HKH-HYCOS regional flood information system – and its benefits to SAsiaFFG system

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Outline of presentation

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- Flood disasters in the Himalayan region
  - Key issues
- HKH HYCOS achievements
- Development of a regional flood outlook
  - Why a regional flood outlook?
  - Flood outlook model
    - Data inputs
    - Data assimilation
    - Calibration and validation
    - Flood outlook/flood forecast
    - Performance of the model
- Opportunities for cooperation
- Role of ICIMOD in the SAsiaFFG system

Intergovernmental, knowledge, learning and enabling centre

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Member countries

- Afghanistan
- Bangladesh
- Bhutan
- China
- India
- Myanmar
- Nepal
- Pakistan

Mission

Enable sustainable and resilient mountain development for improved and equitable livelihoods through knowledge and regional cooperation.

Vision

ICIMOD's Vision is that the men, women, and children of the Hindu Kush Himalayas enjoy improved wellbeing in a healthy mountain environment;

Disaster statistics from 1985-2014
Himalayan region countries

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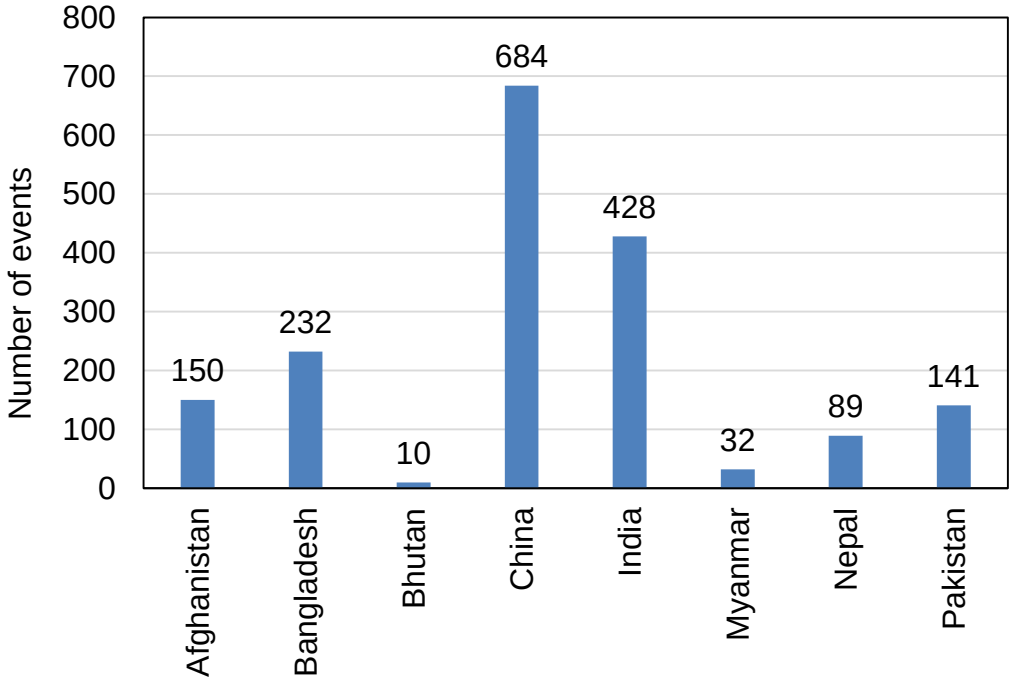
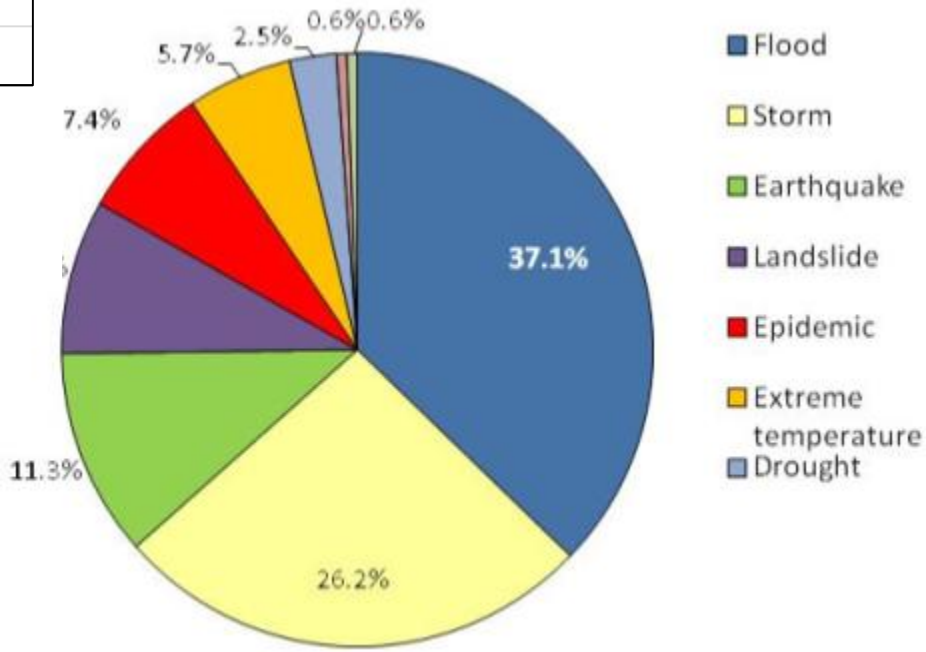


(Source: EM-DAT – The OFDA/CRED International Disaster Database)

The region has an average of 60 disaster events each year



On average, annually more than 24,000 people are killed and 160 million affected by natural disasters .

One-third of these disasters are floods

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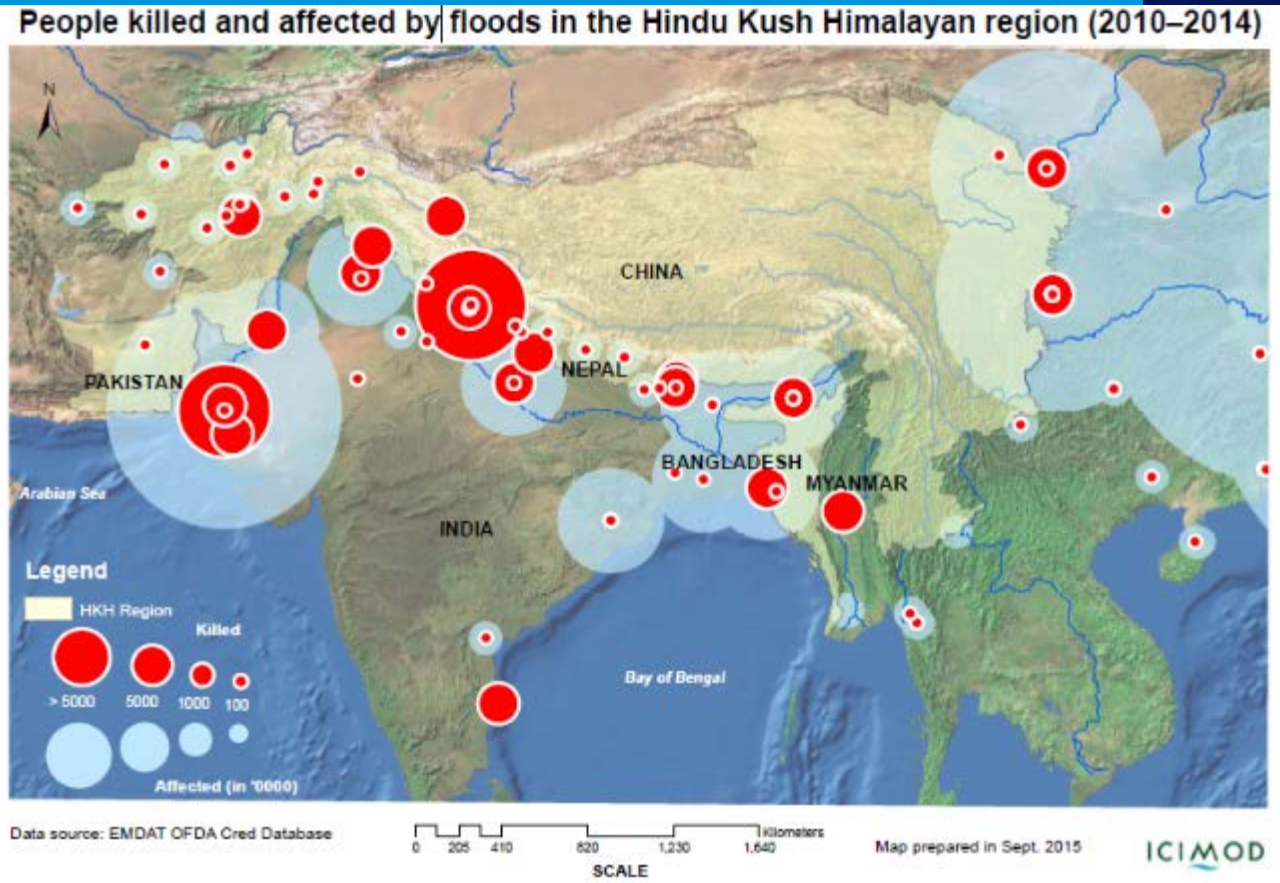

- Transboundary floods - shared vulnerability across national borders
- Globally, 10% of all floods are transboundary, but they cause over 30% of all flood causalities and displace close to 60% of all those displaced by floods (Bakker 2006)

Increasing frequency and magnitude

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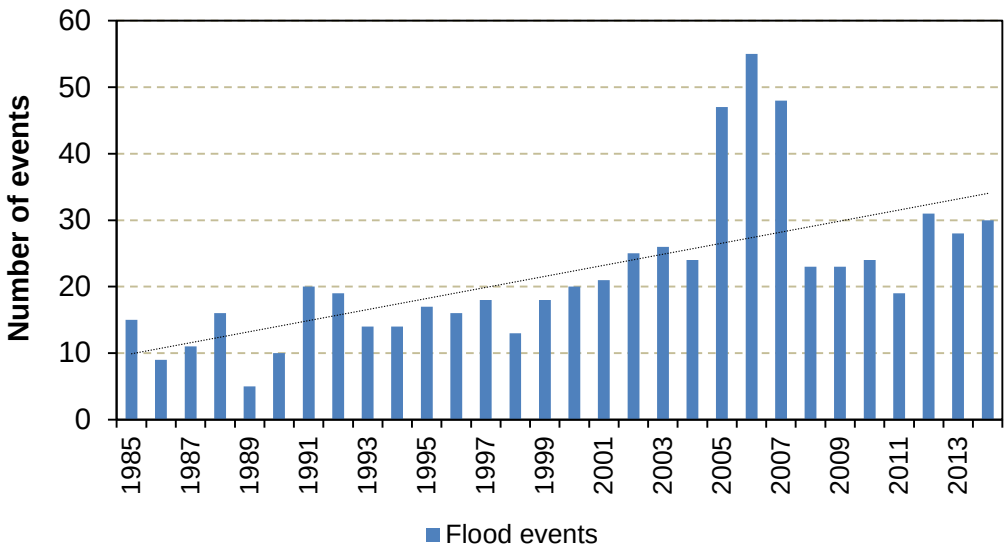

Pakistan floods 2010 (2000 killed)

Uttarakhand floods 2013 (>5000 killed)

Climate change is magnifying risks and increasing disaster losses (UNISDR 2015)

Economic losses from weather- and climate-related disasters have increased, but with large spatial and interannual variability (IPCC, 2012)

Key issues

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- There is a diversity of technical, scientific, and institutional capacity
- Opportunities for sharing knowledge, experiences and know-how
- Application of state of the art tools and technologies can provide timely and reliable flood forecasting and EWS systems to save lives
- There is limited exchange of real-time data especially across national boundaries – increase lead time
- The integration of risk information into EWS is still weak.

