

**FLOOD EARLY WARNING SYSTEM (FLEWS) &
FOREST FIRE MODELING**
NORTH EAST REGIONAL NODE FOR DISASTER RISK REDUCTION (NER DRR)



NORTH EASTERN SPACE APPLICATIONS CENTRE



Dr. S Sudhakar
Director, NESAC

NER – DRR Set-up in NESAC

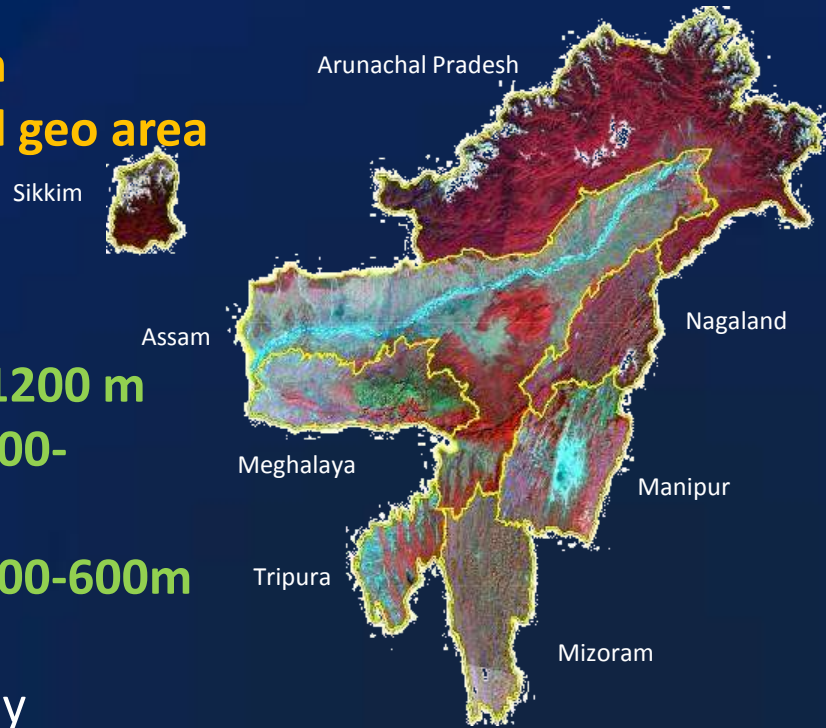
North Eastern Space Applications centre(NESAC)
UMIAM -793 103 Shillong, Meghalaya
www.nesac.gov.in

NE REGION

- 8 states - 26.2 m.h
- 8% of Indian total geo area
- 3.85% of total pop-39 m

- 28.3% pop alt. > 1200 m
- 17.9% between 600-1200m
- 10.8% between 300-600m

• Hilly areas sparsely populated 63/sq.km to 369/sq.km in plains

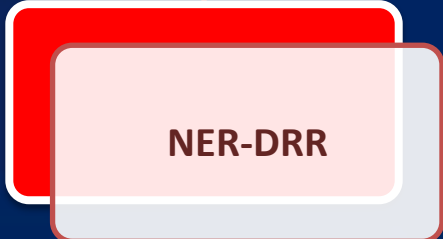
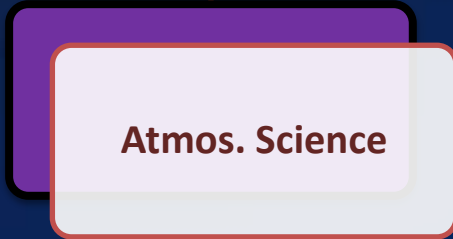
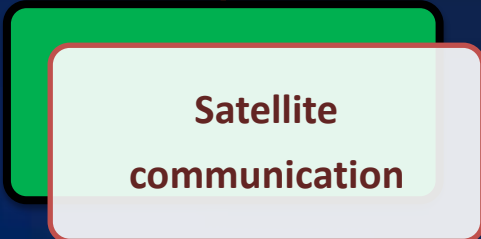
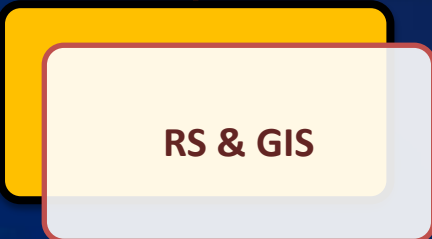
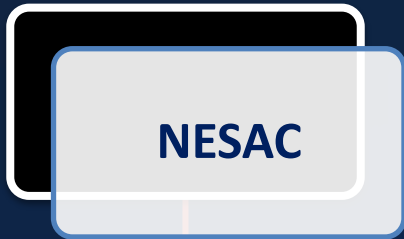


STRENGTHS

- Rich natural resources
- Biological diversity
- Cultural heritage
- Mineral rich
- Hydropower potential

CHALLENGES

- Loss of biodiversity
- Deforestation, soil erosion
- Poor infrastructure
- Disasters



Disasters in NE region

- Apart from earthquake (Zone V), floods, landslides, forest fires, severe cyclones, thunderstorms and river bank erosion are becoming annual events in most parts of the region.
- Drought (Agri) has been affecting parts of NER, particularly Assam and Manipur in last few years.
- Destruction of forests, unplanned construction of embankments and roads, cutting of hill slopes, etc. have further accentuated the problems in the region.

States	Disasters and their spatial distribution in NER							
	Earthquake	Landslides	Flood	Cyclone	Thunderstorm	Cloudburst	For. fire	Drought
Arunachal Pradesh	✓	✓			✓	✓		✓
Assam	✓	✓	✓	✓	✓		✓	✓
Manipur	✓	✓	✓				✓	✓
Meghalaya	✓	✓	✓	✓	✓		✓	✓
Mizoram	✓	✓		✓	✓			✓
Nagaland	✓	✓			✓			✓
Sikkim	✓	✓		✓	✓			
Tripura	✓		✓	✓	✓			✓

Severity level [Red: Very severe, Orange: Severe, Green: Moderate, Black: Low]

- Disaster preparedness in NER is a high priority concern and needs for a coordinated effort for taking up Disaster Risk Reduction activities

Setting up of NORTH EASTERN REGIONAL node for DISASTER RISK REDUCTION (NER-DRR)

- Chairman, ISRO/ Secretary, DOS has inaugurated the setting up of NER-DRR on 26th July, 2011 at NESAC.

NER-DRR is approved with a tentative budget of Rs 395.00 lakhs (Rs 334.00 lakhs as capital one time investment and Rs 61.00 lakhs as recurring) based on Execution document submitted by NESAC.

NER-DRR is envisaged to carry out functions viz.

building comprehensive geo-spatial database for the region

developing decision support tools

developing actionable products and services.



Dr. K. Radhakrishnan, Chairman ISRO/NESAC-GC & Secretary, Department of Space has inaugurated the initiation of setting up of NER-DRR



NER-DRR was briefed to the Hon'ble Minister of State (independent charge) for Development of North Eastern Region (DoNER) and Parliamentary Affairs and Chairman, NEC, President, NESAC-Society [2012]

Towards operationalization

NER-DRR room with fully deployed furniture



Recruited **8 project scientist**

Prepared Standard Operating Procedure
(**SOP**) for major disasters

The registration of **www.nerdrd.gov.in**
has been done as a web portal. This will
be tuned towards geo portal containing
geo-spatial information.



Dr Navalgund committee
reviewed NER DRR)

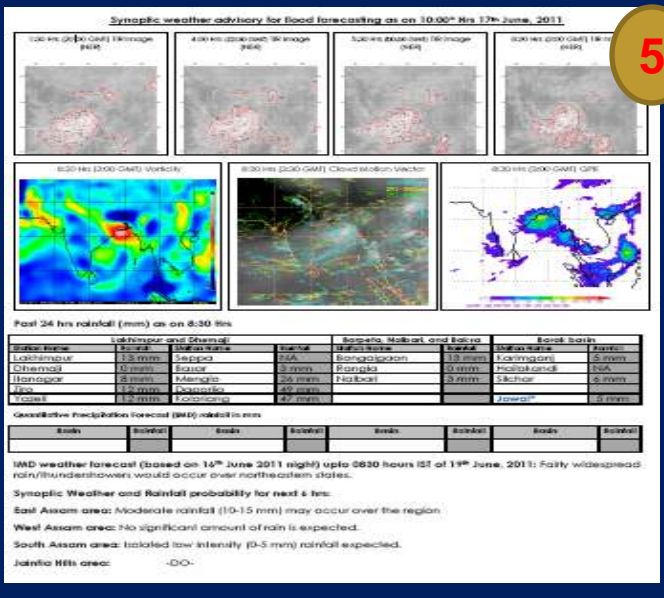
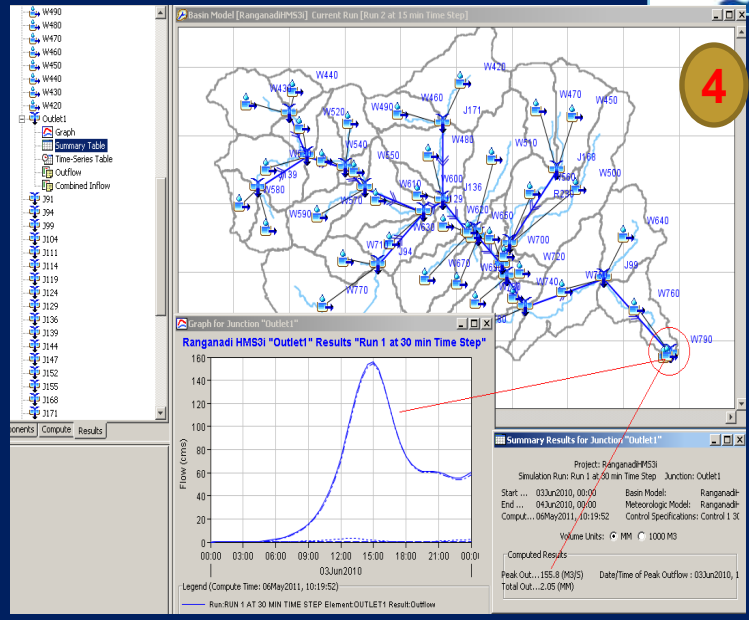
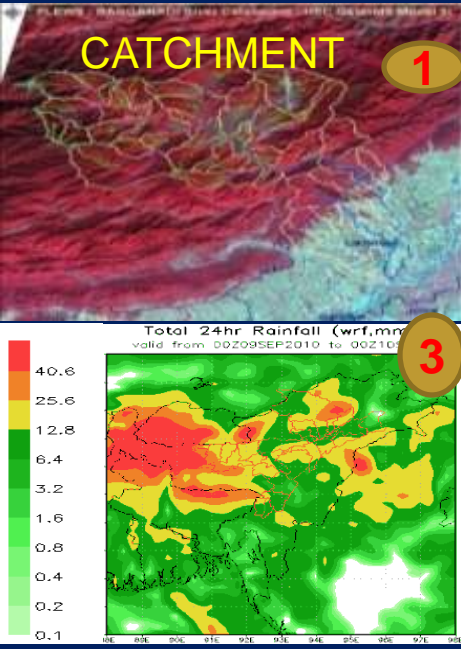
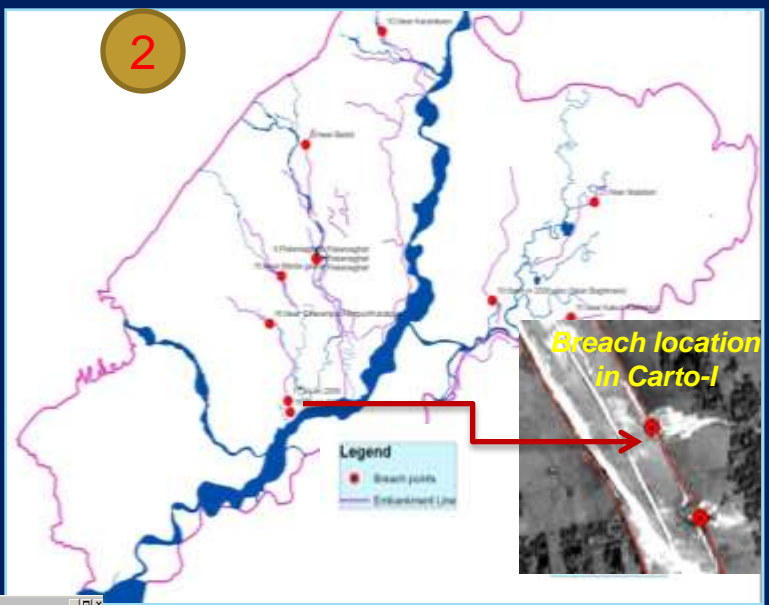
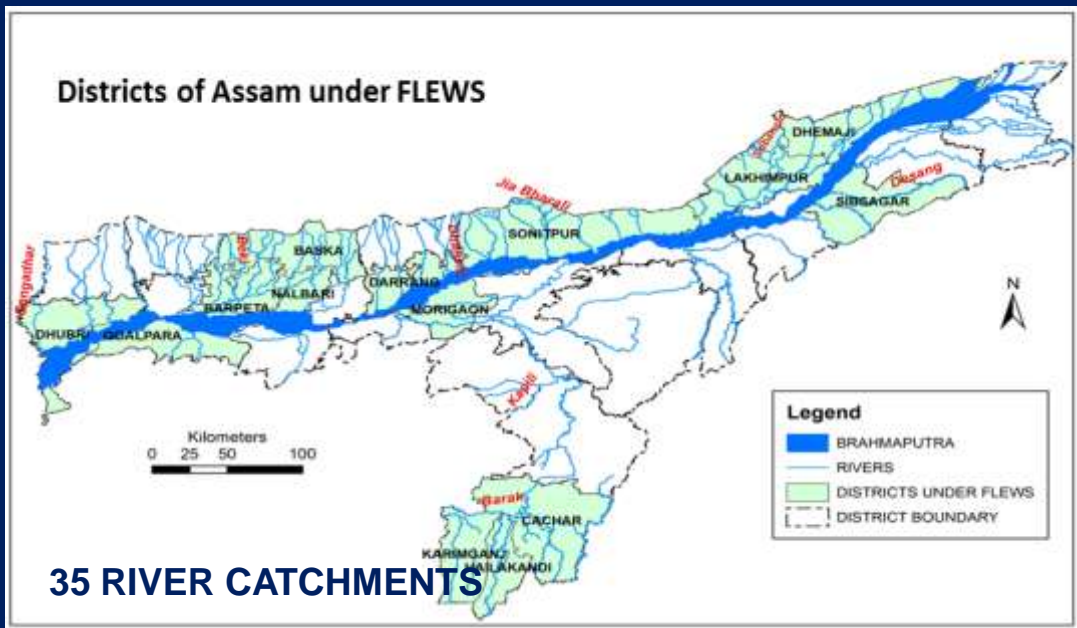
(Jan 2014)

FLEWS was demonstrated
to Dr APJ Abdul Kalam
(July 2013)

FLOOD EARLY WARNING SYSTEM (FLEWS)

