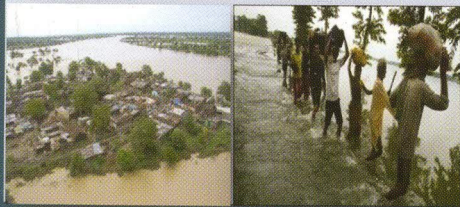


Flood Early Warning System (FLEWS)

a hydro-meteorological approach for flood forecasting using space technology in geospatial platform.



Developed by

North Eastern Space Applications Centre
Government of India
Department of Space
Umiam – 793103
Meghalaya

Web: <http://nesac.gov.in>
Ph +91 364 2570141
Fax: +91 364 2570139

for

Assam State Disaster Management Authority
Government of Assam
Assam Sachivalaya
Dispur – 781006
Guwahati, Assam

with support from

North Eastern Council
Central Water Commission
India Meteorological Department
Assam Water Resource Department
North Eastern Electric Power Corporation
Brahmaputra Board

Background

Flood and associated river bank erosion is a chronic disaster prevalent in Assam. The problem of flood has taken an enormous proportion ever since the massive earthquake of 1950 ripped through the state. In recent years devastating floods have occurred in 1988, 2004, 2007, and 2012.

Conventional warning systems covering only major river channels based on monitoring of river levels alone has been inadequate to minimize the flood damage. A hydro-meteorological modeling using space technology in geospatial platform has the potential for forecasting flood with sufficient lead time in river basin scale. FLEWS was therefore developed with convergence of numerical modeling, space technology, and geospatial technology with input from multiple stakeholders to address the flood problem.

Key Services

- Issue of alert for possible flood situation at revenue circle level with best possible lead time.
- Mapping of embankments with breaches using high resolution satellite data.
- Flood inundation mapping and post flood damage assessment.

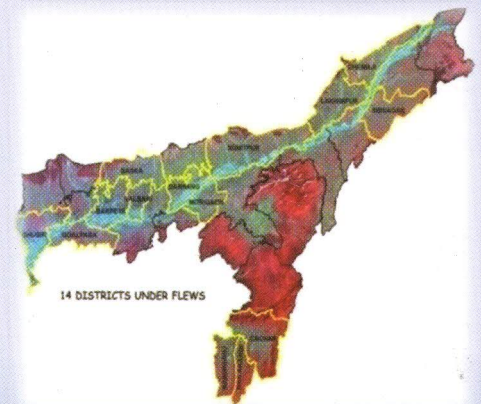
Districts covered

- Lakhimpur
- Dhemaji
- Sivsagar

- Sonitpur
- Darrang
- Marigaon

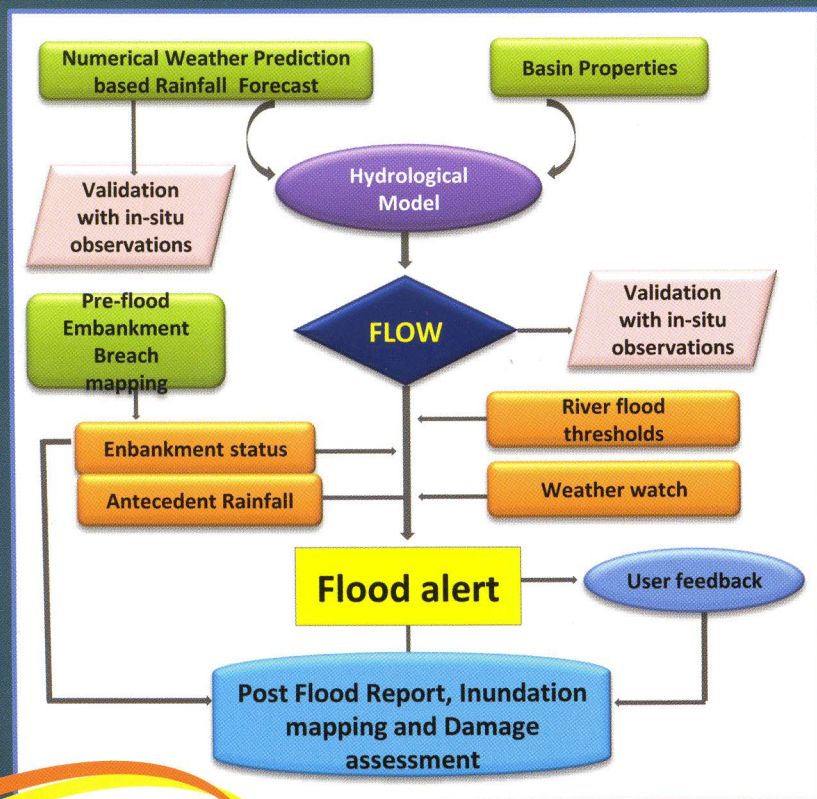
- Nalbari
- Barpeta
- Goalpara
- Baksa
- Dhubri

