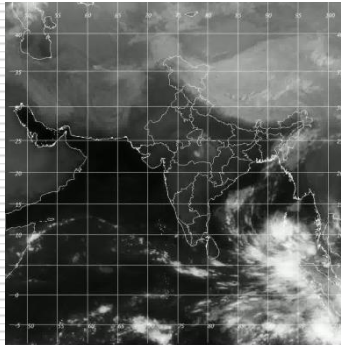
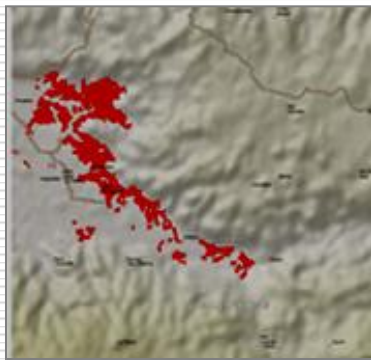
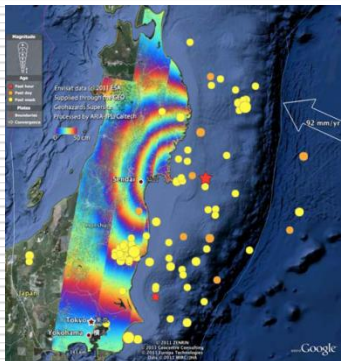


Disaster Management Support (DMS) Programme



Dr. J.V. Thomas
Programme Manager, DMS
ISRO HQ, Bangalore

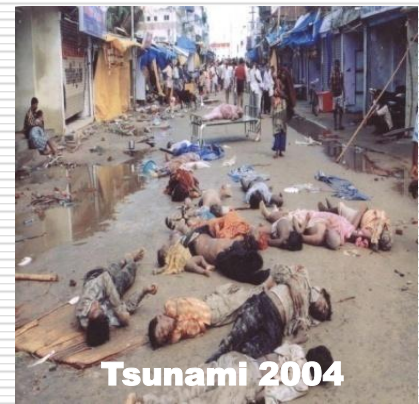


UN / India Workshop on Use of EO Data for Disaster Management and Risk Reduction: Asian Experience