Innovation in technologies for end to end flood early warning system

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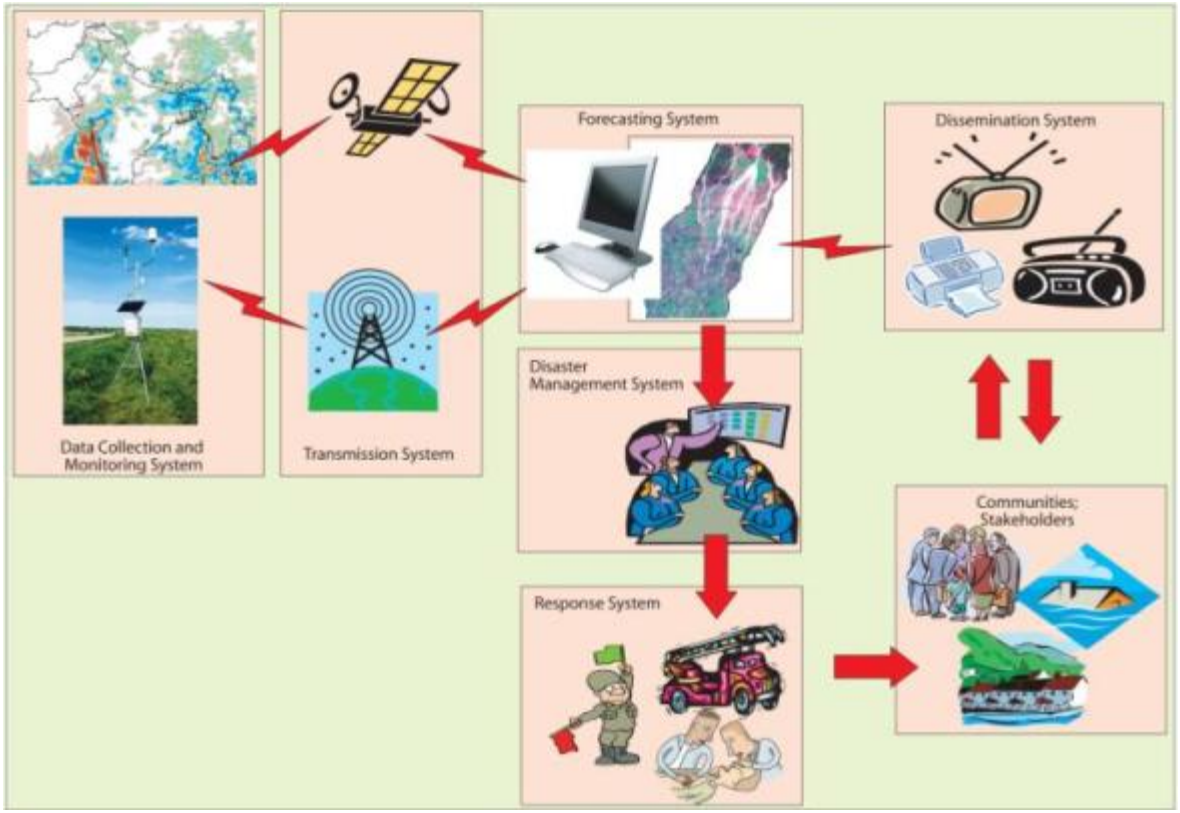

- Advancement in technology : real-time data through sensors.
- Data transmission through CDMA, GPRS/GSM, and satellite iridium.
- Space based technology using earth observations are increasing the lead time, filling data gaps and risk mapping.

Global WMO WHYCOS framework

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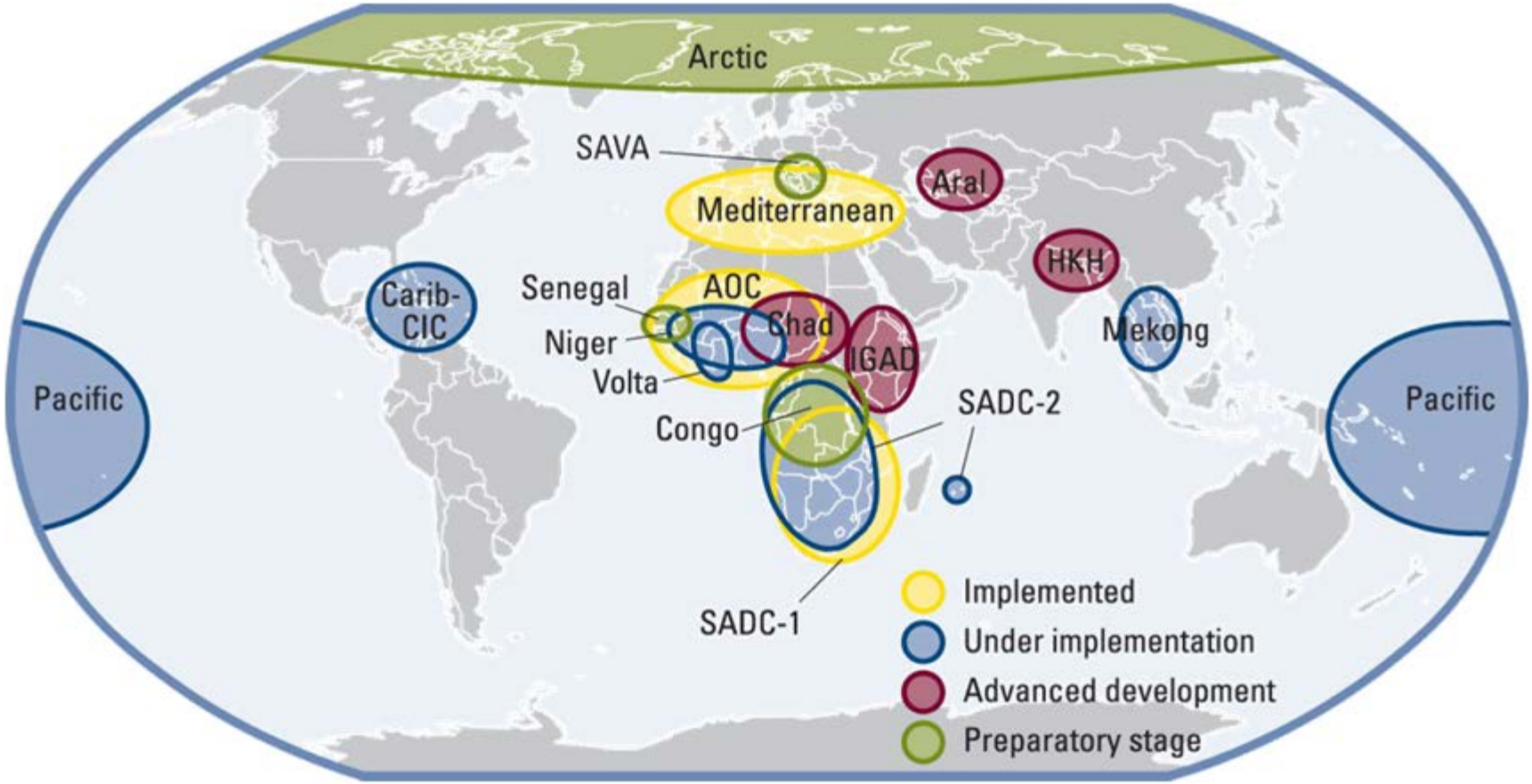

- To improve the basic observation activities,
- To strengthen the international cooperation and
- To promote free exchange of data in the field of hydrometeorology.

HKH-HYCOS: Setting up monitoring stations and establishment of real-time flood information systems

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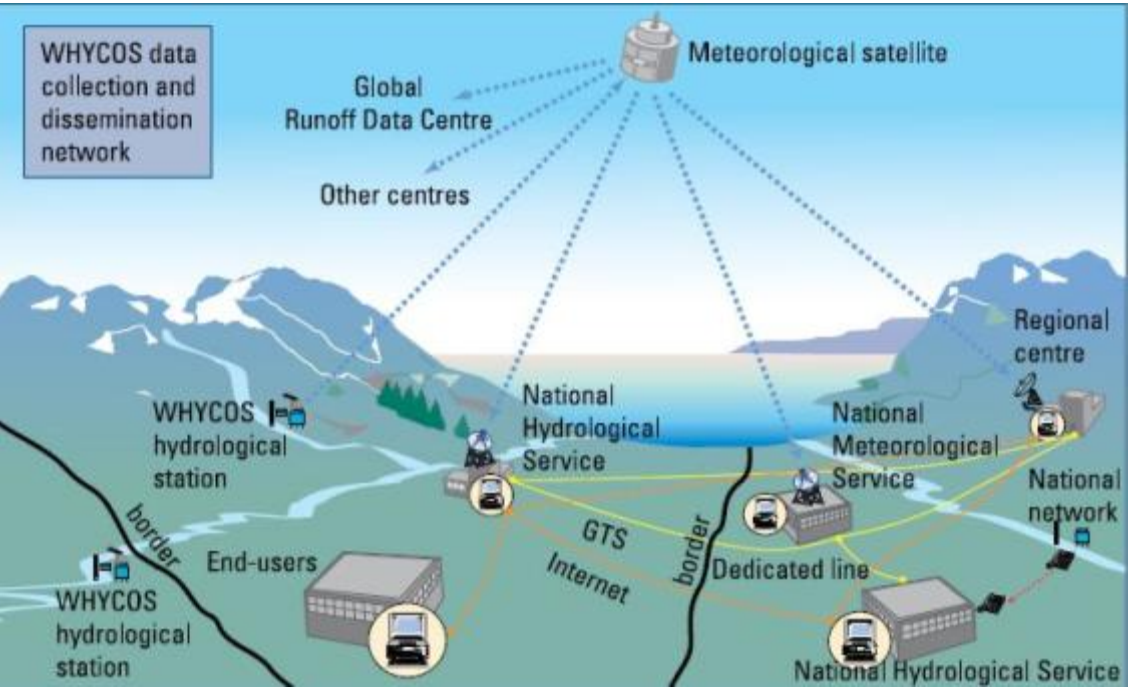
‘Making Information Travel Faster Than Flood Waters’



Establishment of a Regional Flood Information System in the HKH-Region - Timely exchange of flood data and information through an accessible and user friendly platform

HYCOS is a vehicle for technology transfer, training, and capacity building

Project components

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Overall objective: to minimise the loss of lives and property by reducing flood vulnerability in the HKH region

Five distinct components:

Framework for cooperation

Regional flood observation network

Regional flood information system

Training and public awareness

Planning of a full-scale regional project

Project Duration	5 years (Dec 2009 – Dec 2015) and 2016 with ICIMOD support
Partners	Hydro-meteorological services of six participating countries - Bangladesh, Bhutan, China. India, Nepal, and Pakistan
Facilitating Agency	ICIMOD and World Meteorological Organization
Funding	Government of Finland

Achievements: modernization of observation network

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- 38 hydrometeorological stations upgraded in four countries (Bangladesh, Bhutan, Nepal, Pakistan)
- Access to > 300 Global Telecommunication Stations of WMO
- Additional stations contributed by partners