- Karimganj
- Cachar
- Hailakandi

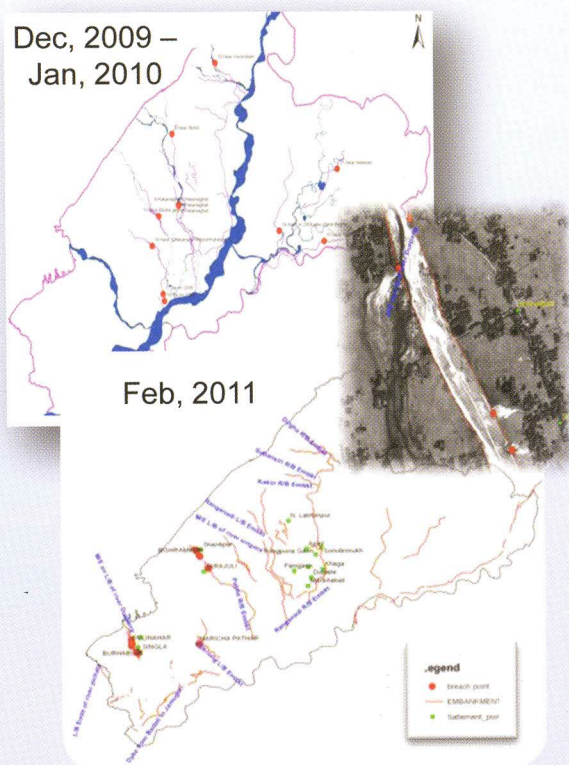


FLEWS workflow

There are two major areas in FLEWS concerning Meteorological aspects to address the issues related to rainfall forecast, past rainfall analysis and weather watch and Hydrological aspects to address river flow estimation, river level analysis and finally to predict flood probability for Flood Early Warning with a lead time of 8 to 16 hrs depending on the catchment area under study. Before the onset of monsoon, the status of embankments are analyzed using Cartosat-1 stereo data and report is submitted to concerned authorities for taking corrective measures. In case of flood affecting any area, the inundated areas are mapped and shared with the concerned authorities to facilitate rescue and relief operation.



Embankment breach mapping

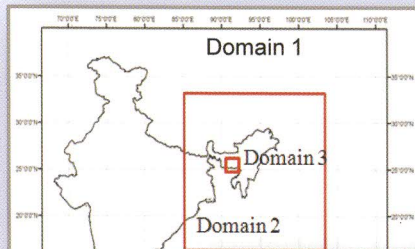


Embankment breach points are identified (table below) and mapped before the onset of flood season using CARTOSAT-1 stereo data and shared with Assam water resource department to enable them to take corrective measures.

