The **8th AWCI ICG Meeting**

Seoul, October 2011

Presented

By

Col Md Ashfakul Islam

Eng Adviser,MOD

&

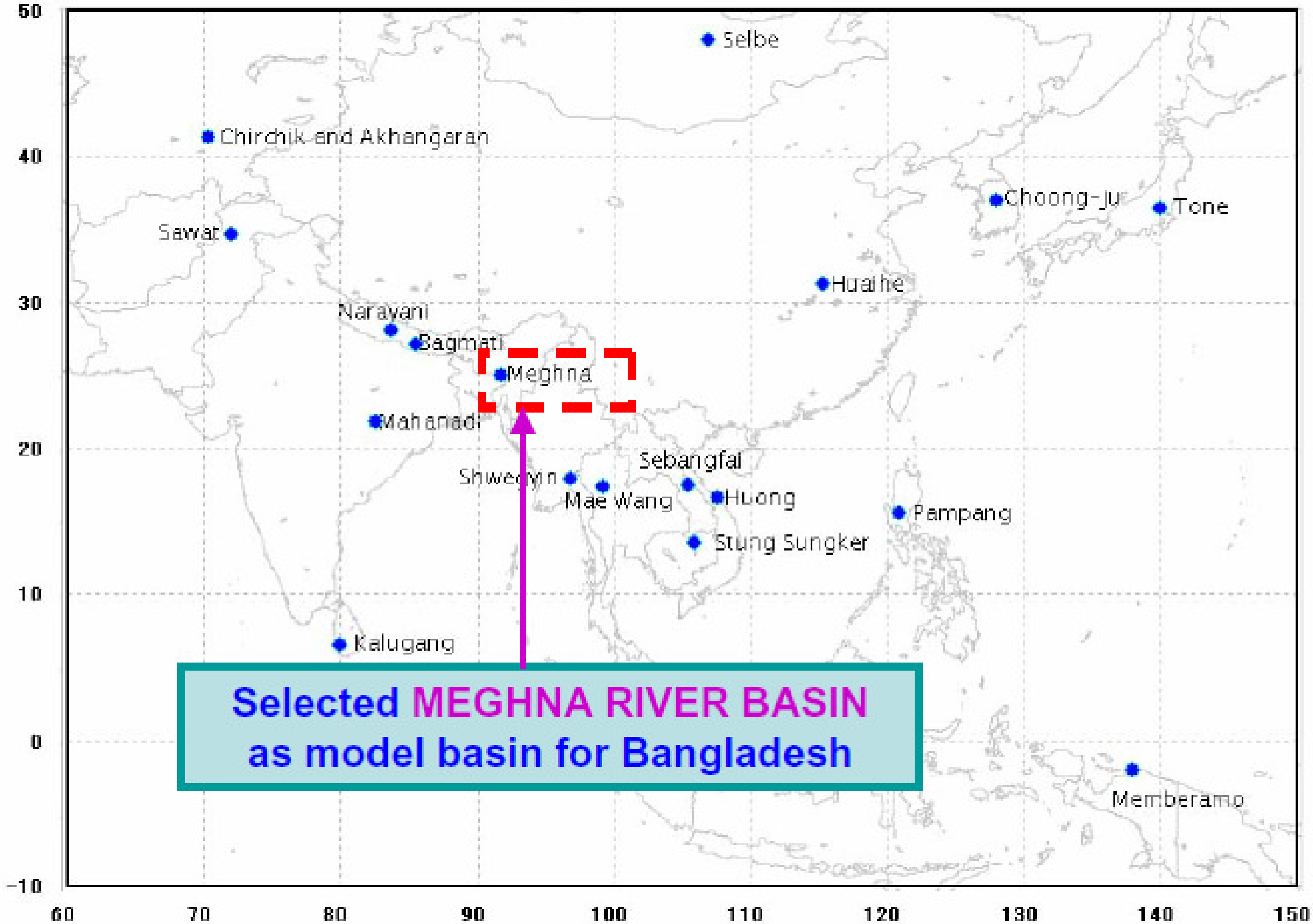
Dr. Md. Mafizur Rahman

Professor

Department of Civil Engineering

Bangladesh University Of Engineering and Technology

GEOSS Asian Water Cycle Initiative (AWCI)
18 River Basins in 18 Countries



Selected MEGHNA RIVER BASIN as model basin for Bangladesh

Objectives

- Developing information system for improved modeling and disaster forecasting
- To make a bridge between regional and global scale data and information for sound decision making and resource allocation.
- Transfer output of joint research achievements to formulate adaptation strategy and enhancing social capacity building technique against disaster.

Collaborators in Bangladesh

- Ministry of Defence (MOD)
- Survey of Bangladesh(SOB),MOD
- Bangladesh Meteorological Department (BMD),MOD
- Space Research and Remote Sensing Organization (SPARRSO),MOD
- Bangladesh University of Engineering and Technology (BUET)
- Environment & Population Research Centre (EPRC)
- SAARC Agricultural Centre (SAC)
- Bangladesh Water Development Board (BWDB)
- Disaster Management Bureau (DMB)
- Institute of Water Modeling (IWM),MOWR
- Military Institute of Science and Technology (MIST)
- Ministry of Health and Family Welfare

Collaborators Organizations in ASIA

- **Coordinated Enhanced Observing Period (CEOP), Tokyo University.**
- **International Centre for Water Hazard and Risk Management (ICHARM)**
- **Japan Aerospace Exploration Agency (JAXA)**
- **Flood hazard mapping, emergency manage (MRC)**
- **United Nations University (UNU)**
- **University of Tokyo, Japan**
- **Sejong University, Seoul, Republic of Korea.**

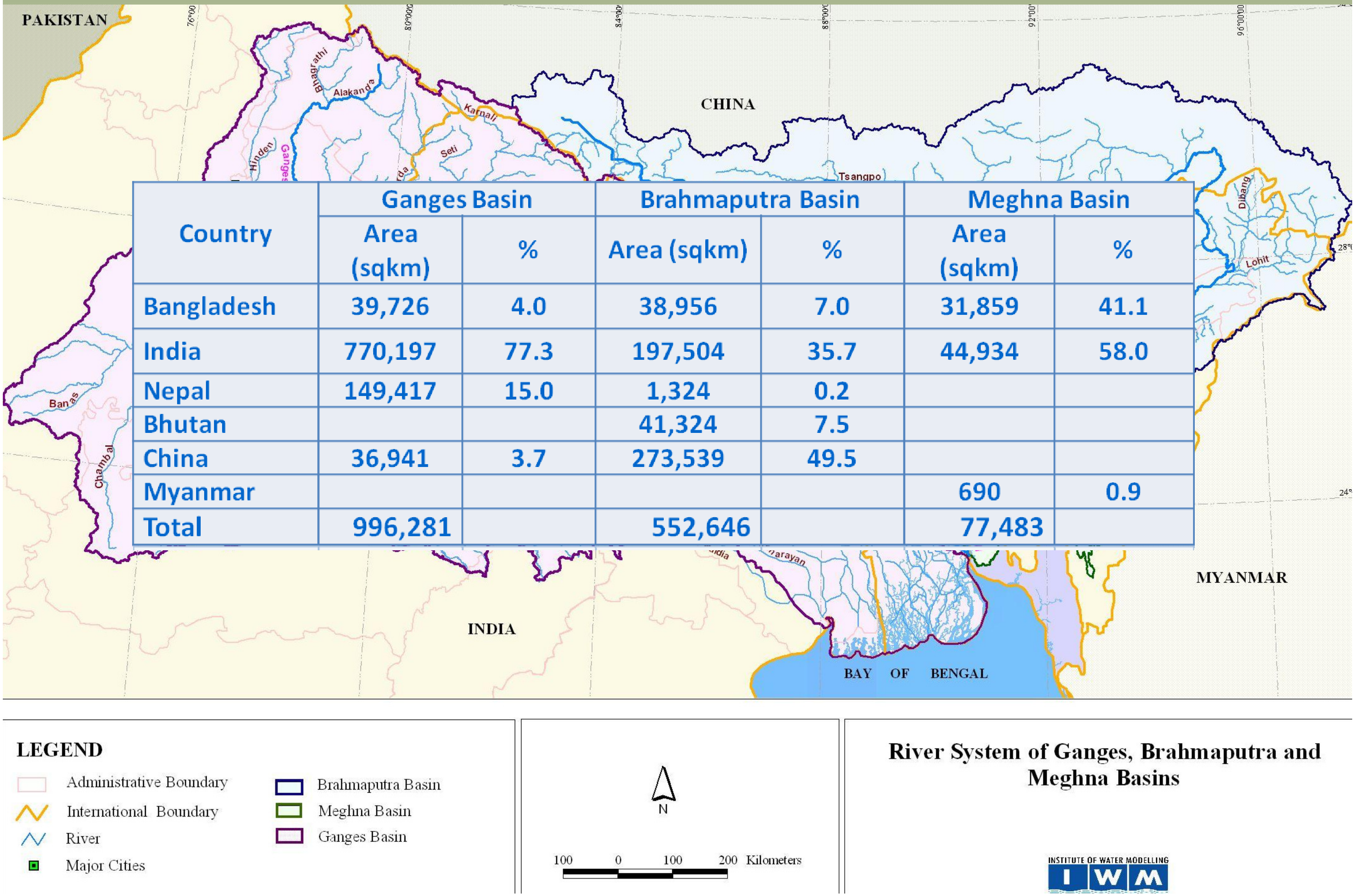
Demonstration Project (DP)

MEGHNA RIVER BASIN

Introduction

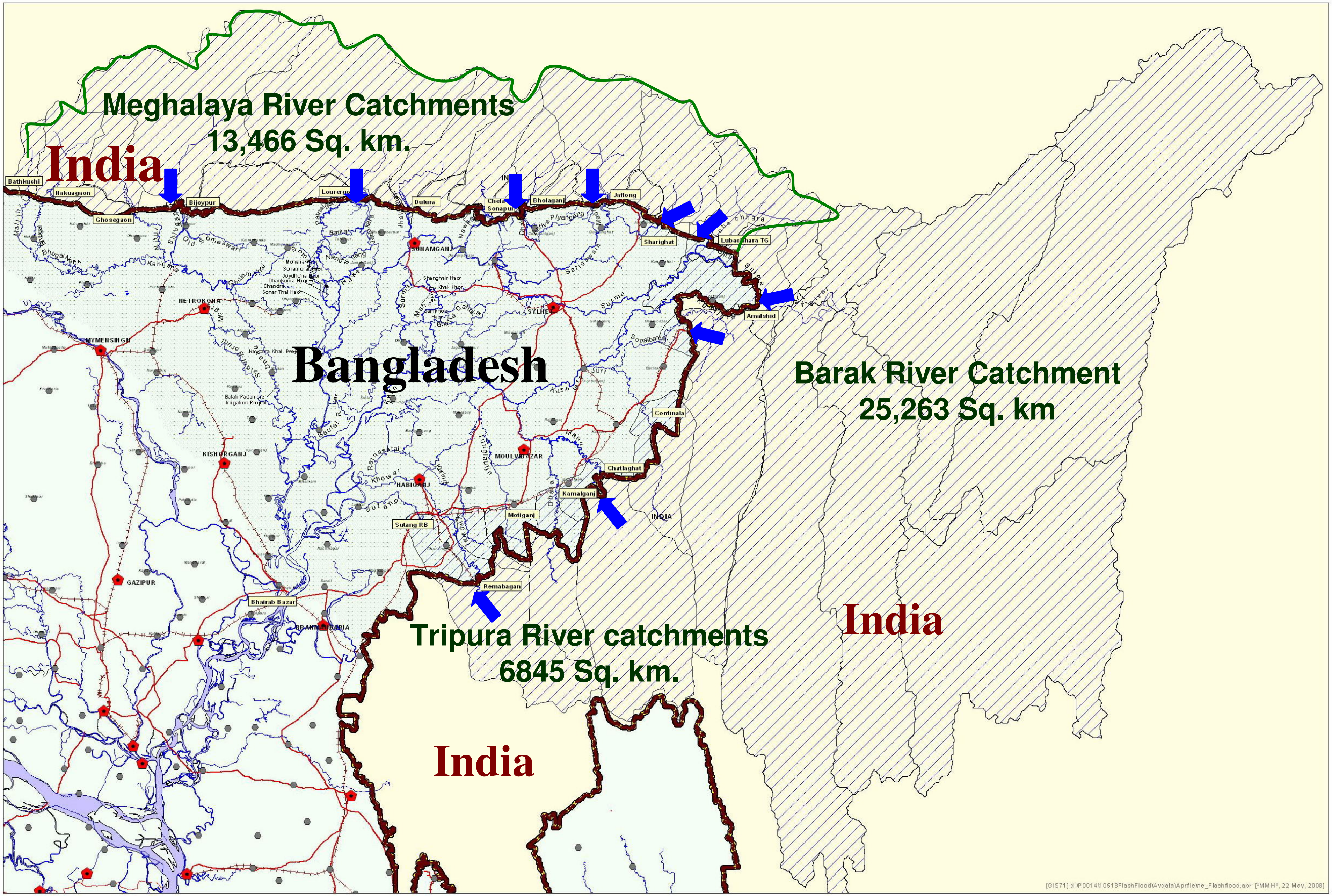
Surma-Meghna River System one of the three major river systems of Bangladesh. It is the longest river (669 km) system in the country. It also drains one of the world's heaviest rainfall areas (eg about 1,000 cm at Cherapunji, Meghalaya, India). The **Surma** originates in the hills of Shillong and Meghalaya of India. The main source is **Barak** river, which has a considerable catchment in the ridge and valley terrain of Naga-Manipur hills bordering Myanmar. Barak-Meghna has a length of 950 km of which 340 km lies within Bangladesh.