ASDMA

Embankment breach map of Lakhimpur district of Assam

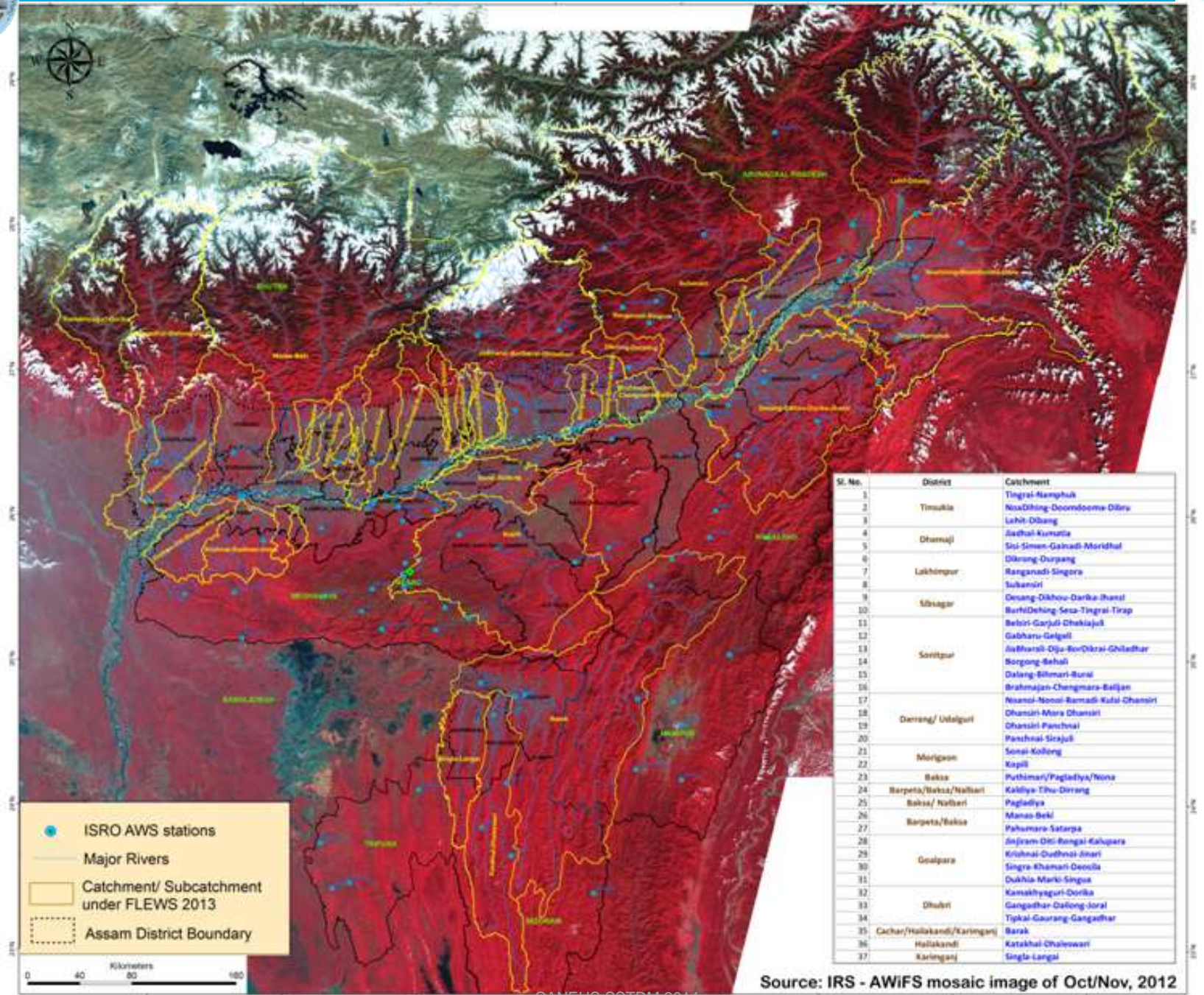


WRF

HEC HMS

SYNOPTIC VIEW

FLEWS – Catchments and River Systems covered upto 2013



Sl. No.	District	Catchment
1		Tingrai-Ramphuk
2	Tezpur	Nosa-Dihing-Doomdooma-Dibru
3		Lohit-Dihang
4	Dhemaji	Jaitoli-Kumaria
5		Sri-Simen-Gahvadi-Moridhal
6		Dikrong-Durgam
7	Lakhimpur	Ranganadi-Singora
8		Tukamari
9	Sibsagar	Orsang-Dikhou-Darba-Ihansi
10		Barkh/Dehing-Seza-Tingrai-Tirap
11		Beholi-Garjuli-Dhekiajuli
12		Gadharu-Galgali
13	Sonitpur	Jalbharoli-Diju-Bov-Dikrai-Ghildhar
14		Sorgong-Behali
15		Dialang-Bilmari-Bural
16		Brahmajan-Chengmara-Baljan
17		Nuanoli-Nonoli-Ramadi-Kali-Ohanoli
18	Darrang/ Ualguri	Ohanoli-Mora-Ohanoli
19		Ohanoli-Panchhal
20		Panchhal-Sirajuli
21	Morigaon	Sonai-Kolleng
22		Kapili
23	Baksa	Puthimari/Pagladitya/Nona
24	Barpeta/Boksa/Nalbari	Kaliya-Tilu-Divring
25	Boksa/ Nalbari	Pagladitya
26	Barpeta/Boksa	Manas-Beki
27		Pahomara-Satarga
28		Dejram-Diti-Bangai-Kalupara
29	Goalpara	Kirishnai-Dudhnai-Jamari
30		Singra-Khamari-Oonolia
31		Oukhia-Marki-Singra
32		Kamakhya-Dorika
33	Dhubri	Gangadhar-Daleng-Jorai
34		Tipkai-Gourang-Gangadhar
35	Cachar/Hailakandi/Karimganj	Barak
36	Hailakandi	Katakhal-Dhalewari
37	Karimganj	Singla-Langal

Source: IRS - AWiFS mosaic image of Oct/Nov, 2012

Catchment Area Coverage

❖ Under Brahmaputra River Basin = 1,92,379 sq km

❖ Under Barak River Basin = 32,595 sq km

Sl.	District(s)	Catchment(s)/River Systems
1	Tinsukia	Tingrai-Namphuk
2		NoaDhing-Doomdooma-Dibru
3		Lohit-Dibang
4	Dhemaji	Jiadhal-Kumatia
5		Sisi-Simen-Gainadi-Moridhal
6	Lakhimpur	Dikrong-Durpang
7		Ranganadi-Singora
8		Subansiri
9	Sibsagar	Desang-Dikhou-Darika-Jhanzi
10		BurhiDehing-Sesa-Tingrai-Tirap
11	Sonitpur	Belsiri-Garjuli-Dhekiajuli
12		Gabharu-Gelgeli
13		JiaBharali-Diju-BorDikrai-Ghiladhar
14		Borgong-Behali
15		Dalang-Bihmari-Burai
16		Brahmajan-Chengmara-Balijan
17	Darrang/ Udalguri	Noanoi-Nonoi-Barnadi-Kulsi-Dhansiri
18		Dhansiri-Mora Dhansiri
19		Dhansiri-Panchnai
20		Panchnai-Sirajuli
21	Morigaon	Sonai-Kollong
22		Kopili
23	Baksa	Puthimari/Pagladiya/Nona
24	Barpeta/Baksa/Nalbari	Kaldiya-Tihu-Dirrang
25	Baksa/ Nalbari	Pagladiya
26	Barpeta/Baksa	Manas-Beki
27		Pahumara-Satarpa
28	Goalpara	Jinjiram-Diti-Rongai-Kalupara
29		Krishnai-Dudhnoi-Jinari
30		Singra-Khamari-Deosila
31		Dukhia-Marki-Singua
32	Dhubri	KamakhyaGuri-Dorika
33		Gangadhar-Dailong-Joral
34		Tipkai-Gaurang-Gangadhar
35		Cachar/Hailakandi/Karimganj
36	Hailakandi	Katakhal-Dhaleswari
37	Karimganj	Singla-Langai



Role

All supports such as Administrative maps, River Index maps, coordination with all concerned state government departments/centres for flood alert dissemination, hydrological database build-up, propagation of FLEWS output to concerned end user through DDMA of concerned districts, etc)

Assam State Disaster Management Authority (ASDMA)

Central Water Commission (CWC)

India Meteorological Department (IMD)

Assam Water Resources Department (AWRD)

North Eastern Council (NEC)

Brahmaputra Board

North Eastern Electric Power Corporation (NEEPCO), etc

EMBANKMENTS

DATA USED

- (i) Temporal Cartosat-1 satellite data Aft Scene of various acquisition dates of 2.5 m spatial resolution
- (ii) River Index Map of Assam (source: WRD Assam)

MAJOR COMPONENTS OF EMBANKMENT BREACH WATCH

1. Monitoring of embankments using high resolution Cartosat-1 data before flood season
2. Post flood embankment breaches identification and mapping at district level.
3. Report breach locations/points in flood prone river systems for mitigation works.



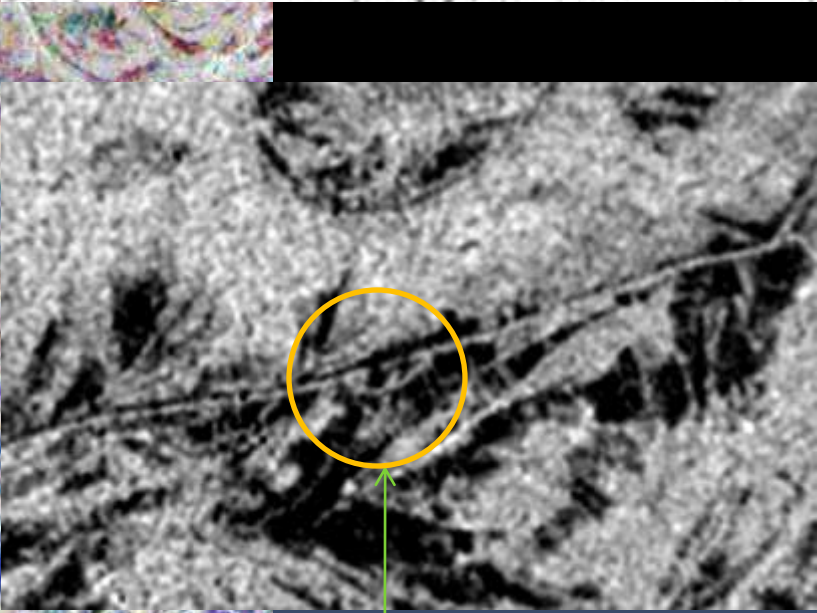
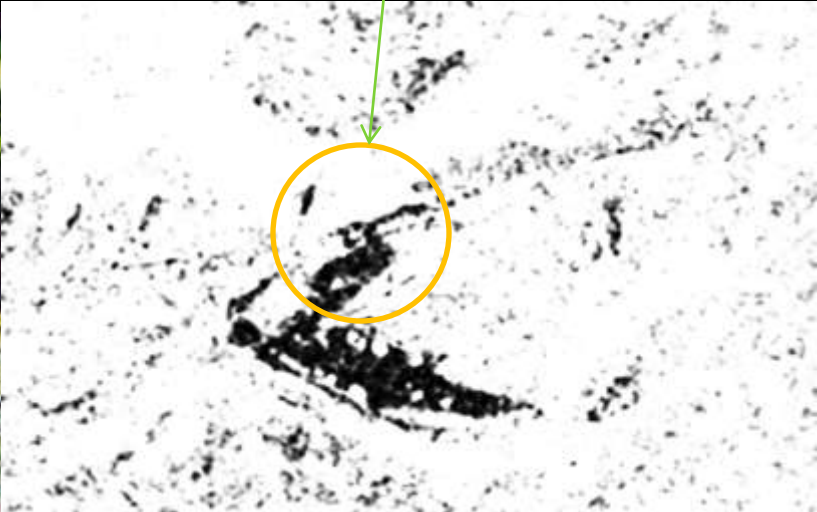
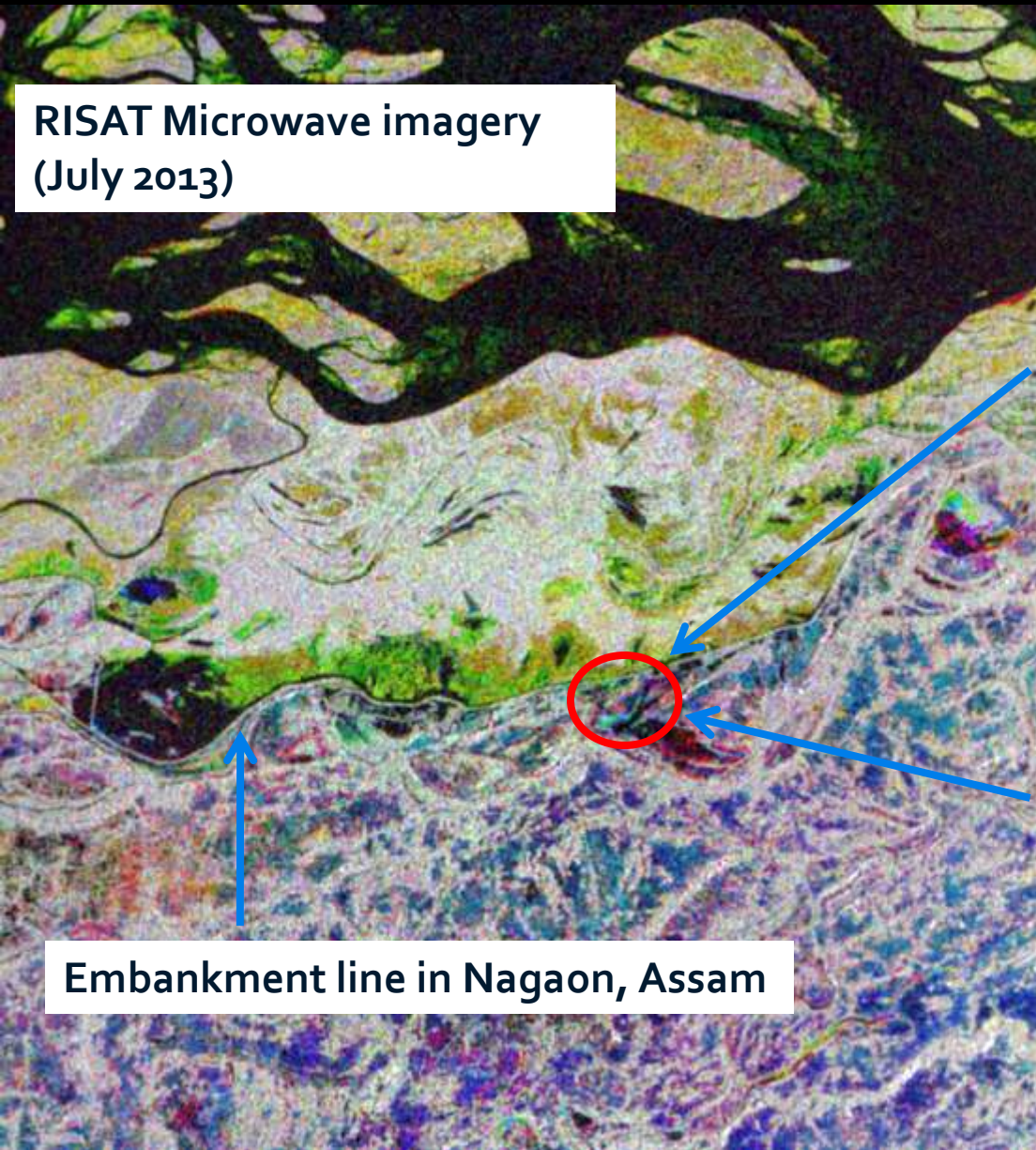
28th December 2012
Cartosat-1 Data
(Breach Location)



Embankment Breach Study using RISAT imagery

Breached Embankment (Histogram equalization), 31st Dec 2012

RISAT Microwave imagery (July 2013)



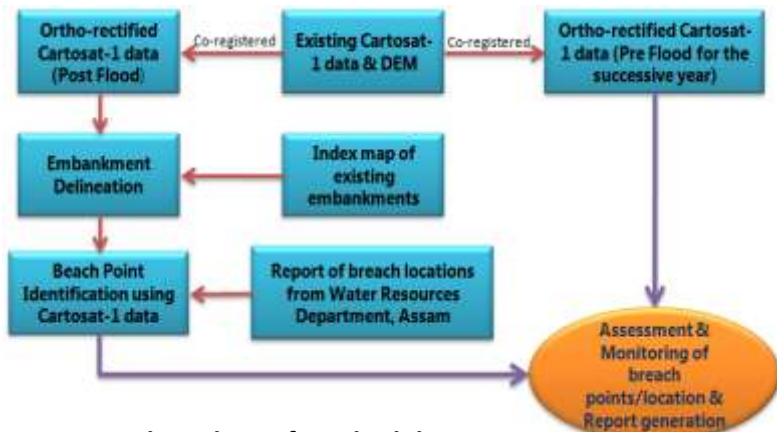
Embankment line in Nagaon, Assam

After Embankment breach correction as on 19 July'2013

ASSESSMENT AND MONITORING OF RIVER EMBANKMENT BREACH LOCATIONS UNDER FLEWS IN ASSAM

Objectives

- 1) To get a detailed stock of Embankment breaches in different district of Assam just after end of the monsoon (post flood).
- 2) To monitor the status of the Embankment breaches well in advance of probable occurrence of flood in subsequent year (pre-flood)



Flow Chart of Methodology



An embanked section before breach



The embanked section after breach

Assessment of Embankment breach

District	River	No of Breaches
Nalbari	Mora Pagladia	4
	Nadla Drainage Channel.	5
Baska	Golondi	1
	Puthimari	2
Karimganj	Longai	1
Morigaon	Brahmaputra	2
Sivasagar	Dikhow	1
	Mitong	1

A total of 39 breaches were identified in different district of Assam under FLEWS

District	River	No. of Breaches
Sonitpur	Brahmaputra	3
	Brahmajan	5
Darrang	Nonoi	1
Barpeta	Deojara	2
	Mora Chowkhowa	2
	Pahumara	3

District	River	Statuses as on 30 March 2012
Dhemaji	Brahmaputra	Not plugged Till 23rd February
	Brahmaputra	Not plugged Till 23rd February
	Brahmaputra	Not plugged Till 23rd February
Sivasagar	Brahmaputra	Satellite data not available
	Dikhow	Not Plugged
Darrang	Mitong	Not Plugged
	Nonoi	Plugged
Nalbari	Mora Pagladia	plugged
	Mora Pagladia	plugged
	Mora Pagladia	plugged

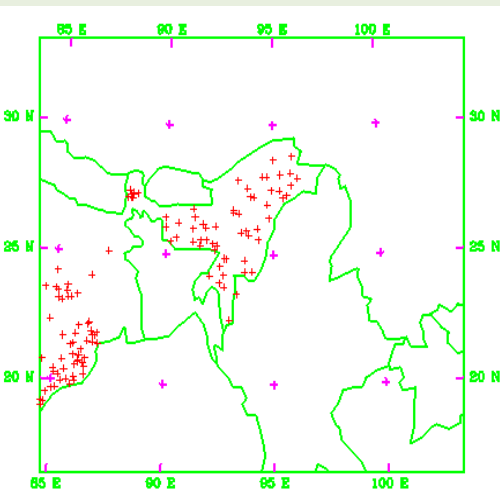
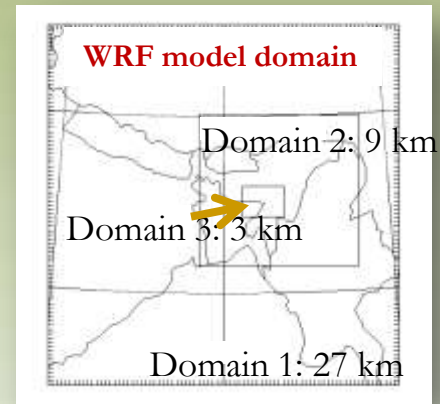
Mar-May

