrated. The governmental equations are usual momentum equation and continuity equation.

- Momentum Eq:

$$\begin{cases} \dfrac{\partial Du}{\partial t} + \dfrac{\partial Du^2}{\partial x} + \dfrac{\partial Duv}{\partial y} = -\dfrac{1}{\rho_w g} D \dfrac{\partial(\varsigma - \varsigma_0)}{\partial x} - \dfrac{1}{\rho_w}(\tau_{ax} - \tau_{bx}) + fDv \\ \dfrac{\partial Dv}{\partial t} + \dfrac{\partial Duv}{\partial x} + \dfrac{\partial Dv^2}{\partial y} = -\dfrac{1}{\rho_w g} D \dfrac{\partial(\varsigma - \varsigma_0)}{\partial y} - \dfrac{1}{\rho_w}(\tau_{ay} - \tau_{by}) - fDu \end{cases}$$
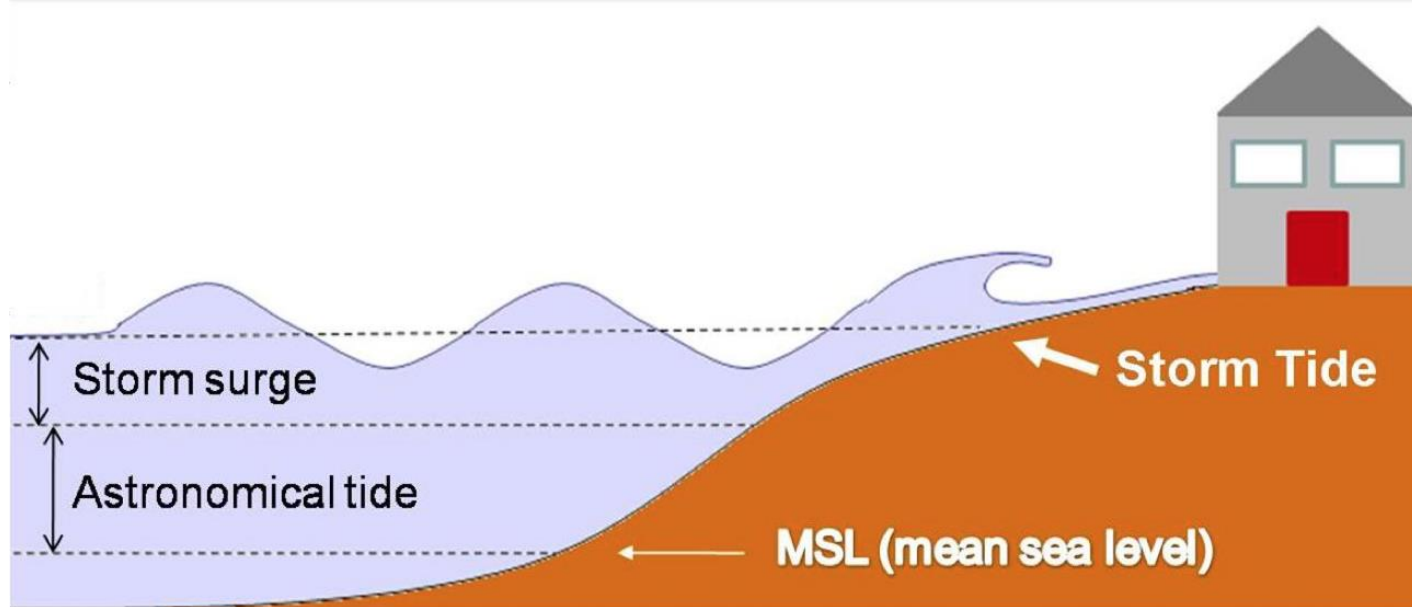
- Continuity Eq:

$$\dfrac{\partial \varsigma}{\partial t} + \dfrac{\partial Du}{\partial x} + \dfrac{\partial Dv}{\partial y} = 0$$

