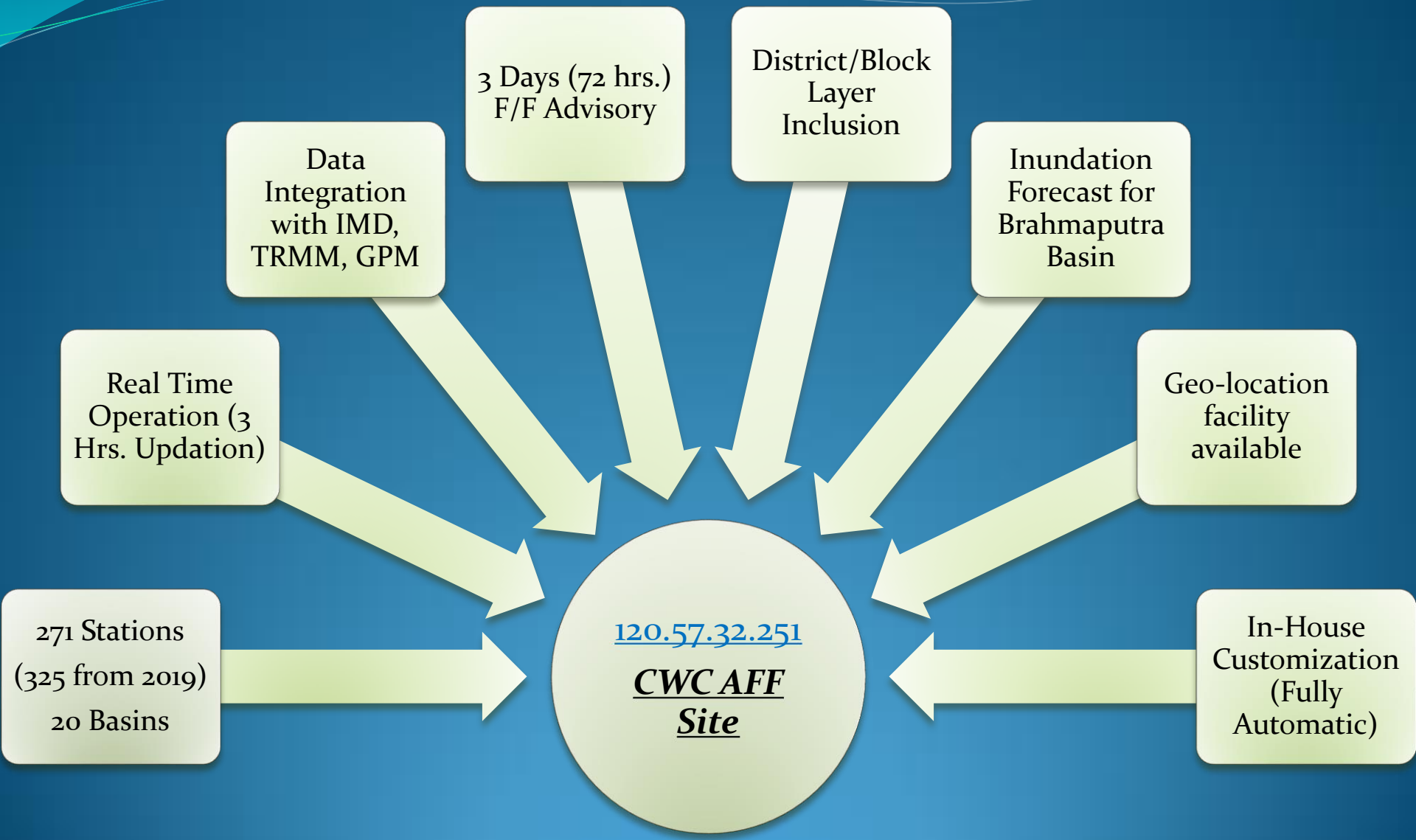
Advisory Flood Forecast (CWC) Opportunities for Dam Managers Challenges in Real Time Rainfall Data processing