Achievements: real-time hydrometeorological stations

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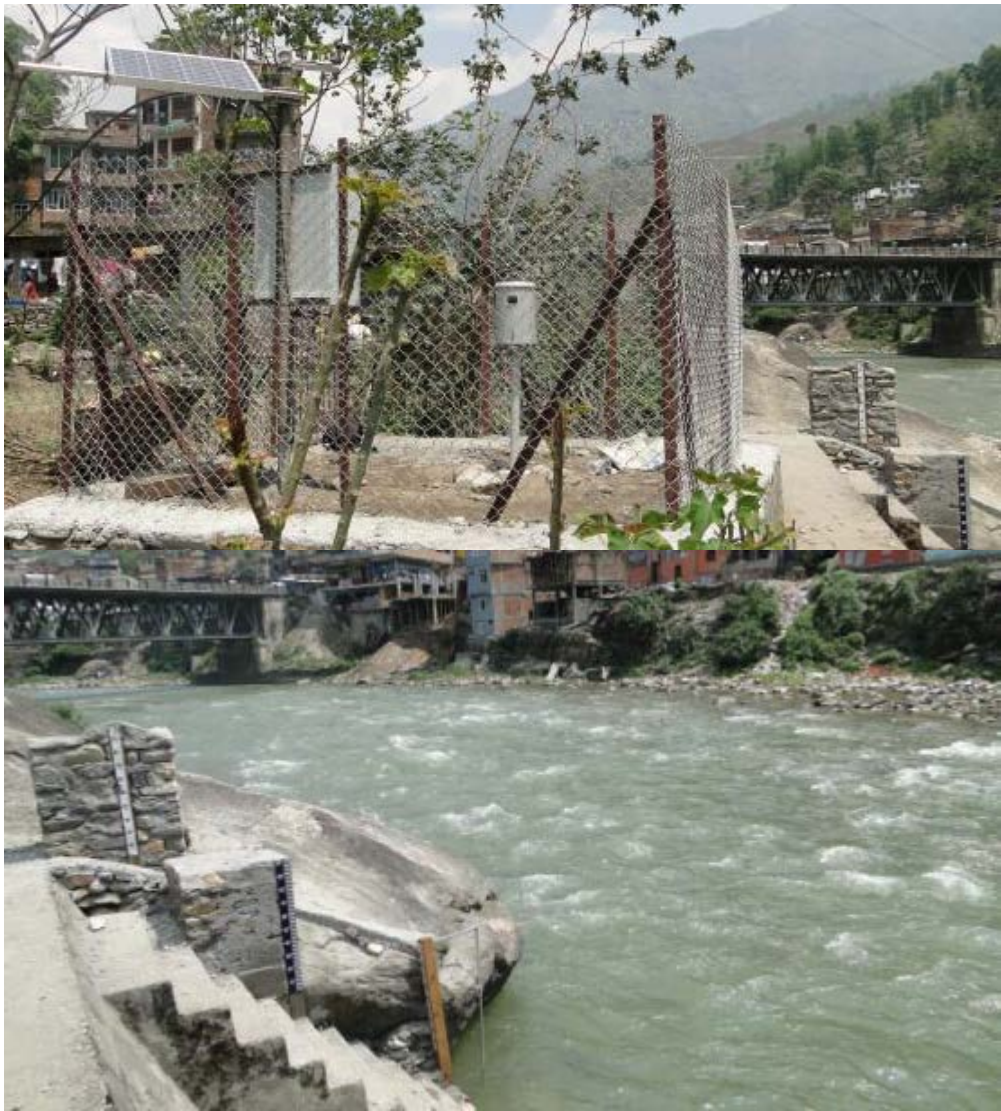
- Use of latest technology for data collection
- Transmission (mobile phone using CDMA/ GSM, satellite communication)
- Establishment of regional and national flood information systems



Availability of upgraded stations and GTS stations

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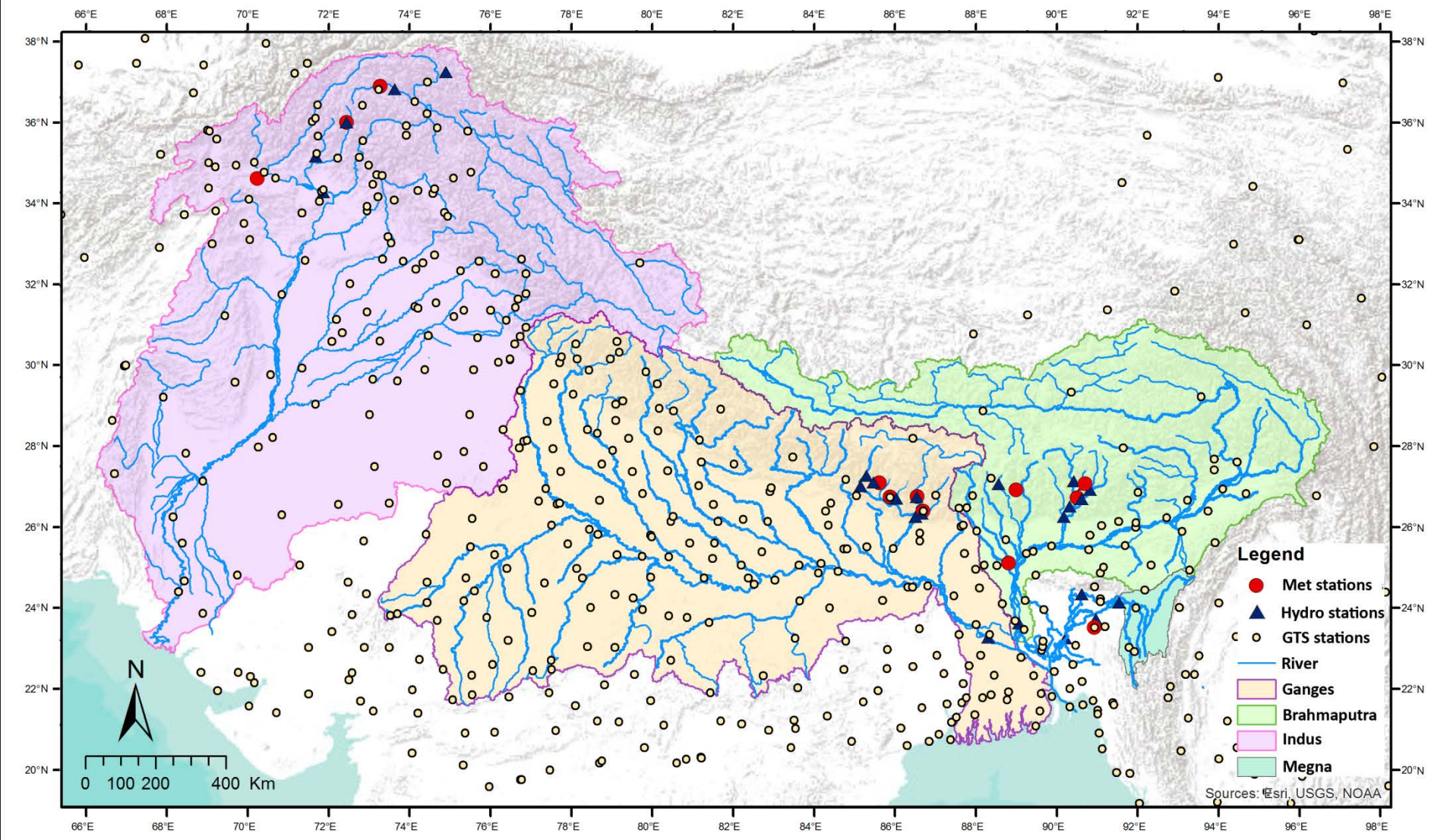

HKH HYCOS
Regional Flood Information System

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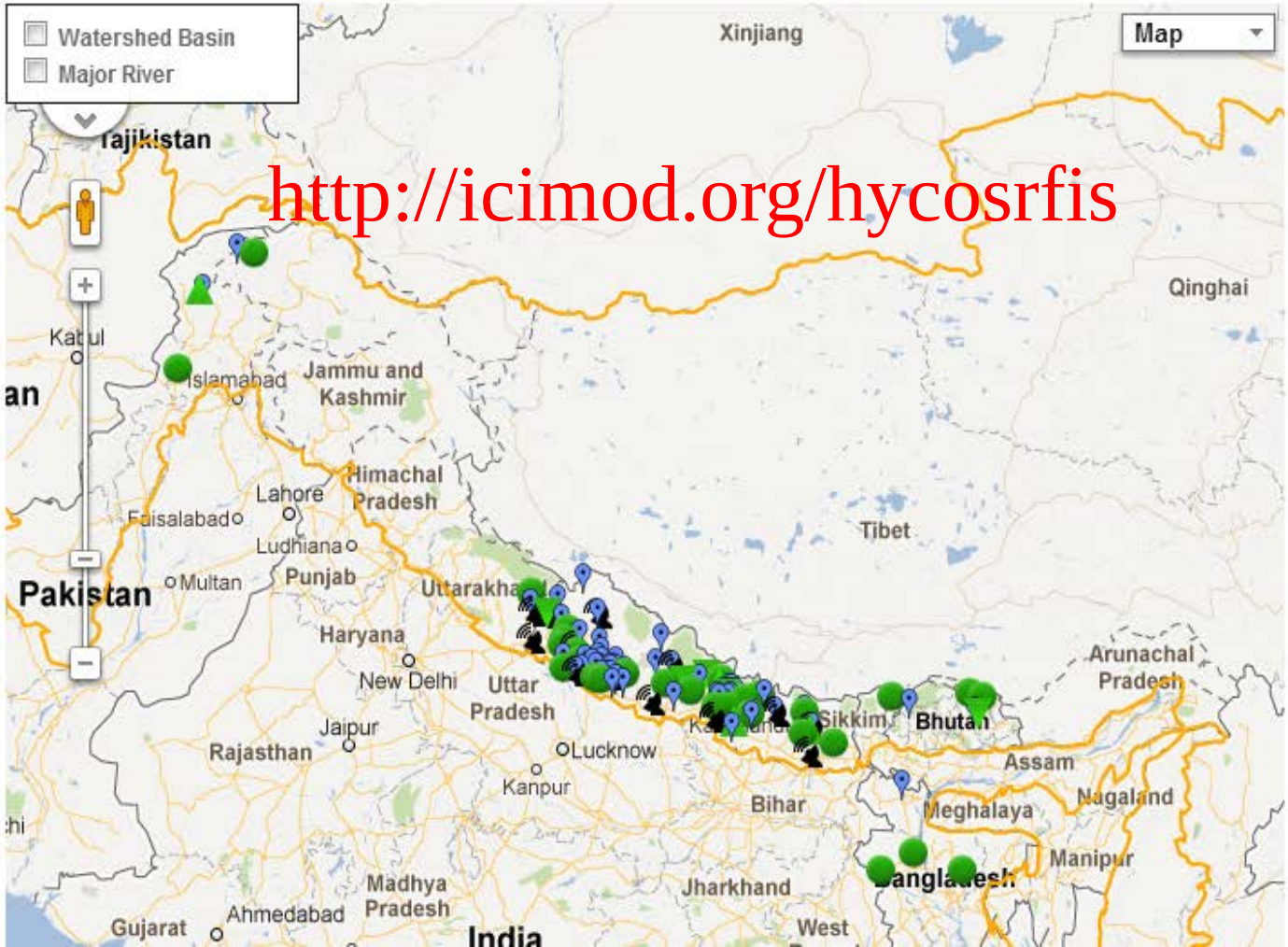
HKH HYCOS
About
- [x] Bangladesh
  - Kurigram
  - Sirajganj
  - Lalon Shah Bridge
  - Bhairab Bazar
- [x] Bhutan
  - Korilla
  - Sumpa
  - Uzorong
  - Trashi Yantshe
  - Hongtsho
  - Gunitsawa
- [x] Nepal (Hycos)
  - Jiri
  - Pachuwarghat
  - Mulghat
  - Dhankuta
  - Busti
  - Tumlingtar



http://icimod.org/hycosrfis

Capacity building and public awareness

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- Mekong Exposure visit
- 1 Regional training is installation, operation and maintenance of equipment
- 1 Regional training in Database management
- 2 Regional training on flood outlook
- 4 National level trainings held in Bhutan , Pakistan, Nepal and Bangladesh
- Local trainings during installation held during each station upgrade
- Training materials and Standard Operating Procedures (SOP) developed for the hydrometeorological equipment