- Input from NWP:
  position of cyclone
  central pressure,
  radius of maximum wind and maximum wind speed
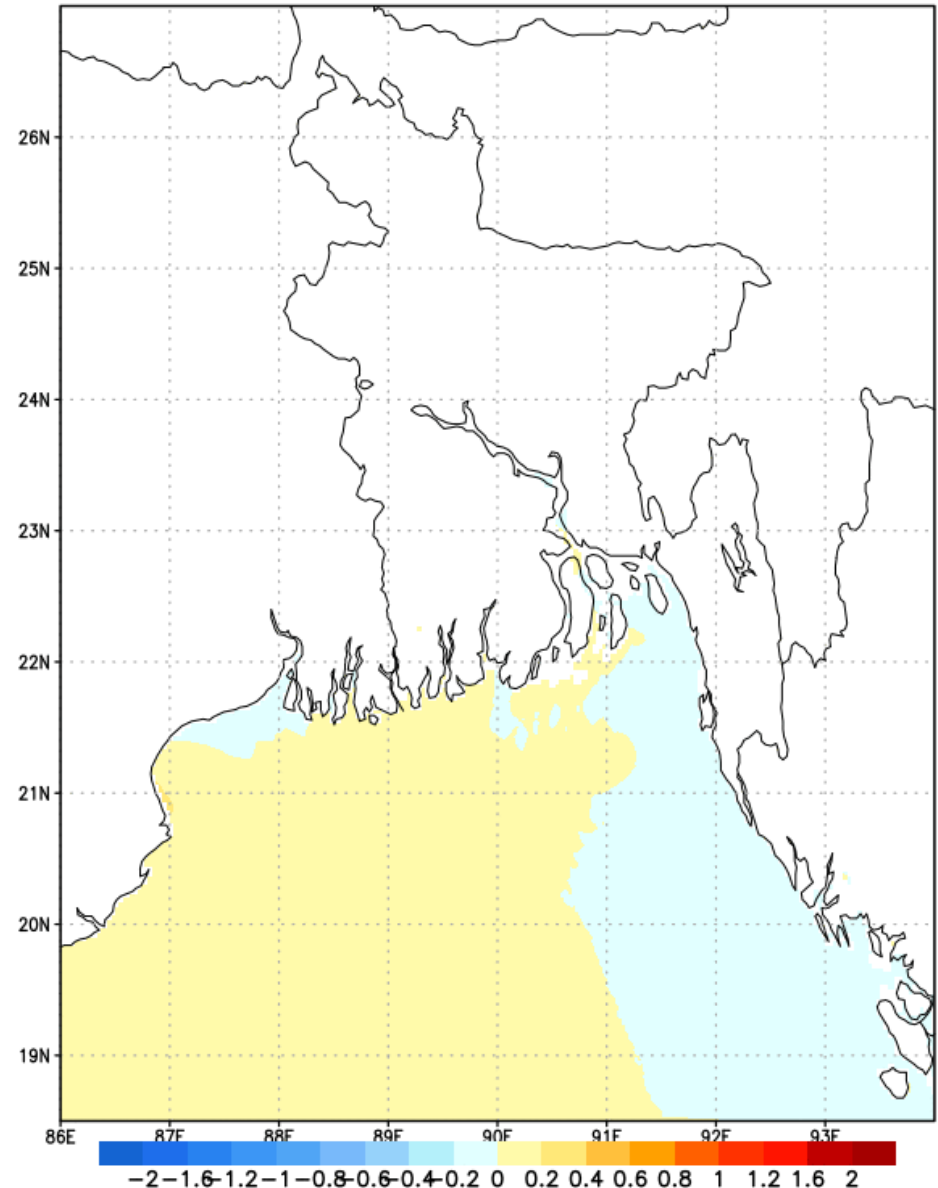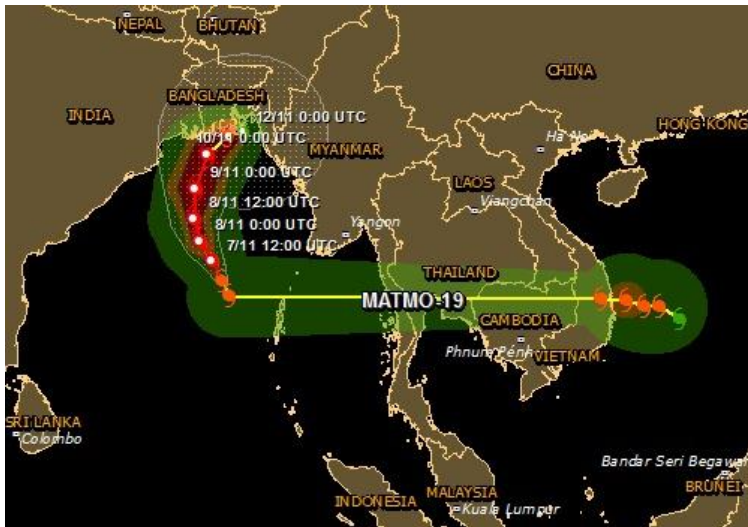
Develop Coastal Inundation Model