25 - Apr 2019

Central Water Commission

Area of study

- Study Area – **Pan-India**
- Activity timeline – **First successful real-time run in Monsoon 2017**


3 Days (72 hrs.) F/F Advisory
District/Block Layer Inclusion
Data Integration with IMD, TRMM, GPM
Inundation Forecast for Brahmaputra Basin
Real Time Operation (3 Hrs. Updation)
Geo-location facility available
271 Stations (325 from 2019) 20 Basins
120.57.32.251
CWC AFF Site
In-House Customization (Fully Automatic)

Model/data

- Major Data used –
  - **IMD ARG, AWS rainfall (as near real-time data)**
  - **TRMM & GPM rainfall (as historical data)**
  - **IMD 3-days WRF rainfall (as forecast data)**

- Models Used –
  - **MIKE-11 (Rainfall-Runoff Model & Hydrodynamic Model)**
  - **MIKE-21 (For 2-D Inundation)**
  - **MIKE Flood (For 1-D & 2-D coupling)**

Approach:

Fully Automated Mode

Scripting and coding languages used:

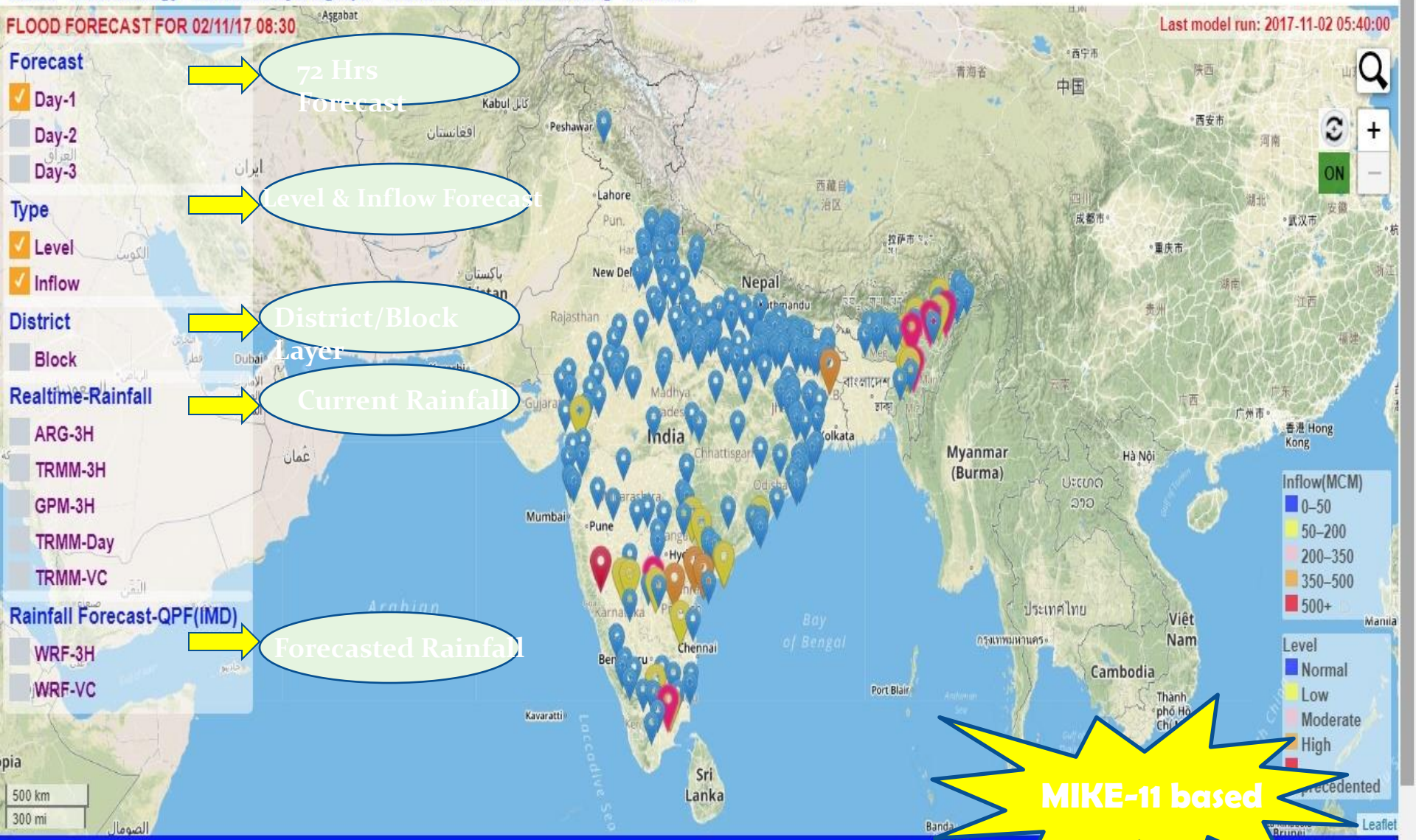
- Python
- Vb –script
- Bat script

- Automated downloading of data
- Processing of data
- Ingestion of data and running of model
- Extraction of results
- Display of results

THREE DAY ADVISORY FLOOD FORECAST

CENTRAL WATER COMMISSION

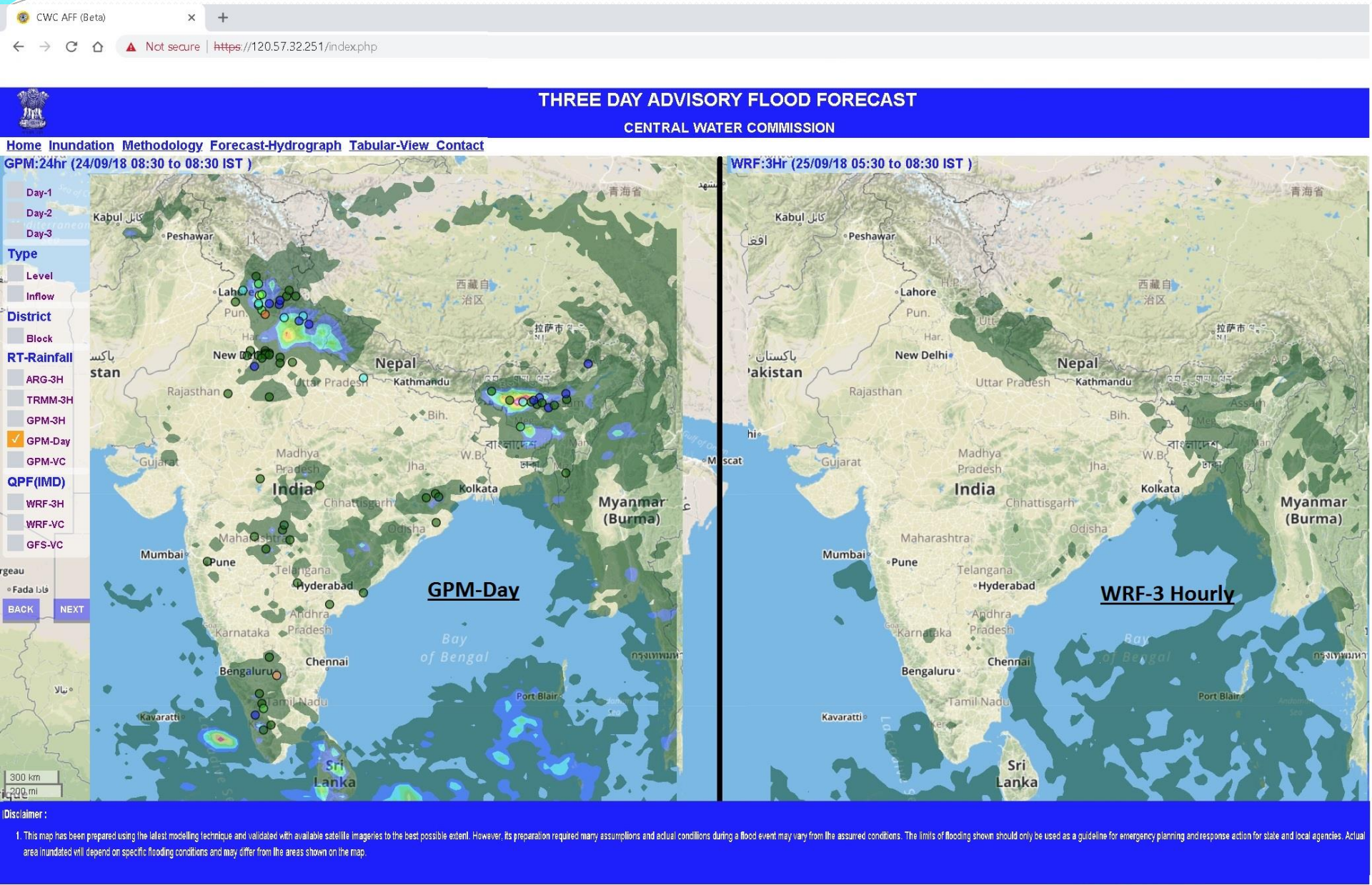
Home | Methodology | Forecast-Hydrograph | Tabular-View | 2D-Modeling | Contact