Embankment Breach Monitoring

Numerical Weather prediction using Weather Research and Forecasting (WRF) model

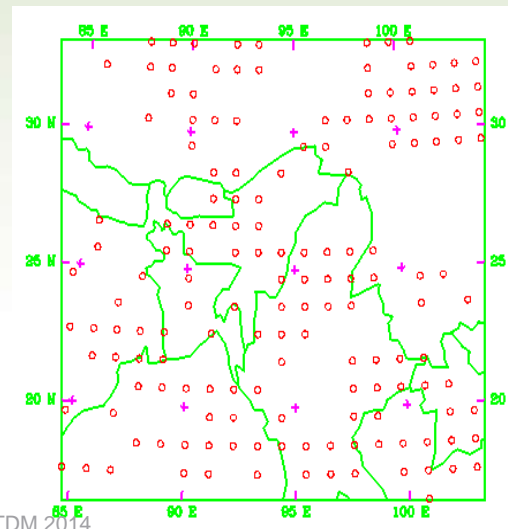
Highlights

- ❑ The WRF model is run in nested domain with 27 km for the primary domain, 9 km for entire NER, and 3 km for the *Leshka*
- ❑ Provision has been made to access the HPC in INCOIS, Hyderabad through remote log in to run the model and the data from AWS and satellite derived wind is assimilated in the model.
- ❑ NARL extended HPC facility for 24/7 now...
- ❑ Shared technical details to Bihar & W B States



AWS data assimilation

- Wind speed,
- Wind direction,
- Temperature,
- Pressure,
- Relative humidity



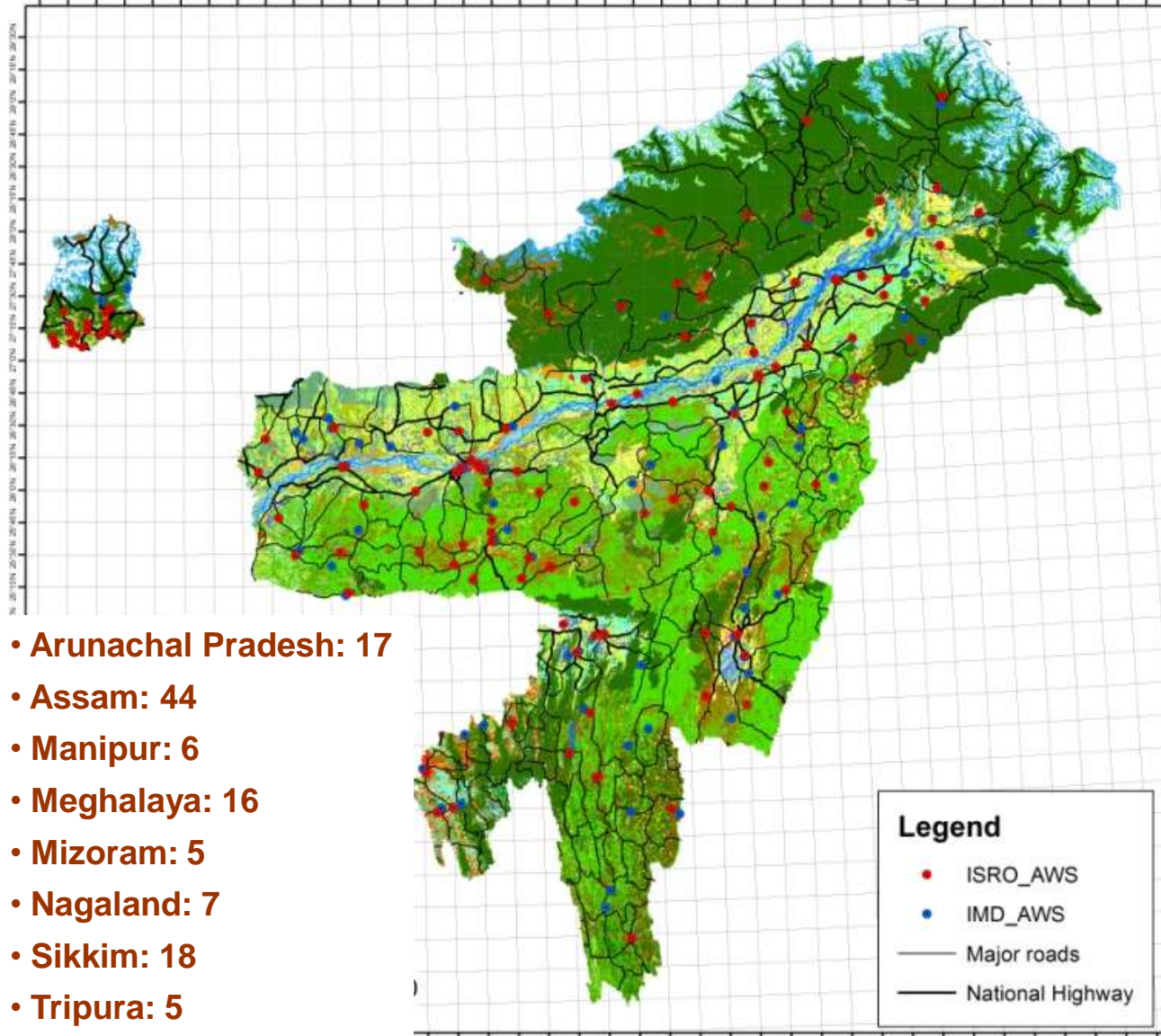
KALPANA - 1 CMV assimilation:

- wind speed and
- wind direction

AWS network in NER of India

- Temperature
- Atm. Pressure
- Relative Humidity
- Rainfall
- Sunshine duration
- Wind Speed
- Wind Direction

ISRO/NESAC AWS network in NE Region



- Arunachal Pradesh: 17
- Assam: 44
- Manipur: 6
- Meghalaya: 16
- Mizoram: 5
- Nagaland: 7
- Sikkim: 18
- Tripura: 5





Data Used

WPS : PREPROCESSING MODULE

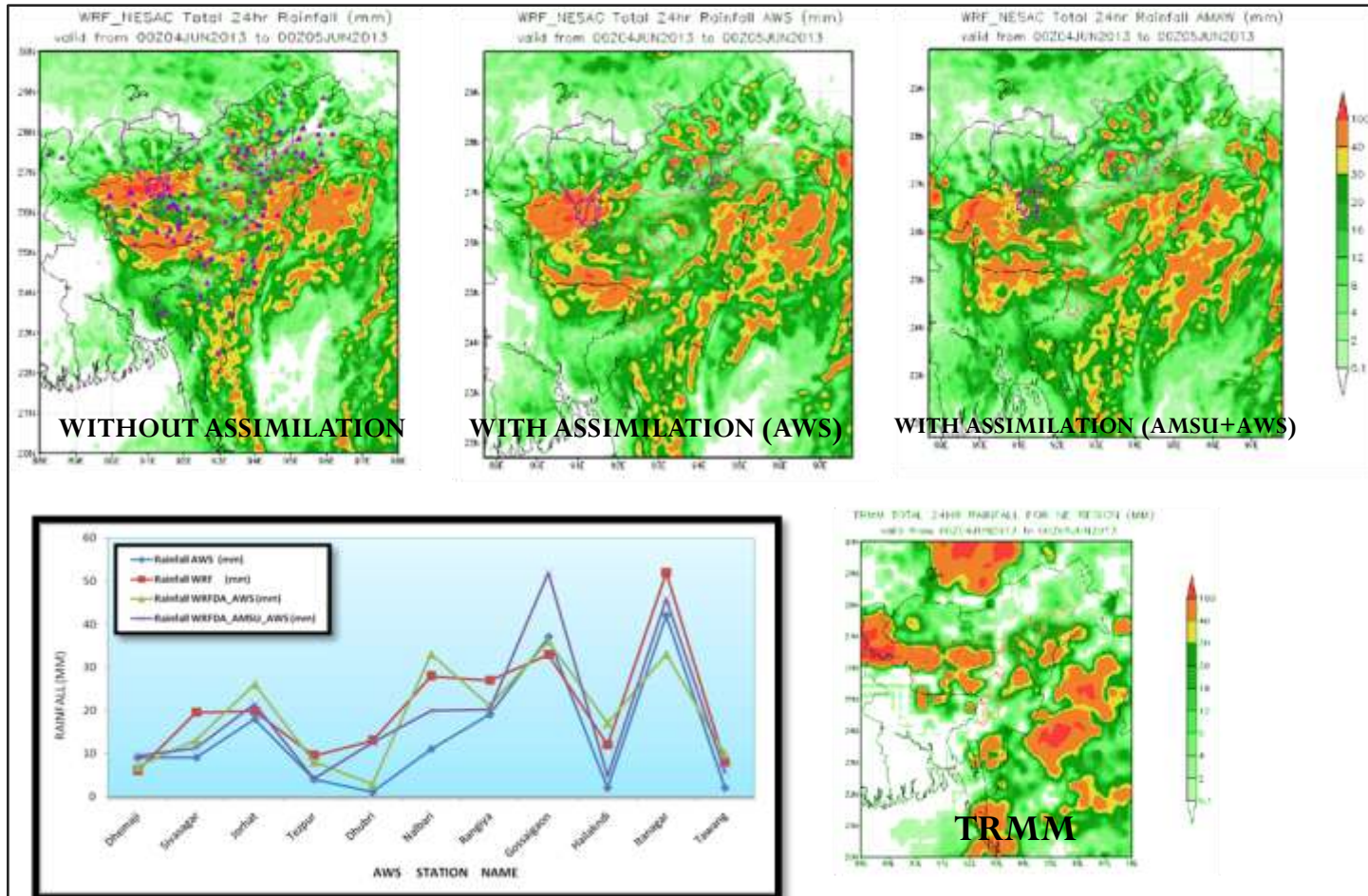
- WRF Terrestrial Data
- NCEP GFS Initial data at $1^{\circ} \times 1^{\circ}$ resolution

WRFDA: DATA ASSIMILATION

- AWS : Wind Speed, Wind Direction, Temperature, Pressure and Relative Humidity
- Kalpana 1: Wind Speed and Wind Direction
- Oceansat 2: Wind speed and Wind Direction
- Radiosonde: Temperature, Pressure, Dew point Temperature, Wind Speed, Wind Direction
- Amsu: Radiance Data

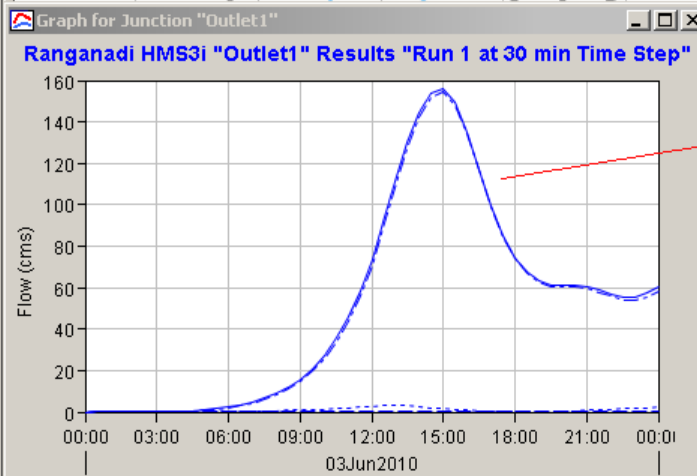
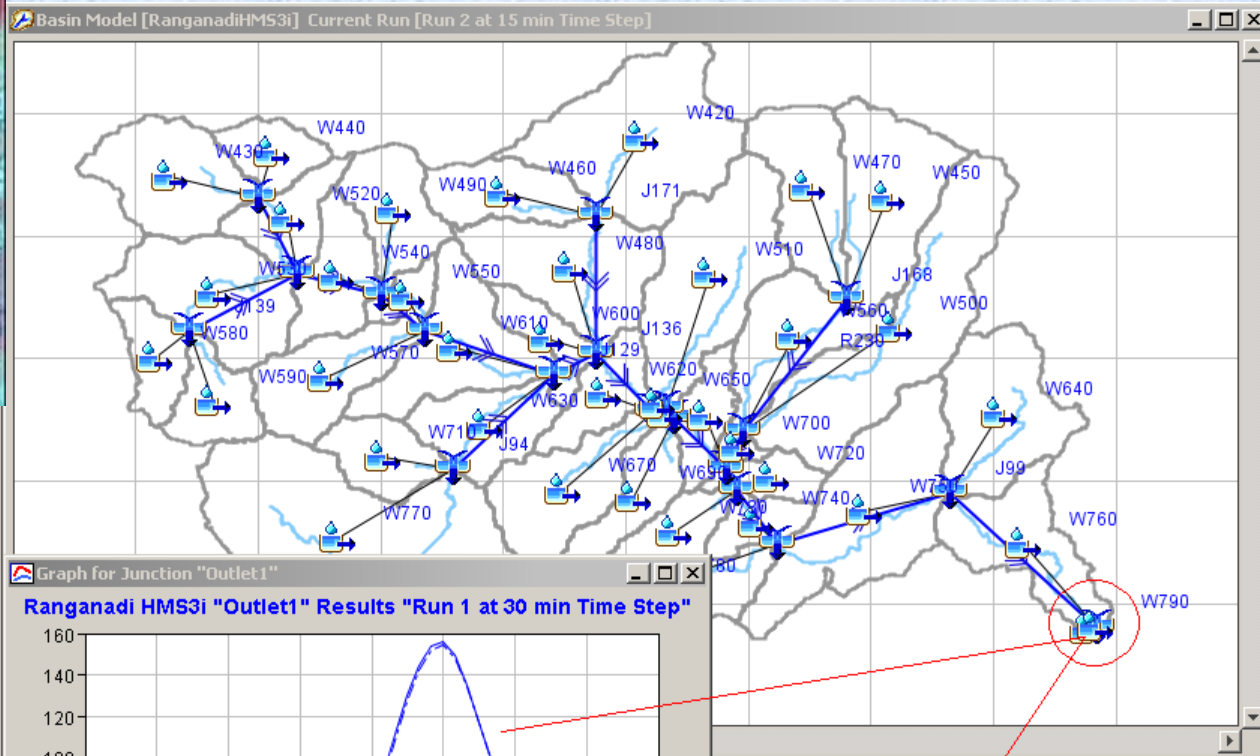
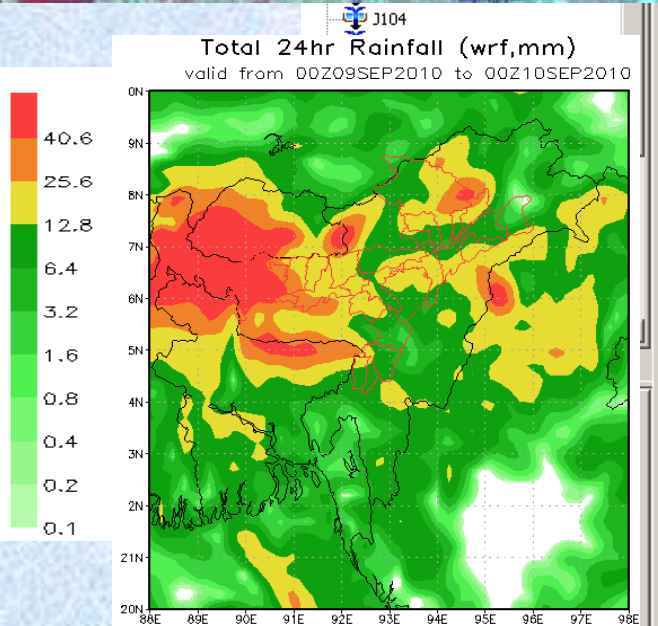
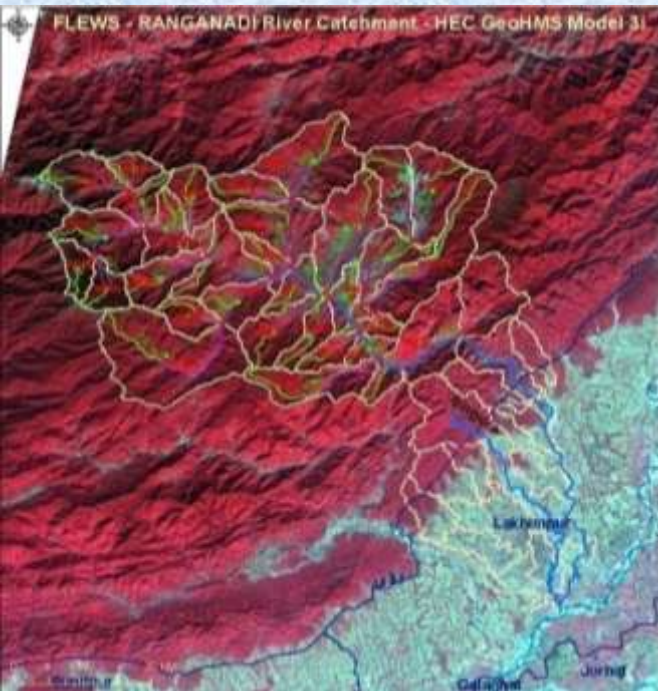


Result of AMSU Data Assimilation for Rainfall forecast



ASSIMILATION OF AMSU RADIANCE DATA INCREASES THE ACCURACY OF WRF FORECAST

HEC Geo HMS model set up



Summary Results for Junction "Outlet1"

Project: RanganadiHMS3i
 Simulation Run: Run 1 at 30 min Time Step Junction: Outlet1

Start ...	03Jun2010, 00:00	Basin Model:	Ranganadi-
End ...	04Jun2010, 00:00	Meteorologic Model:	Ranganadi-
Comput...	06May2011, 10:19:52	Control Specifications:	Control 1 3C