- LISFLOOD-FP inundation model has been integrated. This model forced with a storm surge model (JMA-MRI model) to generate inundation.
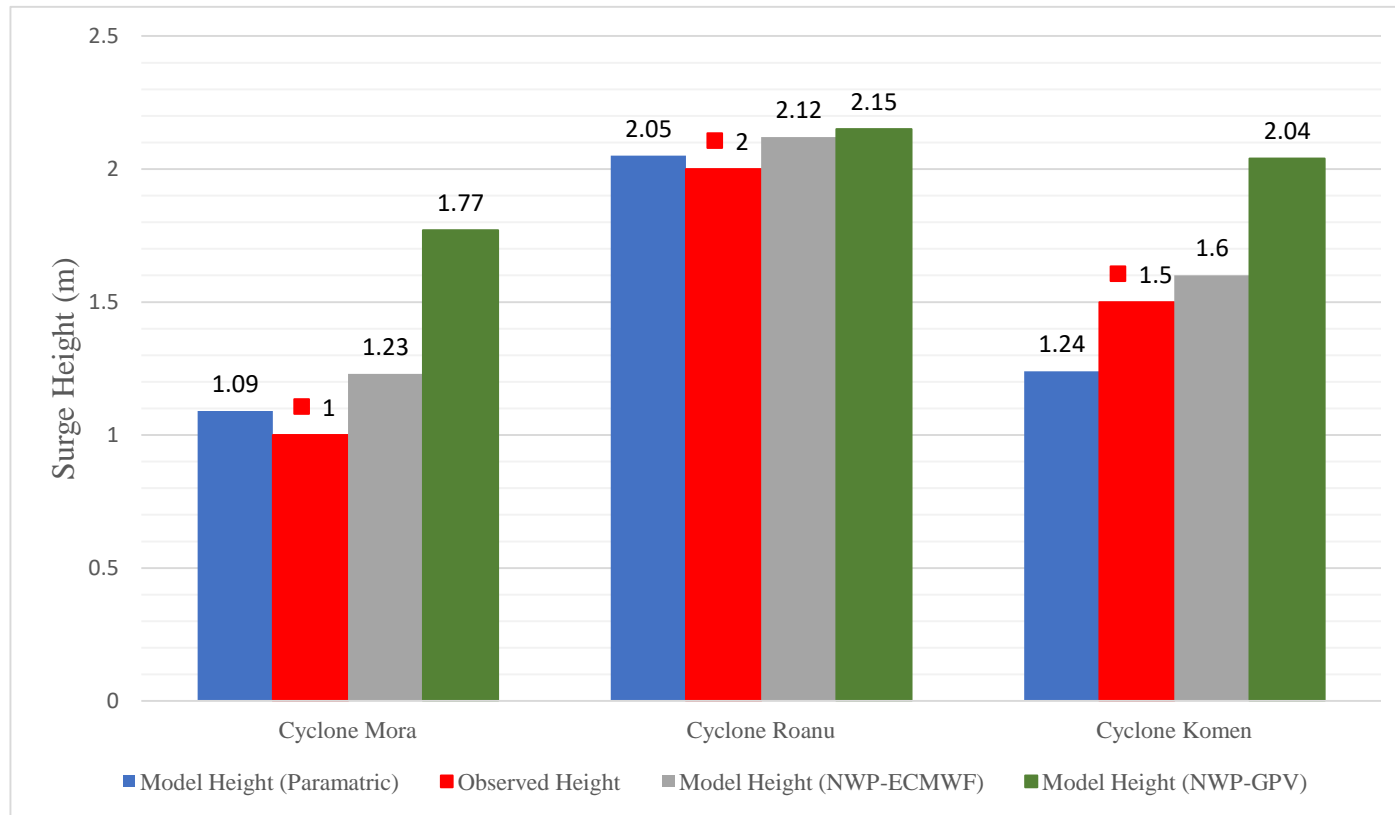
  - Model runs in FEWS Platform

TC BULBUL-19

Storm surges which are associated with severe tropical cyclones constitute the severe natural hazards.

Storm Surge Height Height(m),00Z of 08.11.19 +03H

CIFDP-B

- **System Enhancement**

  CIF model has been upgraded to incorporate multi-model ensembles using ECMWF data

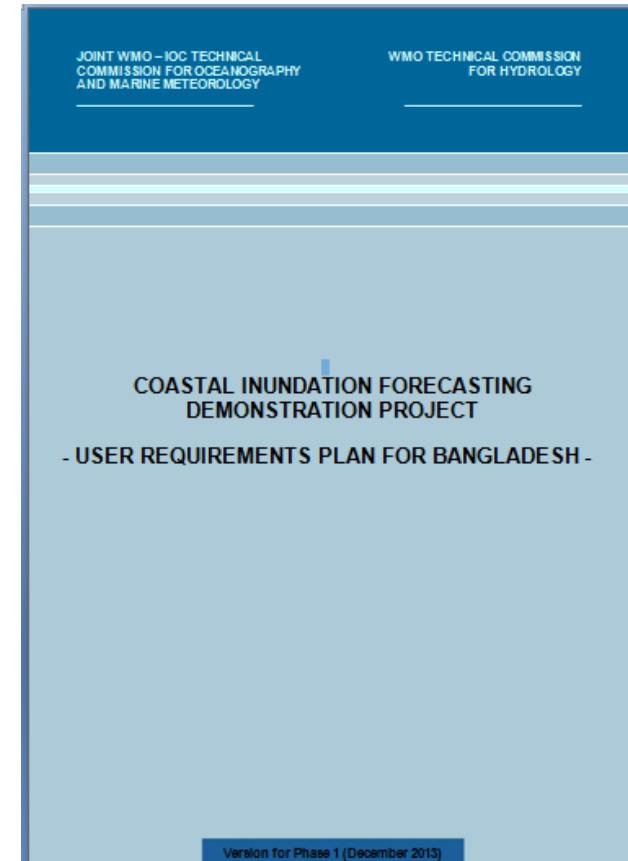# CIFDP-B

- **Training and Capacity Building**
- **Simulation Exercise**

CIFDP-B

- **User Requirements Plan**

 Existing procedures (regulations and practices) for dissemination of CIF.