Hyderabad

March 08, 2016





Tsunami 2004



Cyclone, Bangladesh 2007



Japan Tsunami 2011

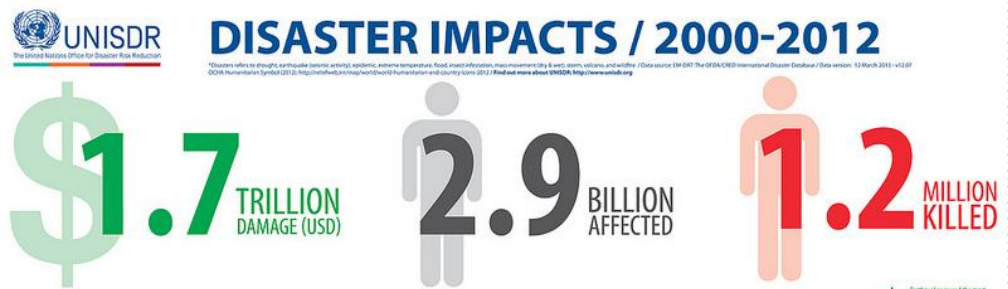


Bihar Floods, India 2008

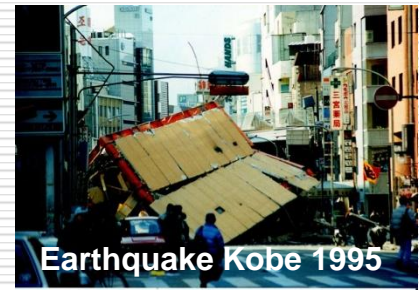
Disasters: Deaths, Miseries and Damages



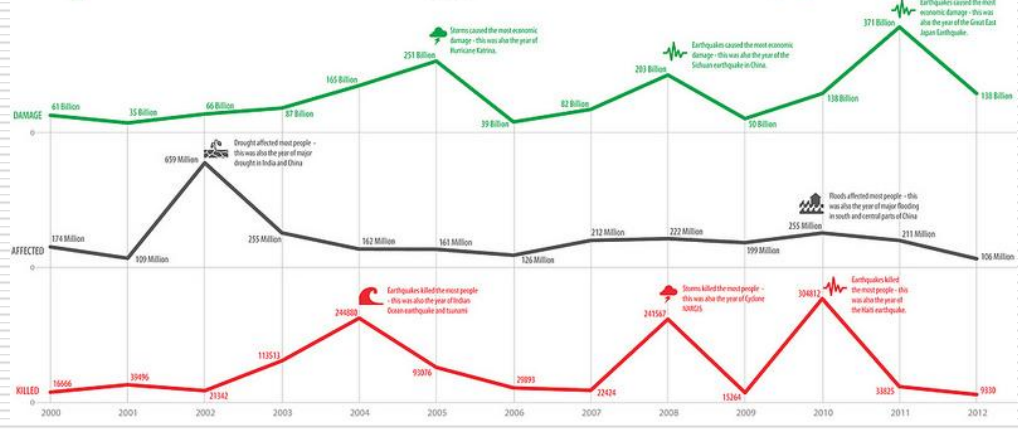
Earthquake Sichuan 2008



Earthquake Muzaffarabad 2005



Earthquake Kobe 1995



Pak Floods 2010



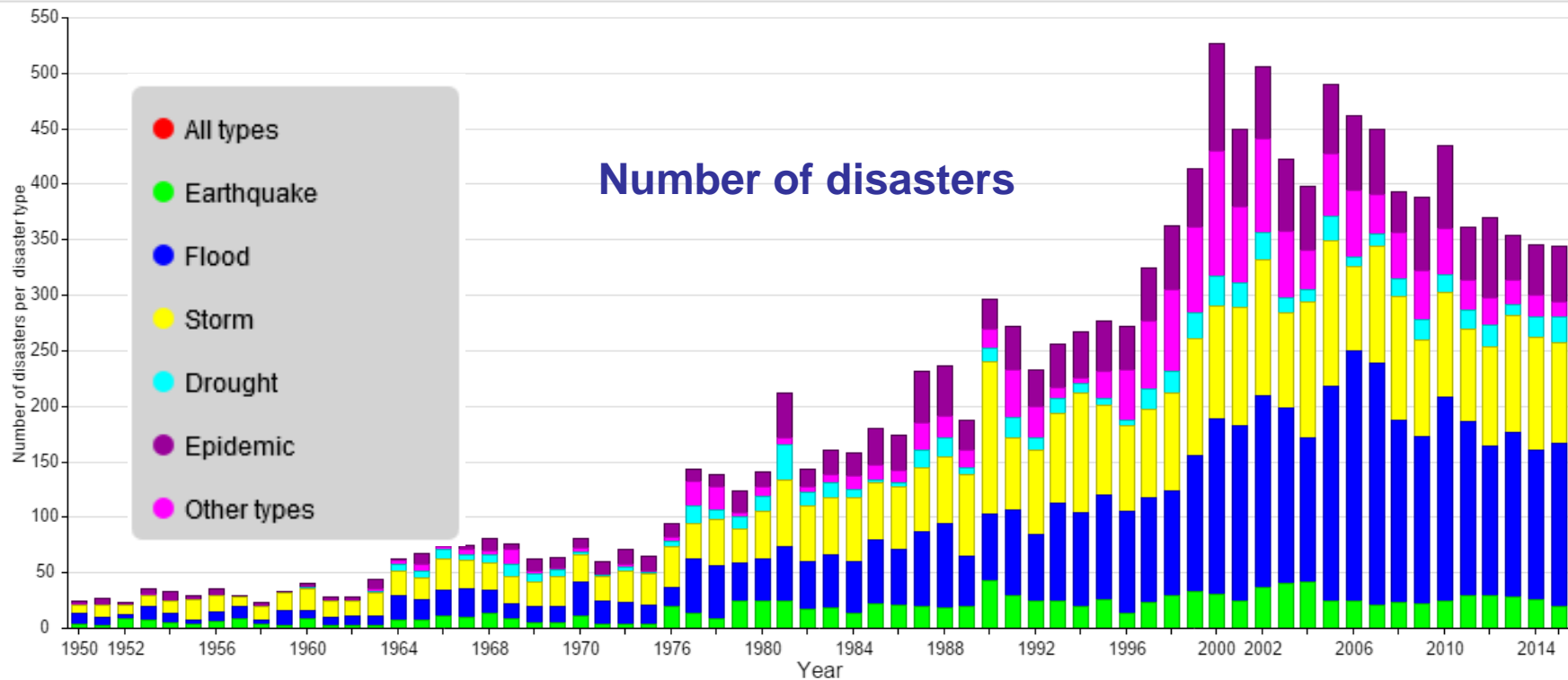
Pak Floods 2010

What Earth Observation could do?

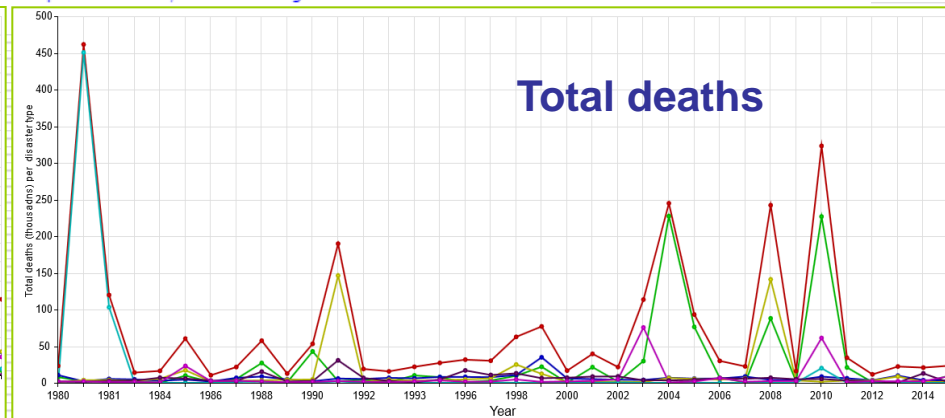
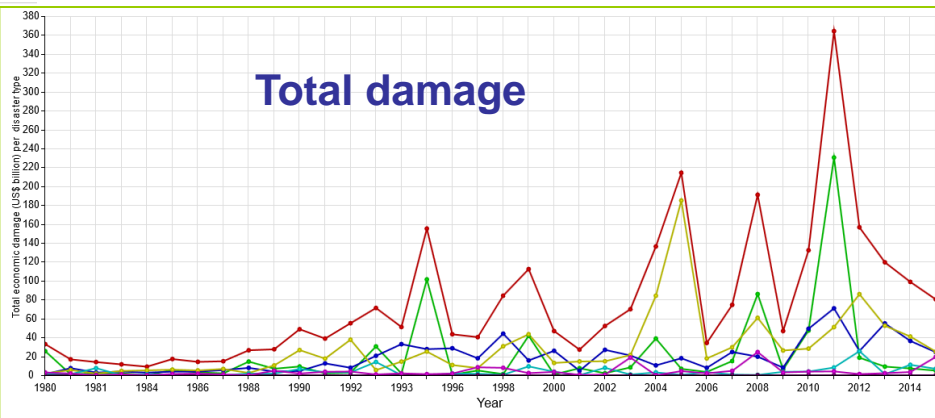


Thai Floods 2011

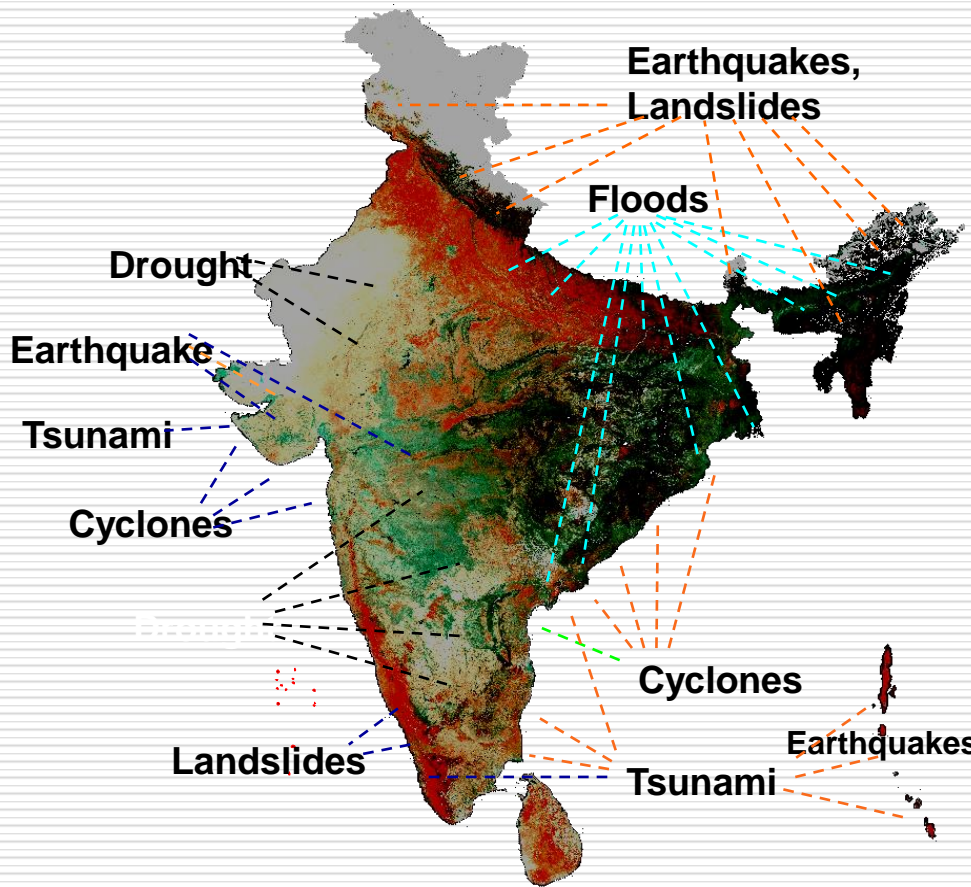
Global Disaster Trends



EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Universite Catholique de Louvain, Brussels - Belgium



India and the Disasters



27 States & Union Territories are disaster prone

- 12% of land area (40 mha) - Flood prone
- 8% of land area (along 5,500 km long coast tract) - Cyclone prone
- Over 65% of land under cultivation - Drought prone
- Around 25% land area - Earthquake prone - Seismic zone IV-V
- Himalayan and Western Ghats region - Landslide prone
- Andaman Nicobar Islands, parts of East Coast, and Gujarat coast – Tsunami