Volume Units: MM 1000 M3

Computed Results

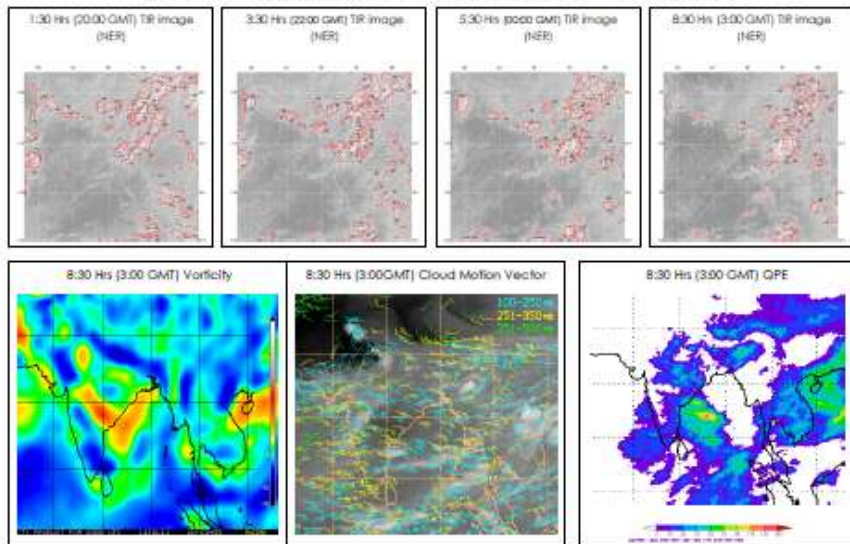
Peak Out...	155.8 (M3/5)	Date/Time of Peak Outflow :	03Jun2010, 1
Total Out...	2.05 (MM)		

Legend (Compute Time: 06May2011, 10:19:52)

— Run:RUN 1 AT 30 MIN TIME STEP Element:OUTLET1 Result:Outflow

Synoptic rainfall forecast for FLEWS

Synoptic weather advisory for FLEWS Project as on 10:00^h Hrs 14th July, 2011



Past 24 hrs rainfall (mm) as on 8:30 Hrs

Lakhimpur and Dhemajli			Barpeta, Nalbari, and Baksa		Barak basin		
Station Name	Rainfall	Station Name	Rainfall	Station Name	Rainfall	Station Name	Rainfall
Lakhimpur	26 mm	Seppa	NA	Bongalgaon	39 mm	Karimganj	7 mm
Dhemajli	50	Basar	55 mm	Rangia	NA	Haliakandi	41
Itanagar	33 mm	Mengla	12 mm	Nalbari	0 mm	Silchar	34 mm
Ziro	19 mm	Daporjo	81 mm	Barpeta	10 mm		
Yazeli	14 mm	Koloriang	69 mm				

Quantitative Precipitation Forecast (IMD) rainfall in mm

Basin	Rainfall	Basin	Rainfall (mm)	Basin	Rainfall	Basin	Rainfall
Subansiri	NA						

NA - Not Available

IMD weather forecast (based on 13th July 2011 Night) up to 0830 hours IST of 14th July, 2011: Fairly widespread rain/thundershowers over northeastern states

Synoptic Weather and rainfall probability for next 12 hrs:

East Assam area: Heavy rainfall reported during last 24 hours. More rainfall amounting to 10-20 mm expected over the area. Some parts of Lakhimpur and Dhemajli district bordering Arunachal Pradesh may receive heavy rainfall amounting to 20-30 mm. Need to observe critically.

West Assam area: Low to moderate rain fall 5-15 mm expected over the area.

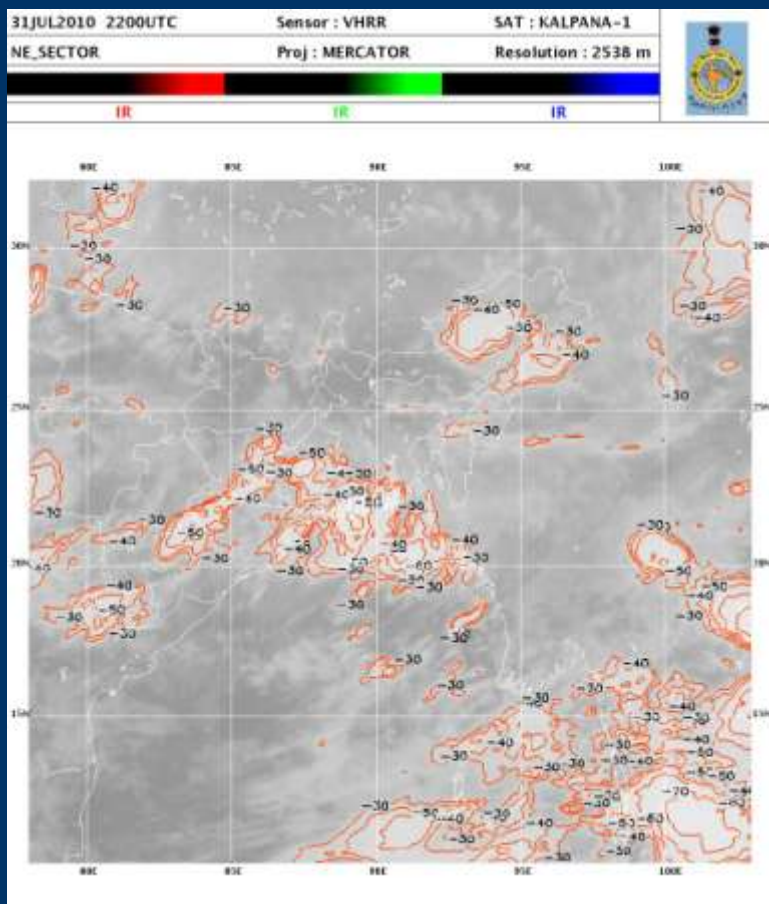
South Assam area: Moderate rain fall (10-20) mm expected over the eastern parts of the basin. Other areas may get low rainfall (0-10 mm).

Salient features of the advisory

- Forecast is issued twice daily.
- Forecast valid for 6-12 hours depending on system intensity.
- Forecast is based on multi-platform and multi-source data.
- Forecast is based on near real time data.
- Rainfall forecast in the range bins of 0-10mm, 10-25mm, 25-50mm, and more than 50 mm.
- Quantitative rainfall forecast for each basin under study.
- IMD synoptic weather forecast also is a part of the advisory.

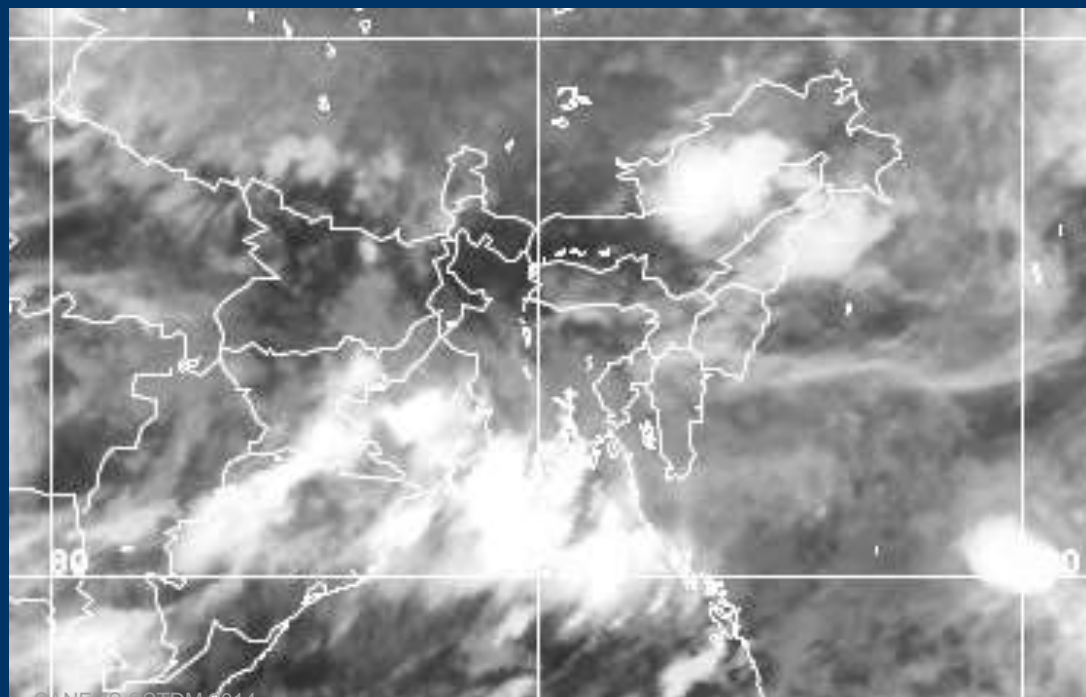
Synoptic weather analysis

Cloud Information from TIR channel image



TIR (10.5-12.5 μm) Image of NER sector and Indian sector (for synoptic overview) is used.

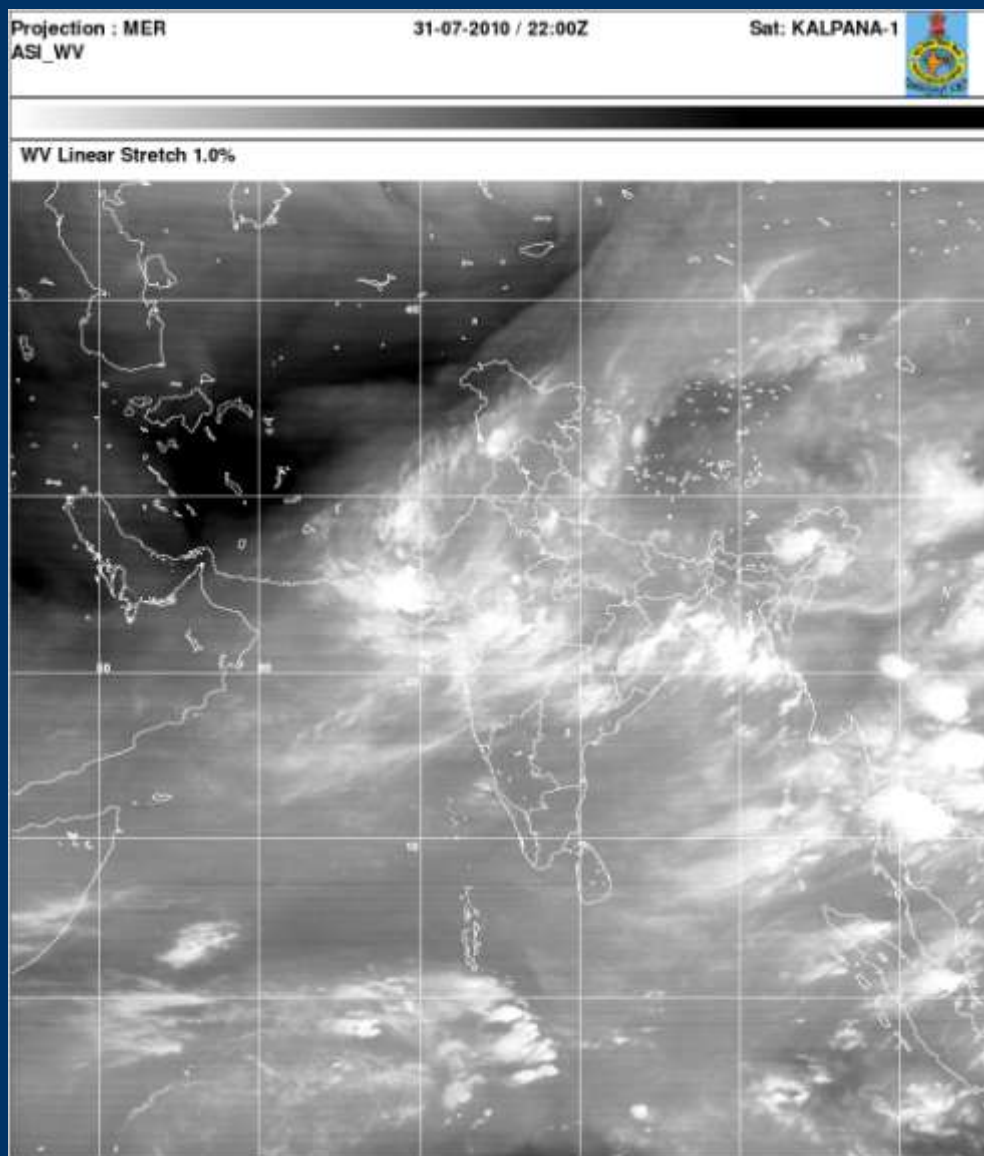
NER sector image is available with cloud top temperature (CTT). CTT value less than $-40\text{ }^{\circ}\text{C}$ indicates presence of cumulonimbus cloud (if not cirrus cloud), which normally gives heavy precipitation (apprx 25 mm)



Source of data: IMD and MOSDAC

Synoptic weather analysis

Columnar moisture from WV channel image



Water Vapor channel (5.7-7.1 μm) Image of Indian sector and NER sector is used.

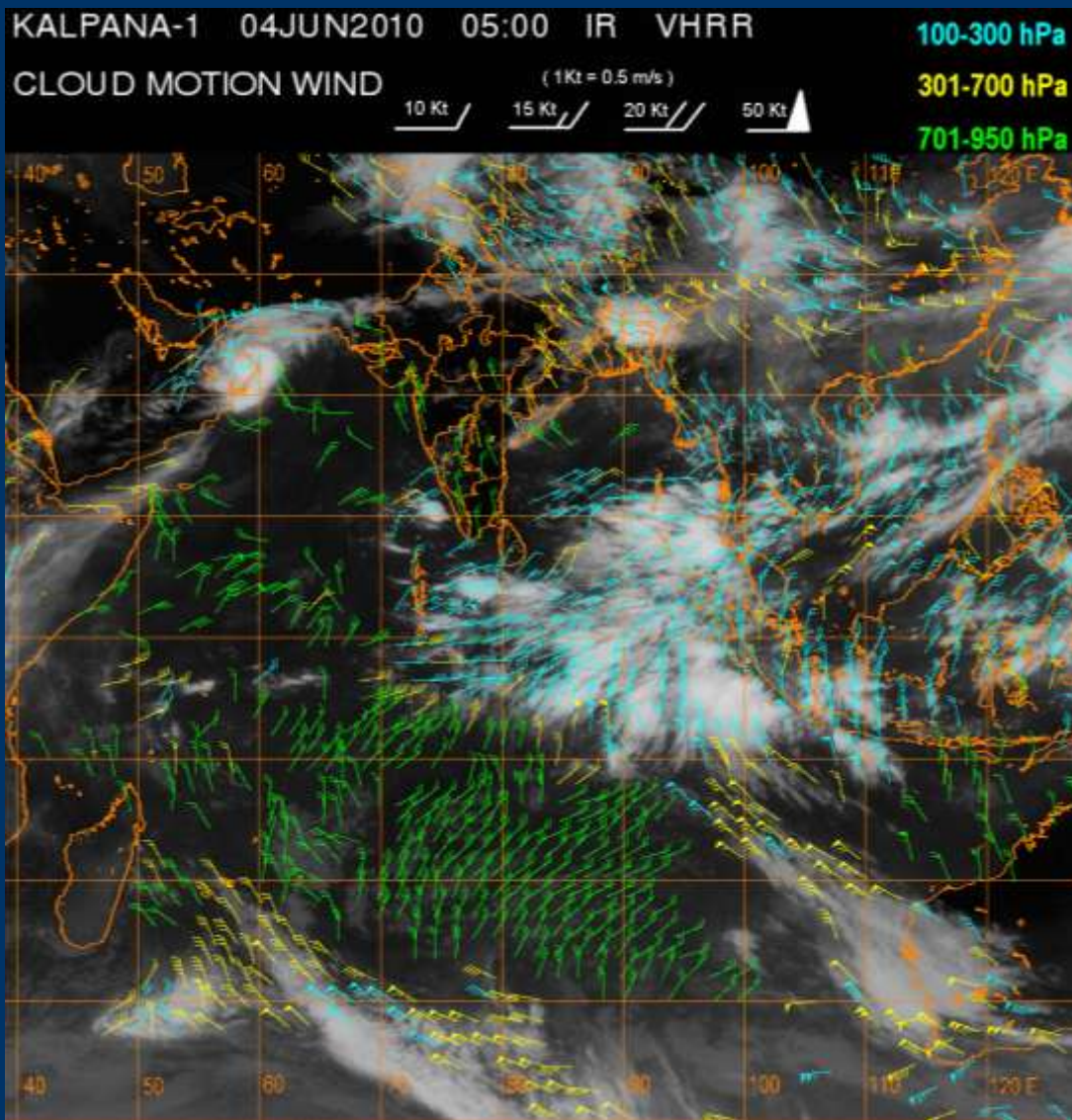
WV image provides information on total precipitable water vapor in the atmosphere column.

WV channel image helps in differentiating the cirrus clouds from cumulonimbus clouds and also to identify presence of moisture in atmosphere.

Source of data: IMD and MOSDAC

Synoptic weather analysis

Cloud Motion Vector (CMV)



CMV gives the wind speed and direction at three levels.

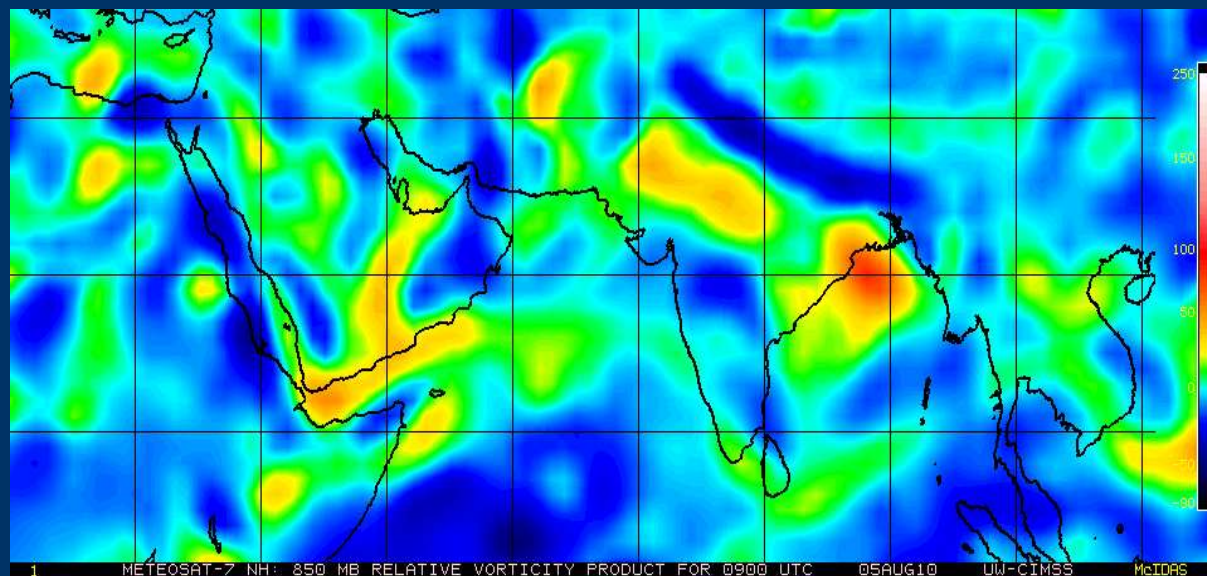
CMV Image is observed to guess the direction of motion of existing cloud during next 12 hours (apprx).