Disclaimer :

1. Forecast is subject to uncertainty due to errors in measurment , rainfall forecast, model parameters ,lack of information on reservoir operating rules/real time releases and

Rainfall forecast



Results

CWC AFF (Beta)

Not secure | https://120.57.32.251/hydro.php

THREE DAY ADVISORY FLOOD FORECAST

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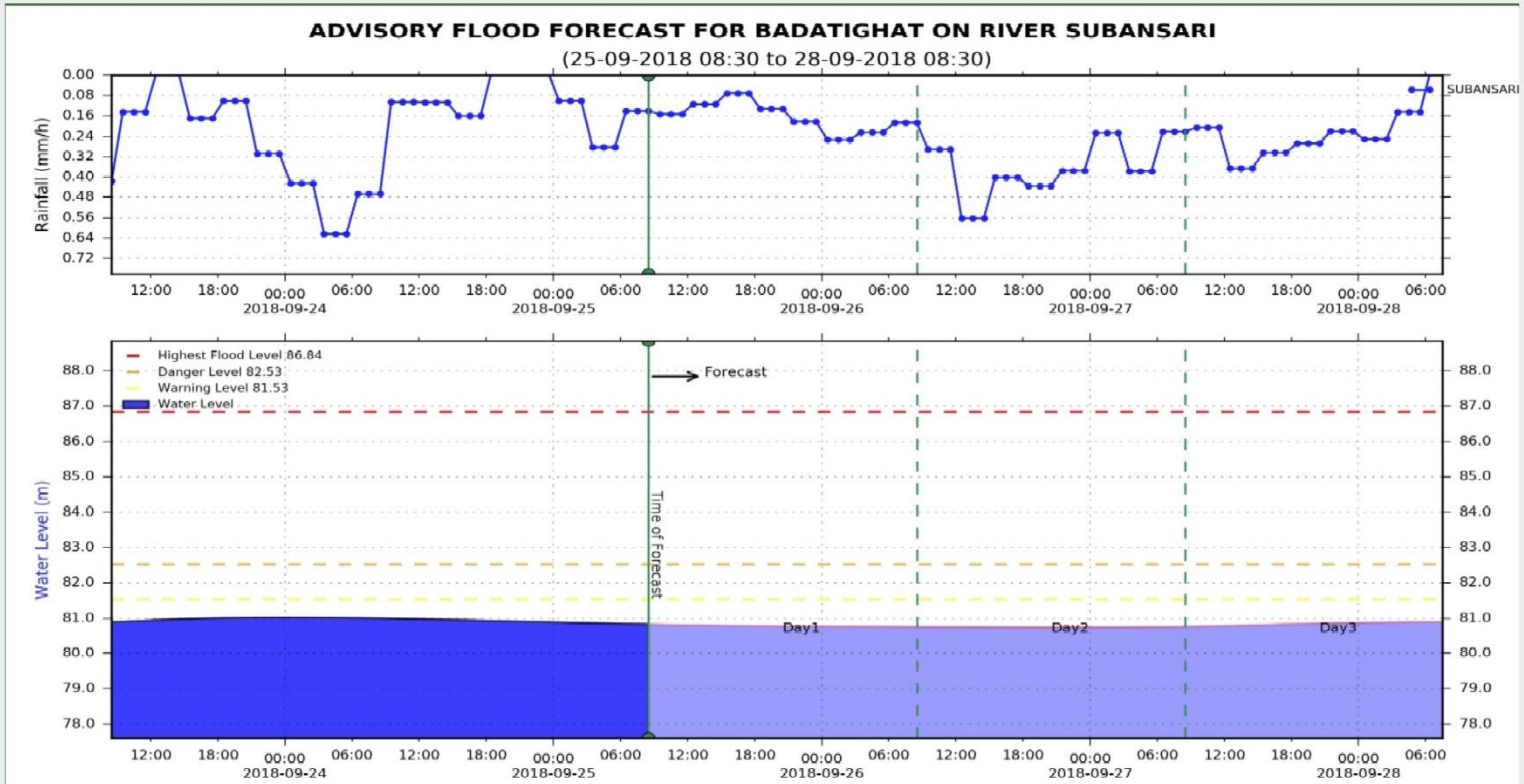
Home Inundation Methodology Forecast-Hydrograph Tabular-View Contact