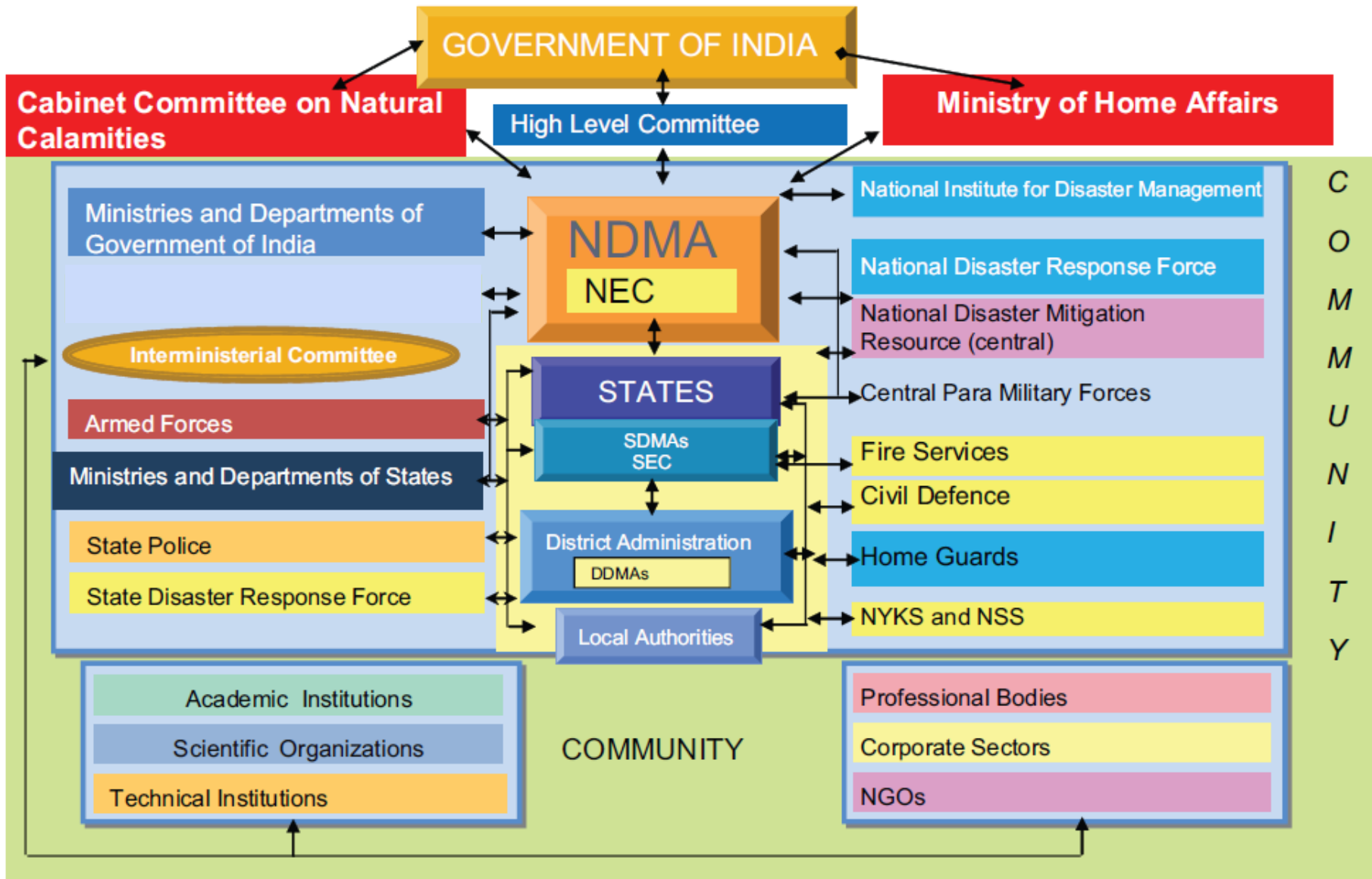
Average Annual Loss

- Direct: Loss of life: 4350 ; Crop area affected: 1.42 Mha; Houses damaged: 2.36 M; Direct loss: 2 % of the GDP (Rs. 25000 Cr)
- Indirect: Expenses on emergency response and relief ; diversion of developmental fund; Indirect socio-psychological losses that can not be quantified

The Indian Sub-Continent is among the World's Most Disaster-prone Areas

Disaster Management in India

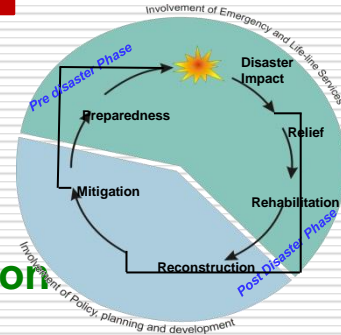
Stakeholders



Disaster Risk Reduction

Role of Space Technology

- Supporting role to national DM efforts, using the Space assets
- Enhanced operational outreach in the newer paradigms of Risk Reduction

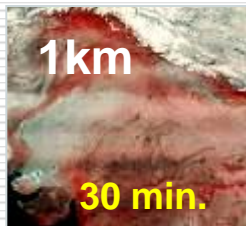
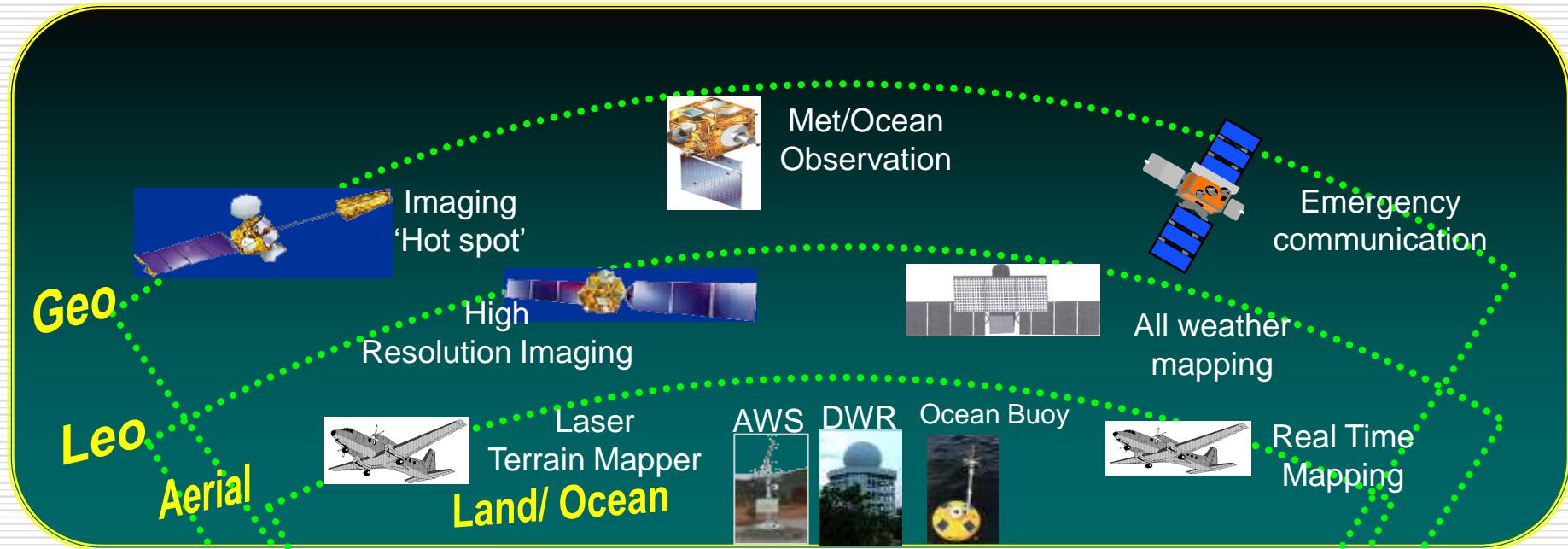