The Ganges, Brahmaputra & Meghna Basins



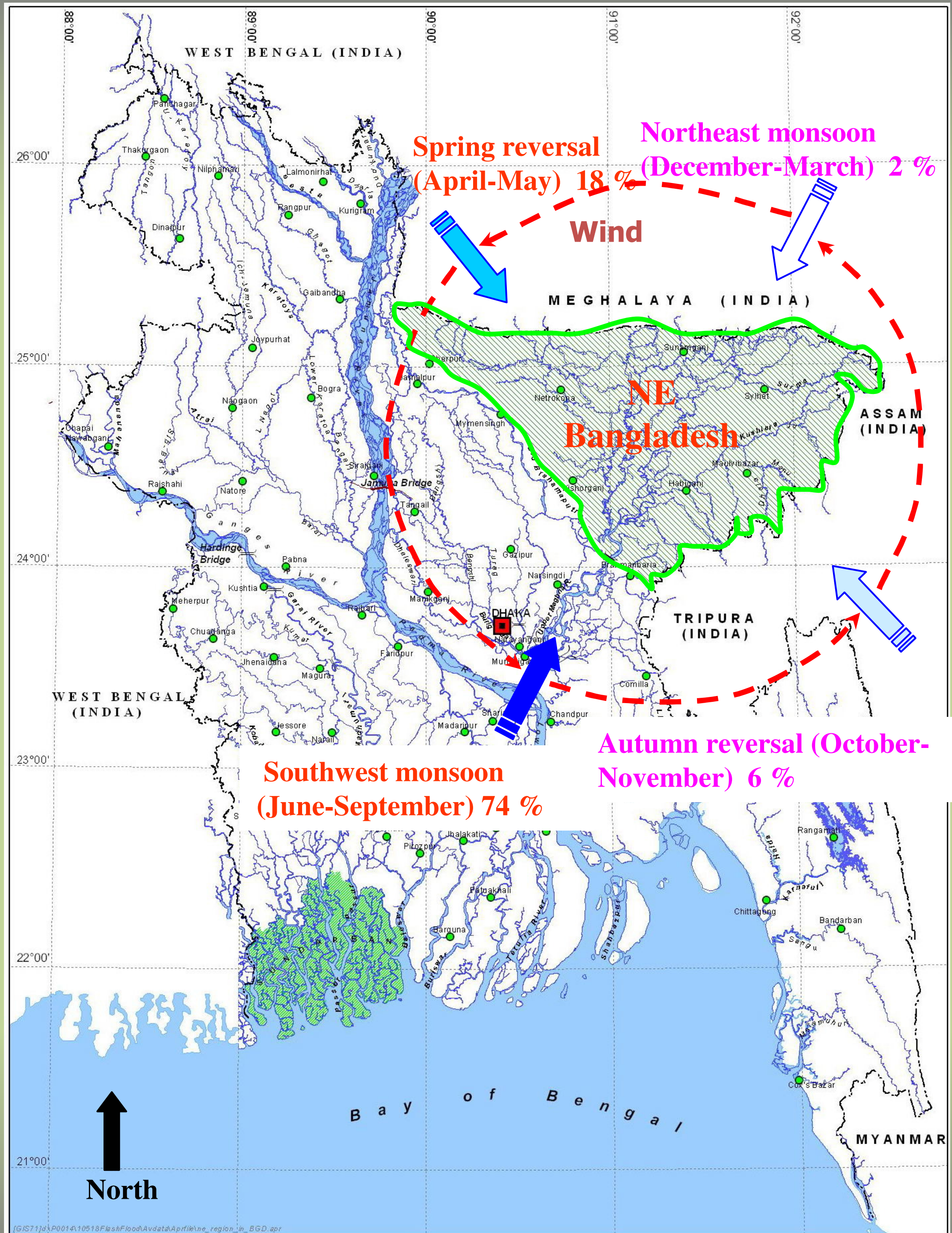
Country	Ganges Basin		Brahmaputra Basin		Meghna Basin	
	Area (sqkm)	%	Area (sqkm)	%	Area (sqkm)	%
Bangladesh	39,726	4.0	38,956	7.0	31,859	41.1
India	770,197	77.3	197,504	35.7	44,934	58.0
Nepal	149,417	15.0	1,324	0.2		
Bhutan			41,324	7.5		
China	36,941	3.7	273,539	49.5		
Myanmar					690	0.9
Total	996,281		552,646		77,483	

Extent of Meghna Basin (Flash Flood Prone)



Climate: Meghna Basin
(Bangladesh, NE Region)

- Mostly flash flood prone, occurs by Spring Reversal
- Spring Reversal is characterized by rainfall ~ 490 mm in the SW to ~ 1290 mm in the NE;
- The area has a tropical monsoon climate characterized by twice-yearly reversal of air movement;



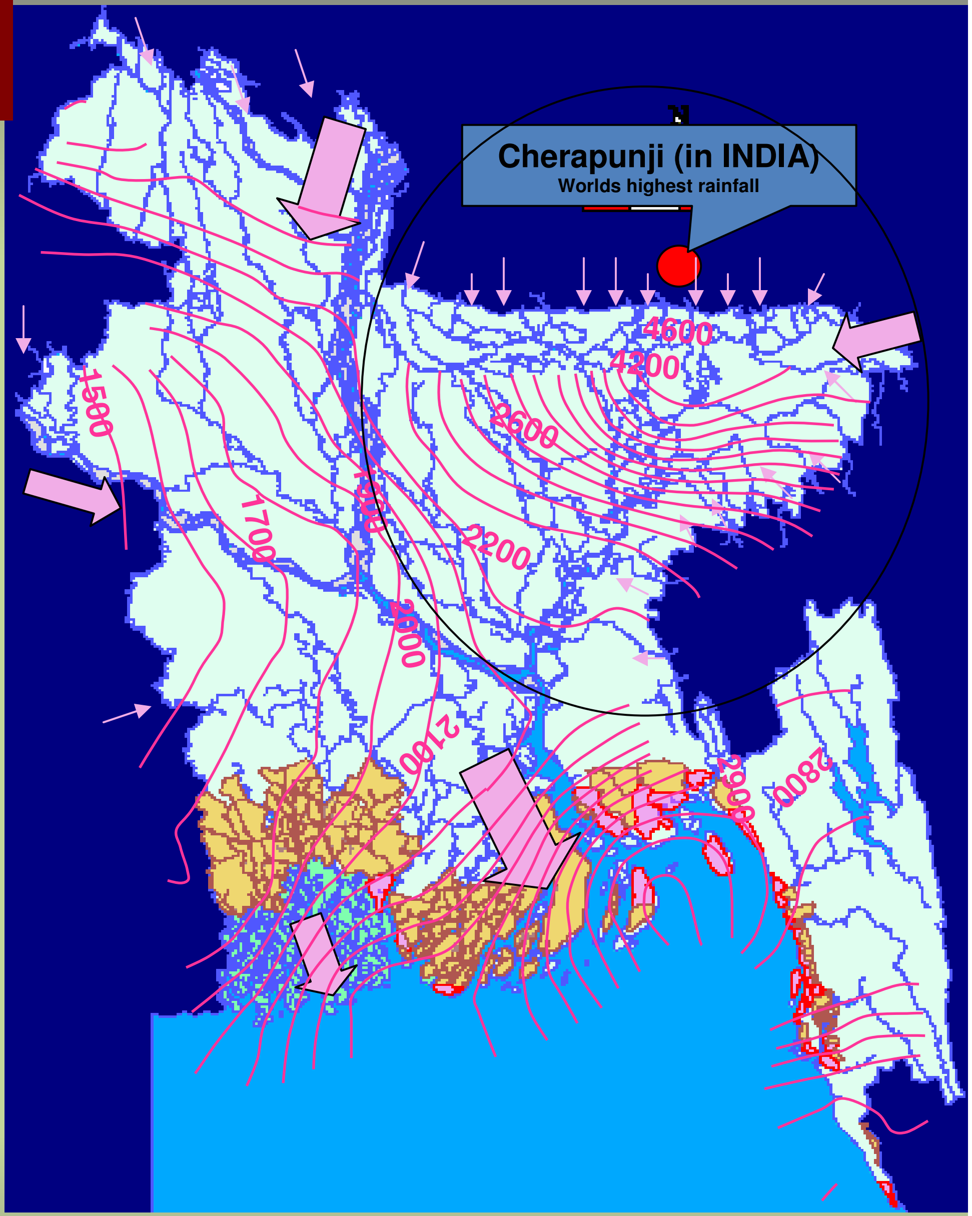
Hydrological Condition

- **River System** (Medium Range)
  - **35,00km** (North East Region Model)
- **Annual Average Rainfall**
  - ~ 2,200mm West , 5,800mm NE , 12,000mm NE corner
- **Annual Flow in the Region**
  - 173 Km^3, 40% rainfall &
  - 60% from Indian catchments (Meghalaya Hills, Barak Basin & Tripura Hills)

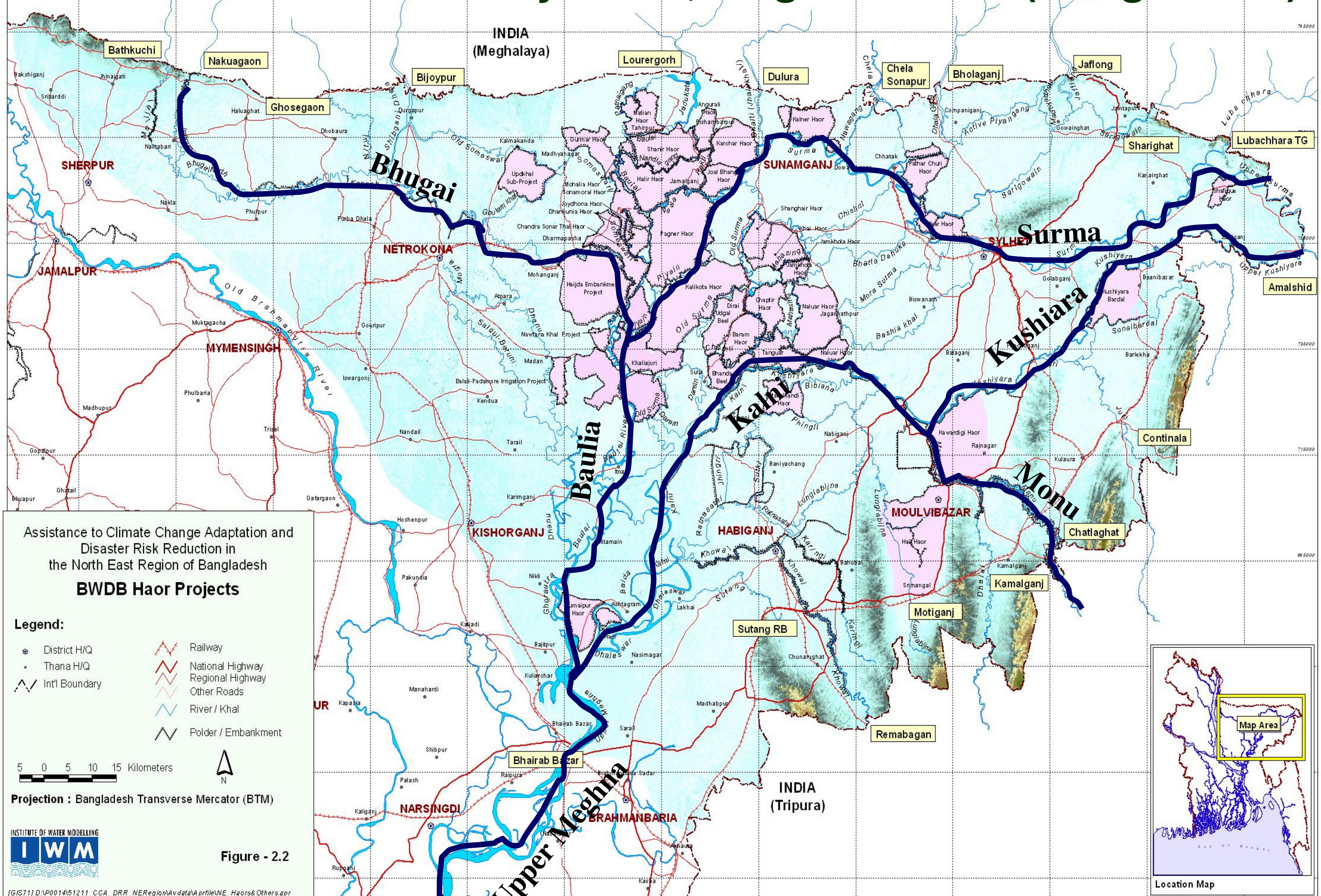
About 411 haors (bowl shaped water bodies)

80% of the area remain under water during monsoon but early flood (flashy nature) in April/May causes huge destruction to lives, crops and properties.

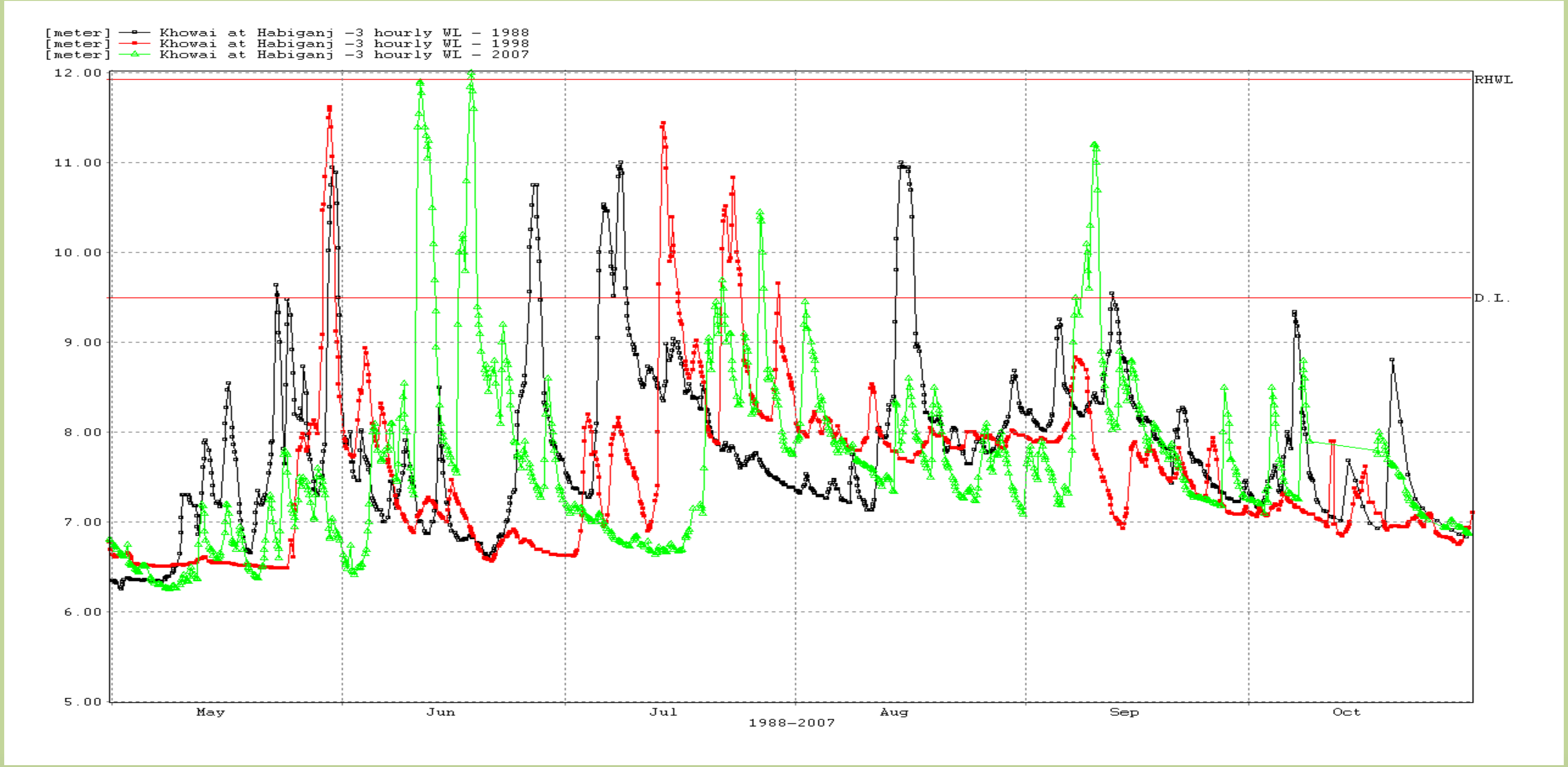
Enriched with various aquatic bio-diversities



