IMPROVEMENT OF THE FLOOD FORECASTING AND WARNING SYSTEM OF BANGLADESH BY ADVANCED TECHNOLOGICAL DEVELOPMENT

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Outline

- Introduction
- Background
- Objective
- FFWC and it’s activity
- Future application & improvement
- Conclusion/Big picture
Introduction

South Asia

Land Area: 1,44,000 sq. Km
South-West: Myanmar
South: Bay of Bengal
Rest of the part: India
Introduction

Ganges: 9,07,000 sq. km
Brahmaputra: 5,83,000 sq. km
Meghna: 65,000 sq. km
Sub-tropical monsoon climate
winter (November–February)
summer (March–June)
monsoon (July–October)

Rainfall averages 2160 mm per annum
1728-mm fall during the monsoon

Temperature
highest temperature in April (34ºC)
lowest in January (12ºC)
Flooding is an annual recurrent event in Bangladesh. Total protection against flood is neither possible nor feasible. Extended lead time with reasonable accuracy could alleviate the problem to some extent.
Background

Flood Damage:

- Area affected by flood – 38 districts
- Crop Damage:
  - fully- 793,140 hectares
  - partly- 656,187 hectares
- Affected People – 10 million
- People taking refuge – 373,939 in 1601 shelters
- Housing units destroyed – 89,048
- Deaths – 192

(As of 8th August 2007, GoB)
Causes of Flooding

1. Monsoon Climate
   Brings very heavy rain and snow
   Soils are leached and heavy runoff results in soil erosion

2. Spring Snow-Melt
   Results in soil erosion and a rapid increase in River Discharge

3. Deforestation in Headwater Areas due to increasing population in Nepal & Tibet.
   Trees cleared for fuel and grazing land.
   Less Evapotranspiration, more runoff and faster soil erosion. Landslides also occur.

4. Rivers Silt-up due to increased soil erosion. This raises the river bed and reduces the capacity of the channel resulting in increased likelihood of flooding.

5. 80% of Bangladesh lies on a huge floodplain and delta, most of which is only 1m above sea level.
This paper aims to discuss:

- current flood forecasting activities
- techniques to improve the lead time & accuracy
FFWC and its activity

FFWC operates model for the estimation of water levels at some selected stations.

The model consists of two separate but closely integrated components:

- rainfall-runoff model
- hydrodynamic model
Model and Boundary Data

Legend:
- Boundary stations
- Update stations
- Monitoring stations
- Levels_internal.shp
- Rivers
- International border
- Coast

Bahadurabad

Hardinge Bridge
Result
Thana Status Map

Status as on 24 July 2004 12:00:00

Thanas
- No Data
- No Flooding
- Normal Flooding
- Moderate Flooding
- Severe Flooding
Presently FFWC is disseminating 3 day forecast with some weaknesses

It’s not possible to extend the model boundary

Data collection system is not automated

Qualitative rainfall forecast is not enough for the model input

3 day lead time is not sufficient
Future Application/Operation

- Doppler Radar
- Satellite Based RF and Q estimation
- Application of Numerical Weather Prediction Model Result
The spatial and temporal resolution of an event like flash flood can only be captured by Doppler radar.
Satellite-based RF and Q Estimation

Satellite derived 3 hourly rainfall data of TRMM is promising

The reliability of the remotely sensed data?

TRMM is producing error within acceptable range

practicable to generate boundary discharge with ANN

So, the combination of satellite rainfall and ANN is capable to improve boundary estimation and thereby extending FF lead time
3-individual time horizon are used to predict river Q at the U/S and regional precipitation

1-10 day: issued daily

20-30 day: issued 5 day interval

1-6 months: issued at 1 month interval

However, 1-10 day forecasted data has been used for FF, on experimental basis
Application of Numerical Weather Prediction Model Result

CFAN Data:

Rainfall

Discharge
### Application of Numerical Weather Prediction Model Result

**Data (Rainfall):**

- **Satellite observed Rainfall**
- **ECMWF forecasted Rainfall**

The resolution is 0.5°

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<tr>
<th>24hr precip [m]; longitude [deg]; latitude [deg]</th>
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The flood forecasting is based on ECMWF model result.

Real time rainfall over the catchment is provided by satellite estimation.

ECMWF has 51 Ensemble Prediction data set.

The 51 scenarios then combined into an average or small number of alternative forecasts.

Only 3 sets of data are used in real time forecasting.
### Application of Numerical Weather Prediction Model Result

<table>
<thead>
<tr>
<th>Forecast Initialization Start Time:</th>
<th>15 7 2006</th>
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<td>97.5% Quantile:</td>
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Comparison Station

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<tr>
<th>Station name</th>
<th>River name</th>
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<td>Jamuna</td>
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<tr>
<td>Mohadevpur</td>
<td>Atrai</td>
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</table>
Forecasted Result

Jamuna River at Serajganj (Year 2006)

Water level (meter)

00:00 00:00 00:00 00:00 00:00 00:00 00:00 00:00 00:00

RHWL
Danger Level

Observed LR (-1 Stdv.) UR (+1 Stdv.) Mean
# Forecasted Result

Forecast made on: 03-08-2006

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<th>Station</th>
<th>Water Level in [m]</th>
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Performance of Trend Prediction

Dhaka: Model Performance (10-day FFWC forecast) in Predicting Correct Trend (Rise or Fall)
Conclusions

Further extension of existing (3day)forecasting lead time is required

Newly introduced technology shows its capability of extending lead-time for more than 3 days

However, the forecasting performance starts to deteriorate after 5 day
Conclusions

The model succeeded 58% of the time in predicting correct trend (10-day)

The actual drawback remains on the course grided weather prediction model and satellite RF

Therefore, the overall forecasting performance can be improved by reducing the uncertainty of satellite and ECMWF data over the catchment area
Discharge prediction of the 2 boundary stations are required to be improved for 10-day lead time.

Calibration of the weather prediction model along with satellite measured rainfall estimation is vital.

Downscaling of the ECMWF forecast can be helpful.
THANK YOU!