Sub-systems

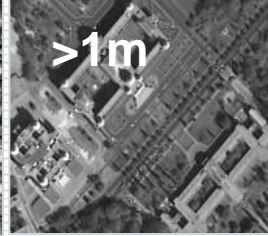
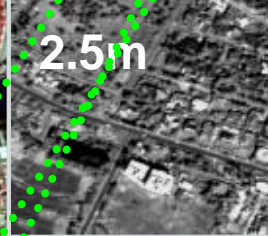
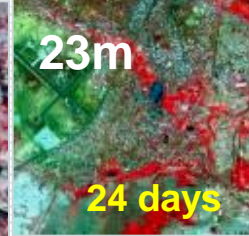
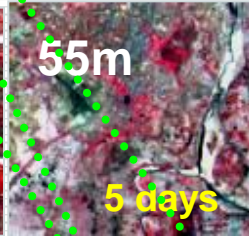
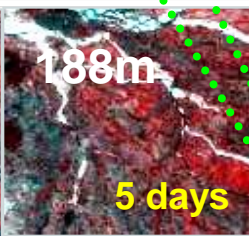
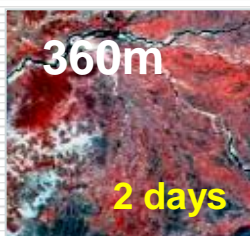
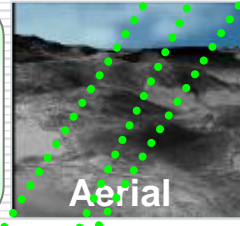
Early Warning	Early detection of events/ related parameters; and dissemination
Risk Information	Info. on terrain, hydrologic, climatic socio-economic and ecological aspects of community vulnerability
Impact Assessment	Pre and Post event change detection, identification of damages, assessment..
Preparedness	Creation of vulnerability info. for developmental planning, reconstruction
Emergency Communication	Broadcasting, VSAT, WLL-VSAT, Sat-phone, DCP

Components of Space Applications

Space & Ground Assets for DRR

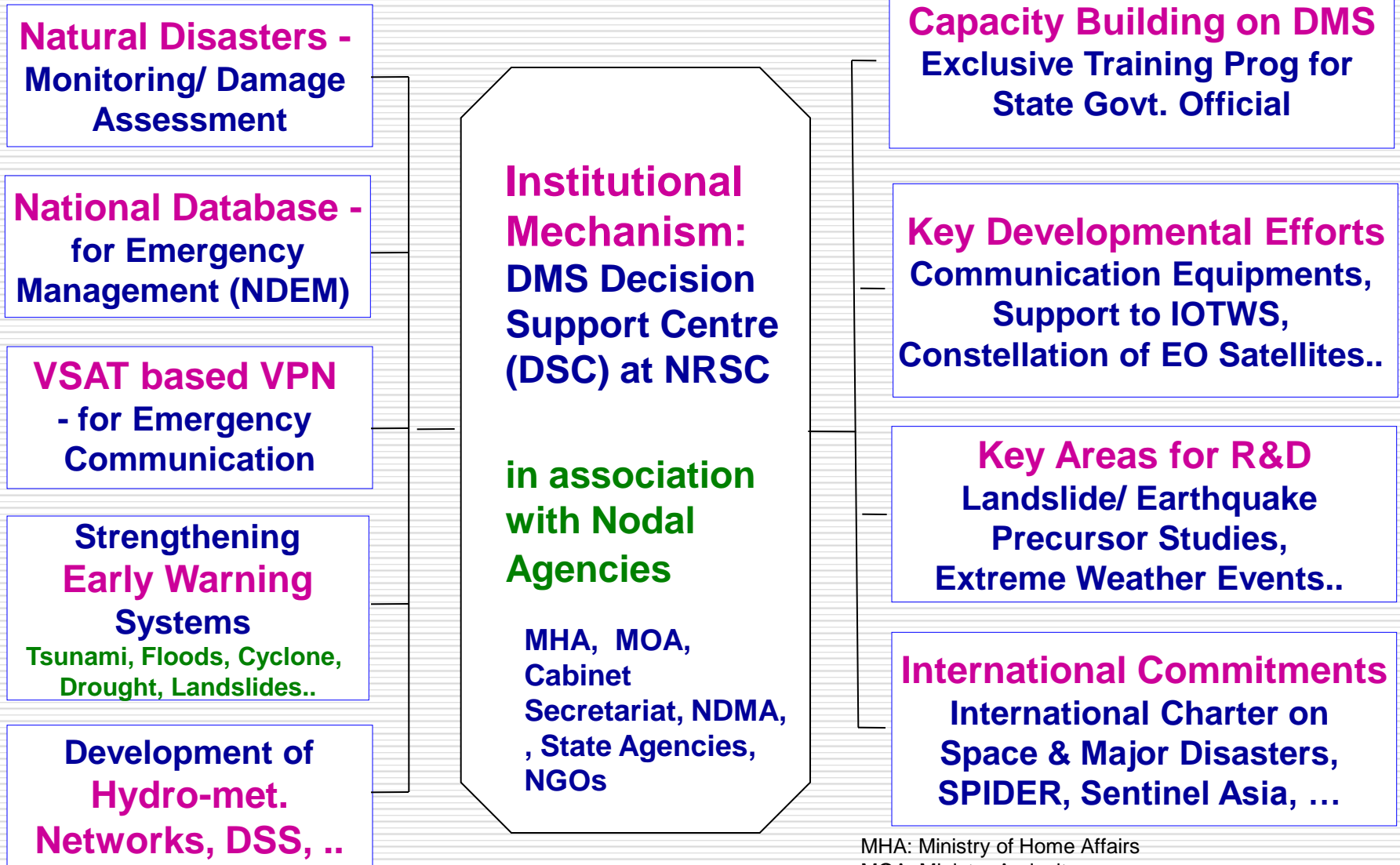


Aerial Laser Terrain Mapper
Large Format Digital Camera
Synthetic Aperture Radar (SAR)



ISRO's DMS Programme

- At a glance



MHA: Ministry of Home Affairs

MOA: Ministry Agriculture

NGO: Non-Governmental Organisations

NDMA: National Disaster Management Authority

DMS - DSC Operations

Data Acquisition, Analysis & Dissemination

Floods
Agricultural Drought
Weather & Cyclone
Landslides
Earthquakes
Forest Fires

ALERT
Advance Info.
on Disaster/
Trigger

Disaster Knowledge Institutions
(CWC, IMD, GSI, ...)
Other Sources
(Press/ TV, Local Bodies, NGO)

Satellite Data Programming
and
Acquisition
(NRSA Earth Station / NDC)

Data
• Satellite, Aerial
• Coarse - High
Resolution
• Optical Microwave

ASAR/ALTM/DC etc.

Flight Planning

Defense clearance

Data acquisition,
process and
transfer



Acquisition of data

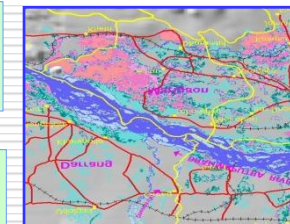
Database,
Knowledge Banks

Ground / Ancillary
Information

Data Analysis

Hardware &
software

Customized
Analysis Tools



Outputs

Dissemination to Users
VSAT, FTP, Web page, E-mail etc.