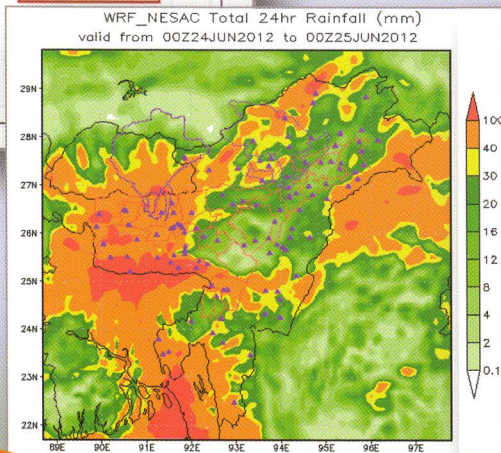
Embankment name	No of Breach point	Locality
Pabha right bank	2	Tunijan Dafila Pathar, Bishrampur, Tarajuli
Dikrong right bank	1	Maricha pathar
Durpang left bank	2	Burhaburi, Singla
Durpang right bank	1	Pulinahar

Numerical Weather Prediction

The Weather Research and Forecasting (WRF) Model is a next-generation mesoscale Numerical Weather Prediction (NWP) system designed to serve both operational forecasting and atmospheric research needs. The WRF model is run on daily basis with nested domain of 27 km, 9 km, and 3 km resolutions to generate rainfall forecast for every 3 hours. The data from the network of AWS and Kalpana 1 satellite derived wind vector are assimilated in the model. The forecast is validated with Tropical Rainfall Measuring Mission (TRMM) multi satellite rainfall estimate for the river basins falling under the FLEWS project.

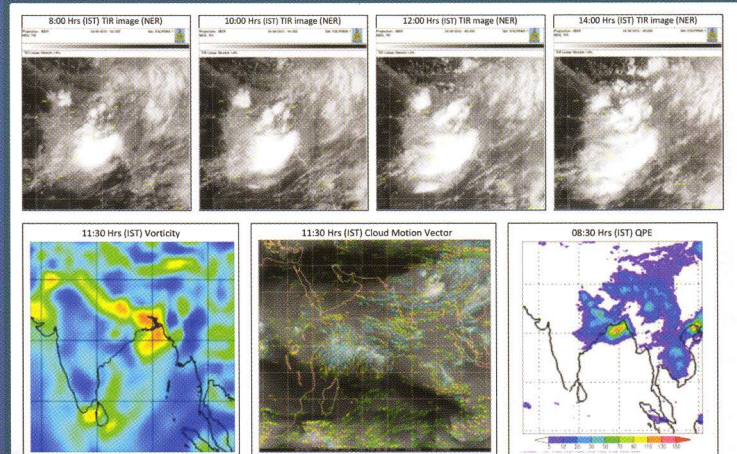


The WRF model is run in the high performance computing system in INCOIS, Hyderabad & NARL, Tirupati through remote access.



Synoptic Weather Forecast

Quantitative rainfall forecast for different regions are given based on analog synoptic weather report (as shown below) prepared by continuously monitoring and analyzing the cloud properties over and around the area under study (using satellite image in visible, TIR and WV channel), prevailing wind speed and direction at different heights (using CMV), and the condition of the atmosphere in terms of its ability to allow or suppress convection (using vorticity, CAPE, wind shear, etc).



Rainfall (mm) during last 24 hours

Lakhimpur, Dhemaji, and Sivasagar		Barpeta, Nalbari, Baksa, Dhubri, and Goalpara		Darrang, Morigaon, and Sonitpor		Karimganj, Cachar, and Hailakandi			
Station Name	Rainfall	Station Name	Rainfall	Station Name	Rainfall	Station Name	Rainfall		
Lakhimpur	19 mm	Basar	2 mm	Bongalgaon	44 mm	Mangaldoi	3 mm	Karimganj	6 mm
Dhemaji	16 mm	Menglio	7 mm	Rangia	13 mm	Silghat	7 mm	Hailakandi	3 mm
Itanagar	31 mm	Daporijo	NA	Nalbari	10 mm	Viswanath Ch.	1 mm	Silchar	8 mm
Ziro	64 mm	Koloriang	NA	Barpeta	16 mm				
Yazeli	24 mm	Sivasagar	3 mm	Dhubri	19 mm			Jowai	53 mm
Passighat	130 mm			Goalpara	50 mm				
Seppa	15 mm			Gossalgaoon	20 mm				

RMC, Guwahati weather forecast: Light to Moderate rain/thundershowers would occur at many places over NE states. Heavy rain may occur at one or two places over the NE states during next 48 hours.