River Systems, Meghna Basin (Bangladesh)

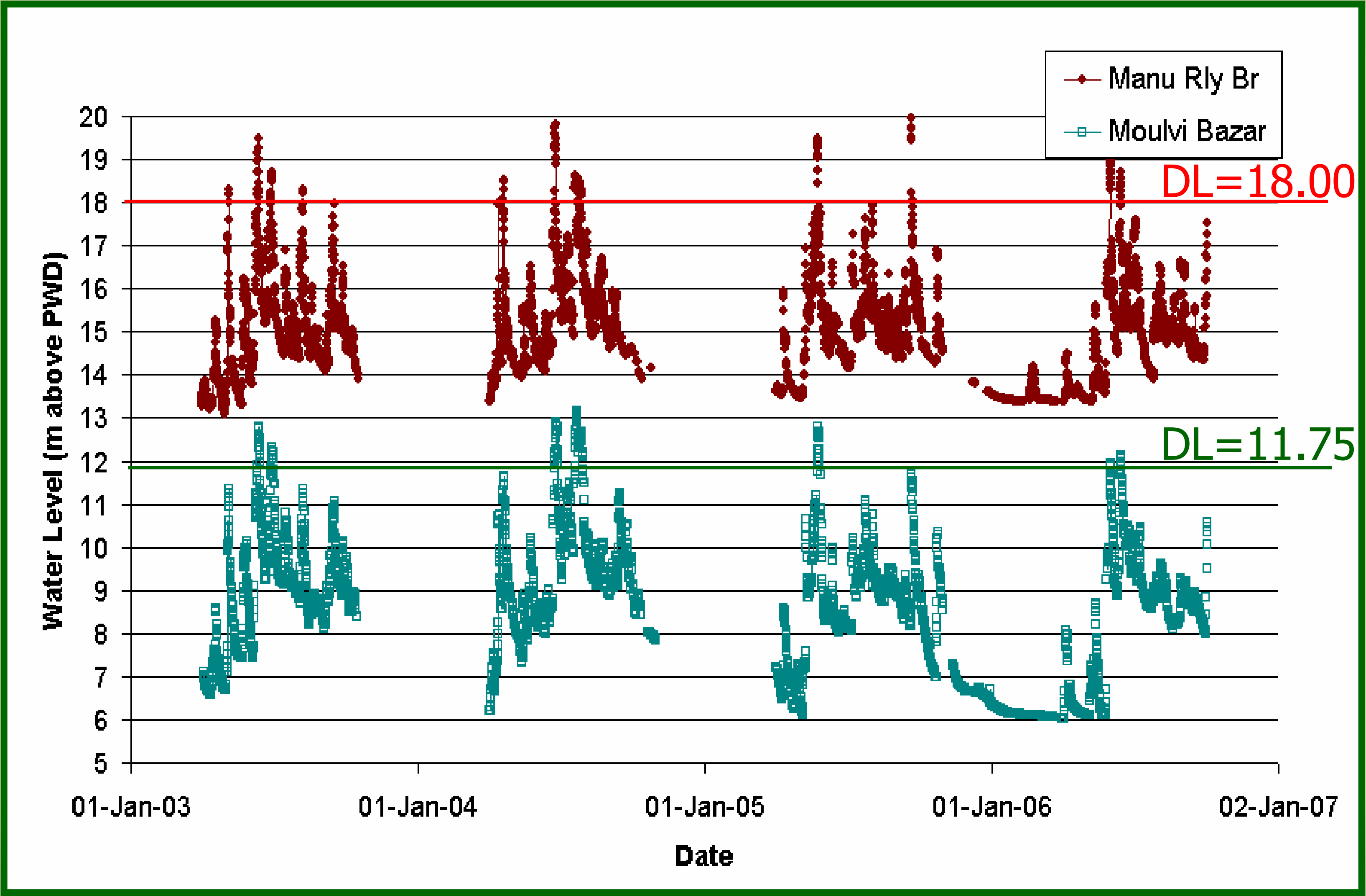


Status of Flash Flood Fight in Bangladesh

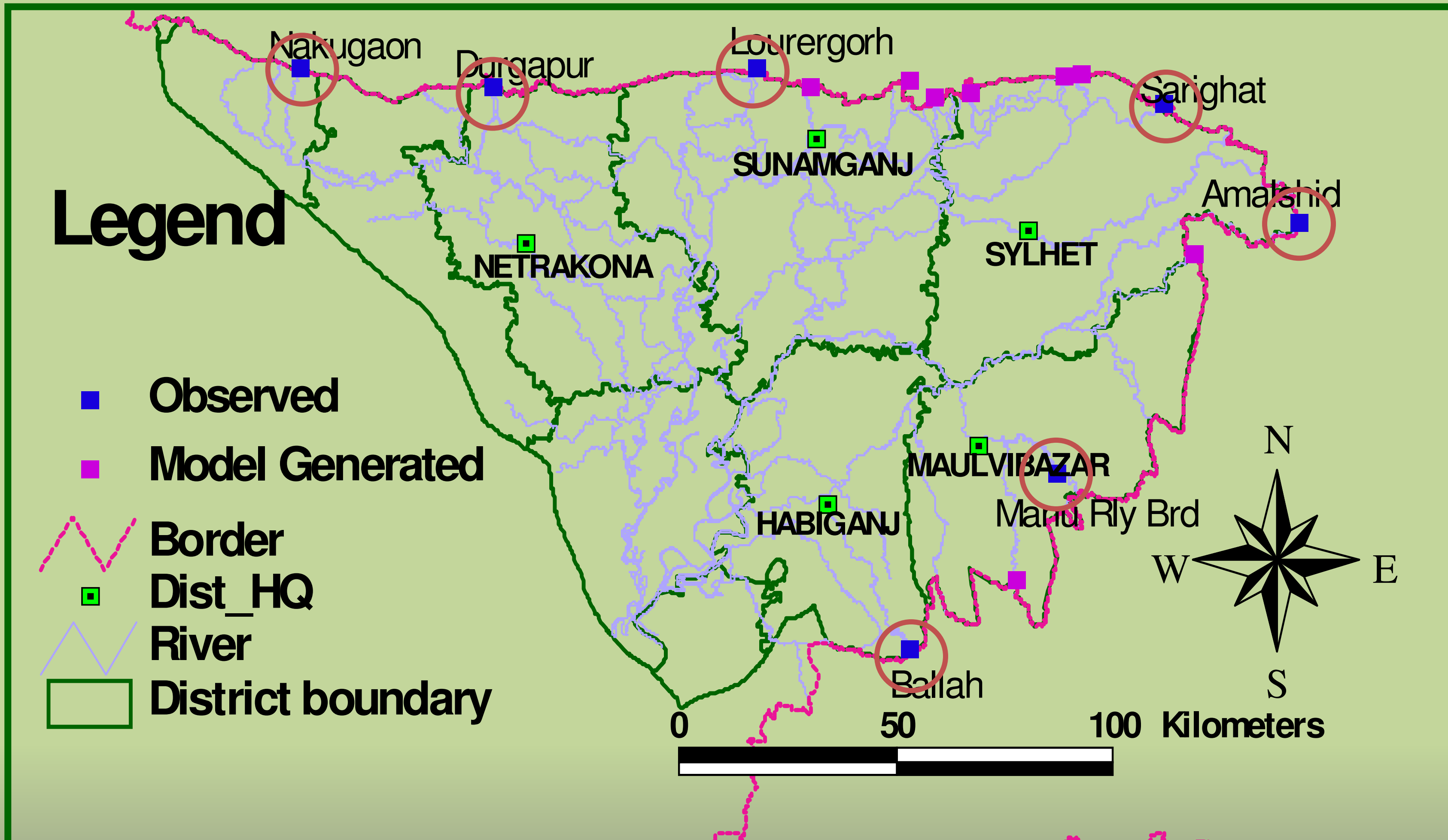


Flood Forecasting & Warning Center
Bangladesh

Water Level in Manu River



Flood Peak Travel Time



Flow

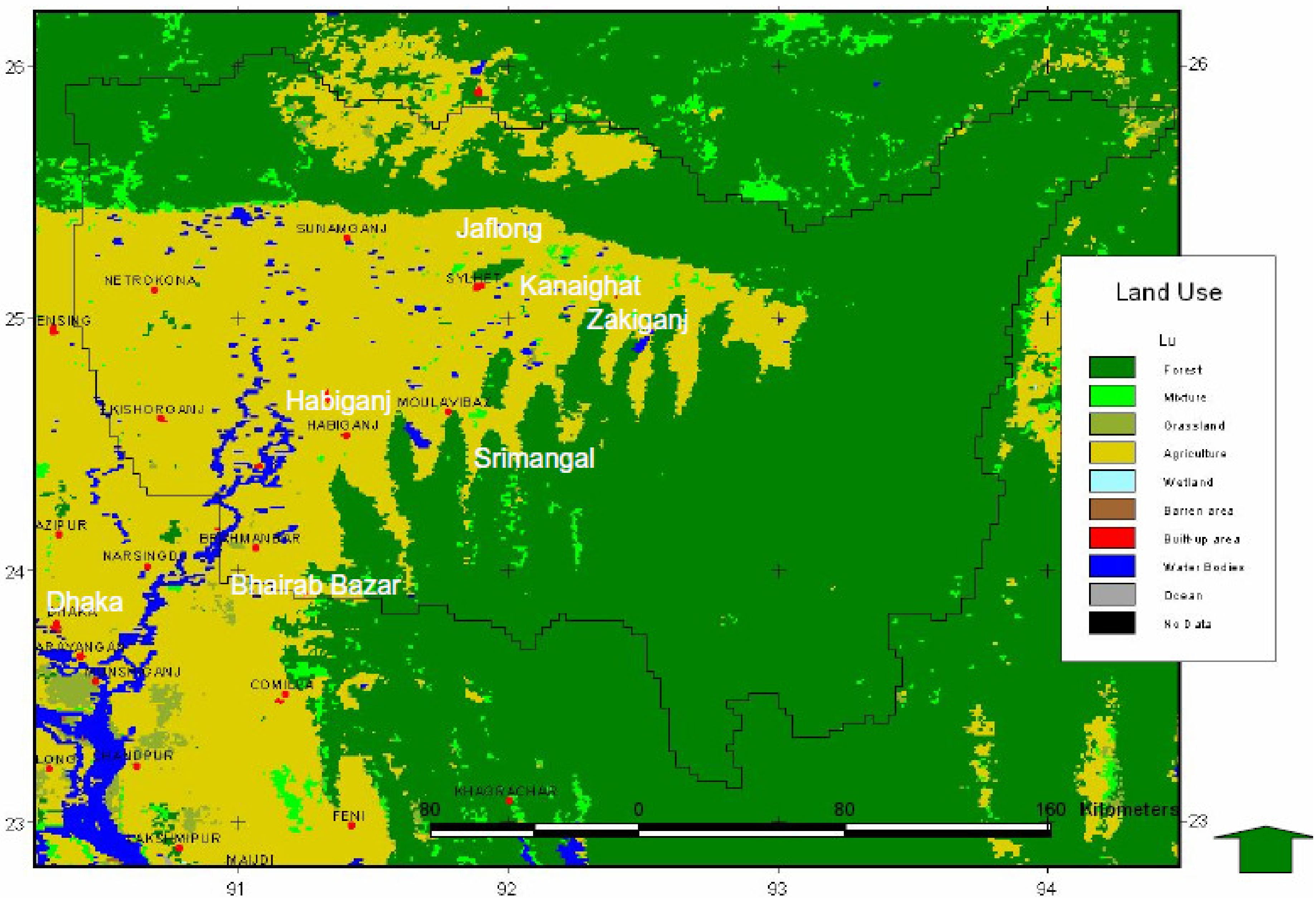
- The Ganges-Padma: 1,000 ~ 120,000 cumec
- The Brahmaputra: 2,400 ~ 102,000 cumec
- The Meghna: 500 ~ 30,000 cumec

Annual Sediment Transport

- The Ganges-Padma: 886 Mtons
- The Brahmaputra: 600 Mtons
- The Meghna: 1 Mtons

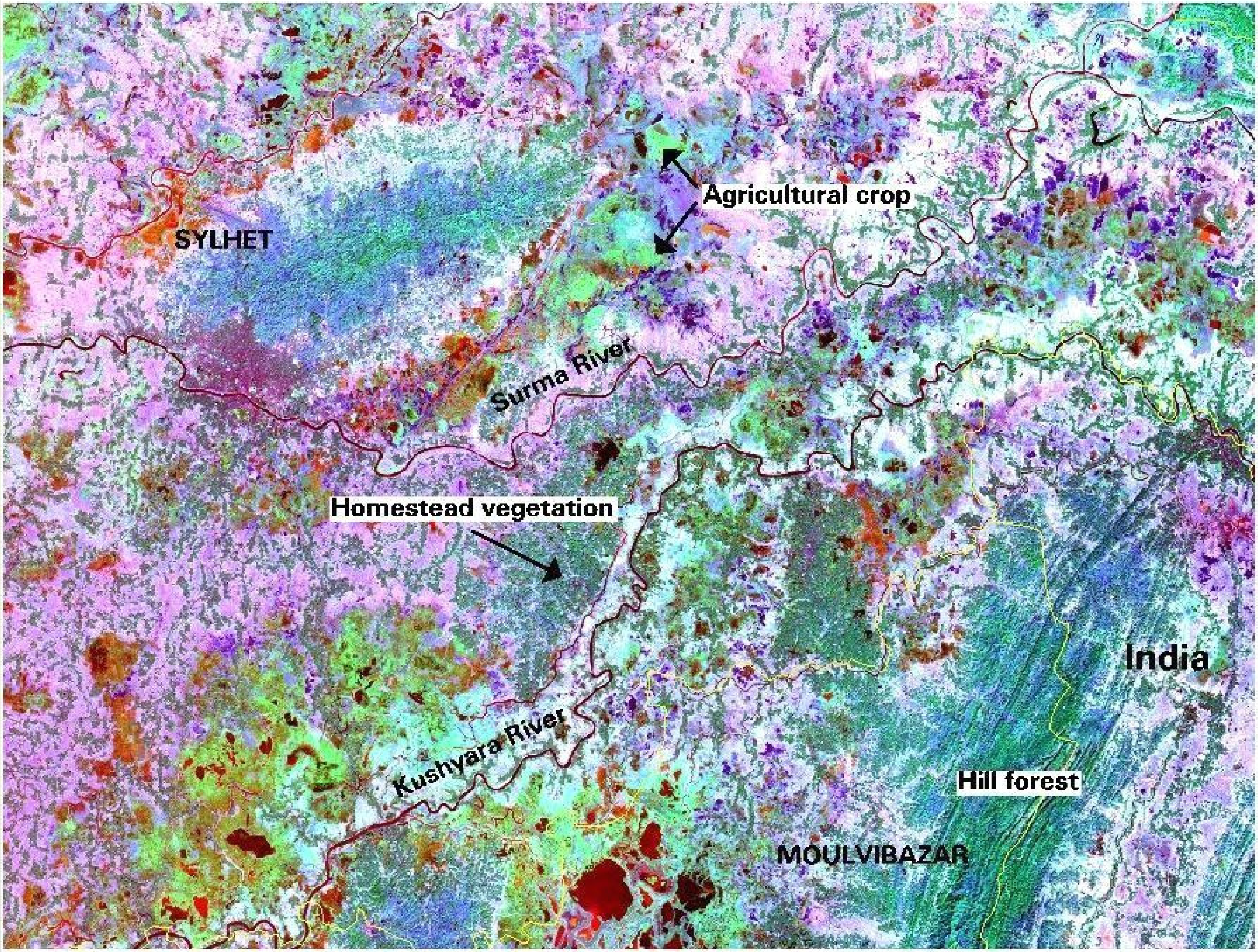
- Stored over Bangladesh Plain would have about 9.0 m of standing water depth
- Stored over Bangladesh flood plain would have about 1.6 cm thick sedimentation