CMV is available for lower (0.5 - 3.5 km), middle (3.5- 8.0 km) and upper (8.0 -16.0 km) atmosphere.

Source of data: IMD, MOSDAC, University of Wisconsin

Synoptic weather analysis

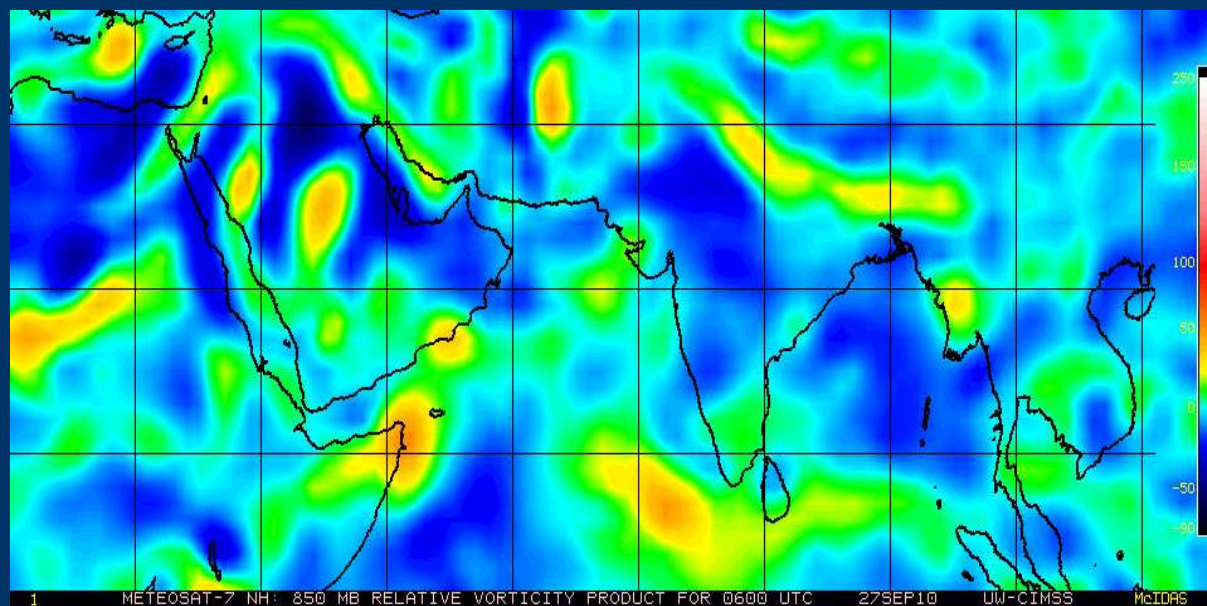
Relative vorticity



Relative vorticity at 850mb, 700 mb, and 500 mb indicates about degree of instability in the atmosphere (a condition conducive for convection).

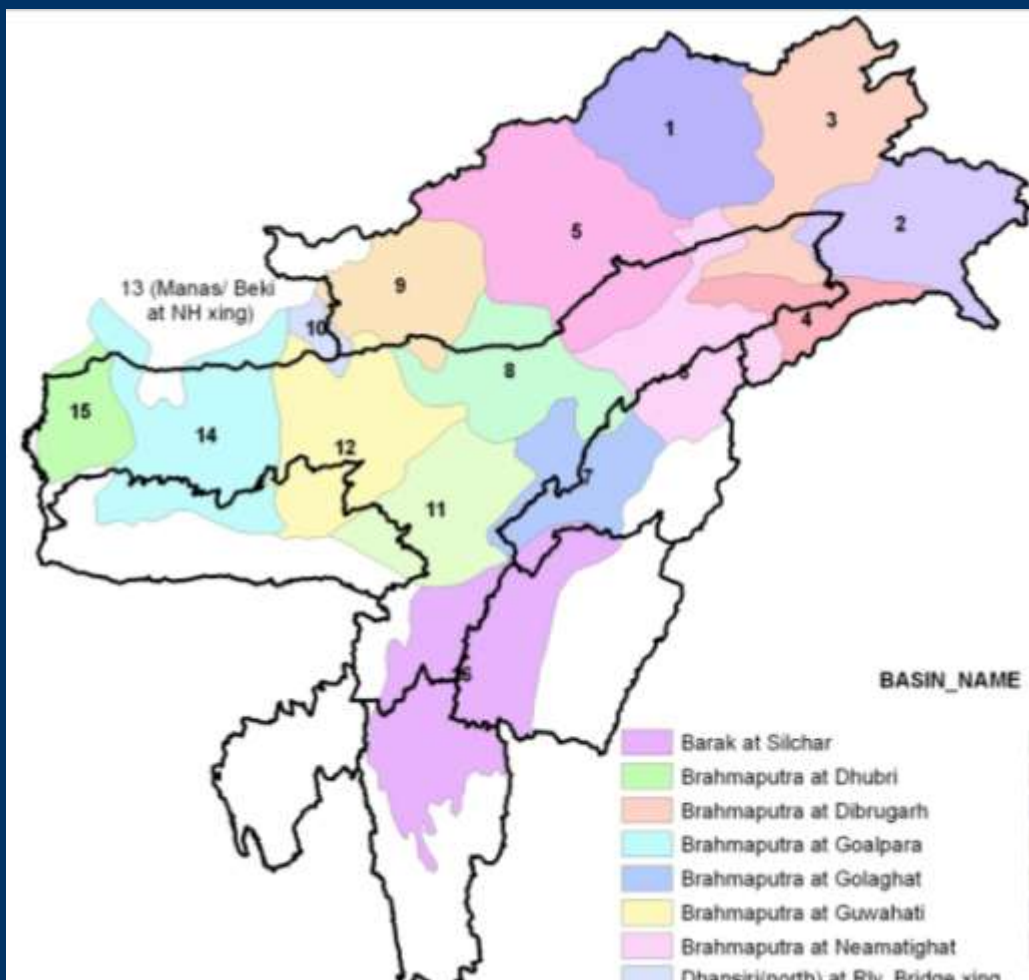
During monsoon season, Strong vorticity normally leads to strong system formation, because of steady moisture supply.

Source of data: Cooperative Institute for Meteorological Satellite Studies (CIMSS), Wisconsin University, USA.



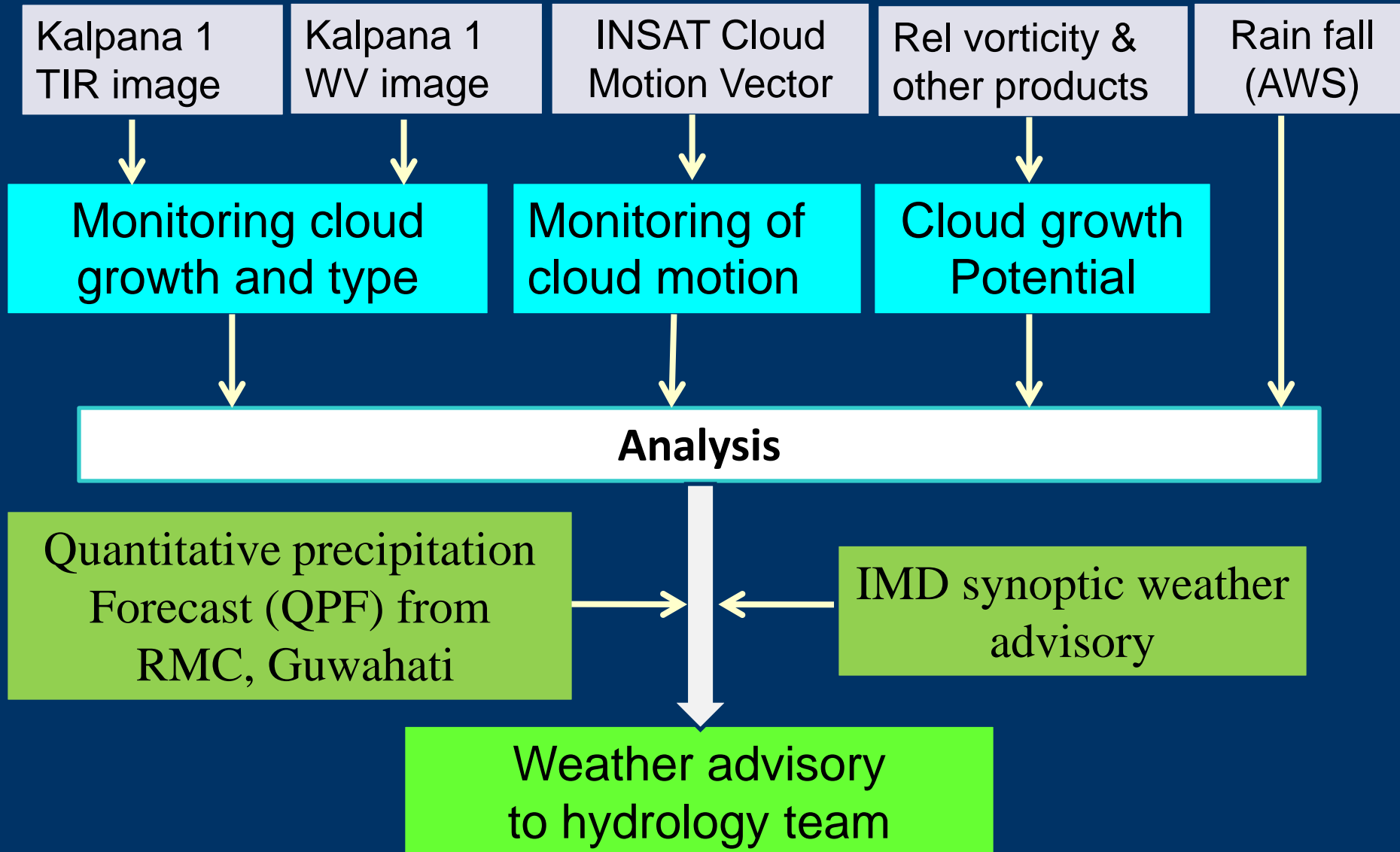
Quantitative Precipitation Forecast (QPF)

FMO, RMC, Guwahati provides basin-wise rainfall forecast for 24 hours using analog forecasting technique.

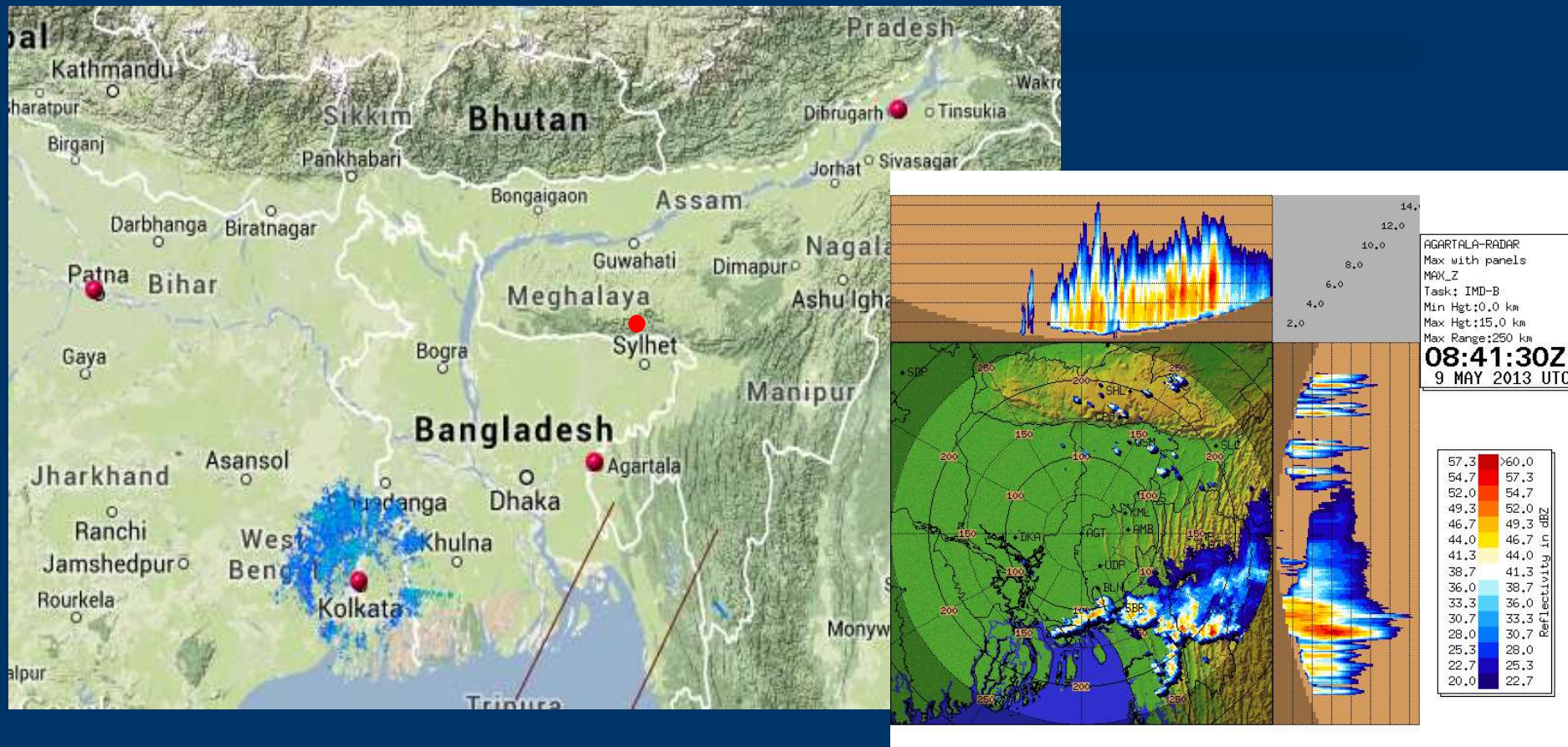


Sub-Catchment wise				
Ariial Average Rainfall (AAR) & up dated QPF Issued , Dated				
Catchment NO	E/A	QPF	0830 hrs ,Rainfall of IMD Statio	
			Station Name	Rainfall
1	19.5	11-20	Guwahati	27.5
2	7.4	11-20	Mohanbari	Trace
3	12.6	11-20	Agartala	0.0
4	13.5	-	Imphal	0.3
5	4.9	-	Silchar	14.8
6	1.9	-	Tezpur	73.4
7	1.1	-	Shillong	1.8
8	8.2	-	N/Lakhimpur	20.4
9	1.9	11-20	Dhubri	22.7
10	12.7	-	Passighat	12.4
11	1.8	-	Cherrapunji	41.6
12	12.2	-	Aizwal A/P	0.0
13	4.7	1-10	Jorhat	12.3
14	13.0	-	Itanagar	3.4
15	34.5	-	Kohima	0.0
16	2.0	-		

Synoptic Weather forecasting: Flow Chart



Doppler Weather Radar



- The Z data from DWR at Mohanbari helps in confirming the cloud intensity over eastern Assam area. **DWR at Mohanbari was out of order during 2013 monsoon.**
- The DWRs at Kolkata and Agartala helps in tracking approaching system during summer monsoon season. The DWR in Cherrapunjee, once operational shall help in rainfall forecast over western Assam.

FLOOD ALERT IN THE FORM OF GROUP SMS

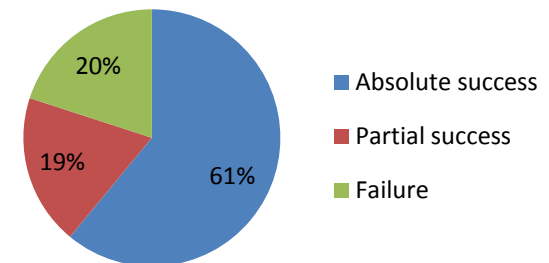


The District Project Officer (Disaster Management) is the nodal officer for the information dissemination of the NESAC warning. He apprises the DC, ADC (DM) and other key stake holders like Circle Officers, Water Resource Deptt., NIC, PWD (Roads) Deptt., National Disaster Response Force about probable flood vulnerability, through SMS and phone, mobile / personnel messenger. National Informatics Centre (NIC), Lakhimpur Unit has provided technical support for sending bulk SMS.

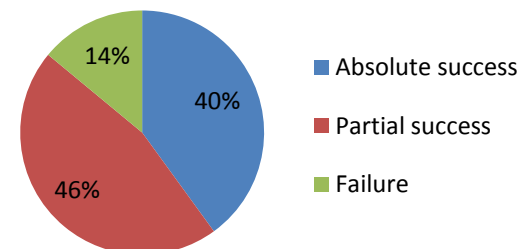
Alerts issued under FLEWS (2012-2013)

Year	2012	2013
Total Alerts issued	64	35
Flood reported (Abs. Success)	39	14
Water Level rise reported (Part. Success)	12	16
No flood reported (Failure)	13	5

Alerts issued under FLEWS 2012



Alerts issued under FLEWS 2013



The alert format

Thursday, 30 August, 2012 15:14 PM

Respected all concerned

Our hydromet analysis reveals a probable low flood situation in Dhemaji in coming 48 hours as per following details.