Synoptic Weather and rainfall probability for next 12 hrs:

East Assam area: Average rainfall of 10 - 20 mm expected over the area. High rainfall of 20-30 mm expected over some parts in Assam and AP border areas.

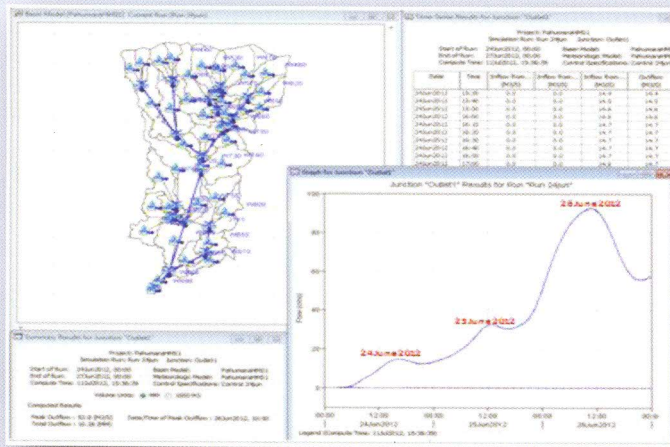
West Assam area: Average rainfall of 15 - 25 mm expected over the entire area. High rainfall of 25-40 mm expected over some pockets in valley area.

South Assam area: Average rainfall of 10 - 20 mm expected over the area.

Middle Assam area: Average rainfall of 10 - 20 mm expected over the area.

Hydrological modeling

It comprises of a hybrid of two different approaches of rainfall runoff modeling namely the lumped and the distributed hydrological model. The lumped approach yields the daily peak discharge value for a river whereas the distributed approach yields the hydrographs in 3 hour time intervals. The 3 hourly WRF rainfall forecast is the input to both the modeling approaches. Distributed Muskingum routing forms the core of the hydrologic model.



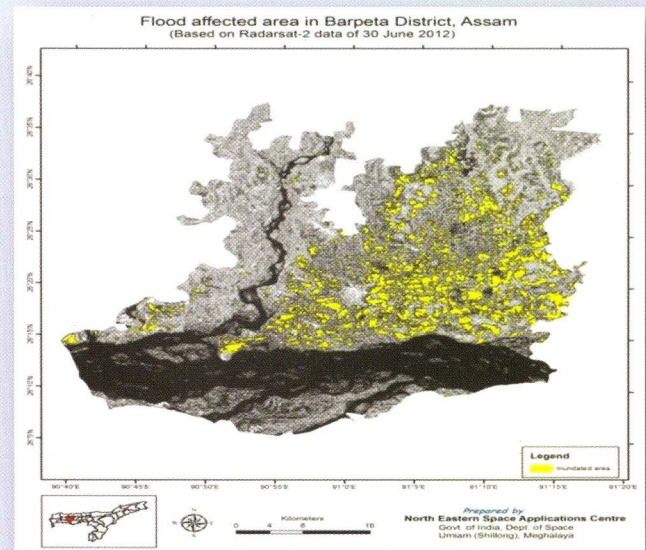
Established flooding thresholds for the rivers are then compared with the peak values of forecast to decide regarding issue of flood alert to all concerned. Overall average success during 2009-2011 is about 75%.

Setting up of the upcoming “North Eastern Regional node for Disaster Risk Reduction (NER-DRR)”, a state of the art facility for disaster support at NESAC by ISRO, Department of Space is the result of preliminary success of the FLEWS project.

Space technology applications for Disaster Management in NER

Flood inundation mapping

Inundated areas are mapped in near real time for major flood events using RADARSAT-2 satellite data to facilitate rescue and relief operations. The village wise inundation area statistics on each of the land uses which are affected by the flood is also prepared and shared with the concerned authorities for assessment of damage.



For more details, please contact

Dr S Sudhakar

Director, NESAC

**Government of India, Department of Space
Umiam – 793103, Meghalaya**

Ph +91 364 2570141 / Fax: +91 364 2570139

mail: s.sudhakar@nesac.gov.in