Land use in Meghna River



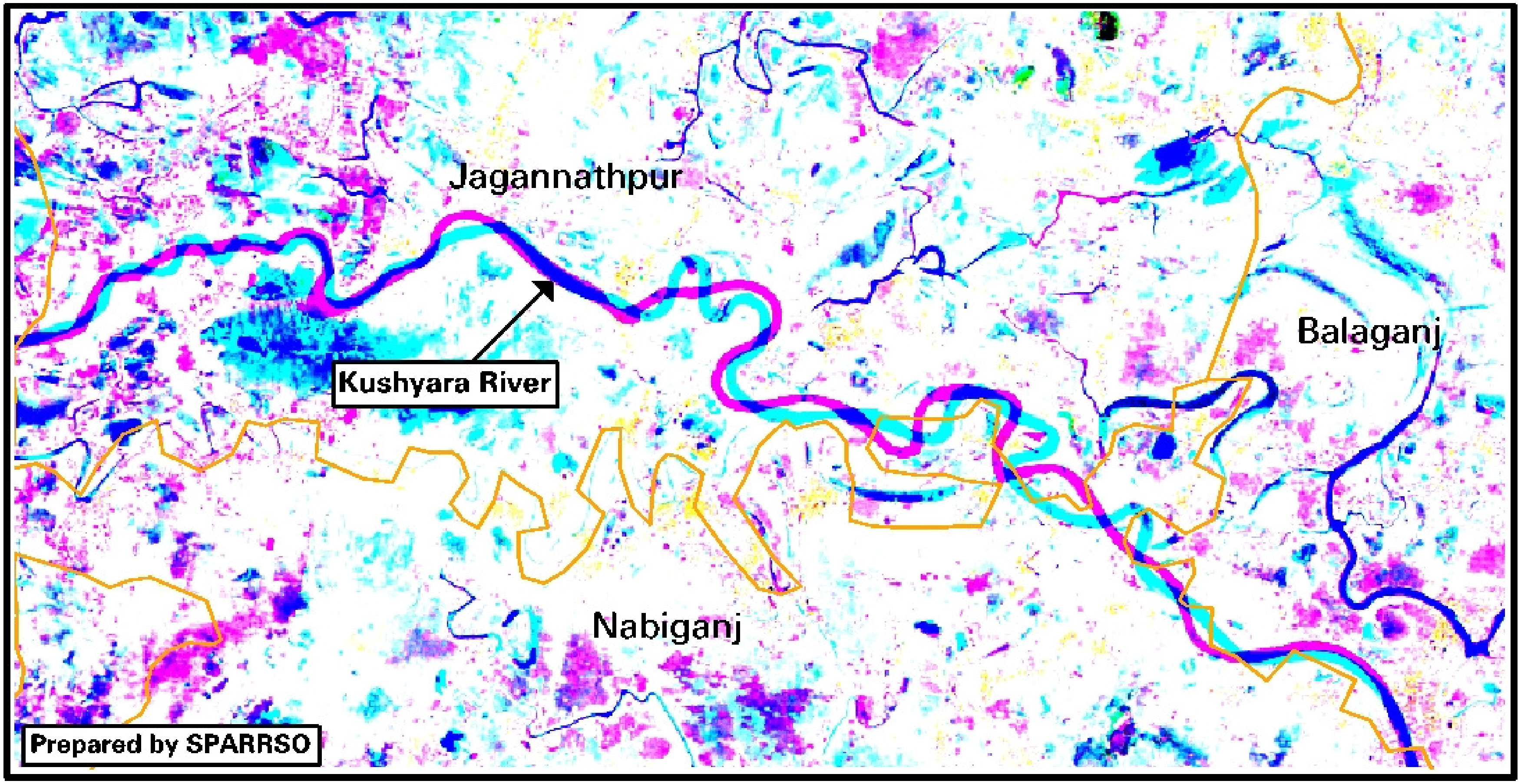
Types of Vegetation in a Part of the Meghna Basin

Landsat TM Image of 8 February 2010



Change of the Kushyara River Course in Jagannathpur, Nabiganj and Balaganj Upazilas

NIR band combination of Landsat TM images



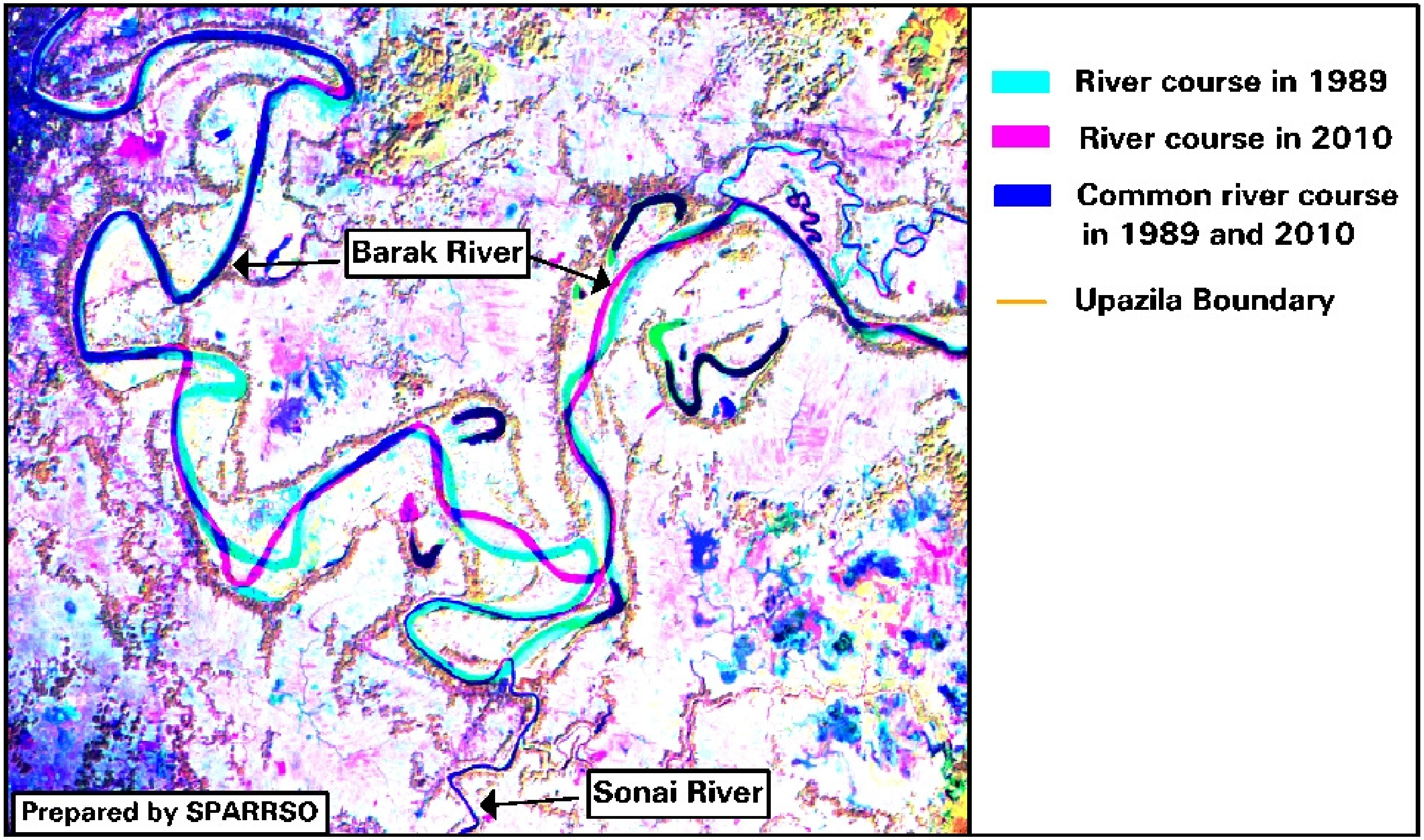
River course in 1989 | River course in 2010 | Common river course in 1989 and 2010