/IAR(Normal, Normal, Normal,) KURSELA(Normal, Normal, Normal,) LALBEGIAGHAT(Normal, Normal, Normal,) MANER(Normal, Normal, Normal,) MATHURA_PG(Normal, Normal, Above Normal,) MAWI(Above Normal, Above Normal, Normal,) MIRZAPUR(Normal, Normal, Normal,) MOHNA(Normal, Normal, Normal,) MUNGER(Normal, Normal, Normal,) NAINI(Normal, Normal, N

Flood hydrograph for

Basin name:
Brahmaputra

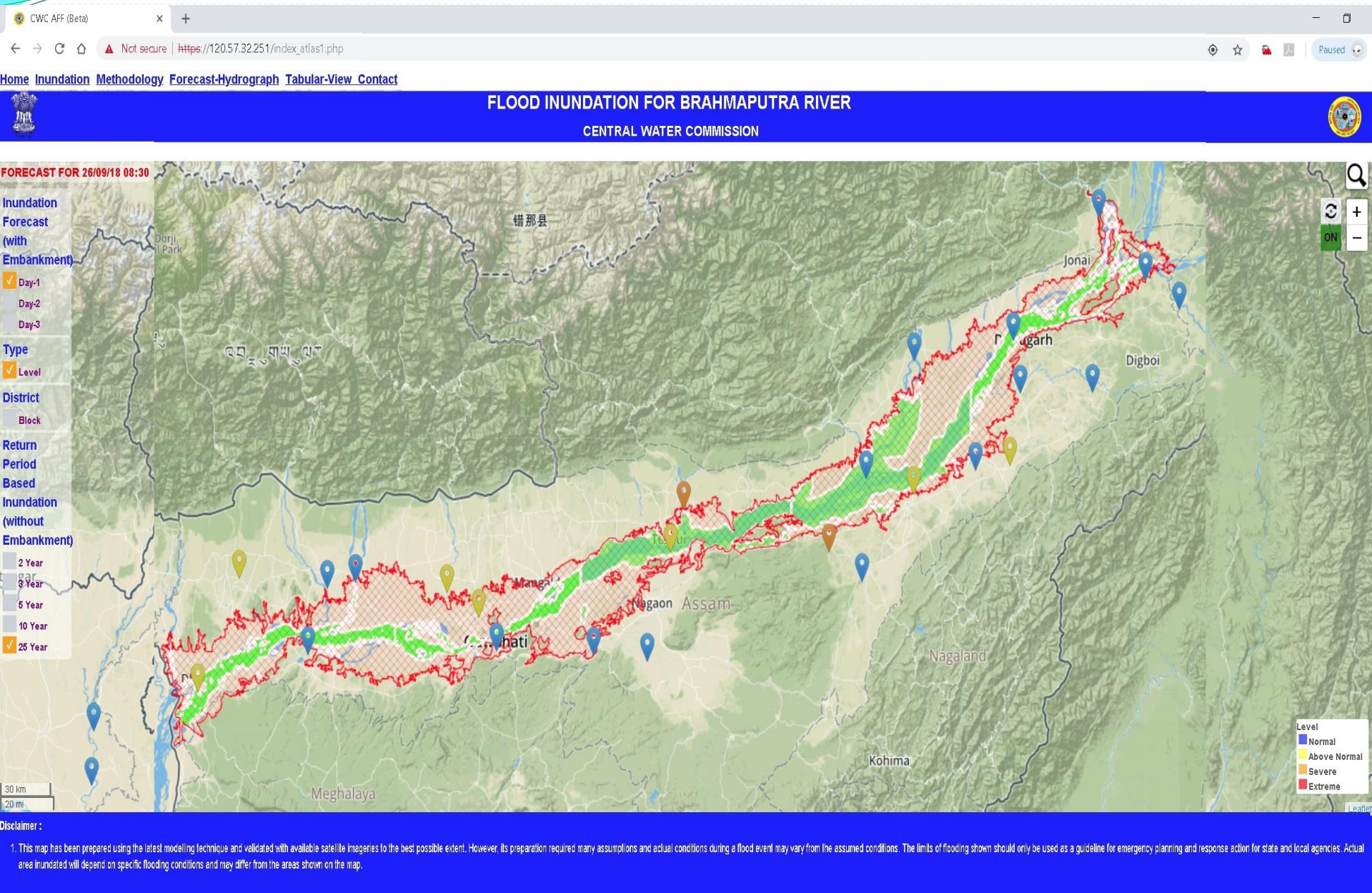
Station name:
Badatighat



Disclaimer :

1. Forecast is subject to uncertainty due to errors in measurment , rainfall forecast, model parameters ,lack of information on reservoir operating rules/real time releases and other unknown factors such as landslide, glacier outburst,embankment breach etc.
2. Background does not depict political boundry

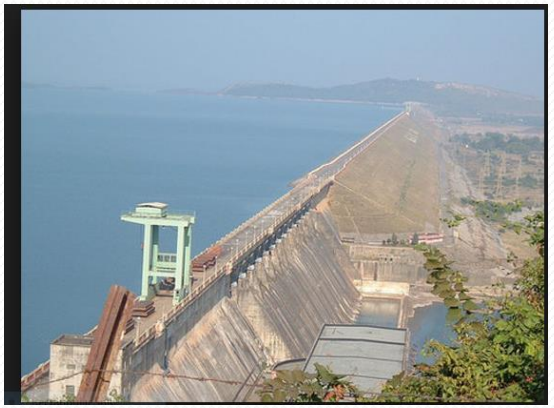
Results/Finding/outcome



Opportunities for Dam Managers

Present Forecast to Reservoirs

- Inflow Forecast to 75 Reservoirs
- Including Major Projects like



- Hirakud
- Sriram Sagar
- Srisailam
- For reservoir management, Emergency Preparedness

10 days forecast

- Polavaram Project
- Construction management

Advantages using Global Near – Real Time products and Forecast Products

- Modeling can be done for Transboundary River basins
- Observational Rainfall Network density – issue can be addressed
- Snow and Temperature products used for assessing snow melt flow
- Extended stream flow forecast can be given up to 10 days

Advantages of Modeling and Extended weather Predictions

- Assessment of inflow to Reservoir of Extended period
  - Effective Operation of Hydropower plants
- Modeling integrated reservoir operation
  - Managing system of connected Reservoirs
  - Reducing damages due to flood downstream
  - Effective in catering the demands of stateholders