District: Dhemaji

Rivers: Jiadjal-Kumatia & Subtribs (Gogamukh, Dhemaji RCs)

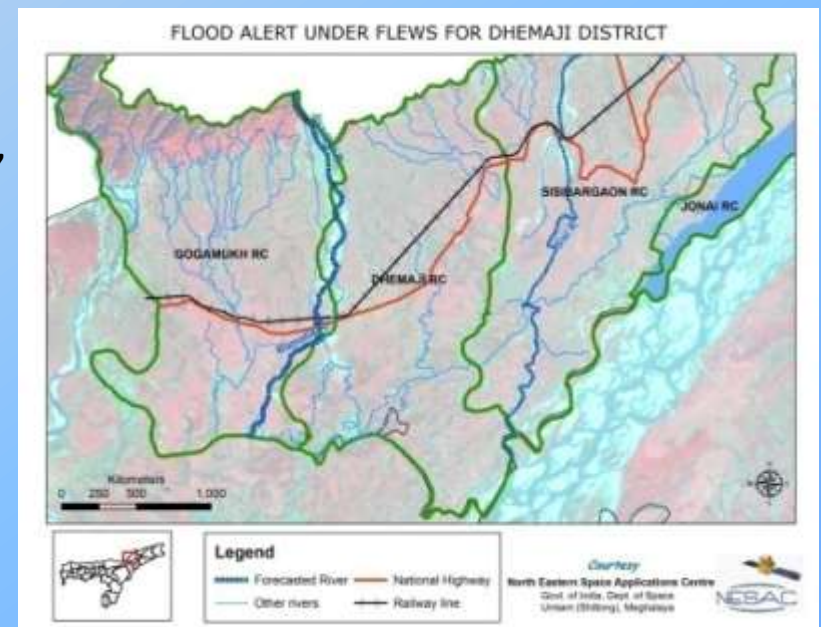
Gainadi & subtribs (Sisiborgaon RC)

Severity: Low

This alert has the approval of Director, NESAC

Regards

FLEWS Team, NESAC



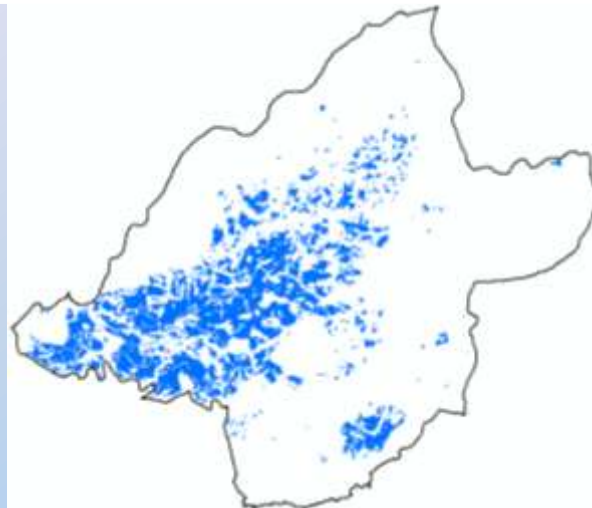
Disclaimer: This alert is a planning tool only and not for legal purposes.

Attachments: **Revenue Circle maps showing rivers under forecast**
(A brief alert through Group SMS)

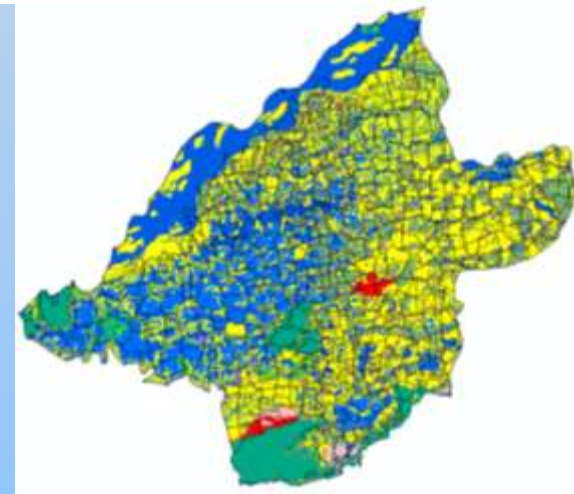
Post Flood Damage Assessment in Morigaon District of Assam



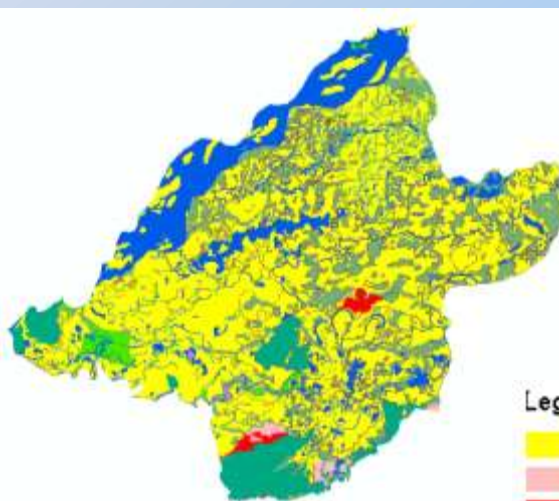
Radarsat-2 data of 30-06-12



Flood inundated area



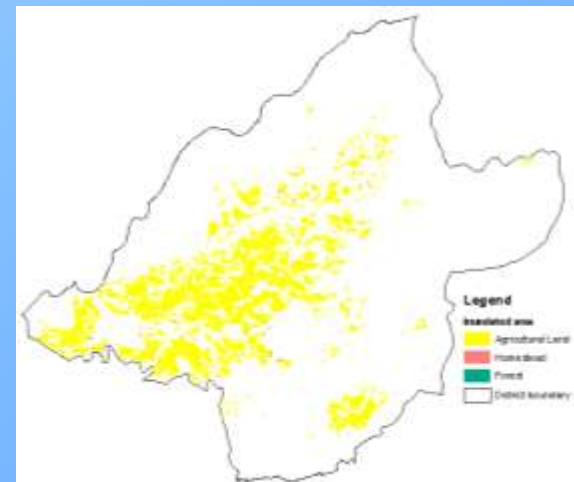
Village boundary overlaid on inundation layer & land use



- Legend**
- Agricultural Land
 - Agricultural Plantation
 - Built Up
 - Forest
 - Natural Grassland
 - Tree Clad Area
 - Open Scrub
 - Waterbody



Village boundary

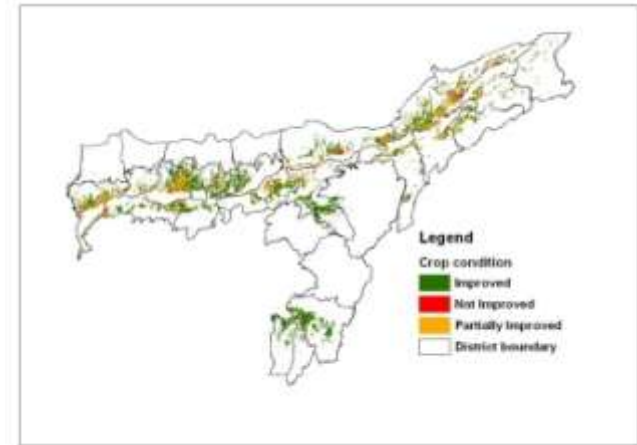
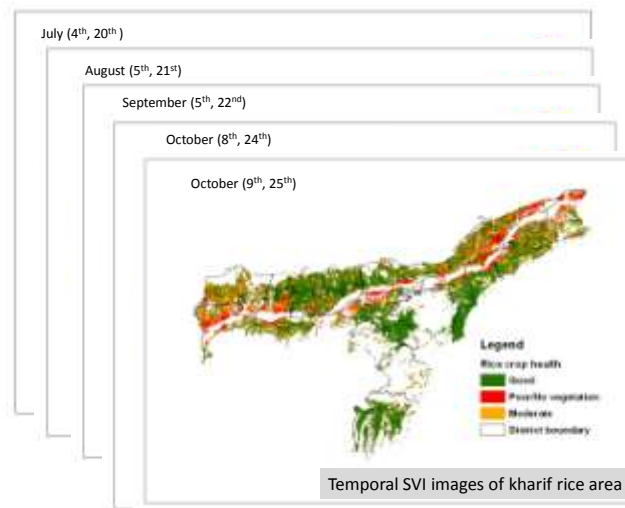
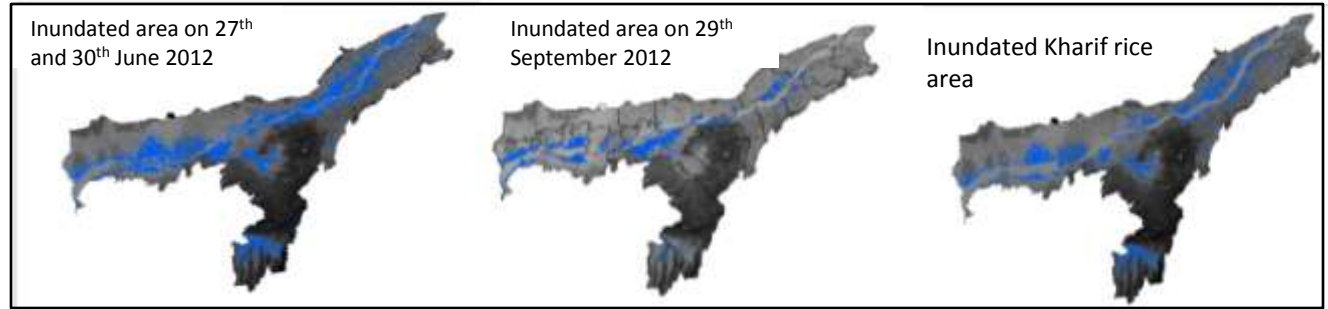
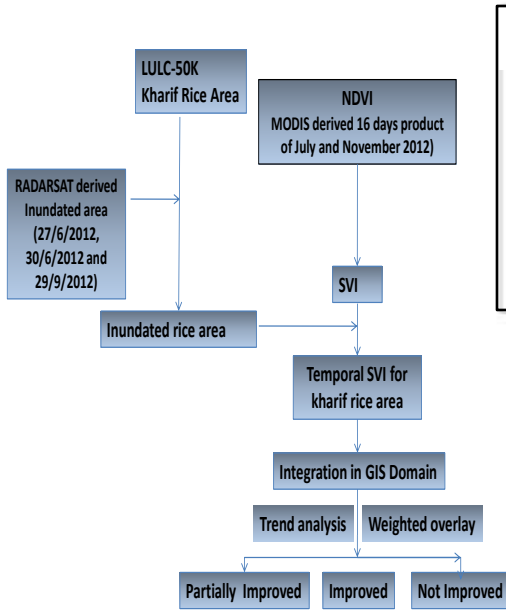


- Legend**
- Inundated area
 - Agricultural Land
 - Homestead
 - Forest
 - District boundary

Affected Village/land use	No/ Area
No. of villages	309
Homestead	167.32 ha
Agricultural land	22417.83 ha
Forest	14.29 ha

Land Use

Monitoring of flood inundated kharif rice area of Assam and assessment on the current state of recovery using remote sensing and GIS technique.



Not improved (River course change in Goalpara district)



Partially Improved (late transplanting in Haiakandi)



Improved In Kachar

Continuous monitoring of crop health using SVI image derived from MODIS data

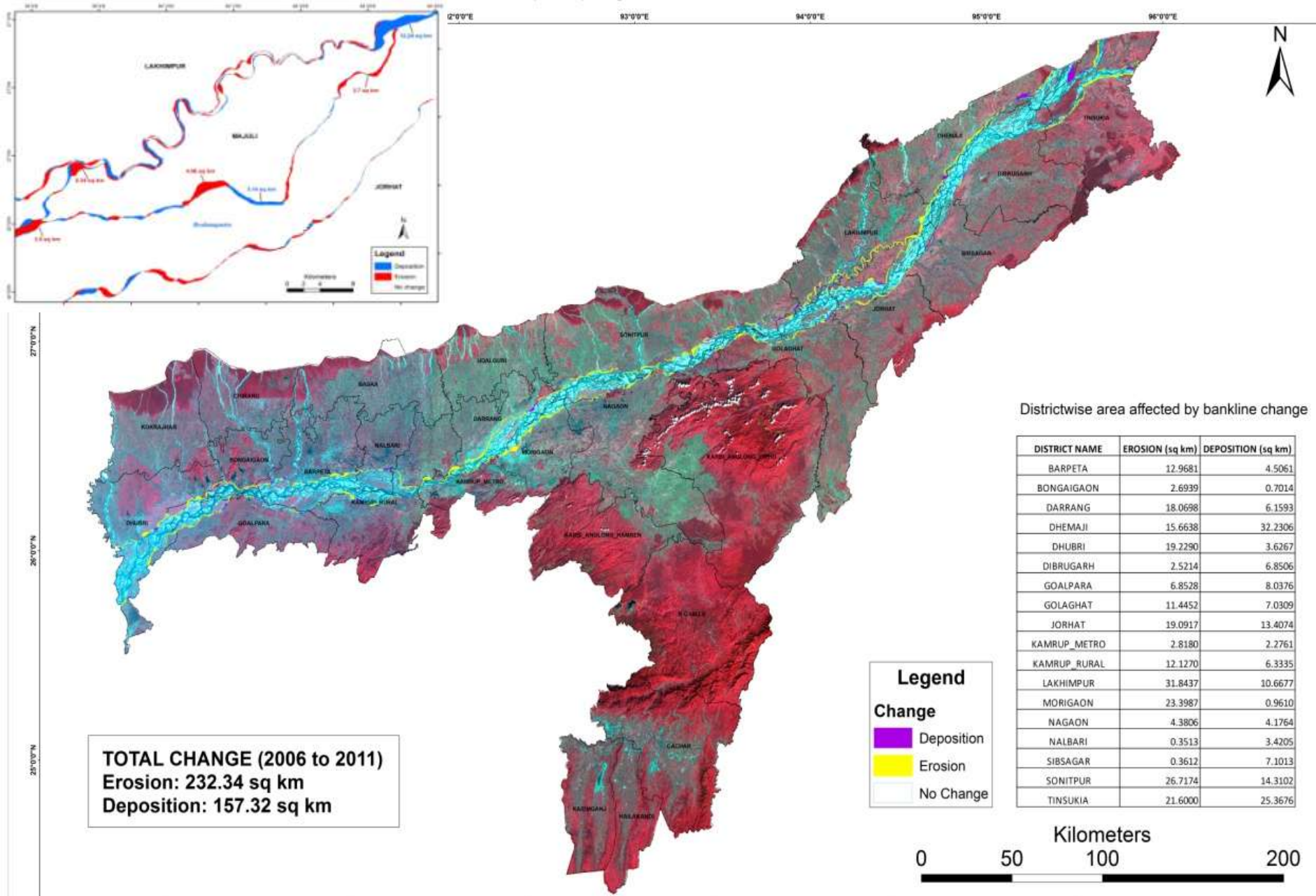
Crop recovery status of flood inundated kharif rice crop area

Inundated Kharif crop area(hac)	Improved (hac)	Not Improved (hac)	Partially Improved (hac)
194115	101811	26097	66207

Report submitted to ASDMA and Chief Scretary, Govt of Assam

BRAHMAPUTRA BANK EROSION STUDY

Based on Satellite (AWiFS) images of December, 2006 and November, 2011



Districtwise area affected by bankline change

DISTRICT NAME	EROSION (sq km)	DEPOSITION (sq km)
BARPETA	12.9681	4.5061
BONGAIGAON	2.6939	0.7014
DARRANG	18.0698	6.1593
DHEMAJI	15.6638	32.2306
DHUBRI	19.2290	3.6267
DIBRUGARH	2.5214	6.8506
GOALPARA	6.8528	8.0376
GOLAGHAT	11.4452	7.0309
JORHAT	19.0917	13.4074
KAMRUP_METRO	2.8180	2.2761
KAMRUP_RURAL	12.1270	6.3335
LAKHIMPUR	31.8437	10.6677
MORIGAON	23.3987	0.9610
NAGAON	4.3806	4.1764
NALBARI	0.3513	3.4205
SIBSAGAR	0.3612	7.1013
SONITPUR	26.7174	14.3102
TINSUKIA	21.6000	25.3676