Upazila Boundary

Change of the Barak River Course Near Banskandi Town of Silchar District

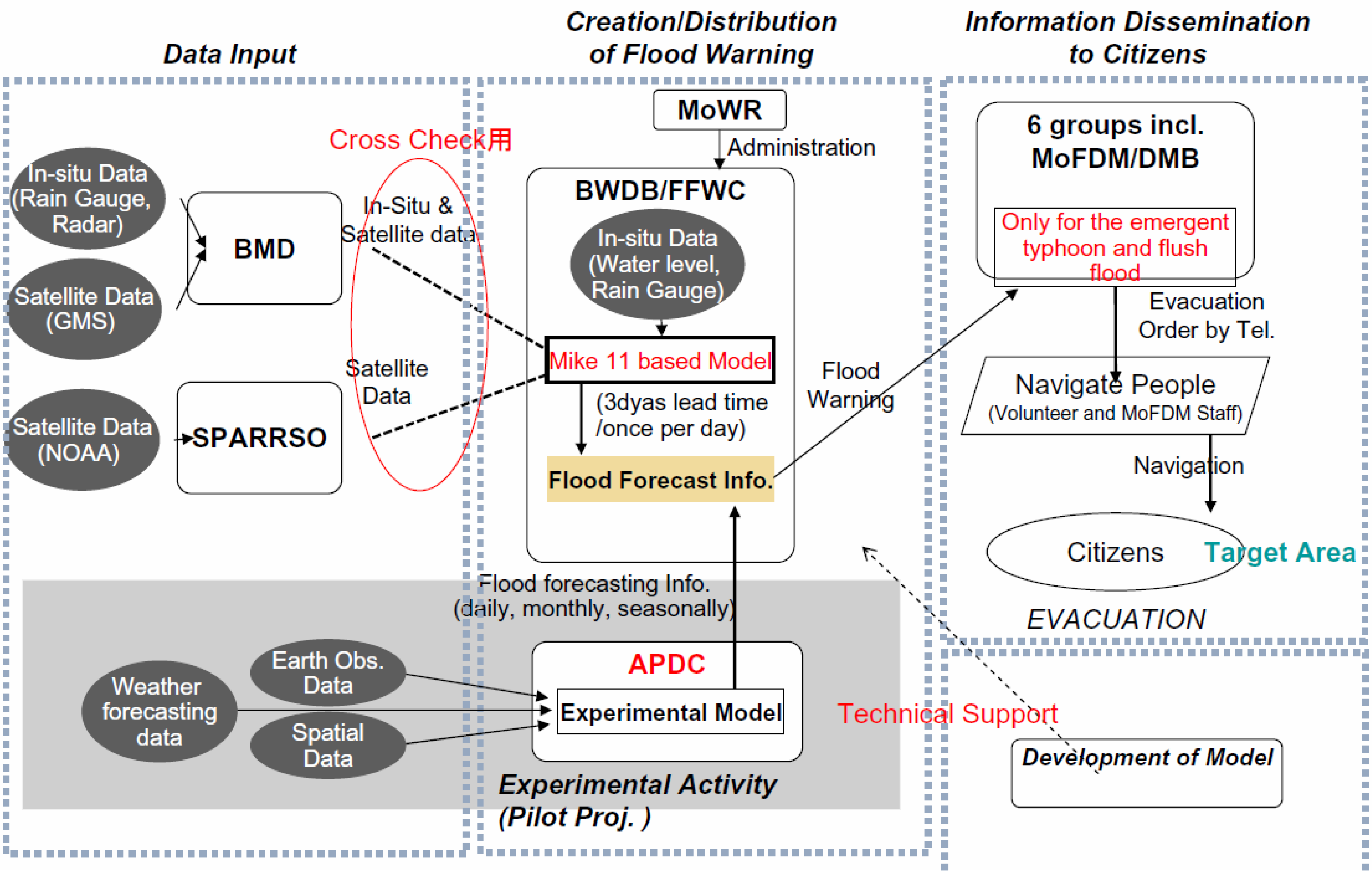
Under Assam State of India

NIR band combination of Landsat TM images

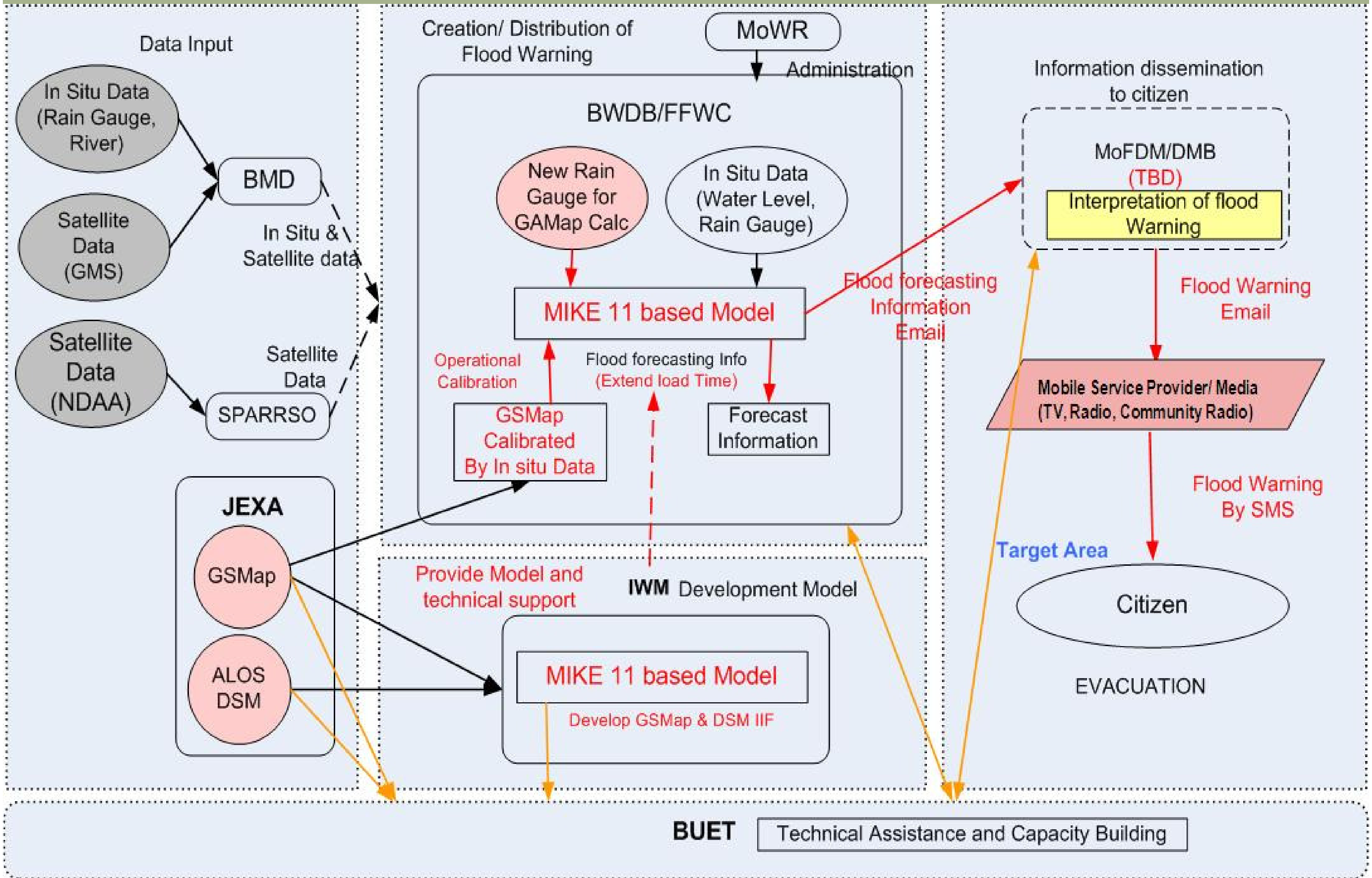


Design Current

Flood Warning System in Bangladesh (Current)



Design Idea


Data Input
In Situ Data (Rain Gauge, River)
Satellite Data (GMS)
Satellite Data (NDAA)
BMD
In Situ & Satellite data
Satellite Data
SPARRSO
JEXA
GSMap
ALOS DSM
Creation/ Distribution of Flood Warning
MoWR
Administration
BWDB/FFWC
New Rain Gauge for GAMap Calc
In Situ Data (Water Level, Rain Gauge)
MIKE 11 based Model
Operational Calibration
Flood forecasting Info (Extend load Time)
GSMap Calibrated By In situ Data
Forecast Information
Flood forecasting Information Email
Provide Model and technical support
IWM Development Model
MIKE 11 based Model
Develop GSMap & DSM IIF
Information dissemination to citizen
MoFDM/DMB (TBD)
Interpretation of flood Warning
Flood Warning Email
Mobile Service Provider/ Media (TV, Radio, Community Radio)
Flood Warning By SMS
Target Area
Citizen
EVACUATION
BUET
Technical Assistance and Capacity Building

Accomplished activities

- **Basic Information Submitted**
- **Data uploaded in**
  AWCI Data Upload Center (Ver.3.04 a)
- **Quality Checked**

Station : 15
Obs. Elements : Temperature (Min, Max), Precipitation, Stream flow, River water level
Data interval : Daily
Observation period : 2003 - 2008

Bangladesh_Meghna (Status of 2003/1-2008/12) 15 stations as of 2011-09-26 13:09:35

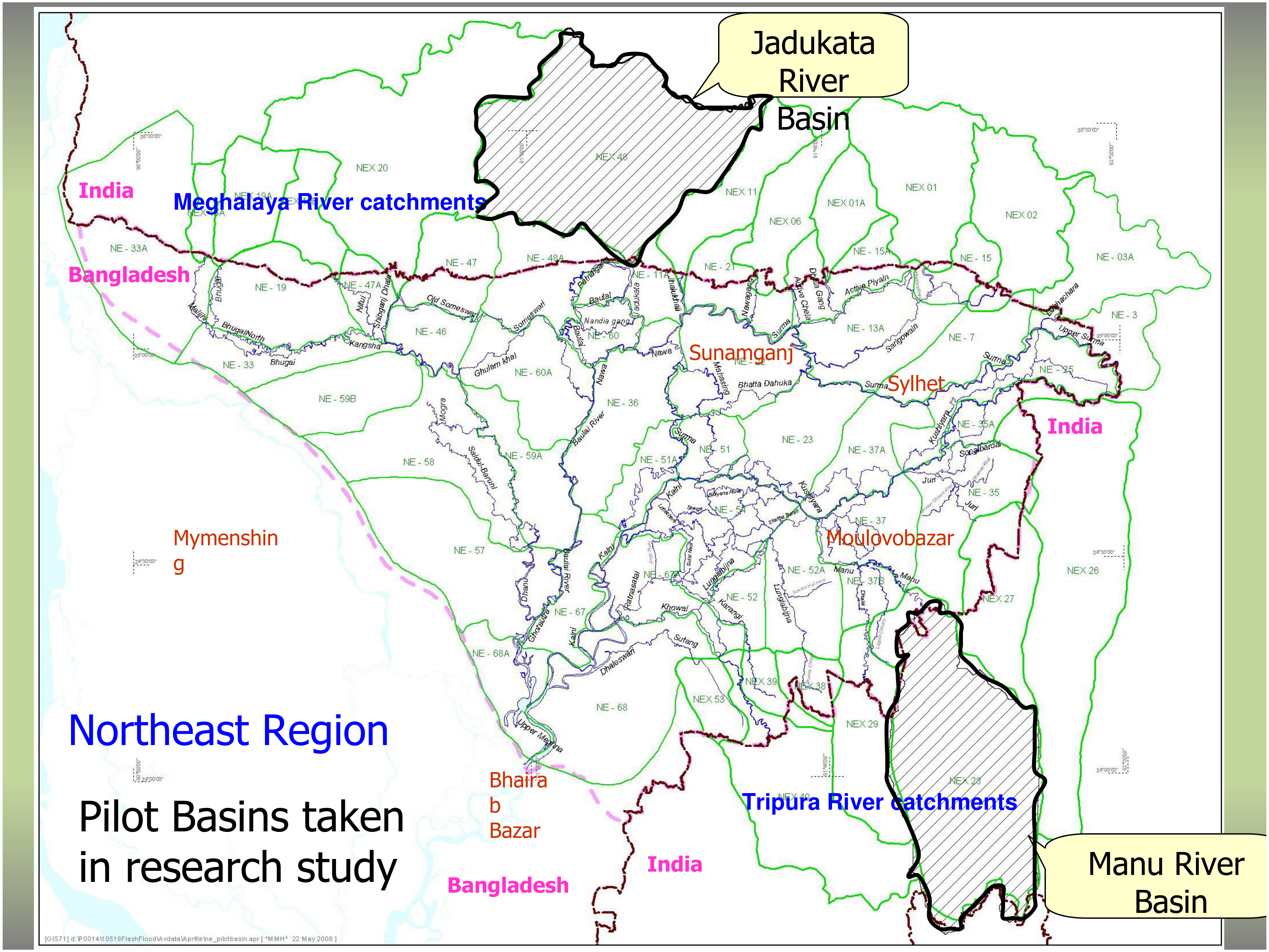
site	station	G	I	D	B	C	M	U	total	%
01:Bangladesh_Meghna	001:Dhaka (2003/1 - 2008/12 in DB)	4384	0	0	0	0	0	0	4384	100 %
01:Bangladesh_Meghna	002:Mymensingh (2003/1 - 2008/12 in DB)	6575	0	1	0	0	0	0	6576	100 %
01:Bangladesh_Meghna	003:Tangail (2003/1 - 2008/12 in DB)	6575	0	1	0	0	0	0	6576	100 %
01:Bangladesh_Meghna	004:Faridpur (2003/1 - 2008/12 in DB)	6557	0	5	0	0	14	0	6562	100 %
01:Bangladesh_Meghna	005:Madaripur (2003/1 - 2008/12 in DB)	6564	0	4	0	0	8	0	6568	100 %
01:Bangladesh_Meghna	006:Comilla (2003/1 - 2008/12 in DB)	7068	0	6	0	0	0	0	7074	100 %
01:Bangladesh_Meghna	007:Chandpur (2003/1 - 2008/12 in DB)	6568	0	5	0	0	3	0	6573	100 %
01:Bangladesh_Meghna	008:Sylhet (2003/1 - 2008/12 in DB)	6750	0	2	0	0	0	0	6752	100 %
01:Bangladesh_Meghna	009:Srimangal (2003/1 - 2008/12 in DB)	6559	0	2	0	0	15	0	6561	100 %
01:Bangladesh_Meghna	010:Sheola (2004/1 - 2007/7 in DB)	320	0	0	0	0	0	0	320	100 %
01:Bangladesh_Meghna	011:Sherpur (2004/1 - 2007/7 in DB)	164	0	0	0	0	0	0	164	100 %
01:Bangladesh_Meghna	012:Monu_Rly.Bridge (2004/1 - 2007/7 in DB)	342	0	0	0	0	0	0	342	100 %
01:Bangladesh_Meghna	013:Parshuram (2004/1 - 2008/1 in DB)	560	0	0	0	0	0	0	560	100 %
01:Bangladesh_Meghna	014:Kanairghat (2004/1 - 2007/7 in DB)	302	0	0	0	0	0	0	302	100 %
01:Bangladesh_Meghna	015:Sunamganj (2004/1 - 2007/7 in DB)	174	0	0	0	0	0	0	174	100 %
site	station	G	I	D	B	C	M	U	total	%

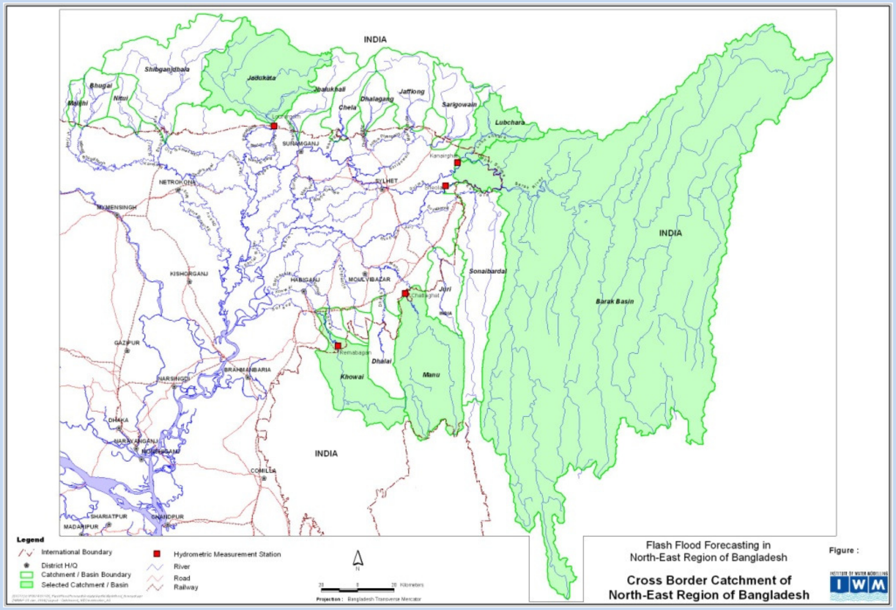
Flash Flood Forecasting in the Northeast Region of Bangladesh Using ECMWF data

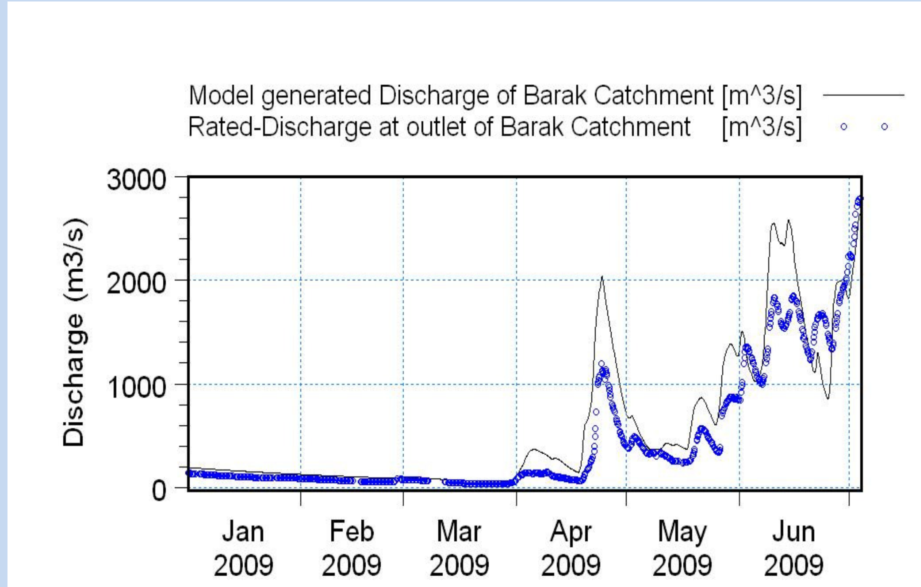
The Study

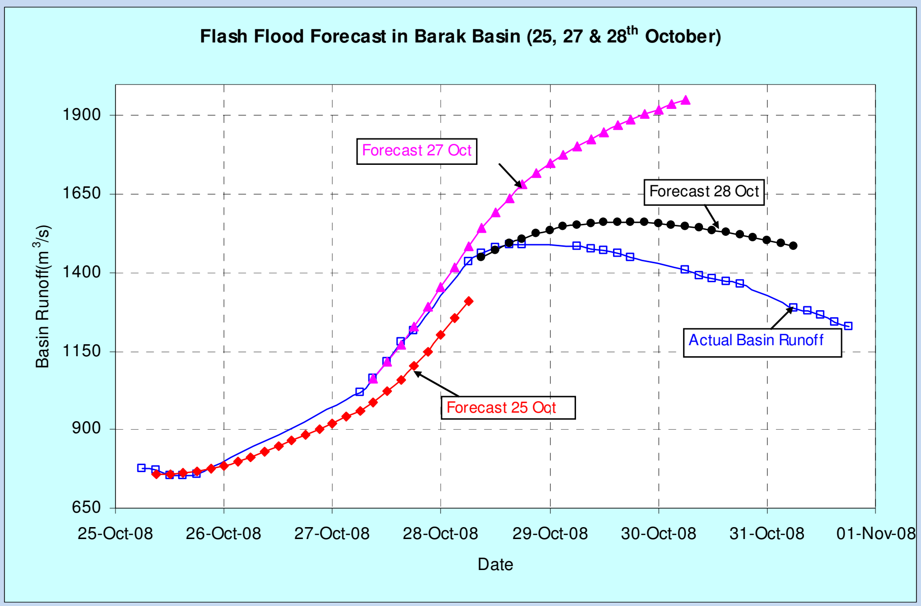
This Study has been conducted on two pilot basins:

- the Manu River Basin and
- the Jadukata River Basin


Jadukata River Basin
Manu River Basin
India
Meghalaya River catchments
Bangladesh
Sunamganj
Sylhet
India
Mymenshing
Moulovobazar
Northeast Region
Pilot Basins taken in research study
Bhairab Bazar
Tripura River catchments
India
Bangladesh
NEX 48
NEX 20
NEX 11
NEX 06
NEX 01A
NEX 01
NEX 02
NE - 03A
NE - 33A
NE - 19
NE - 47A
NE - 47
NE - 48A
NE - 21
NE - 15A
NE - 15
NE - 3
NE - 46
NE - 60
NE - 13A
NE - 7
NE - 33
NE - 60A
NE - 25
NE - 59B
NE - 36
NE - 35A
NE - 23
NE - 37A
NE - 58
NE - 59A
NE - 51A
NE - 51
NE - 35
NE - 37
NE - 57
NE - 52A
NE - 37B
NEX 26
NE - 52
NEX 27
NE - 67
NE - 68A
NEX 39
NEX 38
NEX 53
NE - 68
NEX 29
NEX 28
NEX 40
Surma
Kushiyara
Upper Meghna
Dhaleswari
Manu
Kangsha
Bhugai
Old Someswari
Someswari
Ghulam khal
Baulai River
Kalni
Sutang
Khowai
Juri
Sonaibardal
Mogra
Nawa
Jadukata
Jhalukhali
Nandia gang
Active Piyain
Sarigowain
Upper Surma
[GIS71] d:\P0014\10518FlashFlood\Avdata\Aprfile\ne_pilotbasin.apr [*MMH* 22 May 2008]



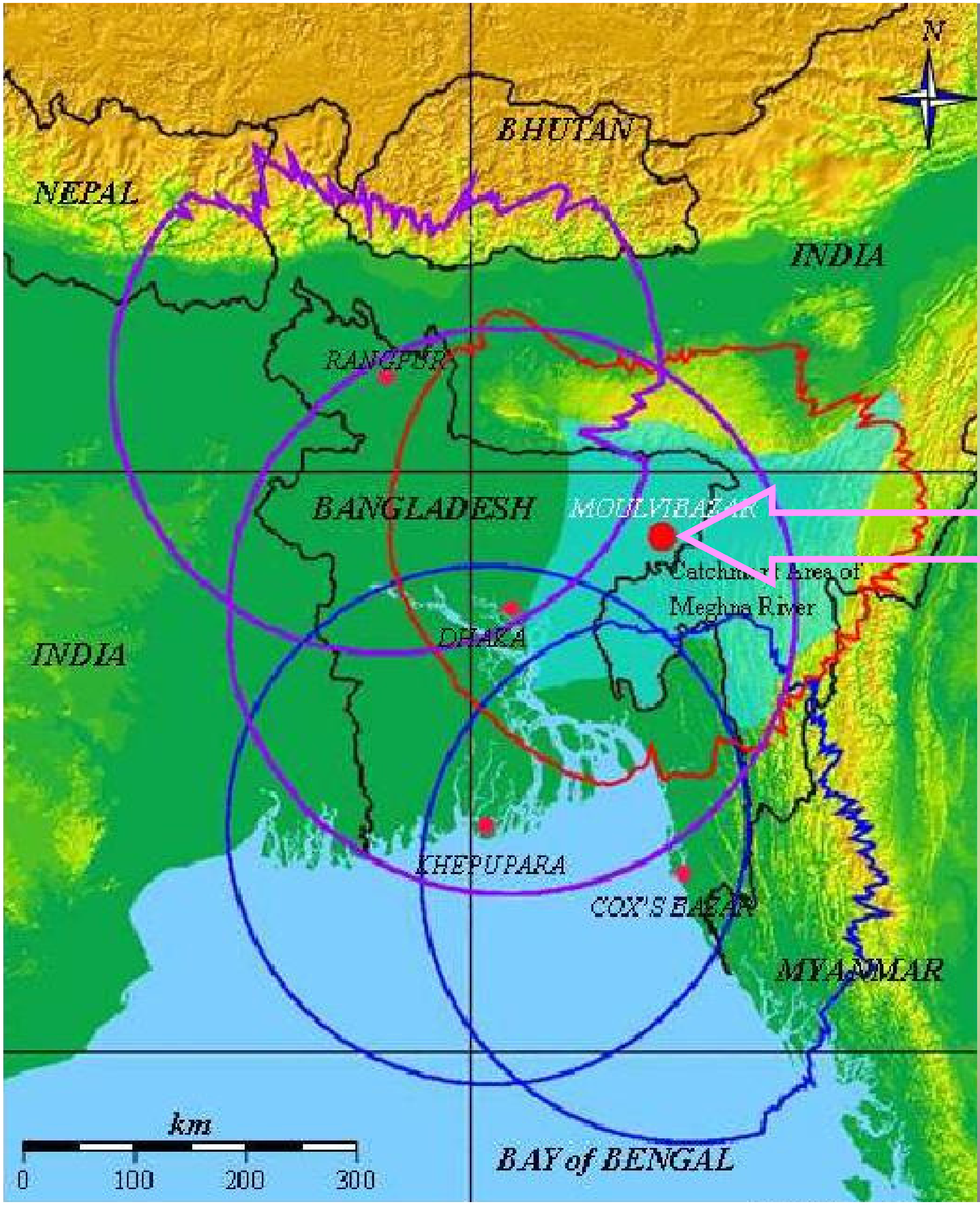




Further improvement required :

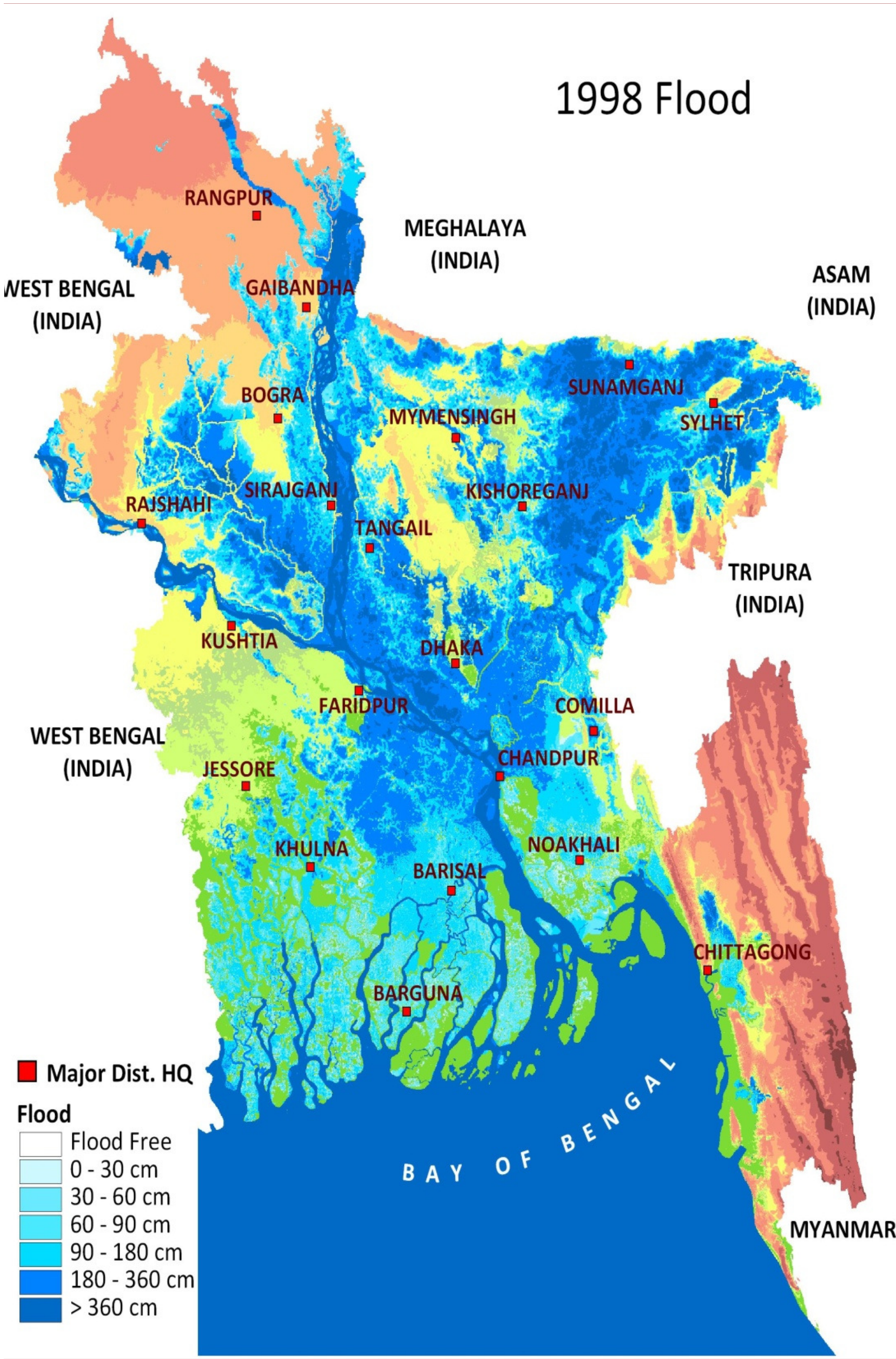
- ❖Information and real time rainfall data for the Indian catchments
- ❖New rainfall stations in Indian catchments
- ❖Calibration of Radar installed at Moulvibazar
- ❖Flash flood flow measurements

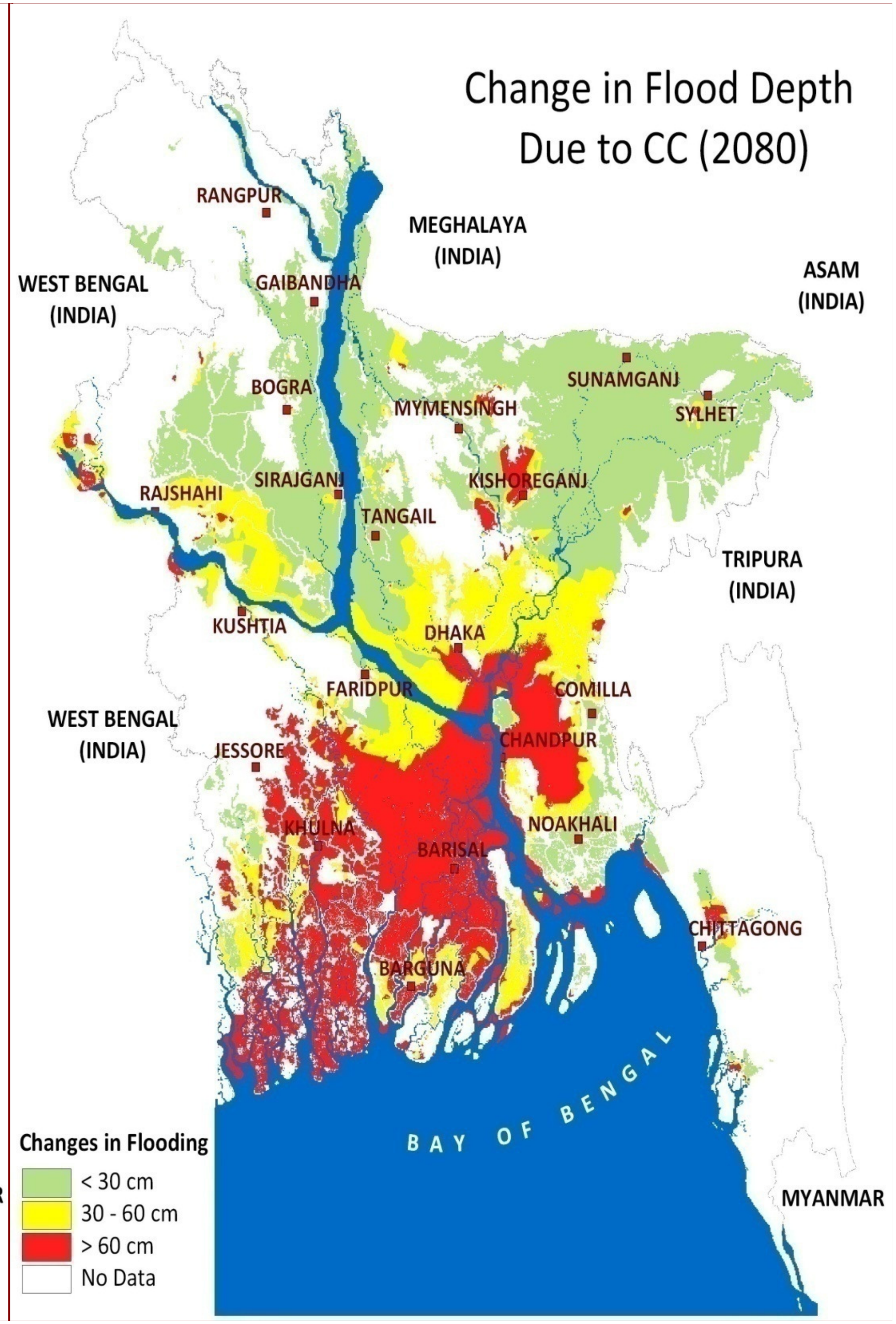
Detection Range of the Proposed Radar System