Achievements
Regional flood information system
Regional flood outlook

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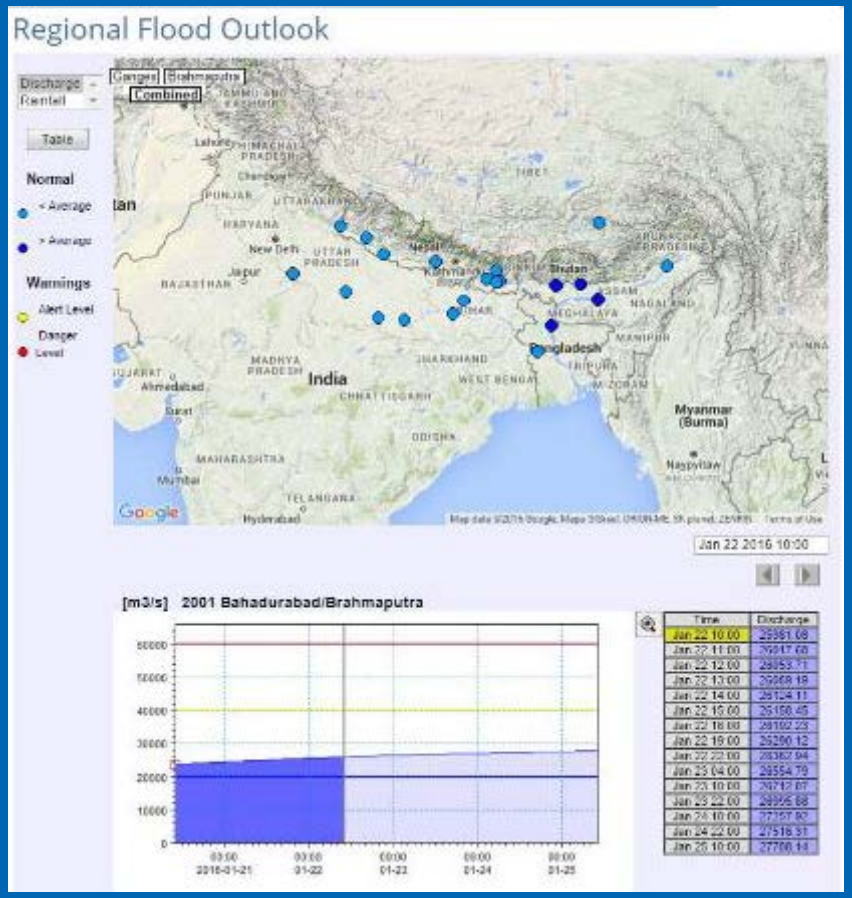

Objective:

- To develop a flood outlook system for the Ganges- Brahmaputra basin utilizing freely available data and weather forecasts

The outlook which, in essence, is a regional flood forecast based on a **mathematical model** describing the **precipitation-runoff process** in the catchments and **hydrodynamic flood routing** along the river system.

The regional flood outlook system

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National RTDAS

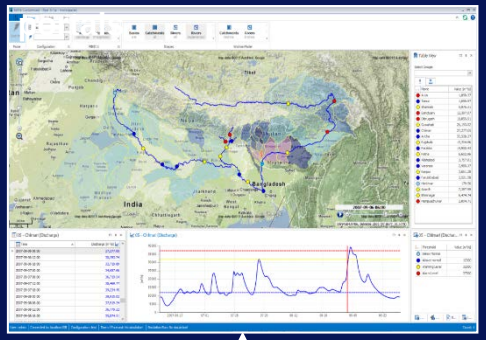
HKH-HYCOS

DATA BASE
Historical data
Real-time data

WEB data

QPF
Met-forecasts

National & regional flood information



Forecasting
MIKE Customised
Real-time platform

Calibrated Models
(RR-HD)

COMMUNICATION
Real-time
Flood information

WEB

Mobile
E-mail

Conceptual 1D model

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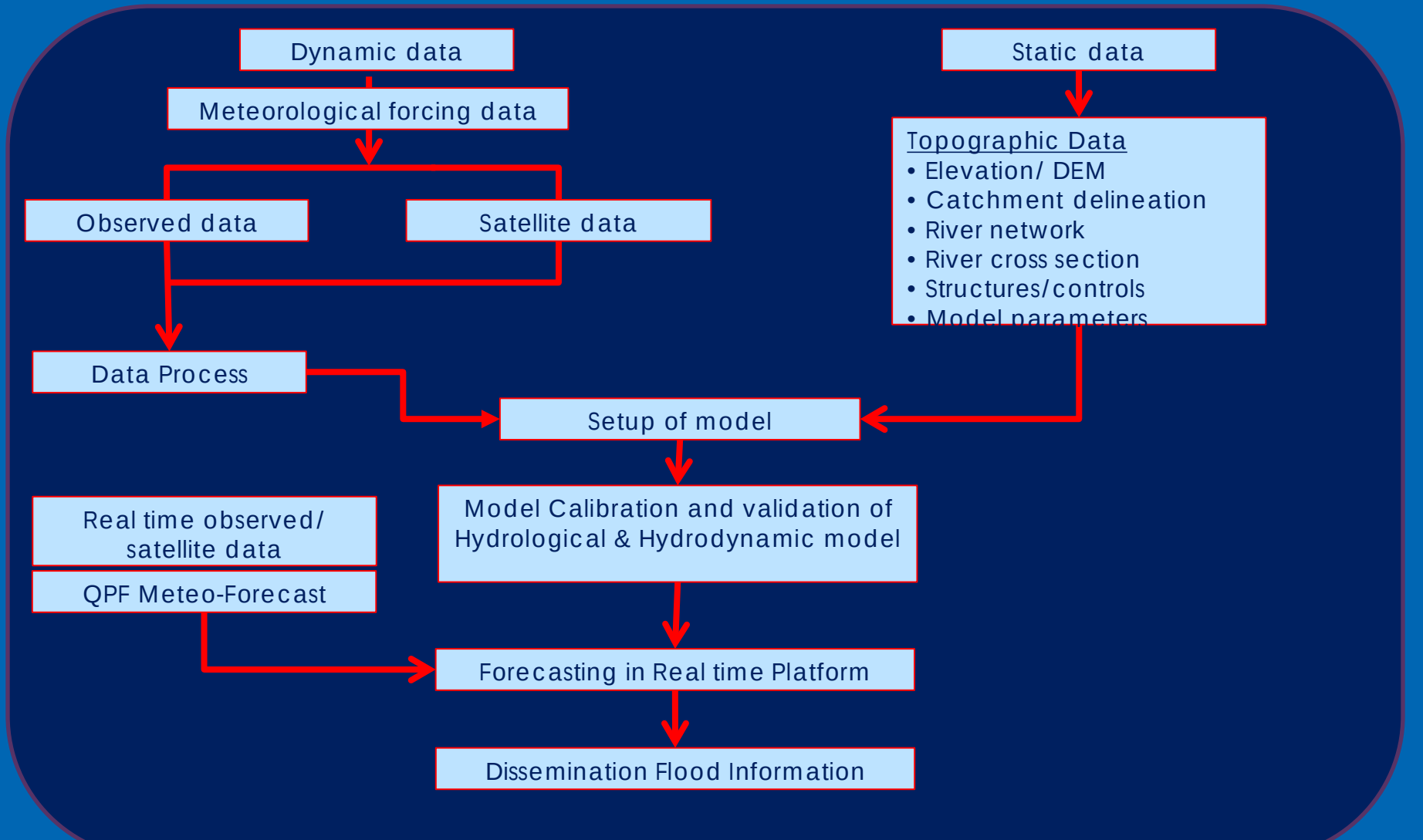

Data/ tool used for modeling

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Observed data

- Rainfall (Bangladesh, Bhutan & Nepal)
- Temperature (Nepal)
- Discharge (Bangladesh, Bhutan & Nepal)
- Water Level (Bangladesh & Nepal)

Topography

- STRM 90m images
- Cross section (India & Nepal –Koshi only)

Software/ tool

- MIKE Zero platform
- ARC VIEW, Google earth
- Excel, Visual Basic, Python & R script

Satellite data

- TRMM Rainfall (3B42) & (RT)
- APHRODITE Temperature (V1204)
- Global ET(GDAS)
- MODIS Snow accumulation
- GFS Rainfall/Temp

Pilot basins: river network & catchment delineation

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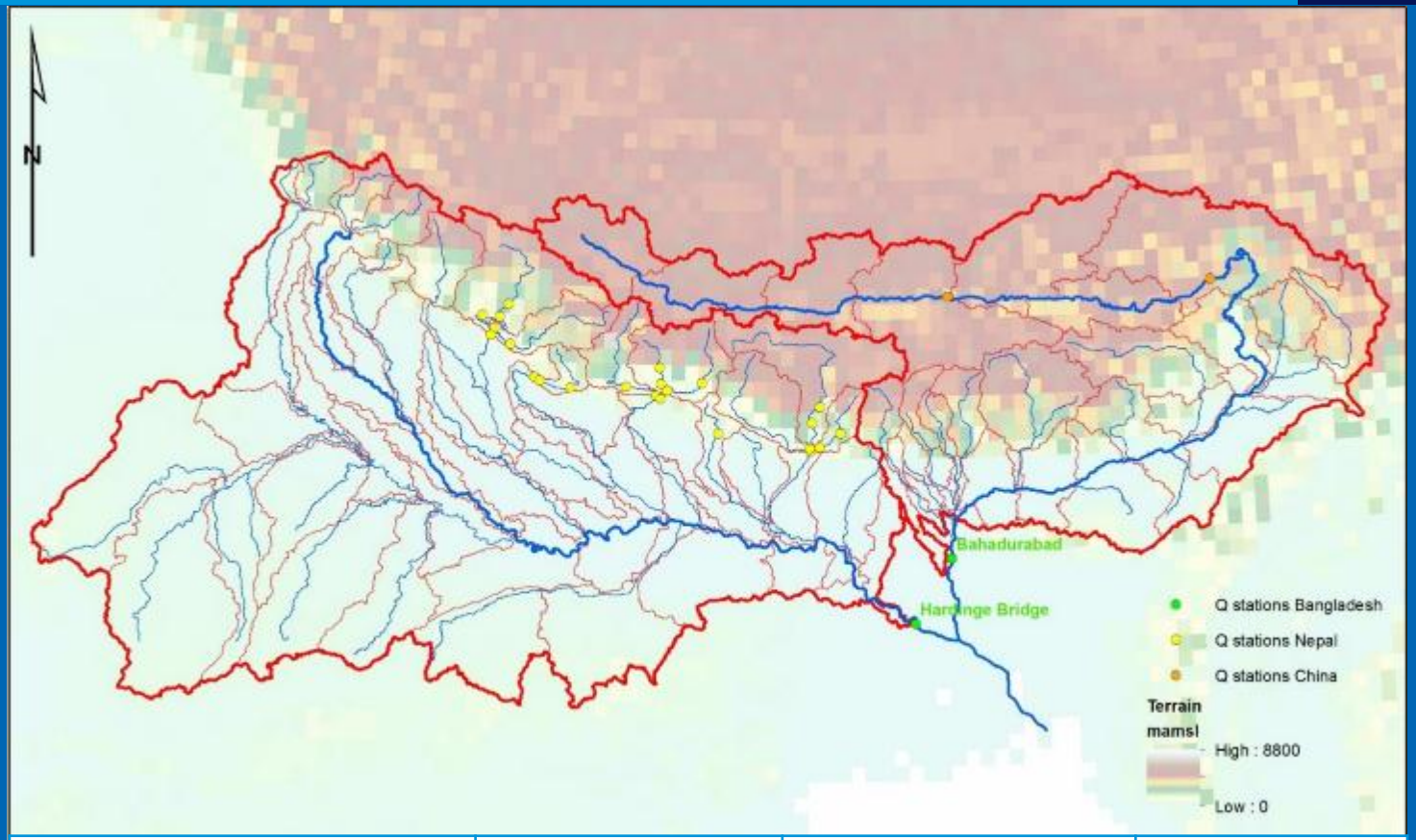