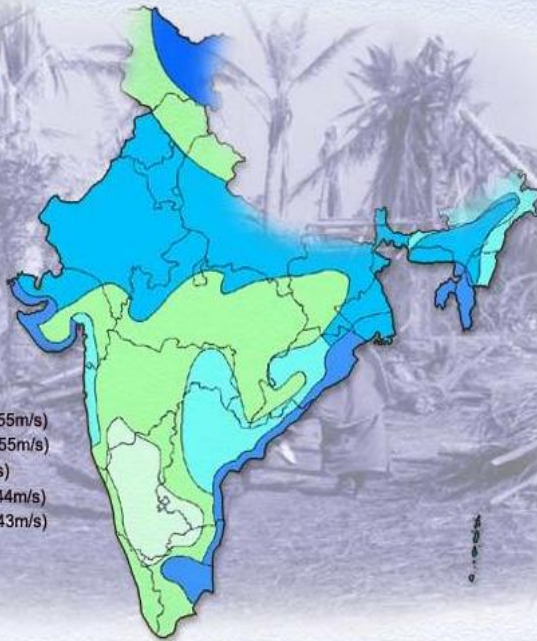


EO for Severe Weather & Cyclones

Wind and Cyclone Zones of India

8000 km long coast-line with occurrence of 5 - 6 tropical cyclones every year.

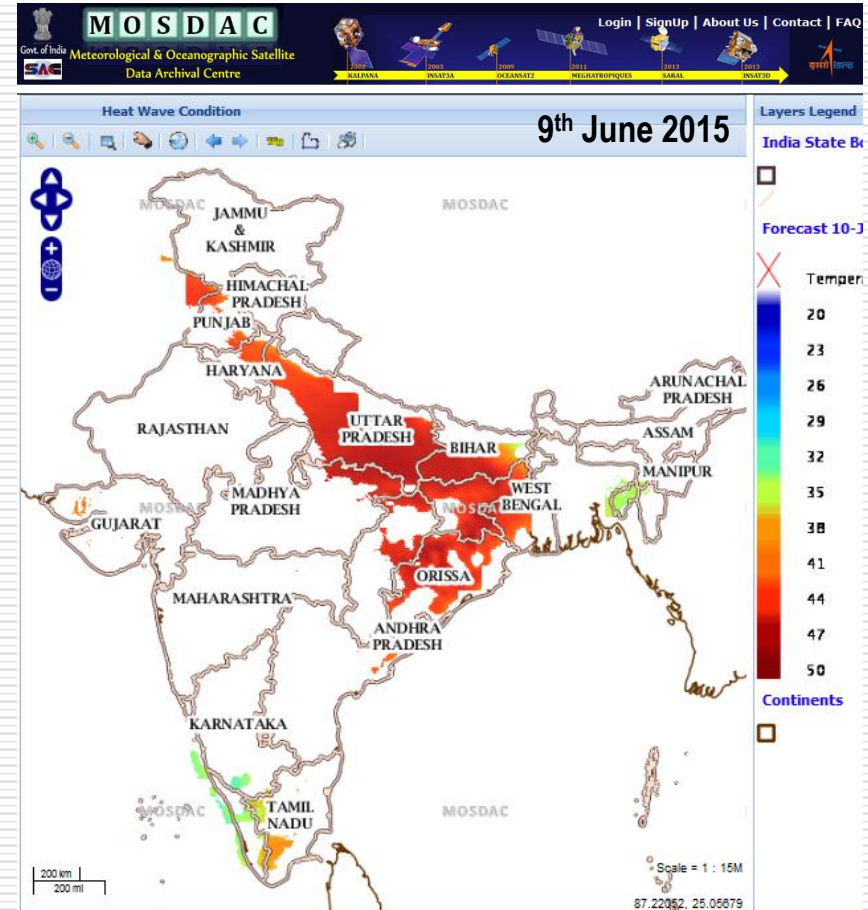
- Very High Damage Risk Zone-A (Vb=55m/s)
- Very High Damage Risk Zone-B (Vb=55m/s)
- High Damage Risk Zone-B (Vb=47m/s)
- Moderate Damage Risk Zone-A (Vb=44m/s)
- Moderate Damage Risk Zone-A (Vb=43m/s)
- Low Damage Risk Zone (Vb=33m/s)



Source: This map was collated based on the

Goals

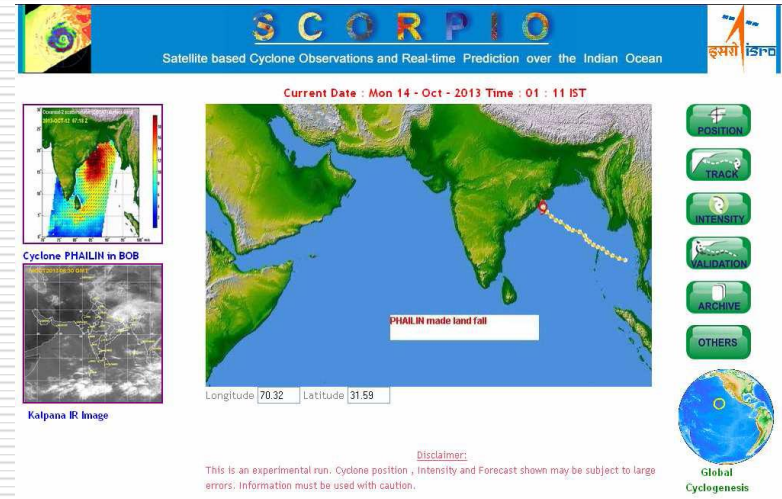
- Cyclone Landfall Time, Place, Intensity prediction (> 48 hrs in advance)
- Storm surge modeling
- Impact Assessment
- Vulnerability/Risk Assessment
- Heat Wave alerts
- Heavy Rainfall alerts



Heat wave alerts

Cyclone Track & Intensity Prediction

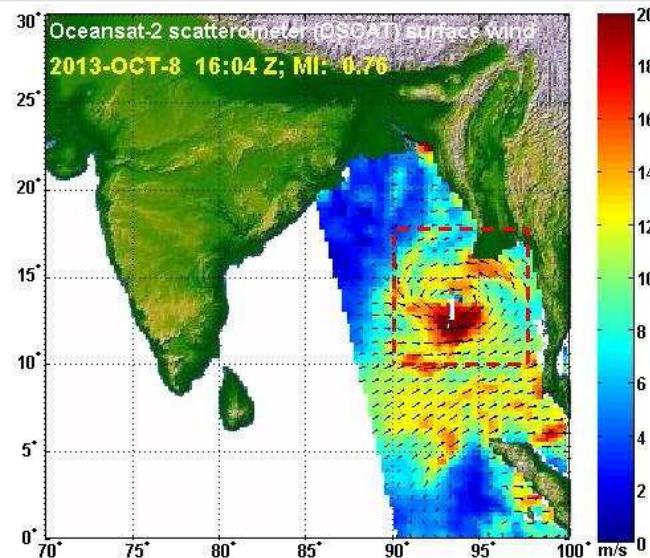
Significant improvement over last decade due to availability of operational SST and Sea Surface Wind (SSW) information and limited TRMM data as well as improved models. Accurate Track intensity change and rainfall prediction still challenging.