New hydrological Doppler Radar in Moulvibazar

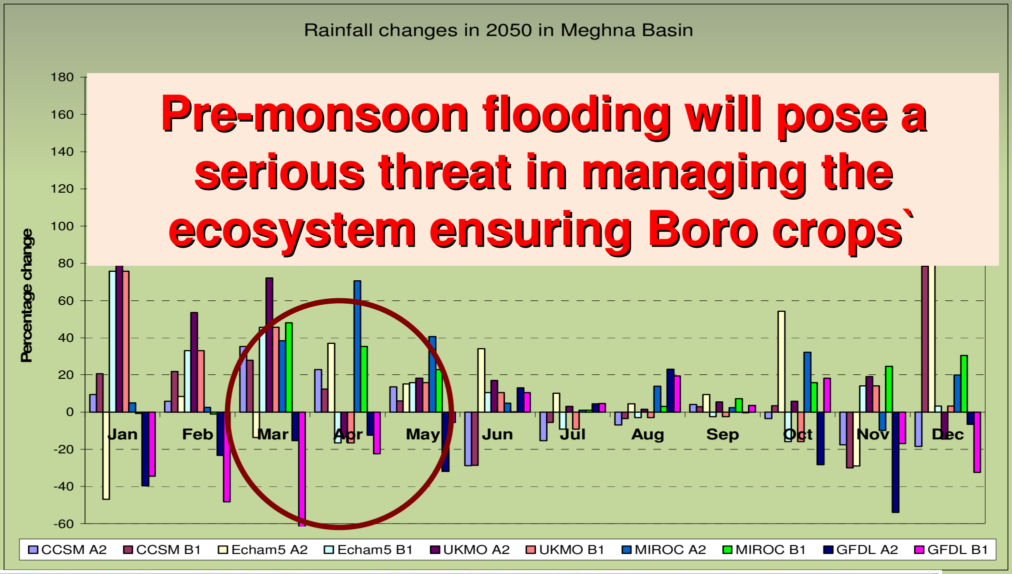
Impact of Climate Change


1998 Flood
RANGPUR
MEGHALAYA
(INDIA)
WEST BENGAL
(INDIA)
GAIBANDHA
ASAM
(INDIA)
BOGRA
SUNAMGANJ
MYMENSINGH
SYLHET
SIRAJGANJ
KISHOREGANJ
RAJSHAHI
TANGAIL
TRIPURA
(INDIA)
KUSHTIA
DHAKA
FARIDPUR
COMILLA
WEST BENGAL
(INDIA)
CHANDPUR
JESSORE
KHULNA
NOAKHALI
BARISAL
CHITTAGONG
BARGUNA
Major Dist. HQ
Flood
Flood Free
0 - 30 cm
30 - 60 cm
60 - 90 cm
90 - 180 cm
180 - 360 cm
> 360 cm
BAY OF BENGAL
MYANMAR

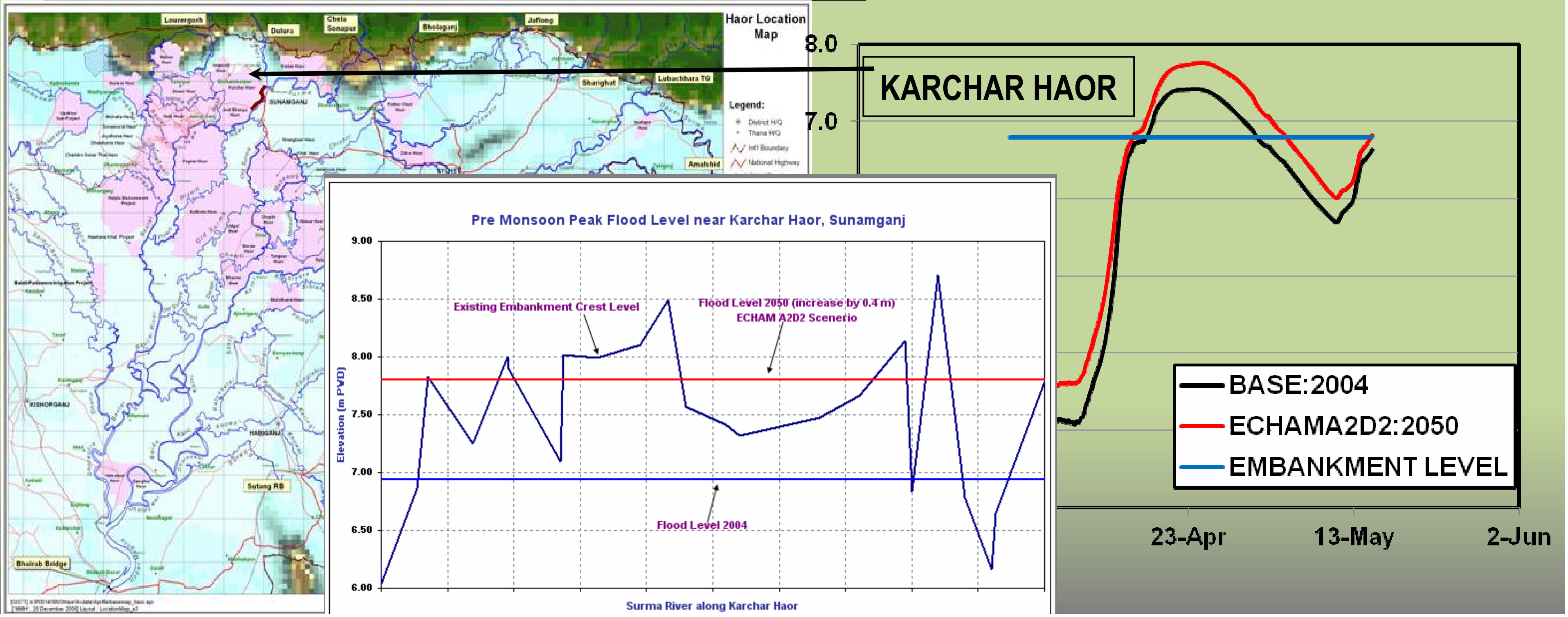

Change in Flood Depth
Due to CC (2080)
RANGPUR
MEGHALAYA
(INDIA)
WEST BENGAL
(INDIA)
GAIBANDHA
ASAM
(INDIA)
BOGRA
SUNAMGANJ
MYMENSINGH
SYLHET
SIRAJGANJ
KISHOREGANJ
RAJSHAHI
TANGAIL
TRIPURA
(INDIA)
KUSHTIA
DHAKA
FARIDPUR
COMILLA
WEST BENGAL
(INDIA)
CHANDPUR
JESSORE
KHULNA
NOAKHALI
BARISAL
CHITTAGONG
BARGUNA
BAY OF BENGAL
Changes in Flooding
< 30 cm
30 - 60 cm
> 60 cm
No Data
MYANMAR

Impact on Pre-monsoon Flood: Haor Area, Northeast

Pre-monsoon flooding will pose a serious threat in managing the ecosystem ensuring Boro crops`



LOCATION	WL_RISE
Karchar Haor, Sunamganj	0.3
Zilkar Haor, Sylhet	0.6
Kawardigi Haor, Moulvibazar	0.3



AVAILBILITY OF DATA
AND
WATER MANAGEMENT TOOLS

Data Availability in Northeast Region of Bangladesh

Hydro-meteorological data (about 40 years)

Rainfall :*44 stations*

Evaporation : *3 stations*

Water Level : *55 stations*

Discharge : 40 Stations

Spatial Data :Topographical and Landuse

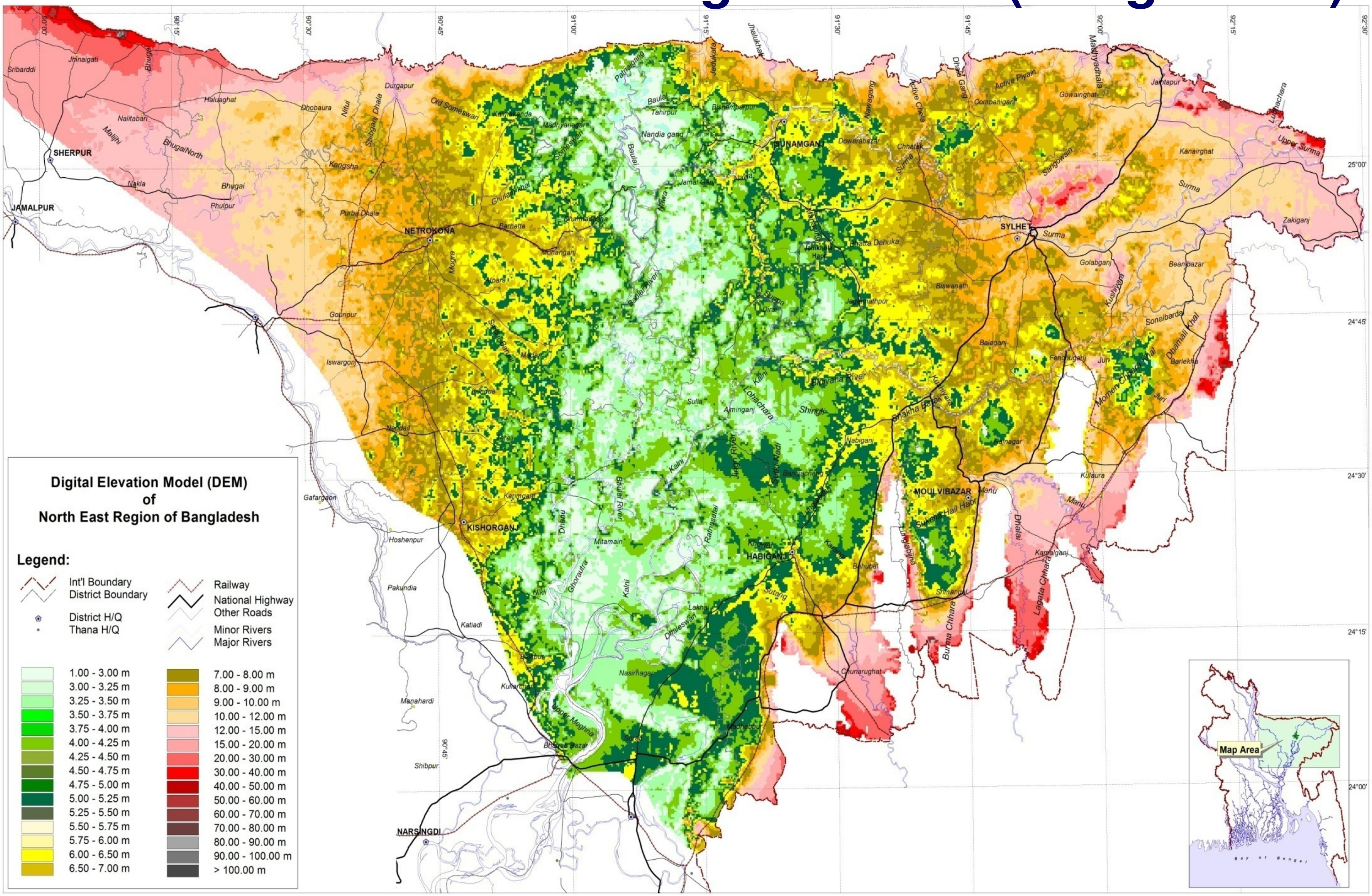
National DEM, SRTM DEM,

Information of BWDB Haor projects

GIS shapes of roads, rivers, Haor inventory

Satellite images

DEM of the Meghna Basin (Bangladesh)



Projection : Bangladesh Transverse Mercator

10 0 10 Kilometers

N

INSTITUTE OF WATER MODELLING
IWM

[GIS71] d:\P0014\5803Haor\Avdata\Aprfile\dem_ne.apr [*MMH*, 28 Sep, 2011]
Layout_DEM_NERM-a2

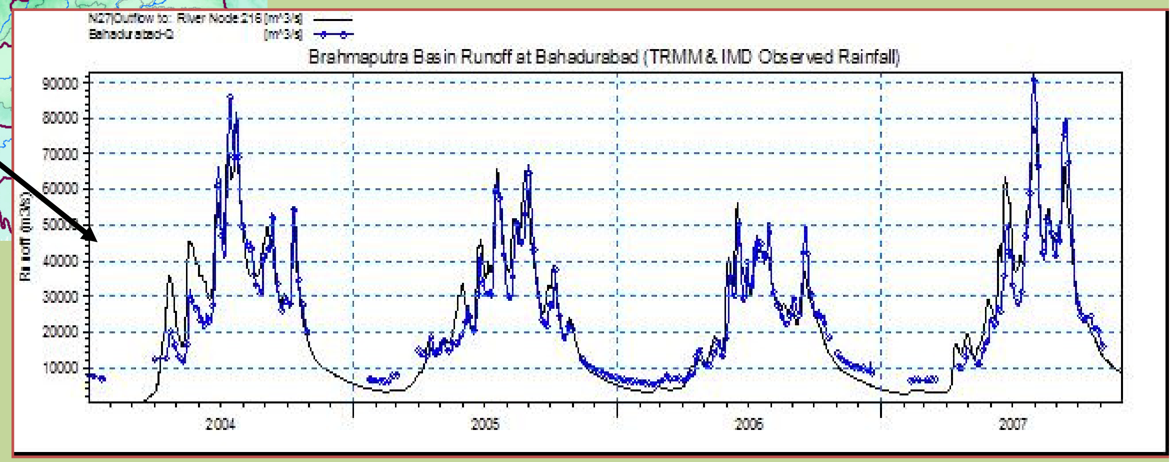
WATER MANAGEMENT TOOLS

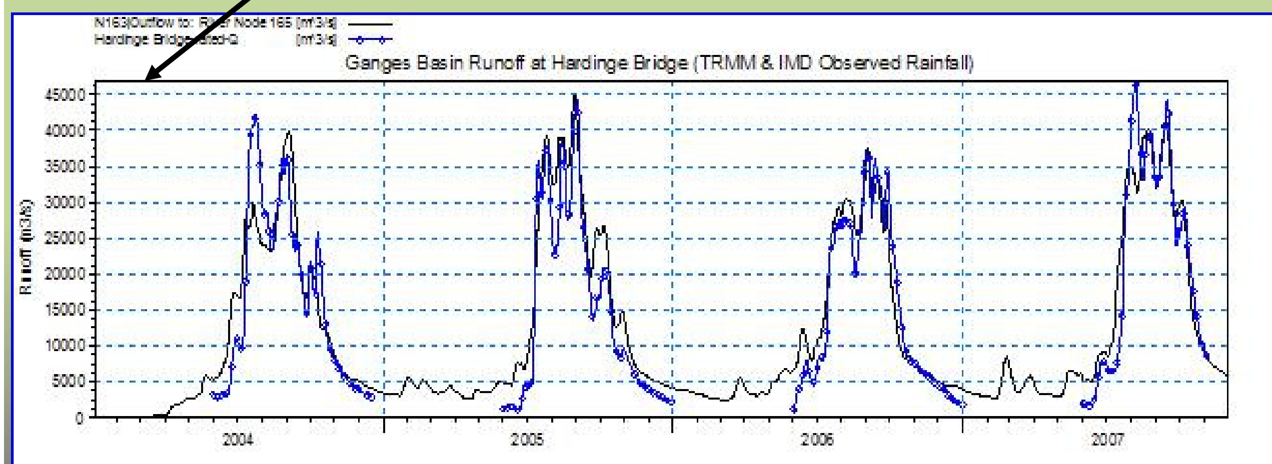
Modelling Tools

- **Basin Model for the Ganges, Brahmaputra and Meghna (GBM) Basin**
- **Hydrological Model for the Northeast Region (Meghna Basin)**
- **Hydrodynamic Model cover significant river system for North East Region**
- **Specific Project Models to address the Local Area Water Management issues and to provide solutions**