Basin	Ganges	Brahmaputra	Total
Rivers	31	15	46
Catchments	53	33	86

Regional flood outlook setup

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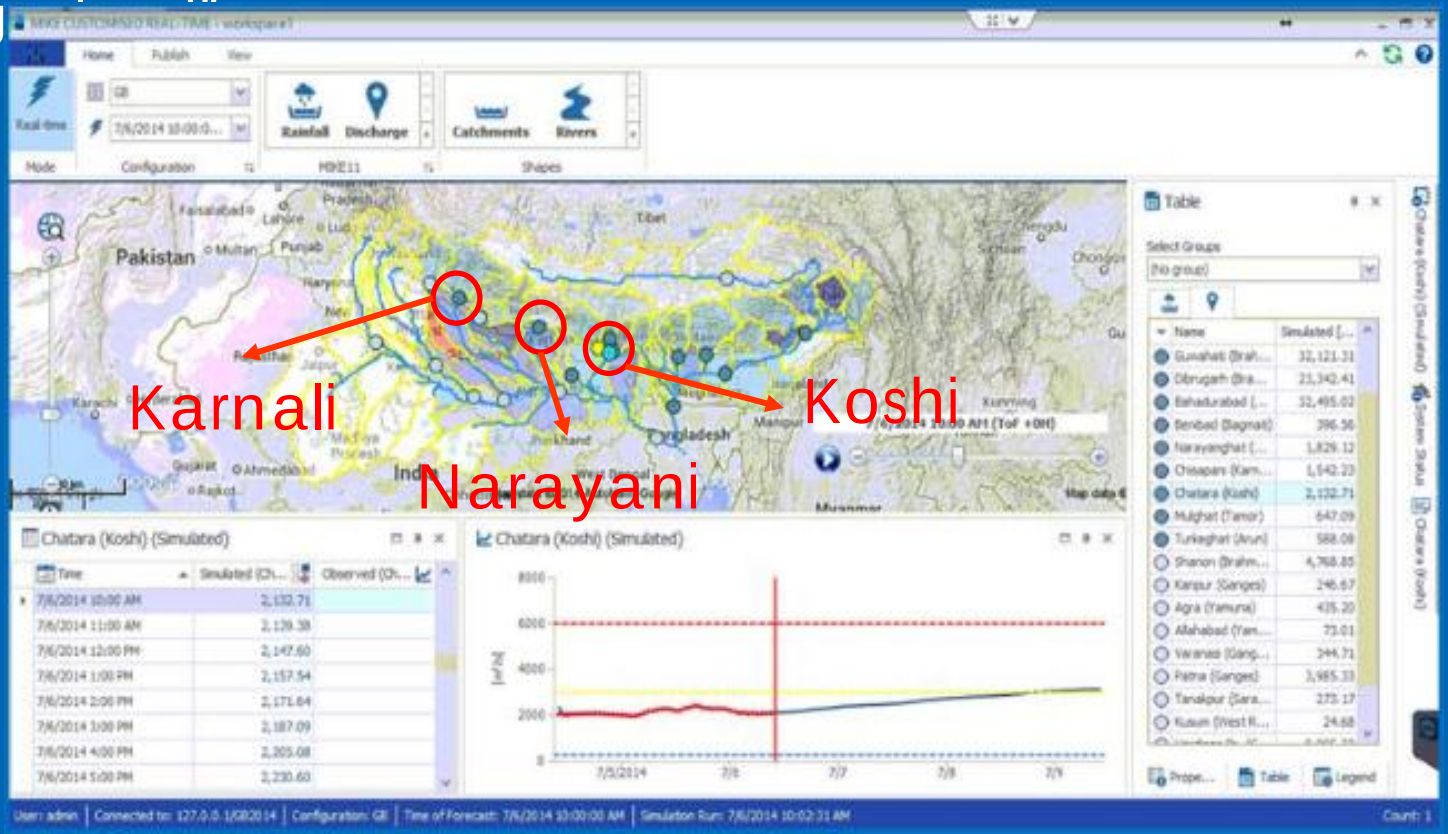
- Setup of a real-time forecasting system for GB Basin
- 21 nodes have included for flood outlook in GB- basin with 3 days lead time
- Currently focus on major rivers of Nepal with ”Alert level” and ”Dang



Preparation of rainfall data

Merge observed data and TRMM(3b42) data

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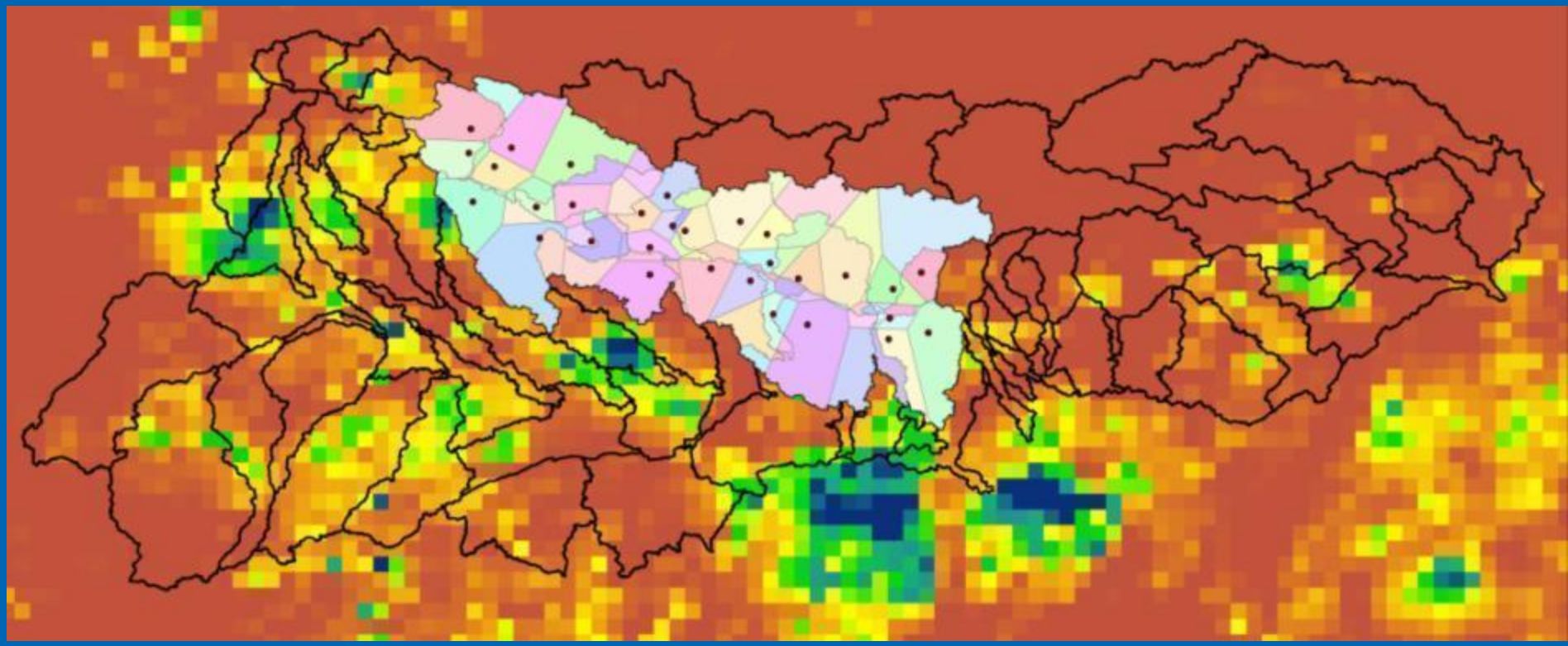
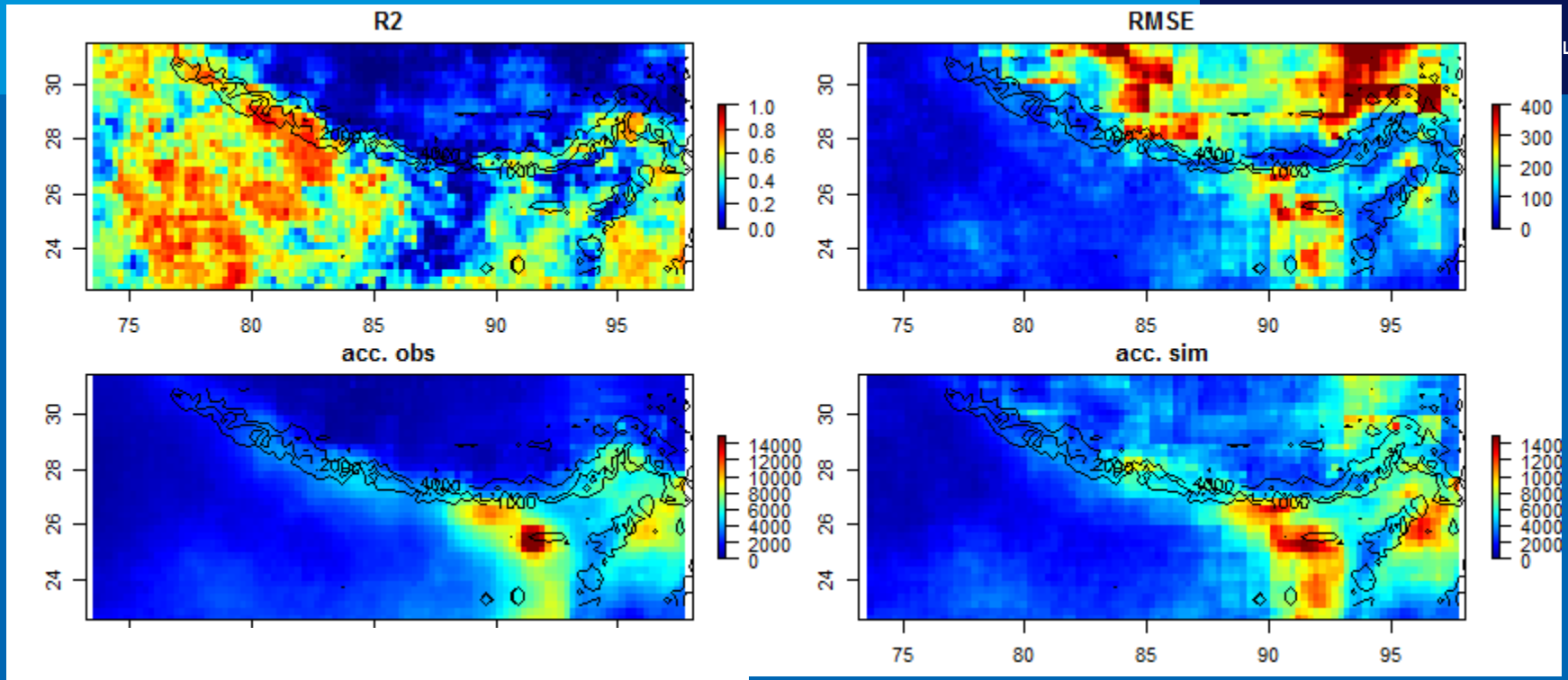