  Users feedback (e.g. response to warnings) and need for future improvement.

 Enhance communications to end user community in the context of CIF.

JOINT WMO – IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY

WMO TECHNICAL COMMISSION FOR HYDROLOGY

COASTAL INUNDATION FORECASTING DEMONSTRATION PROJECT

- USER REQUIREMENTS PLAN FOR BANGLADESH -

Version for Phase 1 (December 2013)

CIFDP-B

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Simulation of Historical Storm Surge Events

- The CIF model computed maximum storm surge showed near to the landfall point and magnitude is very near to the reported storm surge height

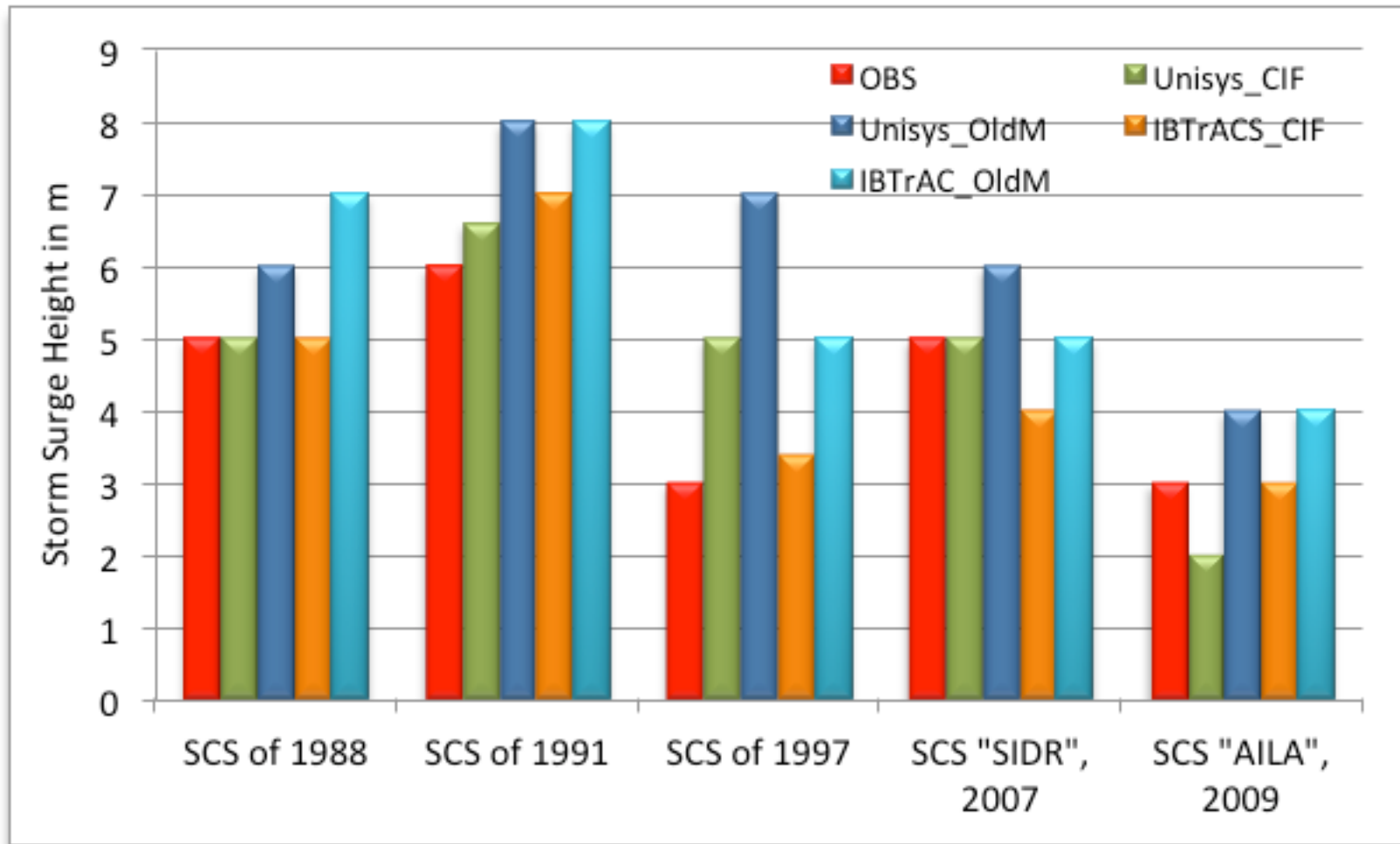- Old model computed storm surge height higher than observed
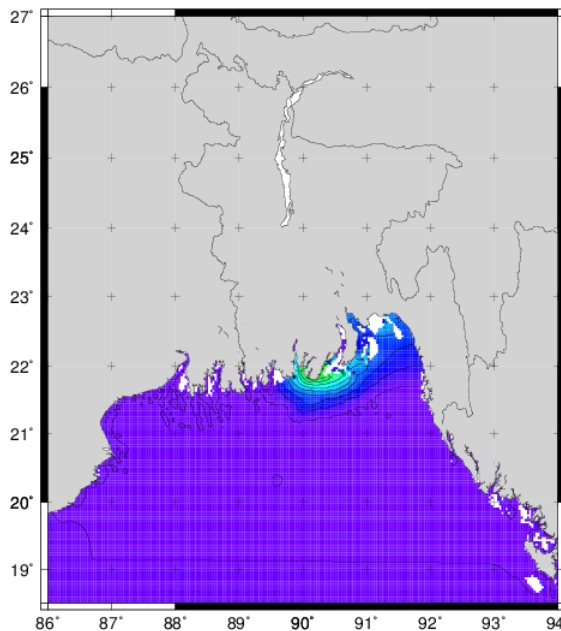
F Model (CIF) computed maximum storm surge (m) generated by SCS "SIDR" using Unisys data