Legend

Change

- Deposition
- Erosion
- No Change

TOTAL CHANGE (2006 to 2011)
Erosion: 232.34 sq km
Deposition: 157.32 sq km



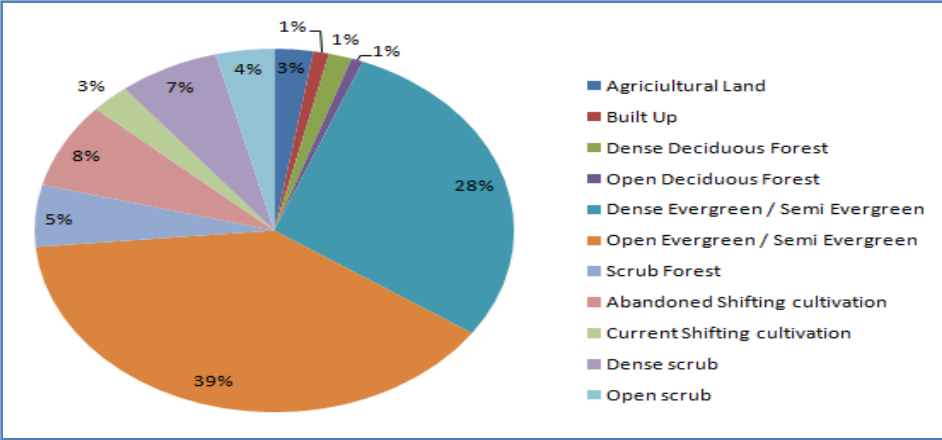
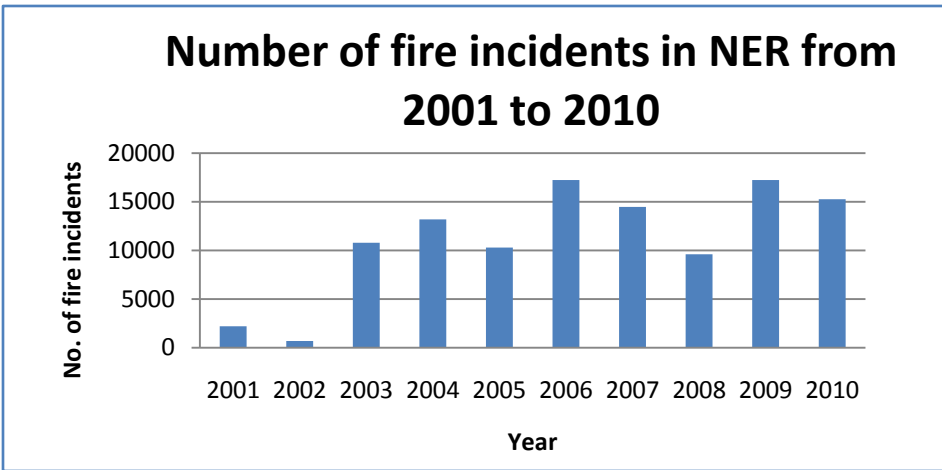
Recognitions for FLEWS

- (1) The project has been recognised as one of the **best innovative practices in governance sector** by the Department of Administrative Reforms, Ministry of Public Grievances & Pensions, Govt. of India and has been funded for its professional documentation (based on its success till 2011).
- (2) The project has also been shortlisted for **Prime Minister's award for innovation in Public Administration** for 2012 and has already been scrutinised by a team of experts on 9th November, 2012 at ASDMA, Guwahati.
- (3) After its encouraging success from 2009 to 2011, Govt. of Assam has funded FLEWS for three subsequent flood seasons of 2012, 2013 & 2014 after inviting financial proposal from NESAC.
- (4) Columbia Water Centre (CWC) of Columbia University, USA has also expressed interest to collaborate with NESAC for developing flood model for the greater Brahmaputra basin (Under MOU signed with Assam Govt.)
- (5) Winner of e North East Award 2013

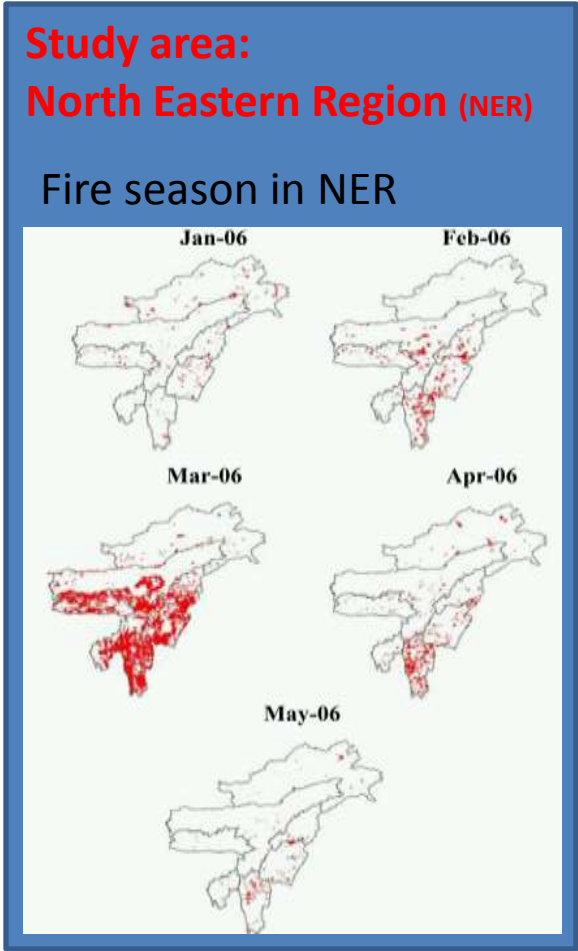
Forest Fire Monitoring in North-Eastern Region



Scope and Objective



Spatial variability differed in forest biomass burned and forest fire counts with biomass burned being largest in central India but fire frequency being highest in the east-northeast India.



The main objectives of the forest fire monitoring under NER-DRR are:

- To support the ongoing **forest fire mitigation programs** in the region by providing fire alerts in the form of forest fire risk zone maps
- To support the forest fire management authorities like forest dept. to take up **advance fire management measures**

FOREST FIRE RISK ALERT & VULNERABILITY ASSESSMENT

- MODIS onboard Terra (EOS AM) and Aqua (EOS PM) satellite acquire data continuously providing global coverage every 1-2 days.
- Terra (EOS AM) passes over the equator at approximately 10:30 am and Aqua (EOS PM) satellite passes over the equator at approximately 1:30 pm for descending node
- Brightness temperature of band 21/22(3.929-3.989 μm) and 31 (10.78-11.28 μm) is used for active fire detection using a contextual algorithm (Giglio et al., 2003)
- A MODIS active fire detection represents the center of a 1km (approx.) pixel flagged as containing one or more actively burning hotspots/fires

INPUT DATA

Daily fire pixel data is downloaded twice (for both Aqua & Terra pass) from EOSDIS/**FIRMS** website in shapefile format. Only pixels with confidence level $\geq 60\%$ is considered. (Confidence level refers to a quality flag of each active fire pixel)

A **mask** is used to extract only the forest fire pixels and eliminate any false alarms

Land-use/Land-cover/Slope/Aspect/Proximity to Waterbody & Settlement is extracted within a area of **3km buffer** centered at each fire pixel location

Integration of **meteorological data** (wind speed, wind direction and dew point) from IMD/ ISRO AWS for each fire pixel location



Forest Fire Vulnerability Assessment Report Format

A report in tabular format for each fire pixel along with the map of the fire pixels are sent to respective forest departments and other stake holders twice daily.

Fire Location (FL)	Longitude	Latitude	Date	State Name	District Name	Vegetation Type/Land Use Land Cover Category (Buffer of 3 Km radius centered at FL)	Road Connectivity to Fire Location	Aspect	Slope (Deg)	Settlement (If Present)	Nearby Water Body (If Any)	Wind Speed (Km/Hr)	Wind Direction	Dew Point (deg C)	Vulnerability
FL1	92.732	24.464	19/03/2014	Assam	Hailakandi	Scrub; open evergreen; jhum; forest blank; dense evergreen; bamboo; agricultural land	National Highway; Village Road - Kutchha	E	15-25	Yes	No	16.7	W	11.6	Low
FL2	92.685	24.468	19/03/2014	Assam	Hailakandi	Scrub; open evergreen; jhum; forest blank; dense evergreen; agricultural land	Metalled Road; Village Road - Kutchha	W	8-15	Yes	No	16.4	W	11.8	Moderate
FL3	92.689	24.472	19/03/2014	Assam	Hailakandi	Scrub; open evergreen; jhum; forest blank; dense evergreen; agricultural land	Metalled Road; Village Road - Kutchha	NW	3-8	Yes	No	16.5	W	11.8	Moderate
FL4	93.056	24.597	19/03/2014	Assam	Cachar	Scrub; open evergreen; jhum; dense evergreen; agricultural land	Village Road - Kutchha	NE	8-15	Yes	Yes	16.8	W	10.3	Moderate
FL5	93.068	24.598	19/03/2014	Assam	Cachar	Scrub; open evergreen; jhum; dense evergreen; bamboo; agricultural land	Village Road - Kutchha	NW	3-8	Yes	Yes	16.7	W	10.2	Low
FL6	93.061	24.608	19/03/2014	Assam	Cachar	Scrub; open evergreen; jhum; dense evergreen; bamboo; agricultural land	NA	NW	8-15	Yes	Yes	16.8	W	10.2	Low
FL7	93.259	25.200	19/03/2014	Assam	N C Hills	Scrub; open deciduous; jhum; dense deciduous; bamboo; agricultural land	Other road	SW	15-25	Yes	Yes	19.4	W	9.3	High
FL8	93.104	25.233	19/03/2014	Assam	N C Hills	Scrub; open deciduous; jhum; dense deciduous; bamboo	Metalled Road; Other road	NW	8-15	Yes	No	19.7	W	10.1	High

Data source: MODIS, Bhuvan, ISRO & IMD-AWS

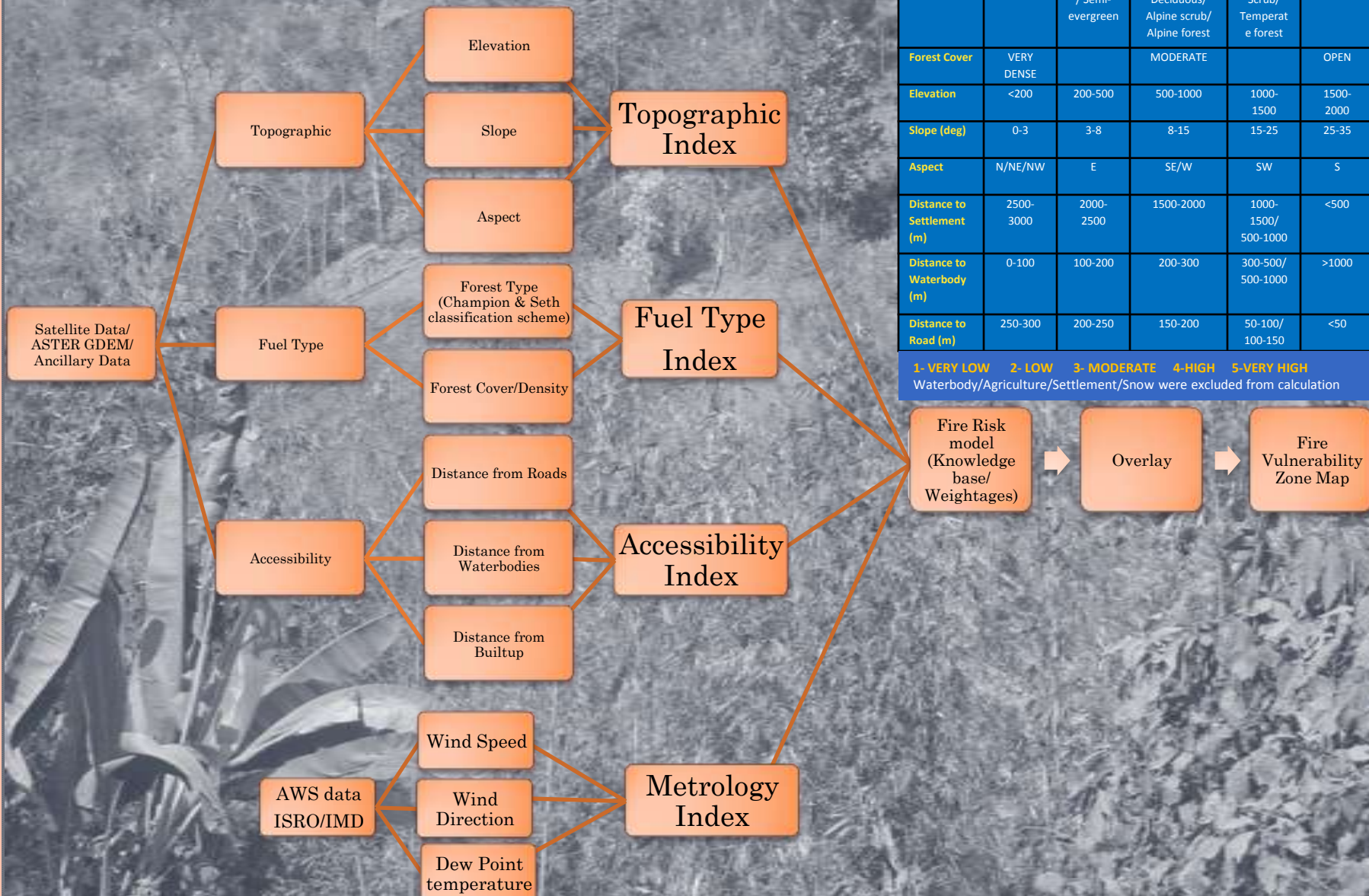
* NA: Not Available

Note: The fire locations reported are with confidence level $\geq 60\%$

Severe
 High
 Moderate
 Low

Disclaimer: This report is only for planning tool not for any legal purposes; NESAC Team

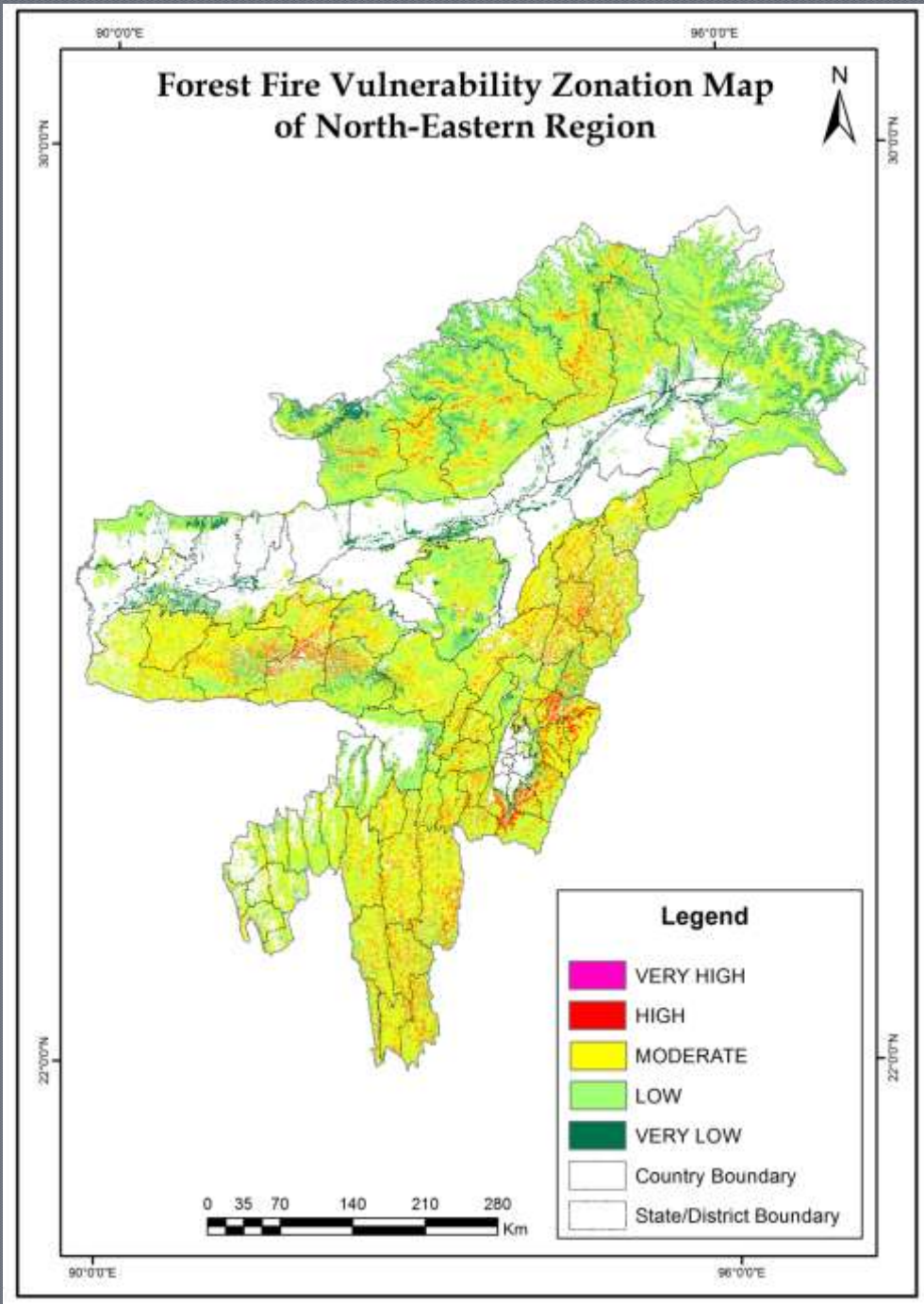
Methodology flow chart for fire vulnerability zone mapping



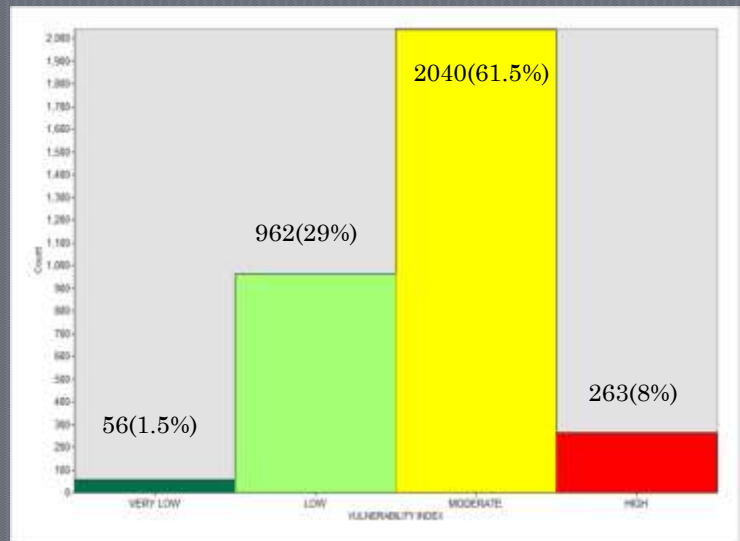
Score	1	2	3	4	5
Parameter					
Forest Type	Plantation	Evergreen / Semi-evergreen	Conifers/ Deciduous/ Alpine scrub/ Alpine forest	Bamboo/ Scrub/ Temperate forest	Pine
Forest Cover	VERY DENSE		MODERATE		OPEN
Elevation	<200	200-500	500-1000	1000-1500	1500-2000
Slope (deg)	0-3	3-8	8-15	15-25	25-35
Aspect	N/NE/NW	E	SE/W	SW	S
Distance to Settlement (m)	2500-3000	2000-2500	1500-2000	1000-1500/ 500-1000	<500
Distance to Waterbody (m)	0-100	100-200	200-300	300-500/ 500-1000	>1000
Distance to Road (m)	250-300	200-250	150-200	50-100/ 100-150	<50