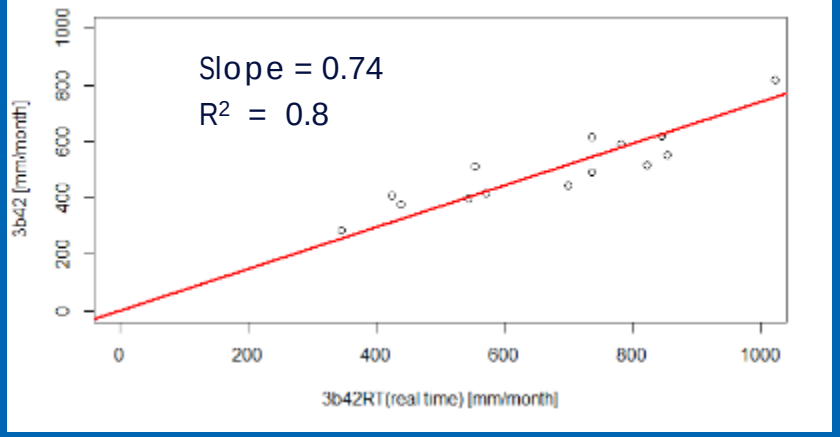
Spatial Resolution : 0.25 degree

Temporal Resolution : Daily

Source : NASA

Bias correction Satellite data

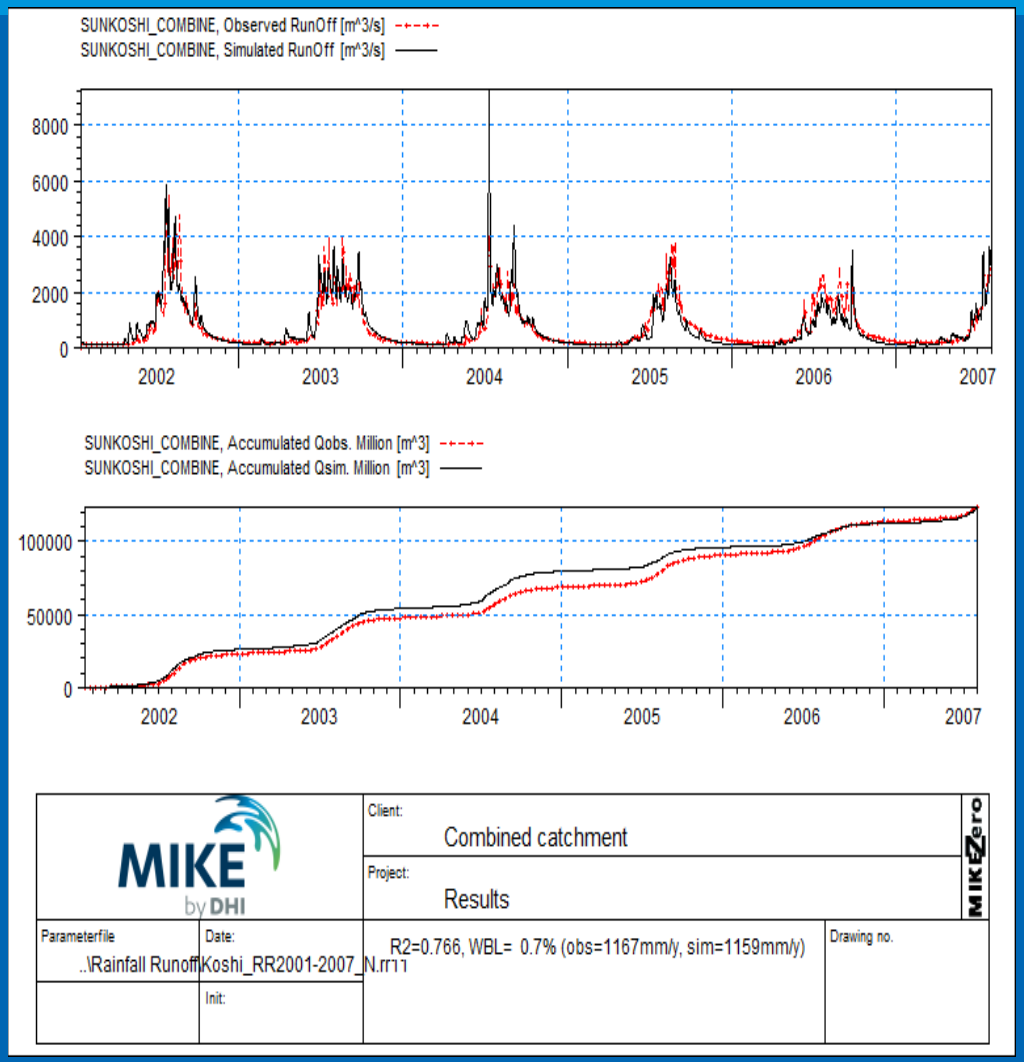


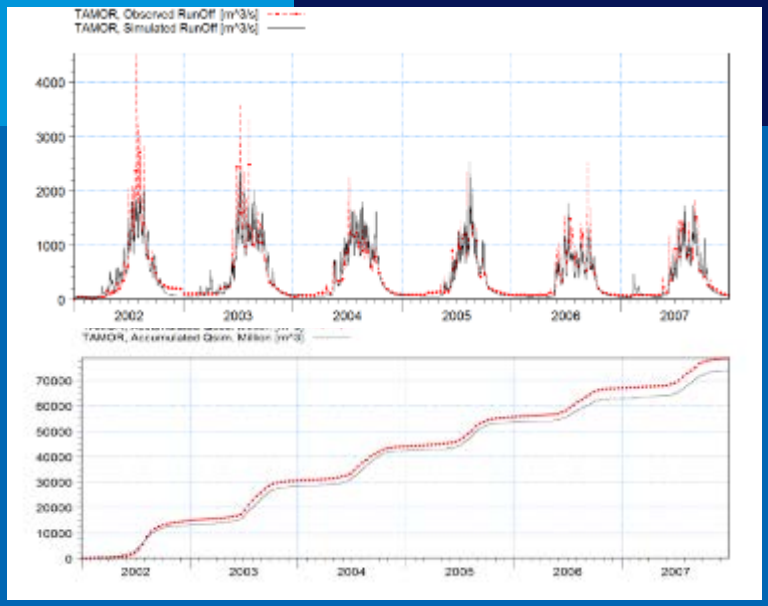


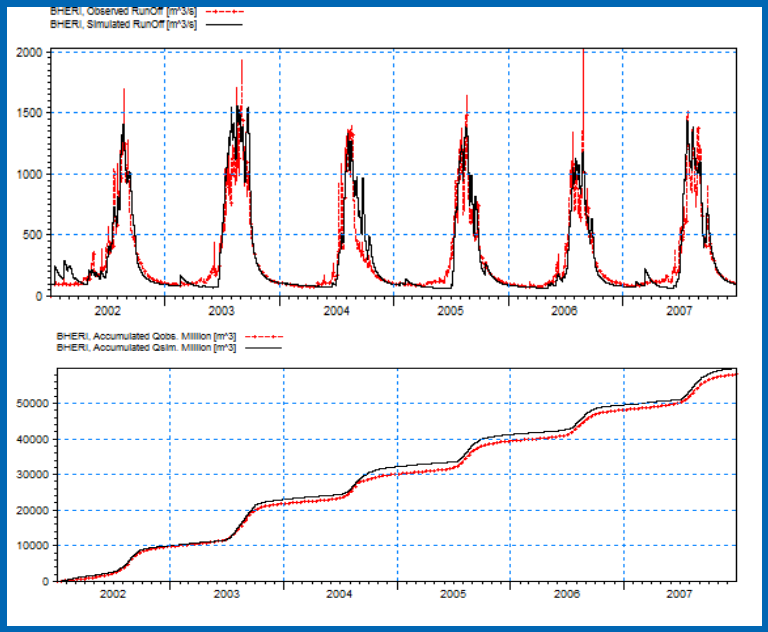
Linear regression in each cell point,

Between monthly values in years 2000 – 2013

Calibration of rainfall-runoff (NAM) model







Simulation comparison - Bahadurabad

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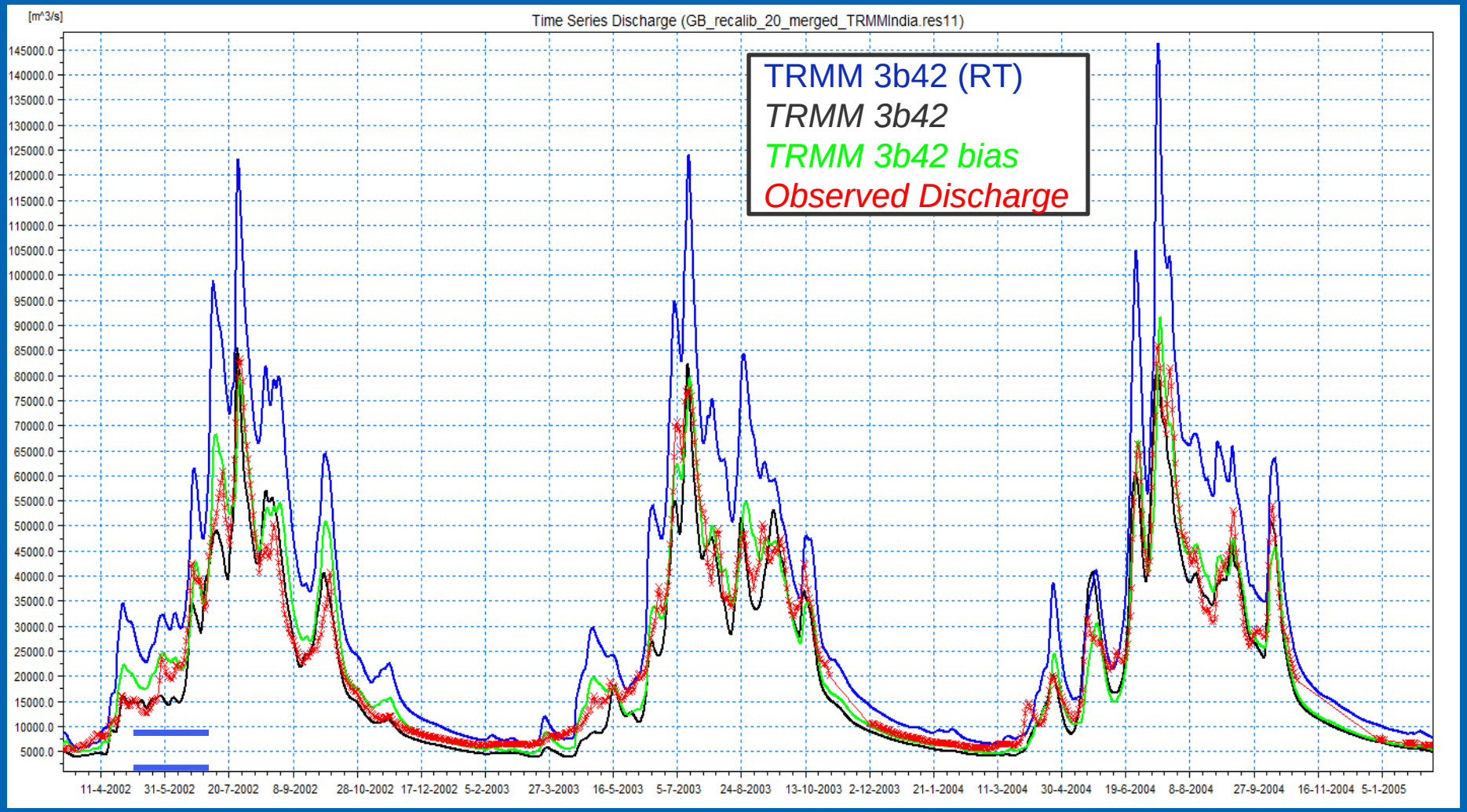