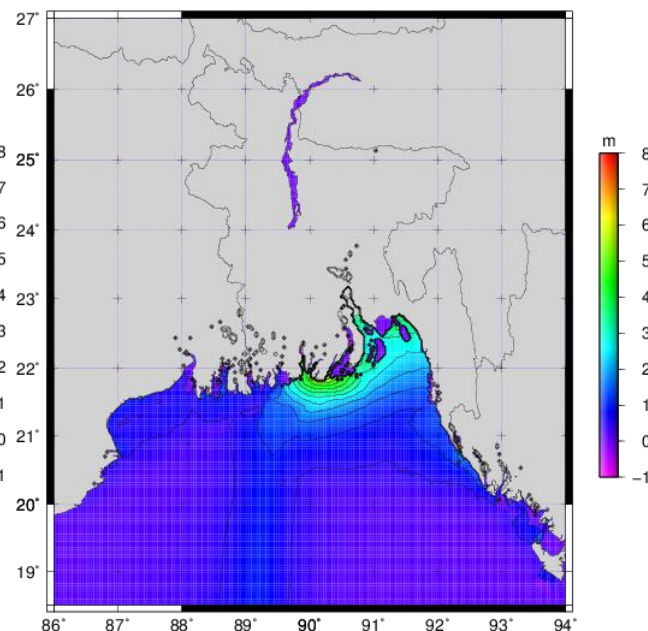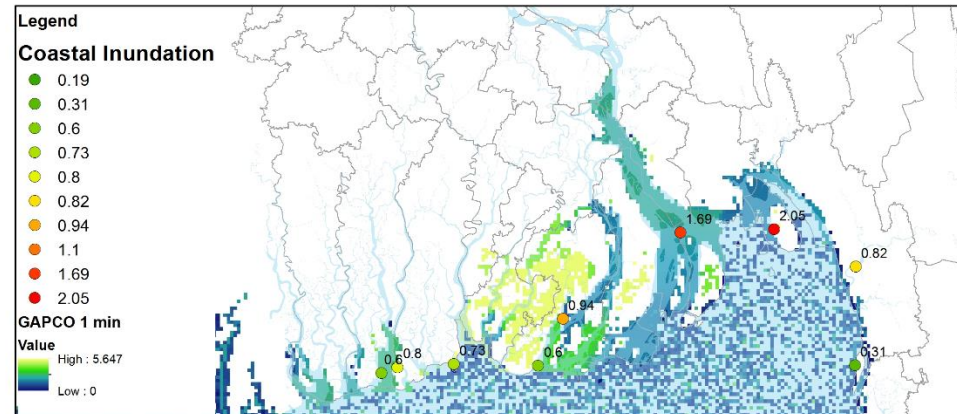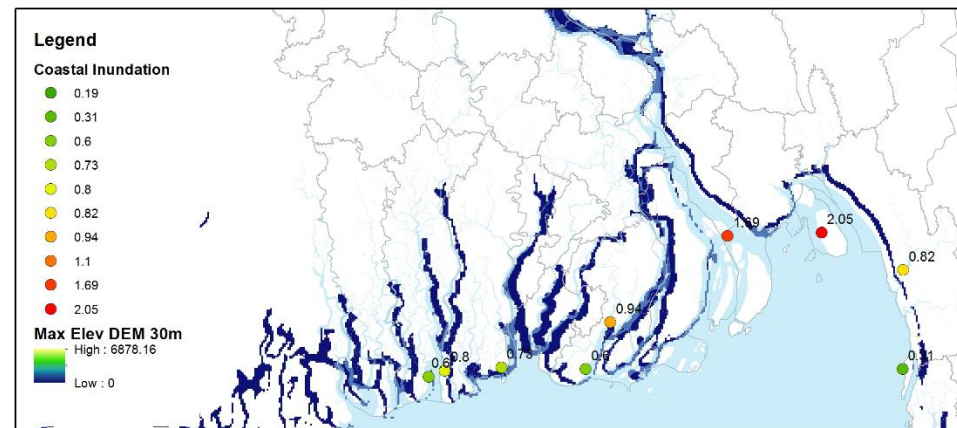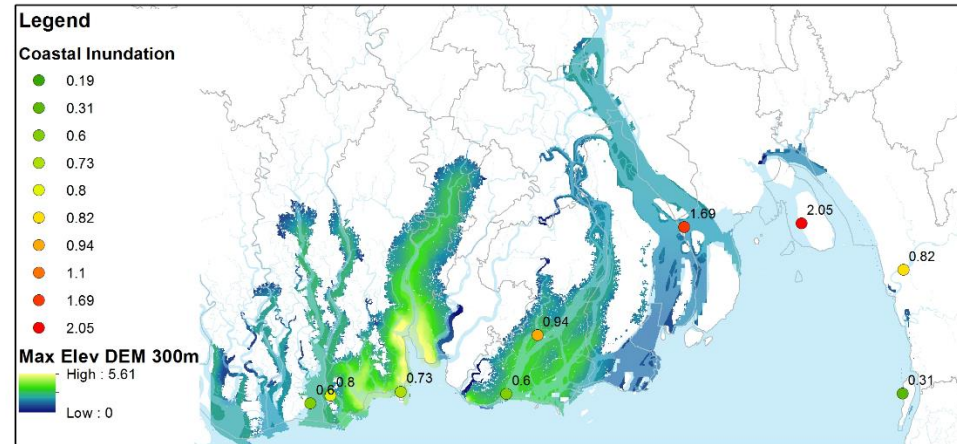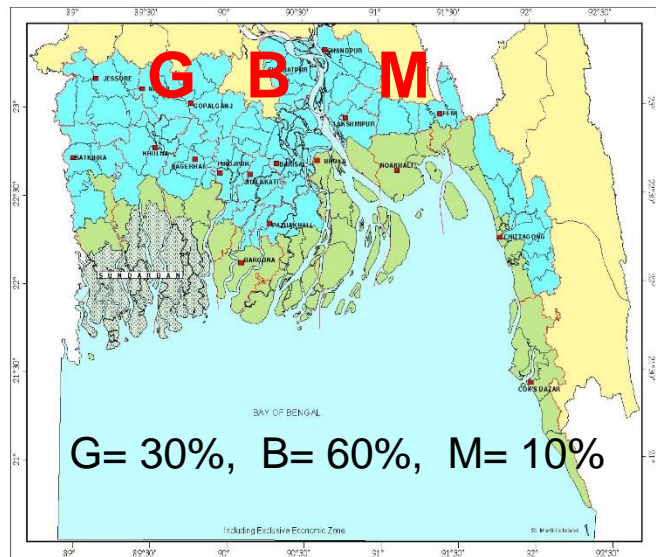
Model (old version) computed maximum storm surge (m) generated by SCS "SIDR" using Unisys data
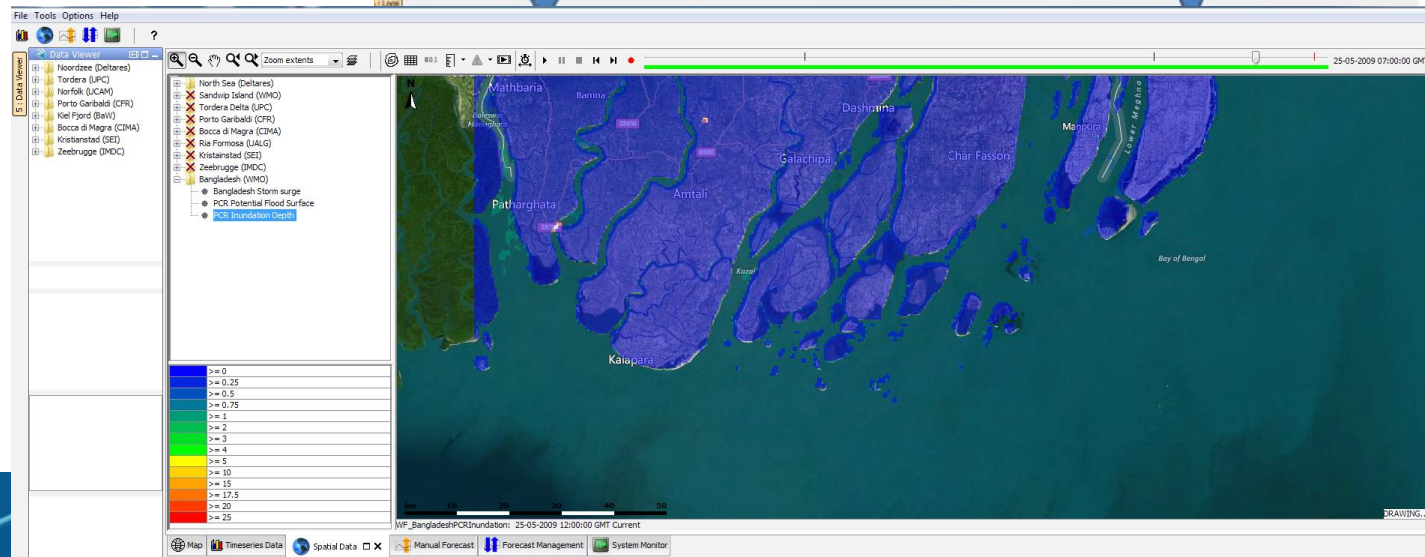
Simulation of Historical Events