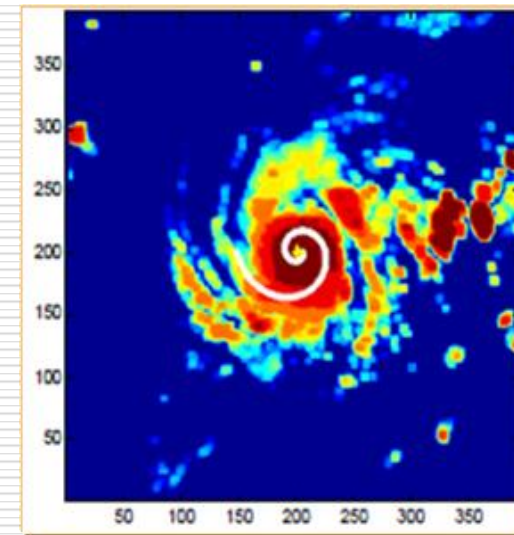
Langrangian Advection model



Cyclogenesis Prediction using Scat Wind

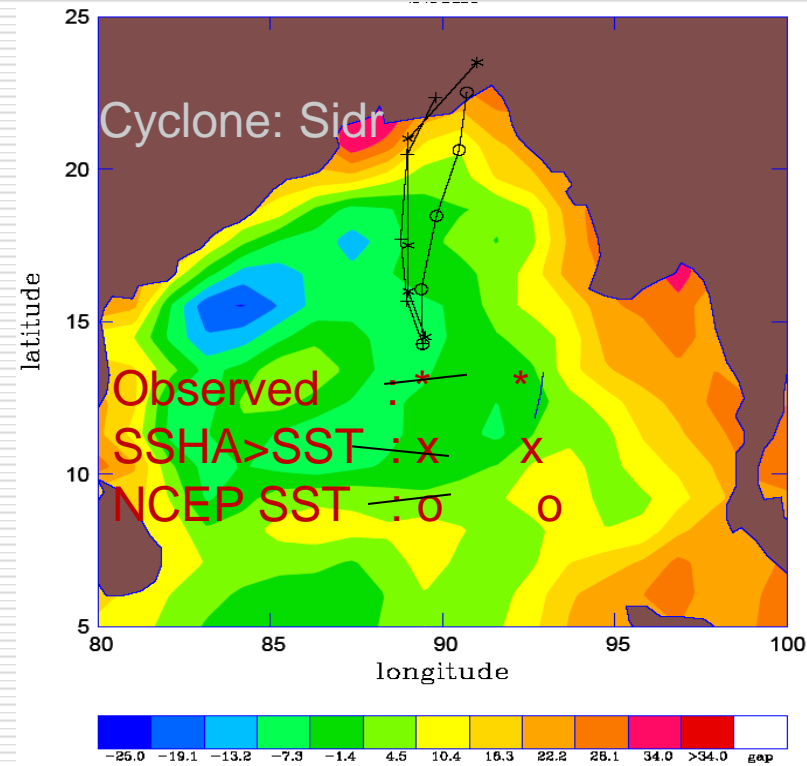
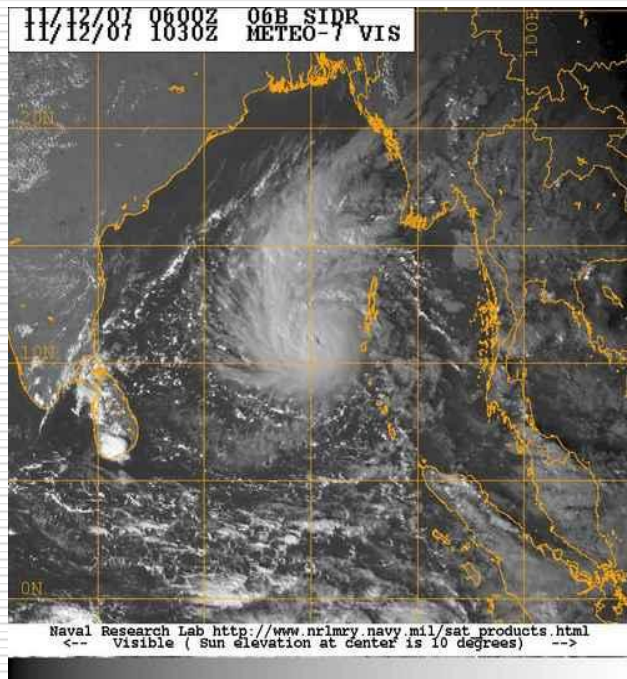


Automatic Centre Detection



Ocean Heat Content for Cyclone intensity

While SSTs play a major role in TC genesis, upper Ocean Heat Content between sea surface and the depth of 26 deg isotherm is found to be better in predicting TC intensity changes. SSHA used as proxy to determine isotherms.



OHC contained in mesoscale features like warm ocean eddies and currents linked to TC intensity changes, provided atmospheric conditions are favourable

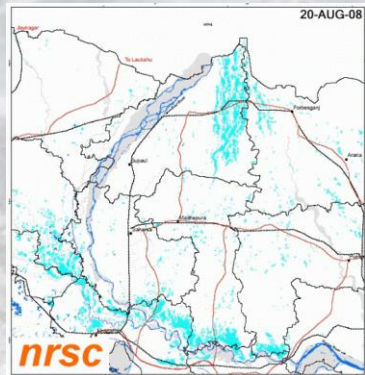
Combination of satellite altimetry with bottom pressure observations from Gravity missions provides better OHC

EO for Flood

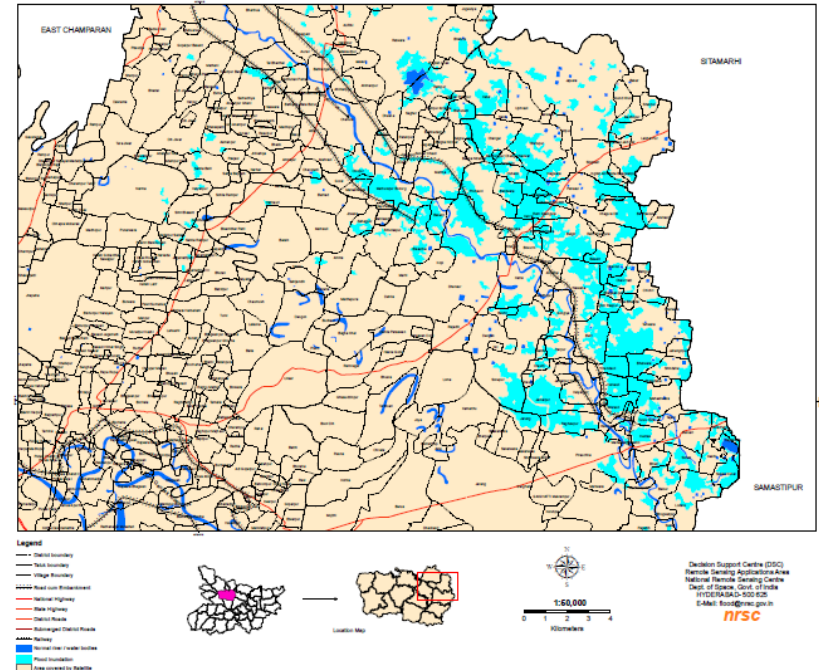
Flood Inundation mapping

Flood Zones of India

40 million hectares of land mass prone to Floods.