System of flow forecast

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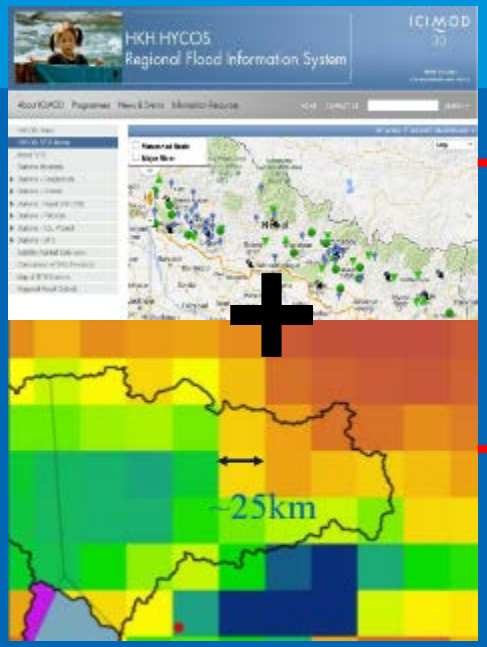
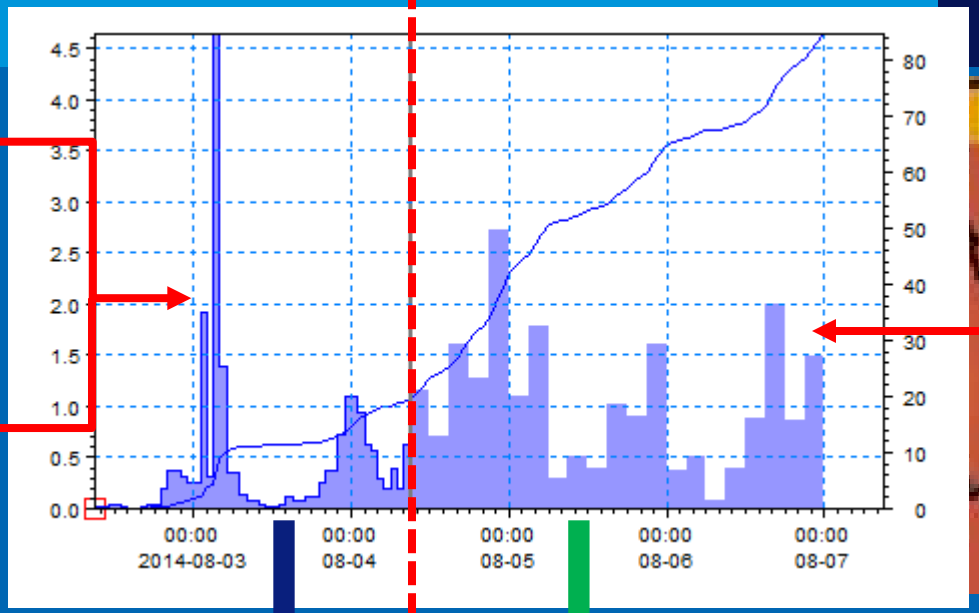
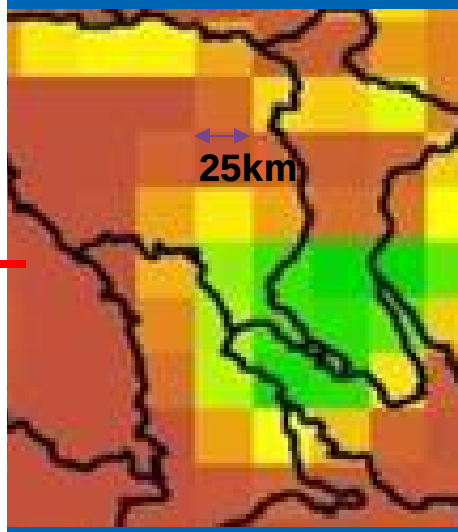
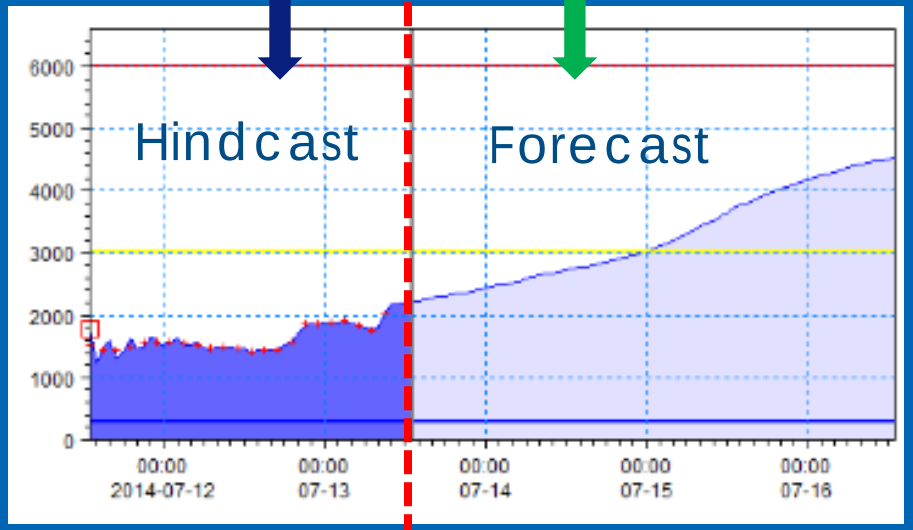
Time of Forecast





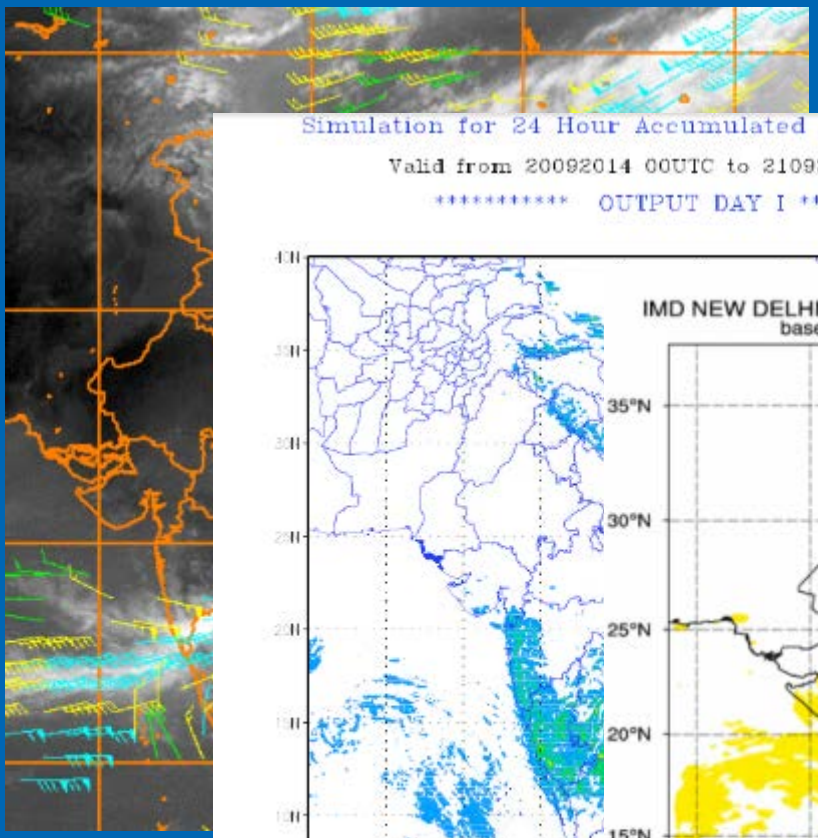




Hindcast (Observed RT data, TRMM (RT), NASA

Quantitative Precipitation Forecast (GFS, NOAA)

Satellite Image



RIMES

WRF

GFS

Meteorological forecasts

Testing G-B flood outlook in 2014

GFS rainfall forecast on 12th Aug 2014 07:00

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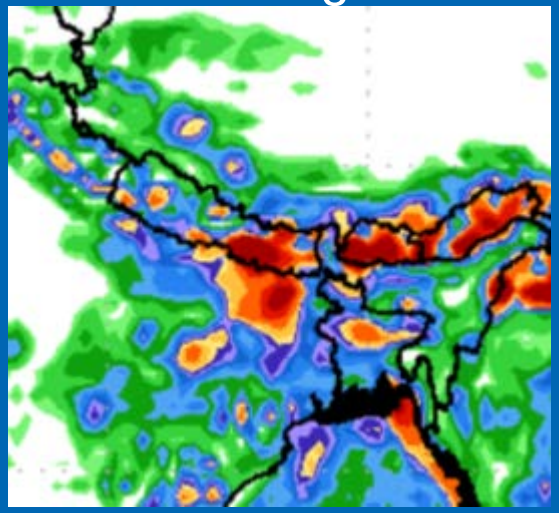
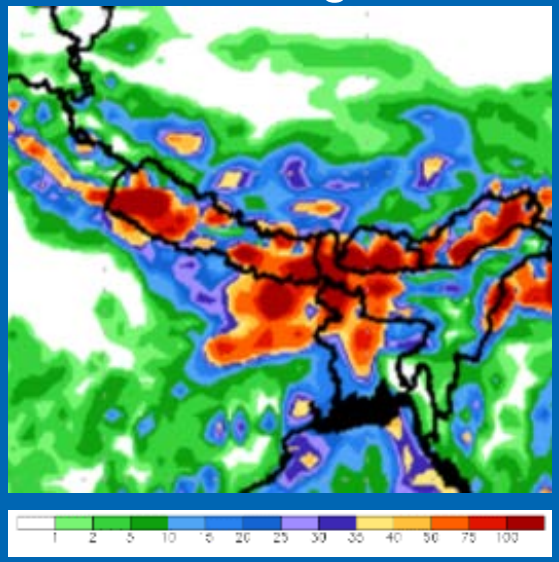
14 Aug



15 Aug



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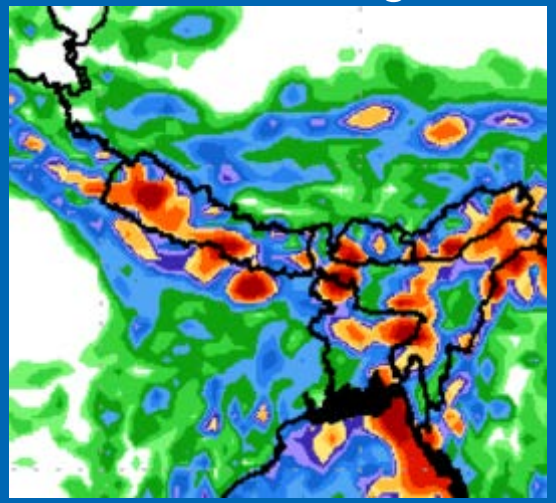
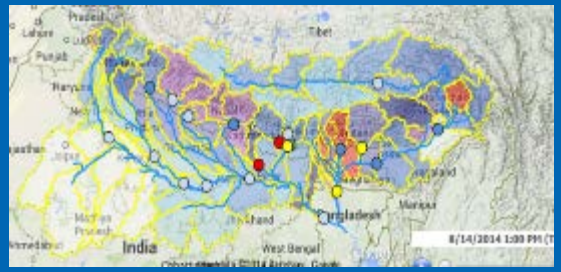
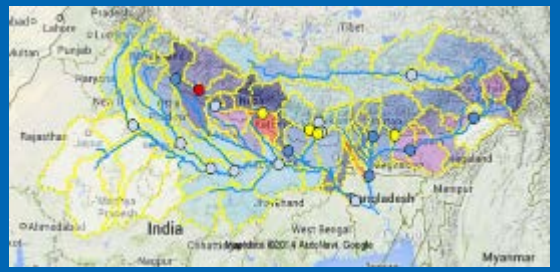