CIFDP-B

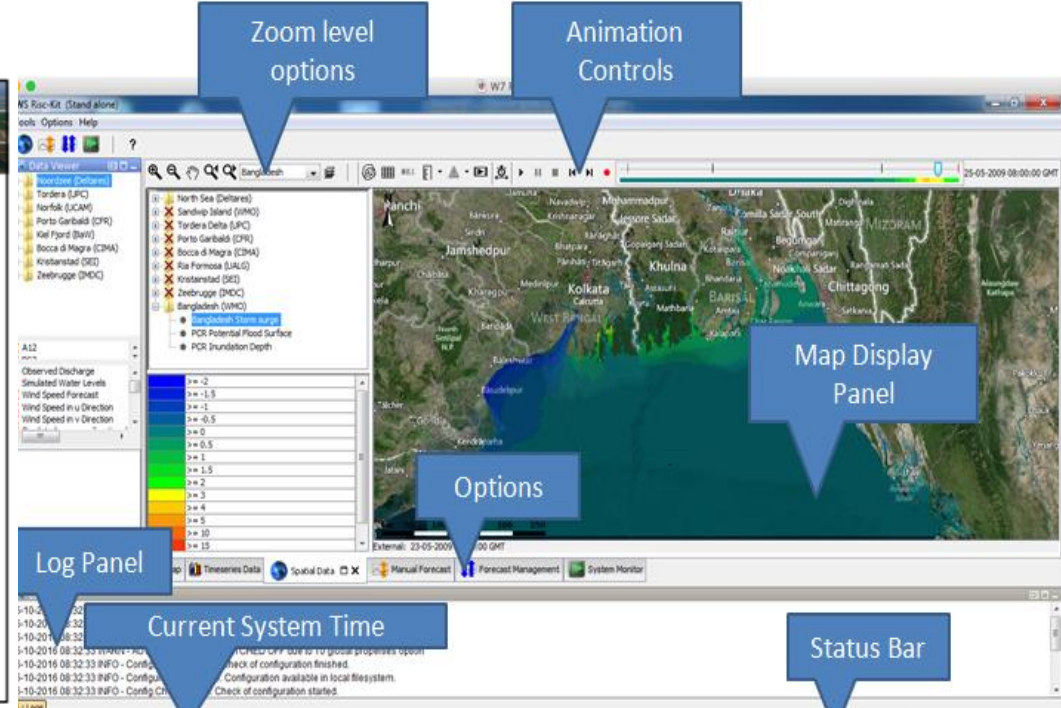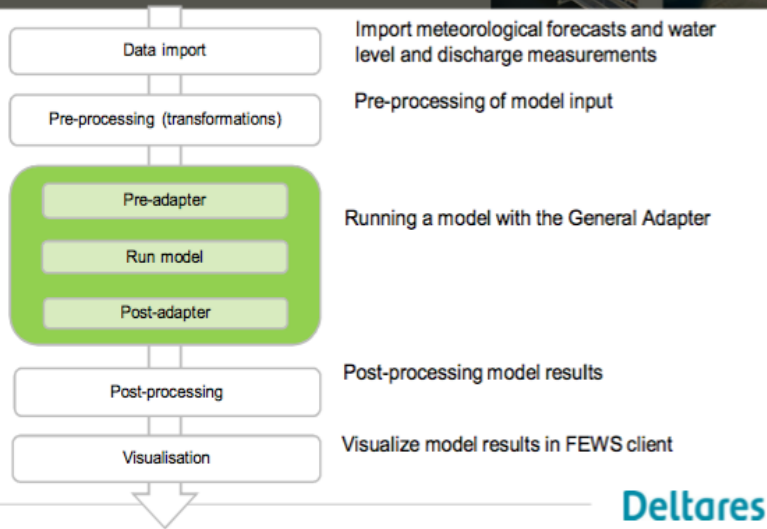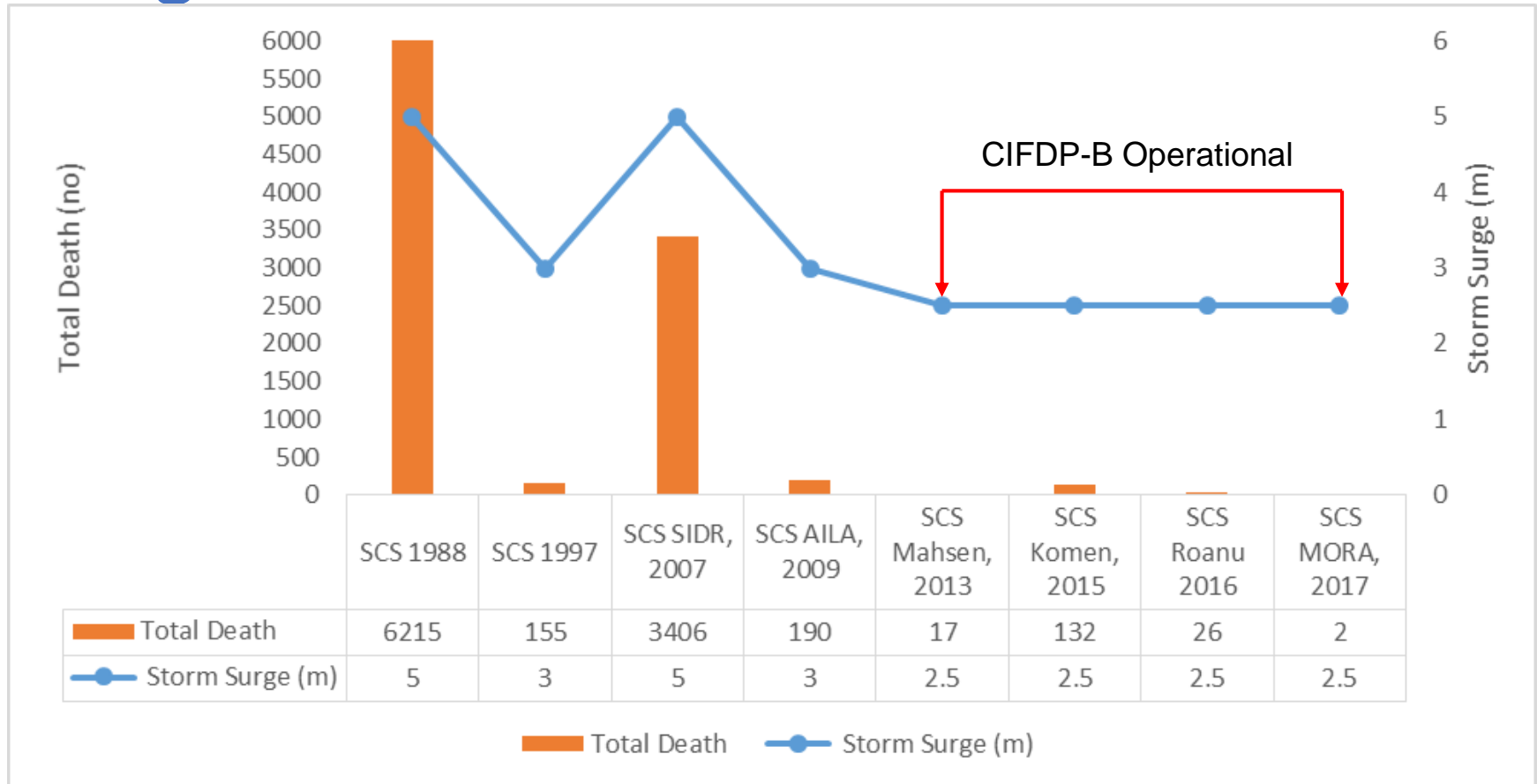## Simulation of Coastal Inundation- LISFLOOD- FP

G= 30%, B= 60%, M= 10%

CIFDP-B

CIFDP-B Contributions to Bangladesh

	SCS 1988	SCS 1997	SCS SIDR, 2007	SCS AILA, 2009	SCS Mahsen, 2013	SCS Komen, 2015	SCS Roanu 2016	SCS MORA, 2017
Total Death	6215	155	3406	190	17	132	26	2
Storm Surge (m)	5	3	5	3	2.5	2.5	2.5	2.5

Thank you