BASIN MODEL
Development and Calibration

Using MIKE Basin with Snow melt option; 95 Catchments

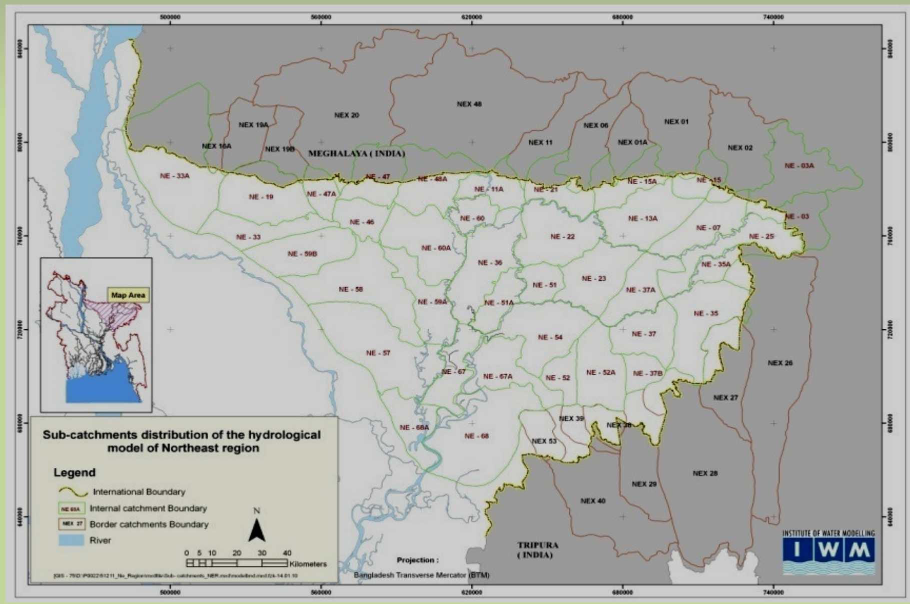


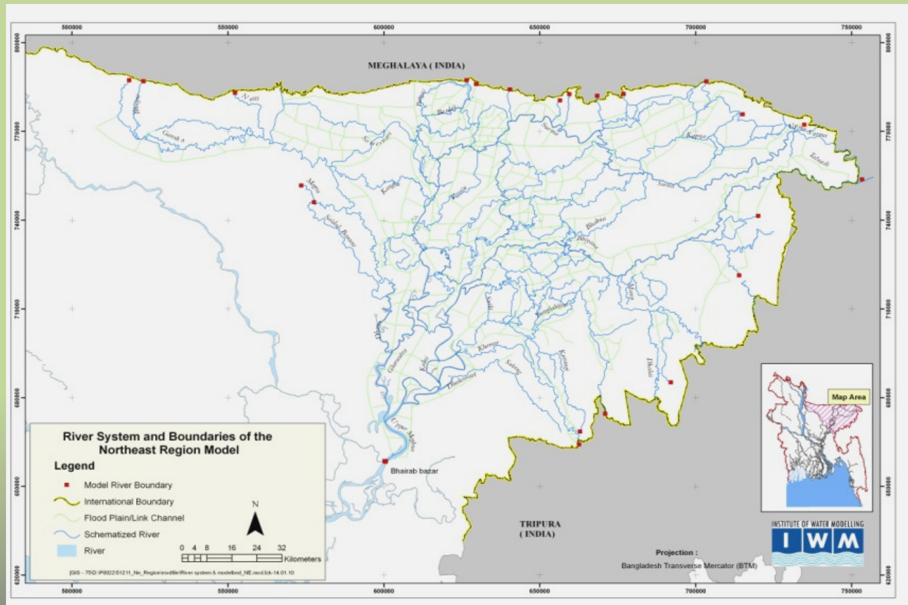


Application of Model

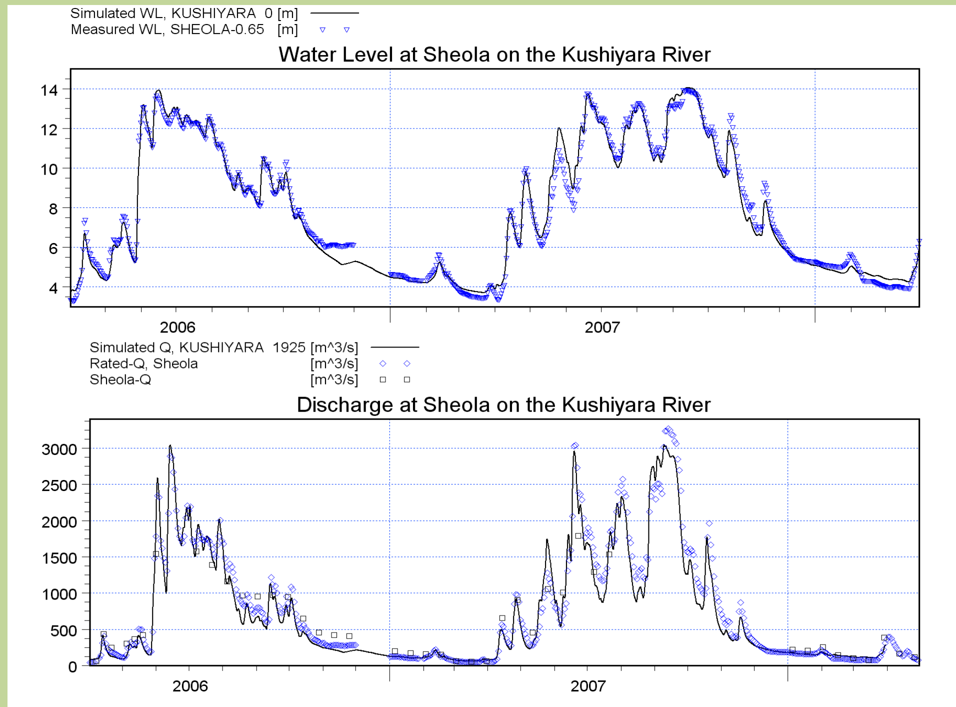
- ***Boundary Data for National Flood Model***
- ***Climate Change Study***
- ***Water Management in the GBM basin area***

Water Management Tools- Mathematical Model





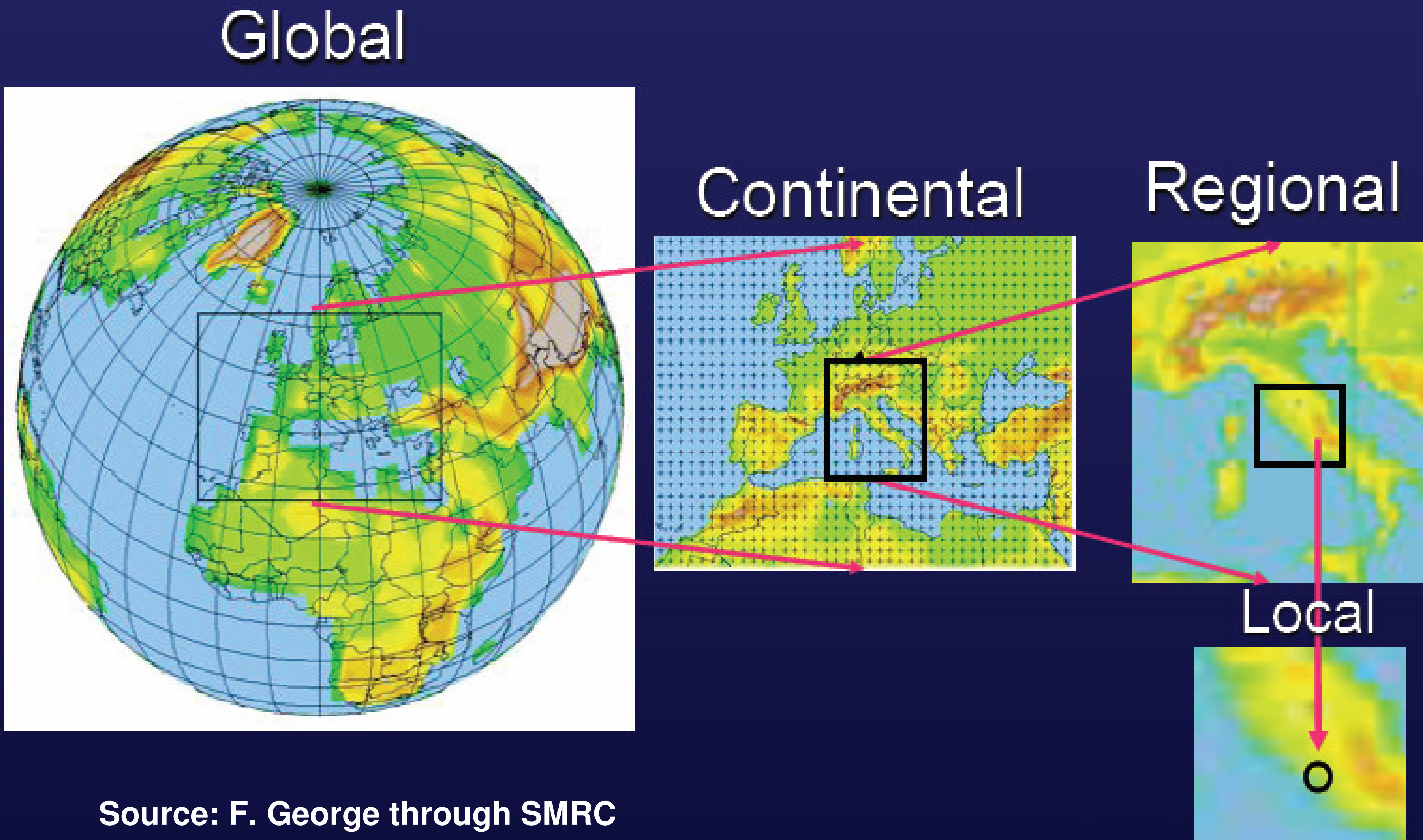
Hydrological Model to generate catchment–runoff; Hydrodynamic model to generate water level and flows and GIS for flood mapping



Model is used for various water management option studies including Climate Change

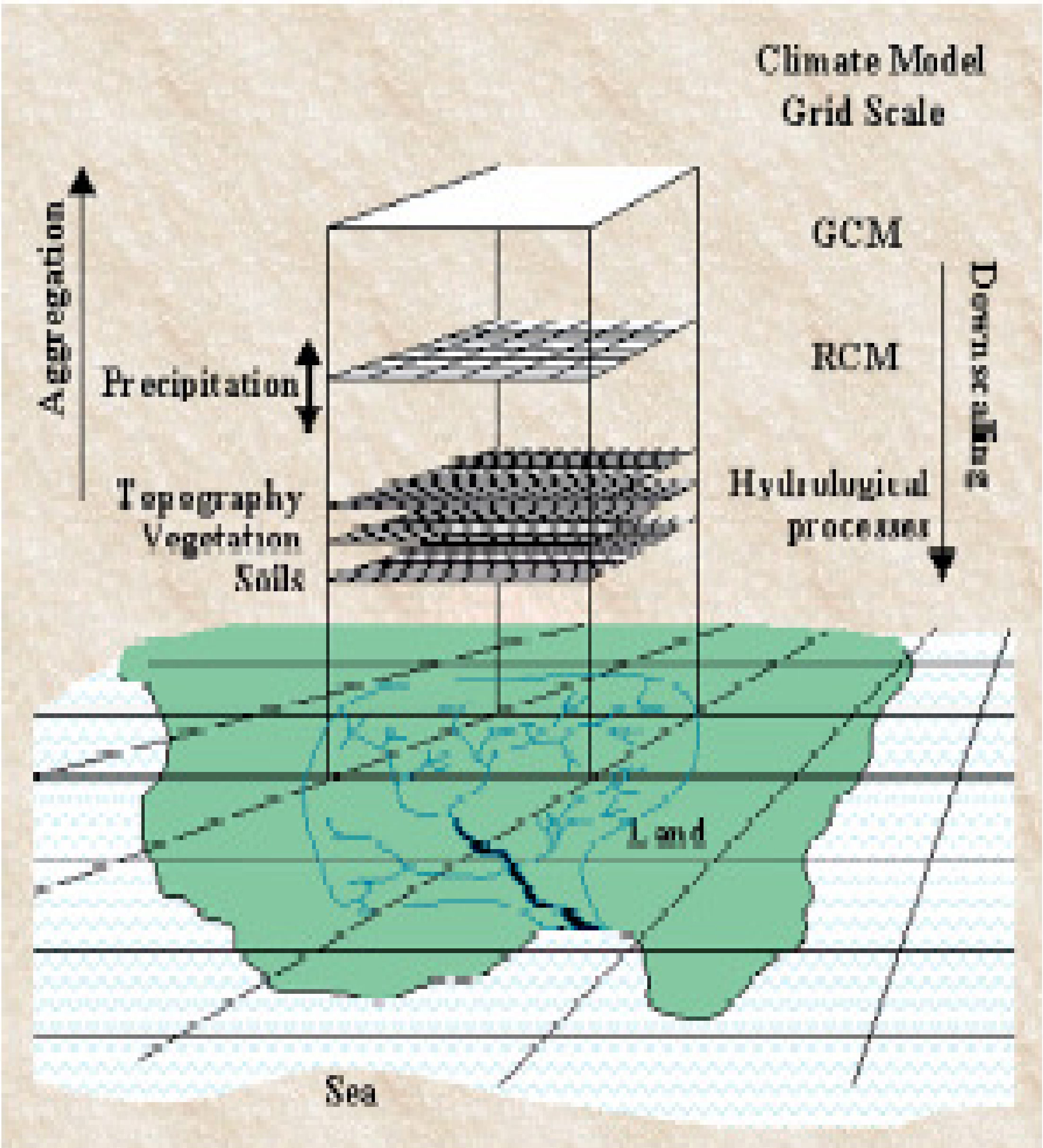
From global to regional climate modeling

The spatial scales of climate processes



Source: F. George through SMRC

Downscaling of GCM



Techniques

❖ **Dynamic Downscaling or *mesoscale simulation***

- nest a finer-scale grid (e.g., 10 km x 10 km) within a GCM over an area of interest

❖ **Statistical Downscaling *or empirical downscaling***

- based on CC parameters for historical period and

- GCM parameters for same past period

Way forward

Methods to improve flash flood forecast in NE region:

- **Continuous WL and RF measurements at border**
- **Meteorological forecast**
- **Measurements inside India**

Way forward contd.

- There are knowledge gaps right from downscaling of the climate model to the considerations of blending meteorological science with the hydrology. Capacity building in these areas will be of prime importance.

- Regional cooperation at the basin level for prediction of climate change impacts and adaptation measures, sharing of knowledge and development of resources (flood moderation and forecasting, navigation etc.)

- Models available in Bangladesh need to updated and upgraded with local level information so that it can be utilised for local level flood management including flood forecasting, flash flood forecasting with increased lead-time

Cost of doing nothing…… retreat to the top of the Embankment

Thank You