Pilot regional flood outlook

Legend

- Danger Level
- Alert Level
- Monthly average Level





Performance

Evaluation of Flood Forecast on Koshi

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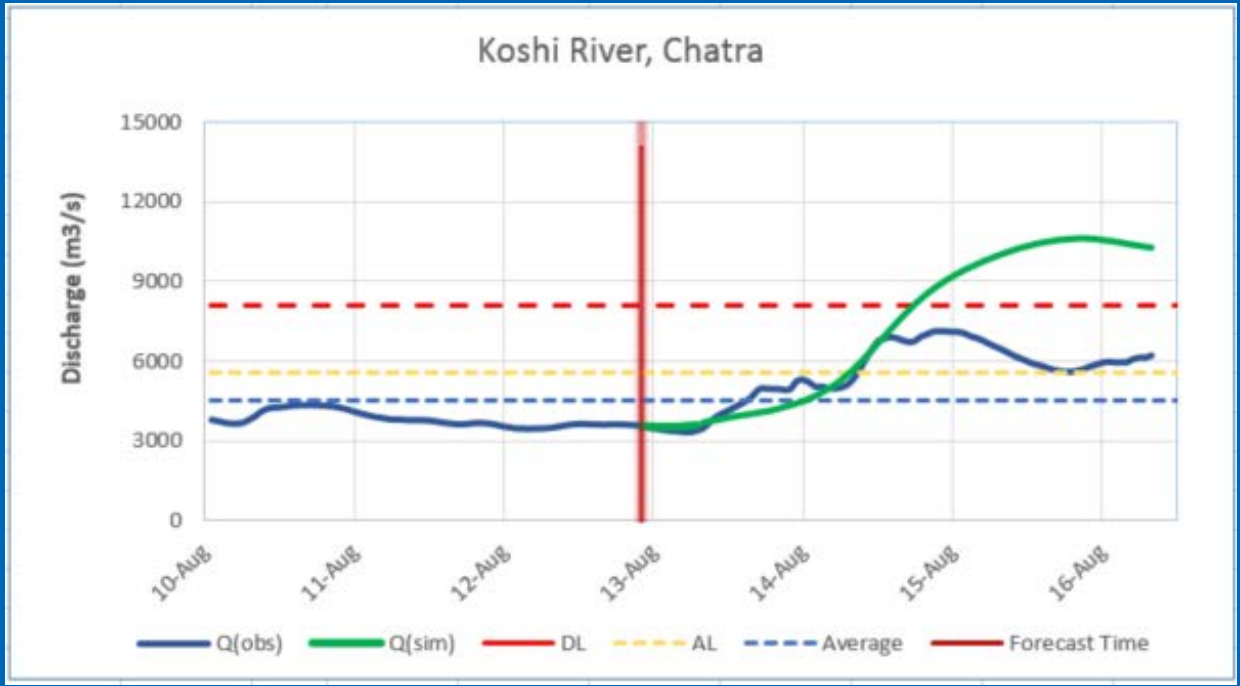

- 24 hour accuracy is very good
- Need to improve accuracy beyond 24 hours

Dissemination of information
Web-based charts and tables

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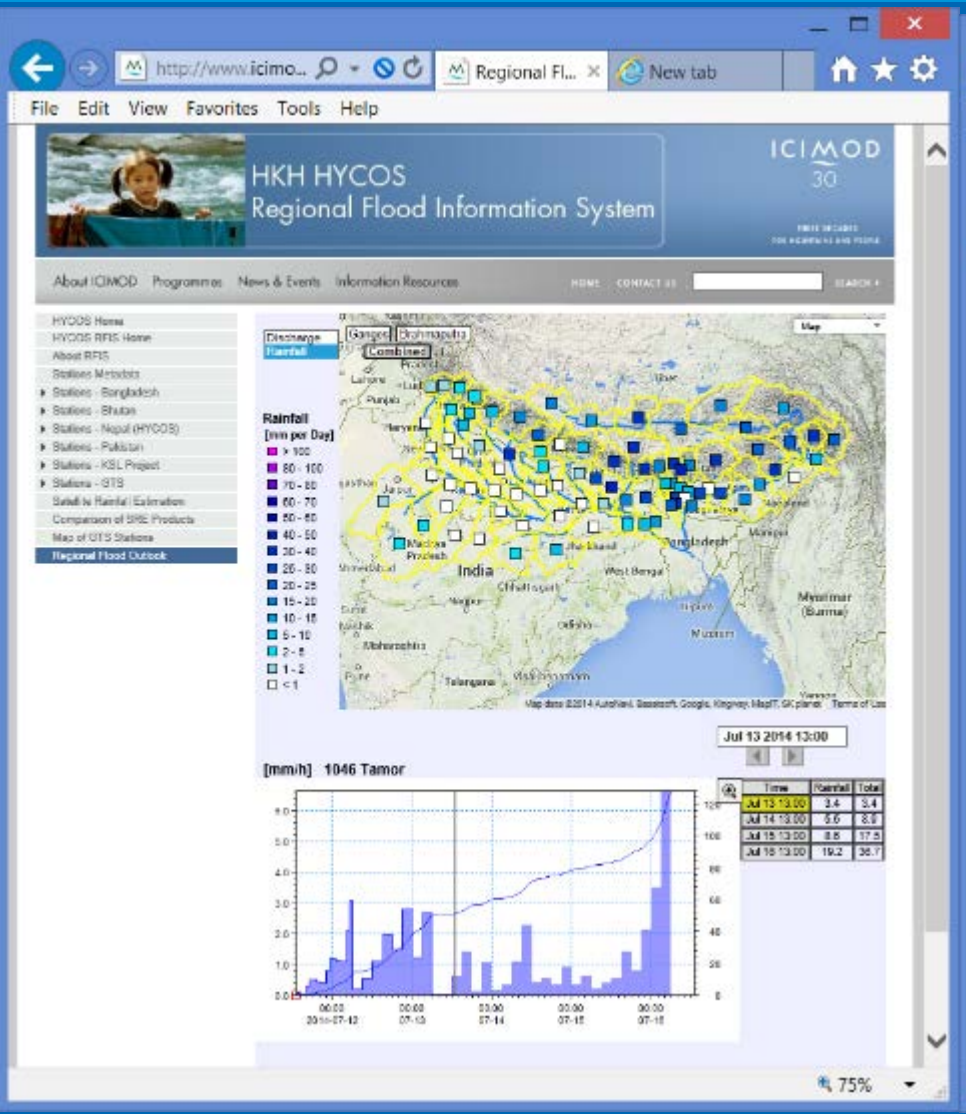

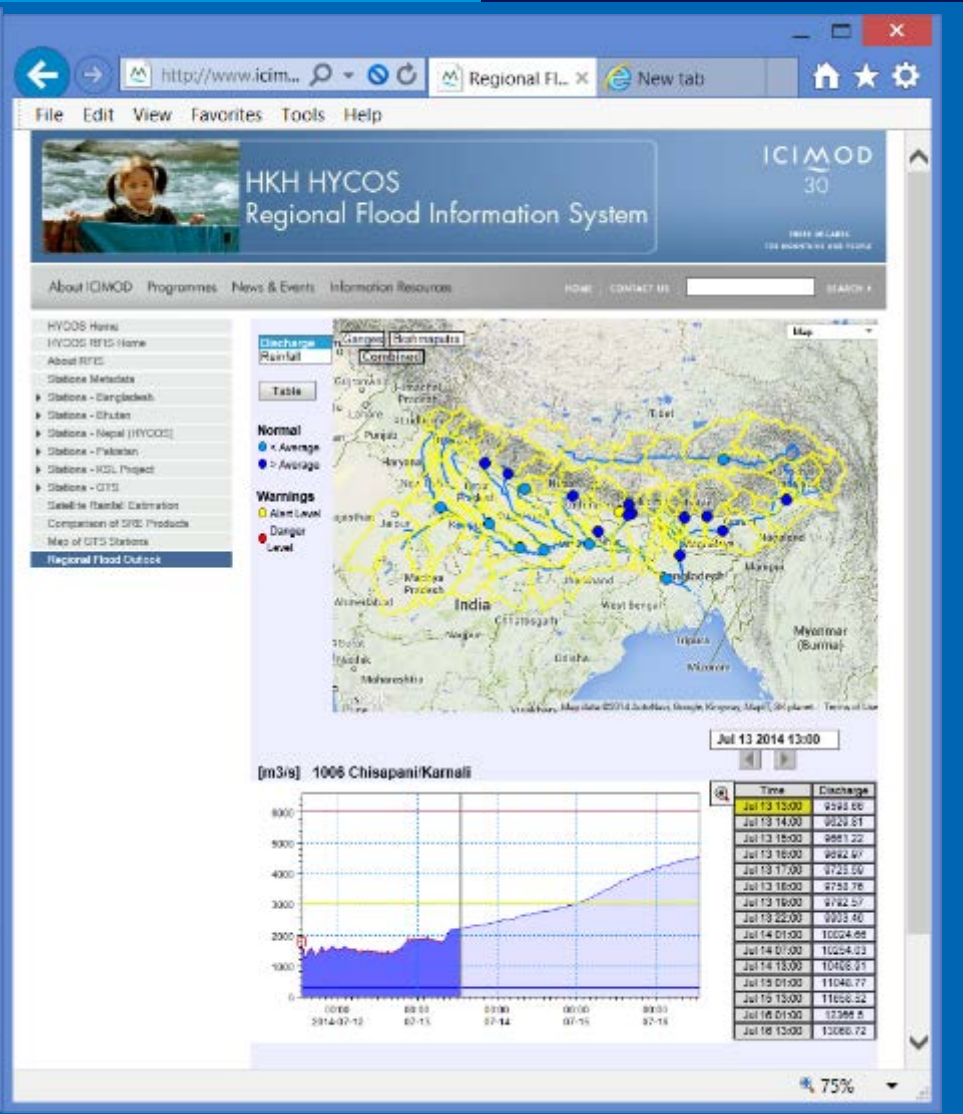

Challenges and opportunities

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- Station operation and maintenance
  - Spare parts
  - Vandalism in some stations
  - Sim card recharge
- Database management
  - Quality control
  - Harmonization of data
- Limited capacity and human resources
- Technical infrastructure and capacity for forecasting and early warning highly variable in the region
- Better integration of science-based climate information and prediction into planning, policy and practices, especially through improved end-user interfaces.

Lessons learnt

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- Latest development in the technology has enabled us to develop flood information system at basin scale
- Limited networks in the region – need further strengthening and sharing
- Utility of data and information for developing flood outlook demonstrated the value of real-time data
- Capacity building and training enhanced cooperation and partnerships
- Flood forecasting and warning needs to be integrated with the disaster risk management activities for an effective end to end flood early warning system
  - Efforts need to be made for risk communication, awareness and better preparedness
- Institutional mechanisms for provision of flood warning to communities need to be strengthened
- Regional cooperation is a long term process which requires building trust and confidence between and amongst countries

Opportunities for cooperation

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- To better understand and analyse extreme events
- To utilize data and information for flood outlook generation and SAsiaFFG system
- To strengthen institutional capacities and build capacity through trainings
- To strengthen mutual learning, knowledge sharing and dissemination through regional platforms for enhanced disaster resilience
- To promote cooperation and collaboration in data sharing for timely warning and promote partnerships and international collaboration in disaster risk reduction.

Role of ICIMOD in SAsiaFFG System

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- ICIMOD could **participate at a technical level** by being a part of the **validation of the satellite based rainfall estimates**. At the moment the flash flood guidance system is ingesting NOAA/NESDIS NOAA/CPC CMORPH) global hydroestimator product. ICIMOD could validate these products for the accuracy and also explore bias correction for improved flash flood detection.
- ICIMOD could hold regional trainings and workshops for the representatives of the national hydrometeorological services.
- ICIMOD would like to be a part of the trainings (online courses on the flash flood guidance system as well as at the HRC training programs)
- **ICIMOD could** work with the regional and international partners to **forge cooperation in the region** and **provide a regional platform.**


Thank you