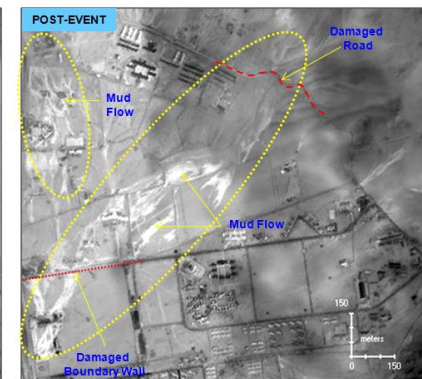


Flood Inundated Areas in Part of Muzaffarpur District, Bihar
Based on the analysis of Radarsat-2 data of 23-July-2012



Goals

- Flood Forecasting and Inundation Modeling
- Real Time Flood Mapping
- Rapid Damage Assessment
- Hazard Zonation and Risk Assessment
- Study on Bank Erosion and Changes in the Flood Plains



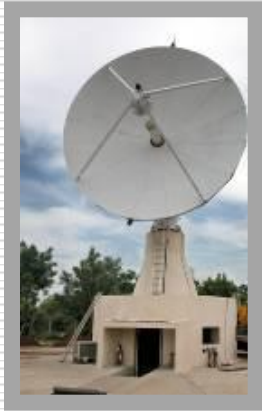
CARTOSAT-1 DATA
OF JULY 16, 2010

CARTOSAT-1 DATA
OF AUGUST 12, 2010

Monitoring & Damage Assessment

DMSP Activities

- Forest Fire



Daily acquisition of
TERRA/AQUA
MODIS data



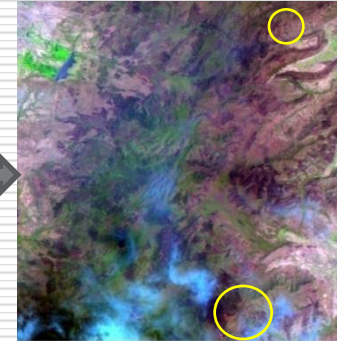
~4 daytime
passes per day



Generation of 2
daily Active Fire
Alerts



MODIS
contextual Fire
Algorithm

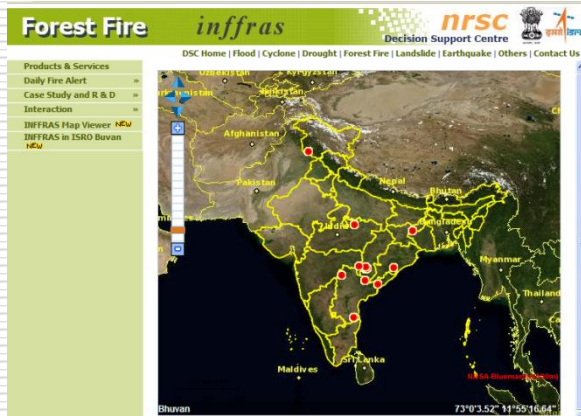


Value additions
•Forest Mask
•Forest & Admin.
overlay

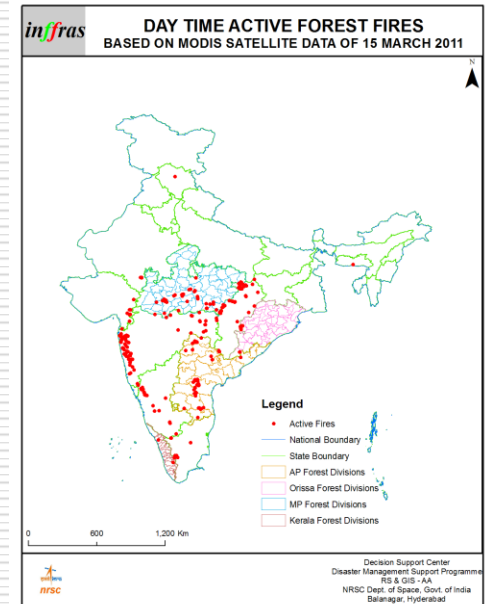
Disaster Management Support
Programme
**Decision Support
Center**

Indian Forest Fire
Response and Assessment
System (INFFRAS)

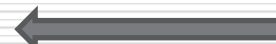
Feedback
↑



2D and 3D
Visualization
through
BHUVAN



Email
Dissemination
to ~400 nodal
officers



Turn-around time of
less than 1 hr from
satellite overpass

Information to
ground
personnel for
fire mitigation



DMSP Activities- Drought

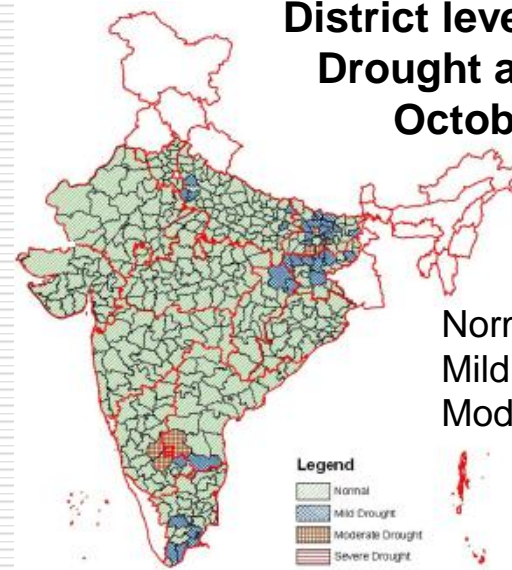
- Conceptualized and developed by National Remote Sensing Centre.
- **Presently Operationally carried out by MNCFC**
- Large circulation list in State & Centre, high demand for a monsoon deficient year.

Components of NADAMS:

- National/state/district level
- 13 states (4 states at sub-district level)
- Multiple Data Sources (NOAA-AVHRR, MODIS, AWiFS, IMD Rainfall)
- Various spectral indices (NDVI, NDWI, SASI) and soil moisture budgeting
- Interpretation using logical modeling and in comparison with long-term data.

Data Use for NADAMS:

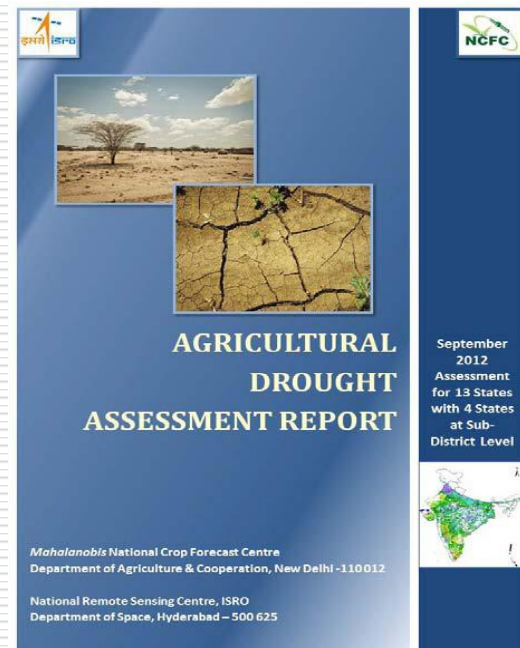
Resourcesat-1/2, NOAA-AVHRR, MODIS and District level weekly rainfall data from IMD