Future works which can be taken up

- Modeling extreme rainfall scenarios
- Glacial lake outburst flood
- Flood due to Dambreak and Landslide created dam

Advantages:

- Assessing Release scenarios for Effective management of Reservoir
- Emergency Releases and inundation scenarios downstream

Challenges in Real Time Rainfall Data Processing

Real Time Data Requirements for Operational Forecasting

- Continuous Flow of Data into the System
- Spatial Distribution of the Stations
- Spatial Resolution of the gridded data
- Temporal Resolution of the Data

Continuous Flow of Data – Observed Data

- Manual Data

  - Significant Time lag

- Instrumentation and Data Acquisition System

- Real time processing of Data obtained from Telemetry Station
- Doing Quality Check at real time
- Converting the data into Gridded or average sub-catchment rainfall

Continuous Flow of Data – Estimated Rainfall Data

- Global Products
- Already Processed available in gridded format
- Available in well defined file structure (easy to automate download and process)
- Near Real Time data (Mostly Satellite Based)
- Since they are rainfall estimates – Accuracy is major concern

Continuous Flow of Data – Forecast Data

- Numerical Weather Prediction model Products

- From IMD and other global agencies
- Already Processed available in gridded format
- Available in well defined file structure (easy to automate download and process)
- Obtained from Global, Regional and Multi-Model based
- Accuracy reduces with the lead time

Spatial Distribution of the Rainfall observation sites

- Very low Network density of (CWC and IMD) in Hilly terrain (in Western Ghats)
- Transboundary Rivers (where catchment area is in other countries)
- Improving network density by collaborating with State Authorities (eg. Karnataka state Natural Disaster Management Centre) and other stakeholders
- Transboundary rivers

– Improving Quality of satellite Rainfall estimates

Spatial Resolution of Gridded Rainfall Products

- Fine Resolution of Products plays critical role in upper catchments which heavy rainfall potential
- Critical in capturing the variation in rainfall distribution

- identifying locations of flash floods
- Rapid inflows in to the reservoirs
- Landslide triggers (predicting rainfall triggered landslides and muddy inflow in the reservoir)

Spatial Resolution of Gridded Rainfall Products

- IMD Gridded Rainfall Data (.25X.25 deg) – 625 sq km
- Satellite Rainfall Estimates
  - GPM (NASA) (.05X.05 deg)
  - GSMAP (JAXA) (.1X.1 deg)
- NWP products (Forecast)
  - WRF (9 X9 km)
  - GFS (12 X12 km)

Temporal Resolution of Products

- It is frequency of the availability of the Rainfall data
- Has a transmission time lag and Processing time lag
- Plays a very important role nature of the flood and runoff generated from the catchment
- more the frequency better for modelling and accuracy of results

Frequency of rainfall data availability

- IMD AWS/ARG – 1 hour

  - format of the AWS/ARG data available

  - number of stations working on real time

  - Removal of non-working station to generate average rainfall

- IMD gridded rainfall (24 hour accumulated Rainfall)
- Satellite Based Rainfall

  - GPM (Every Half Hour)

  - GSMAP (Every Hour)

  - Almost 4-5 hour latency

NWP

  - Available (Every 3 hour) updated twice a day

Areas to Work on

- Sharing of Rainfall data from every Stakeholders to generate a unified Rainfall data source
- Developing interface and protocol for sharing the data, performing quality checks and creation of national rainfall grid
- Improving satellite rainfall estimates through research which will be very useful data sources in inaccessible locations and transboundary catchments

Conclusion

- Modeling is a strong tool for effective management

  - predicting extended flow for managing demand of stakeholders

  - effective operation of hydropower projects

  - integrated reservoir management

  - Assessing release scenarios for Extreme events (Rainfall, GLOF, Landslide Dam break)

  - Inundation scenarios downstream

Conclusion

Global Weather & Forecast Products

- Addressing Low Obsevation Rainfall Network
- Modeling Transboundary Catchment
- Snow melt modeling (Global snow and Temperature products)
- Extended Flow predictions

Thank you