1- VERY LOW 2- LOW 3- MODERATE 4-HIGH 5-VERY HIGH
 Waterbody/Agriculture/Settlement/Snow were excluded from calculation

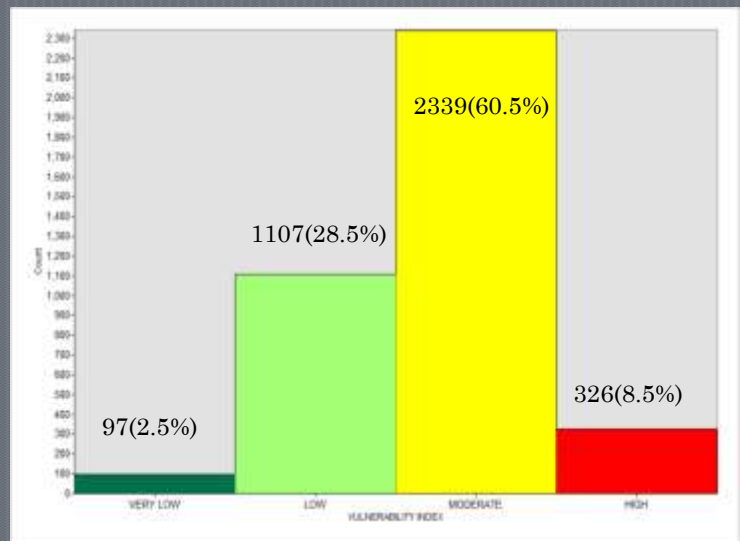
Validation analysis of forest fire vulnerability map with reference to hot spots (1st to 25th March 2014)



Vulnerability Histogram of FSI fire pixels



Vulnerability Histogram of MODIS/FIRMS fire pixels




Fire Alert Map/Report is daily uploaded on NESAC/NER-DRR portal www.nesac.gov.in

www.nesac.gov.in

NER-DRR North Eastern Regional Authority
 NORTH EASTERN REGIONAL AUTHORITY
 ABOUT US HOME CONTACTS FILES ABOUT US CONTACT US

PREDICT FIRE: Preparedness and mitigation measures in North East Region **Fire Alert**



Preparedness:

- Fire drills, evacuation drills
- Regular maintenance of firefighting equipment

Mitigation:

- Mitigation studies and plans
- Fire, safety and risk assessment
- Mitigation measures, emergency response, etc.

01. LITERATURE REVIEW

02. CURRENT STATUS OF FIRE MANAGEMENT IN THE NORTH EAST REGION

03. LITERATURE REVIEW, ASSESSMENT, VULNERABILITY AND RISK ASSESSMENT

04. EMERGENCY RESPONSE STRATEGY

05. MITIGATION MEASURES, ASSESSMENT, VULNERABILITY AND RISK ASSESSMENT

Preparedness: Fire drills, evacuation drills; Regular maintenance of firefighting equipment.

Mitigation: Mitigation studies and plans; Fire, safety and risk assessment; Mitigation measures, emergency response, etc.

01. LITERATURE REVIEW

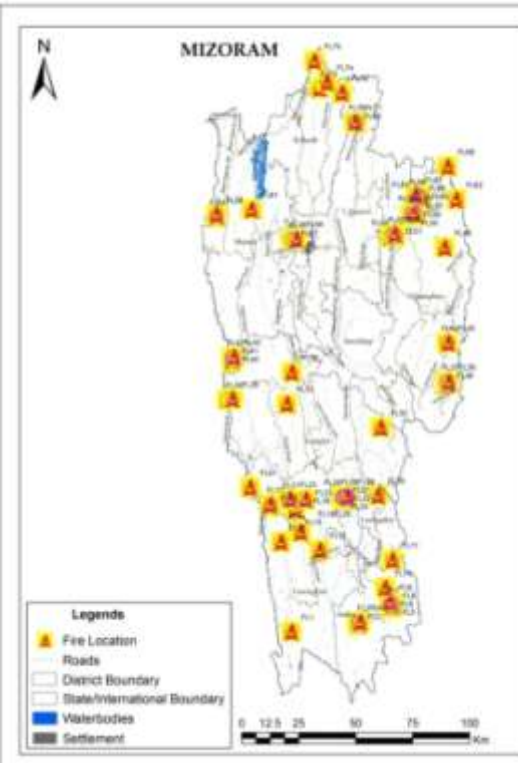
02. CURRENT STATUS OF FIRE MANAGEMENT IN THE NORTH EAST REGION

03. LITERATURE REVIEW, ASSESSMENT, VULNERABILITY AND RISK ASSESSMENT

04. EMERGENCY RESPONSE STRATEGY

05. MITIGATION MEASURES, ASSESSMENT, VULNERABILITY AND RISK ASSESSMENT

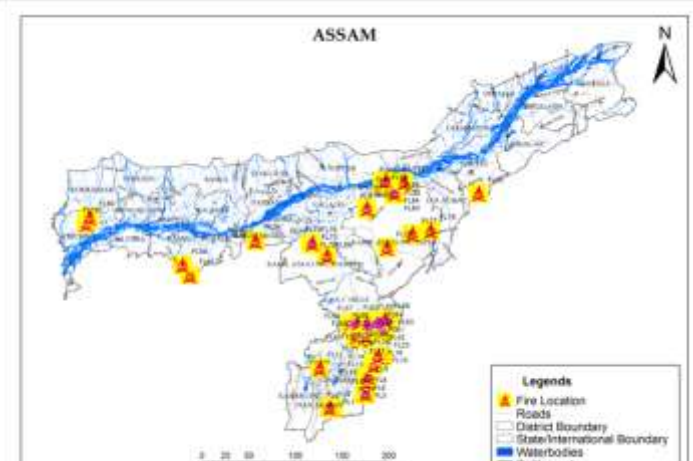
www.nesac.gov.in



MIZORAM

Legend:

- Fire Location
- Roads
- District Boundary
- State/International Boundary
- Water Bodies
- Settlement



ASSAM

Legend:

- Fire Location
- Roads
- District Boundary
- State/International Boundary
- Water Bodies
- Settlement

NER-DRR North Eastern Regional Authority
 NORTH EASTERN REGIONAL AUTHORITY

Fire Alerts Received for 2009: 1888 Alerts for the year 2009

ASSAM :
 108 Alerts : 108 Alerts (108 Alerts) : 108 Alerts (108 Alerts) : 108 Alerts : 108 Alerts

ARUNACHAL PRADESH :
 20 Alerts : 20 Alerts (20 Alerts) : 20 Alerts (20 Alerts) : 20 Alerts (20 Alerts) : 20 Alerts (20 Alerts)

BIHAR :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)

GUJARAT :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)

KARNATAKA :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)

KERALA :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)

KHYASARPATNA :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)

MADHYA PRADESH :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)

MHARASHTRA :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)

ODISHA :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)

PUNJAB :
 10 Alerts : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts) : 10 Alerts (10 Alerts)



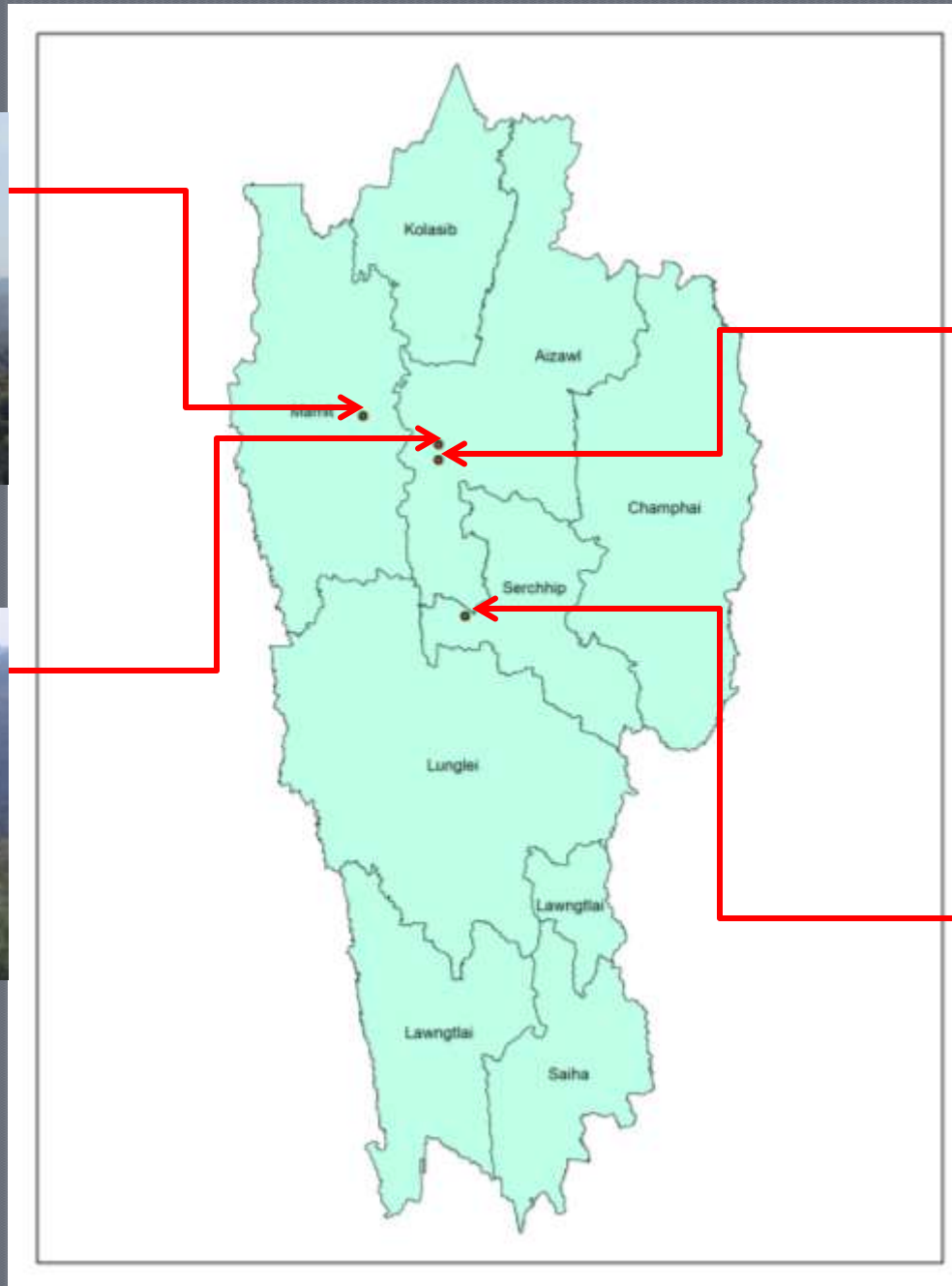
Forest Fire Incidence in Mizoram



23.74N; 92.56E
Date: 12/3/14



23.68N; 92.73E
Date: 13/3/14



23.65N; 92.72E
Date: 13/3/14



23.30N; 92.78E
Date: 13/3/14



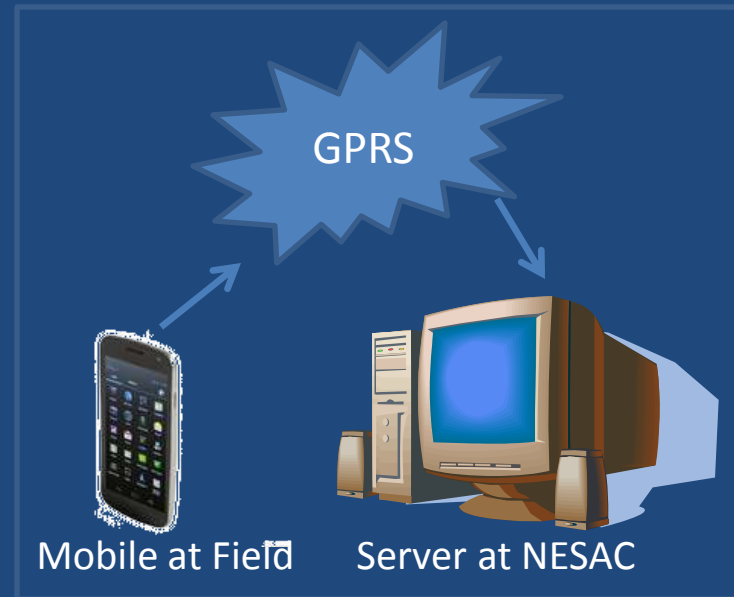
Mobile Application for CSDM

Field Data Transmission using Mobile Technology (FIDATRA)

(Developed by NESAC)

Salient Feature

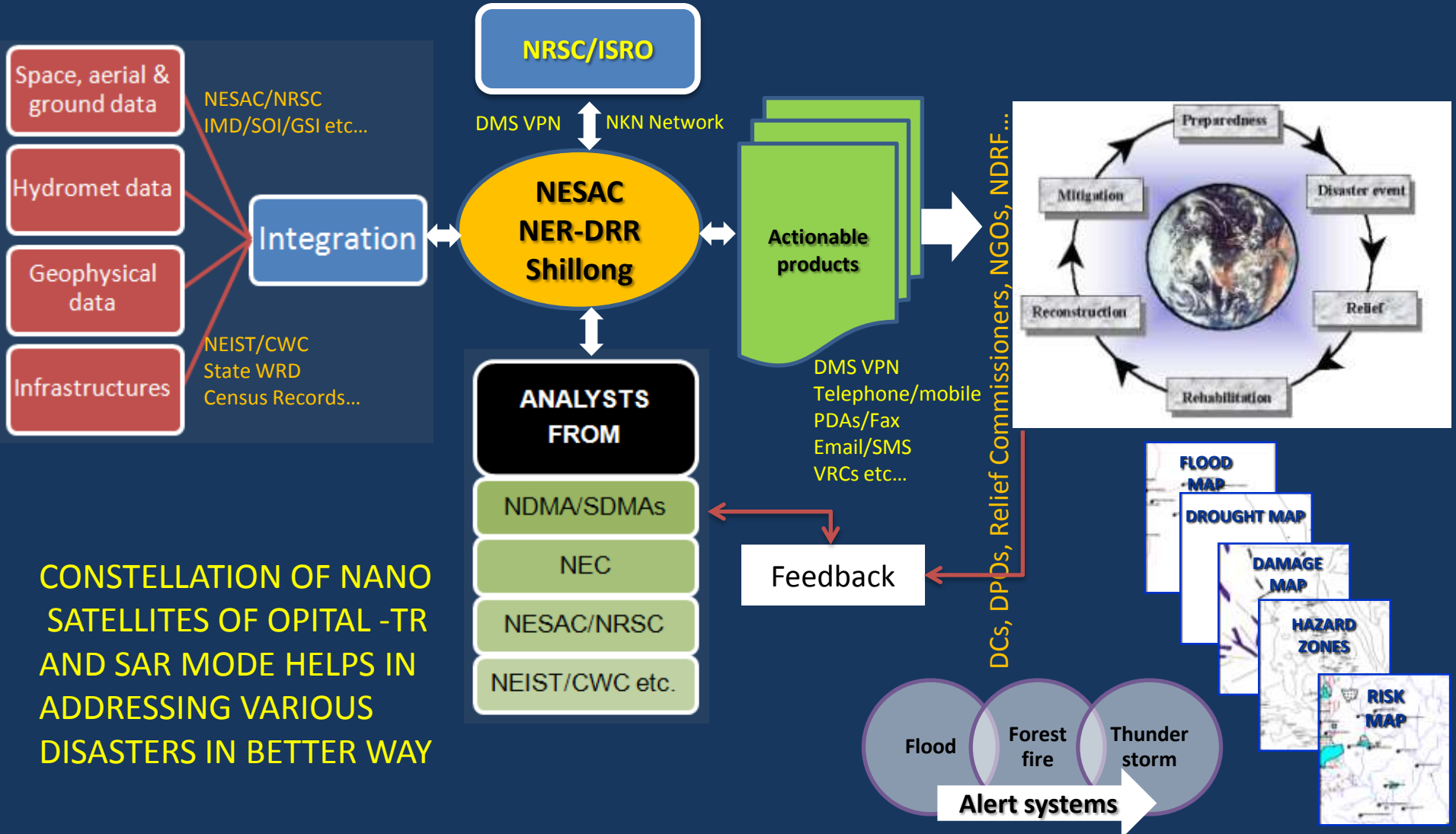
- Apps developed in Android platform
- Any phone with with Android O/S, GPS and Camera can be used
- Communication through GPRS
- Following data may be send
 - Positional data (Lat, Long and Alt.)
 - Photo
 - Video
 - Text
- Graphical representation of data using map/table in the server end
- Also can be used for sending ground truth data from field for any project



Operational view of NER-DRR

...an unique initiation for disaster management support in NER

SHARING OF DATA AND FREE FLOW OF DATABASE



CONSTELLATION OF NANO SATELLITES OF OPITAL -TR AND SAR MODE HELPS IN ADDRESSING VARIOUS DISASTERS IN BETTER WAY



Thank you