District level Agricultural Drought assessment: October 2013

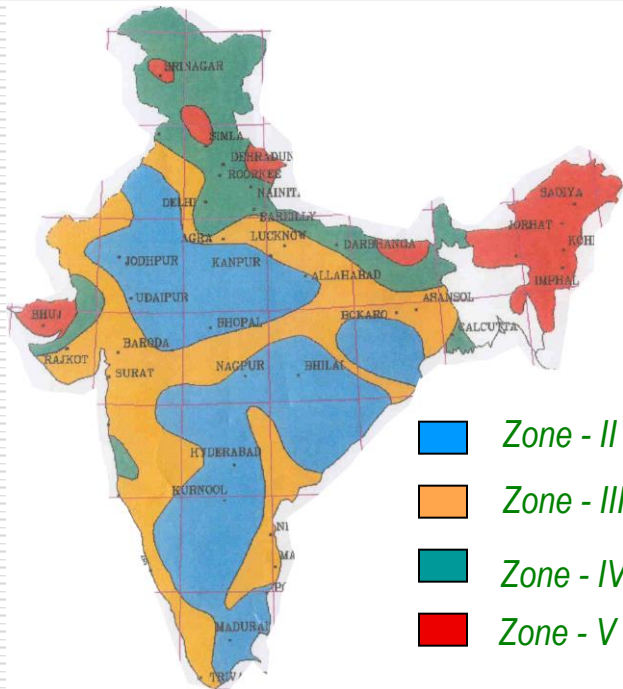


Normal : 369 Districts.
Mild: 34 Districts.
Moderate: 8 Districts

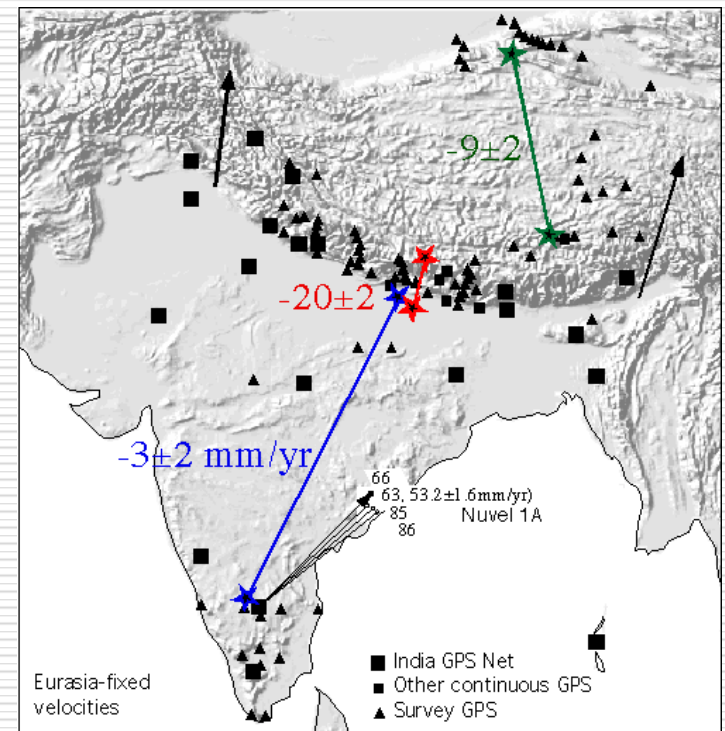


EO for Earthquakes

55% of Geographical Area under Zone 3,4 & 5



- **Dynamic Assessments through InSAR, GPS, Seismicity & Strainmeters of Fault Systems**
- **Constant InSAR monitoring of Deformation to the extent of 1mm/yr; Long time series data collection**
- **GPS & GAGAN/IRNSS data analysis for Intra-Plate Geodynamic Profiling in Active Seismic Zones**
- **Missions with LEO/GEO Constellation – formation flying - with the above payload-mix called for**

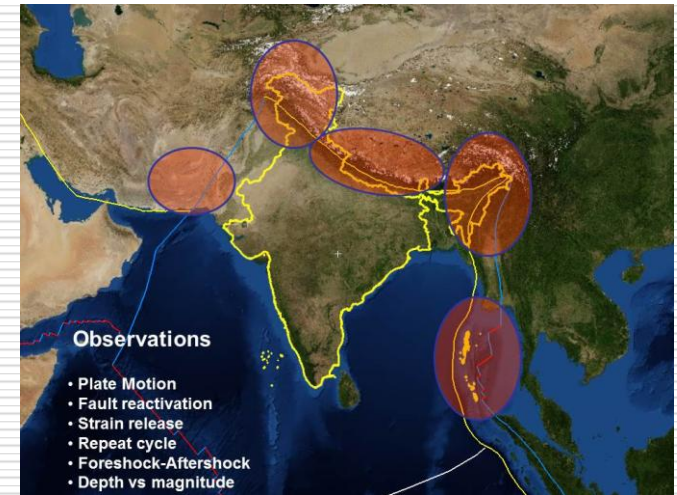


CORS at IIRS, Dehradun

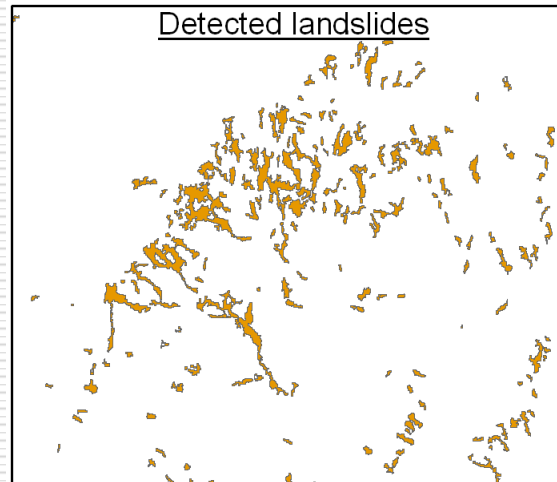
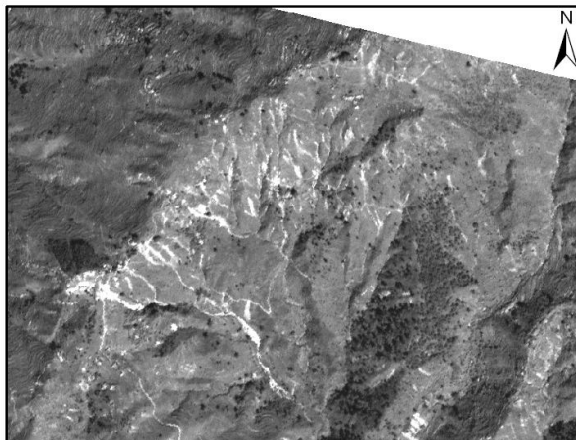
DMSP Activities

Earthquake & Landslides

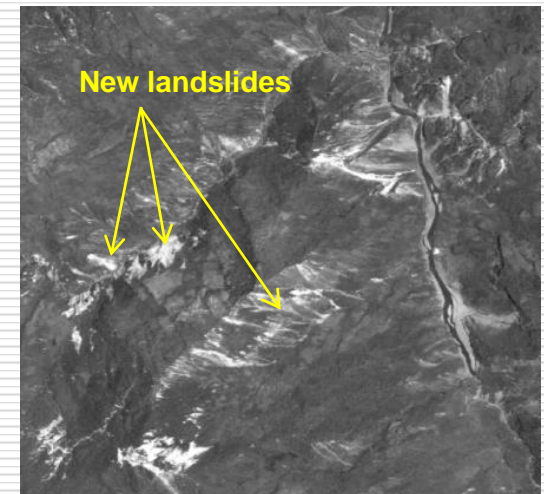
- Monitoring of all earthquakes and landslides in the Indian region.
- Sikkim Earthquake; September 2011 : 1196 new landslides were detected. Using the IRS data.
- Landslide Hazard Zonation mapping for Bombay to Goa route corridor in collaboration with GSI
- Automatic delineation of landslides
- >5000 Landslides identified in Uttarakhand after the flash flood event.



Post-landslide Cartosat-1 (30-September-2011)

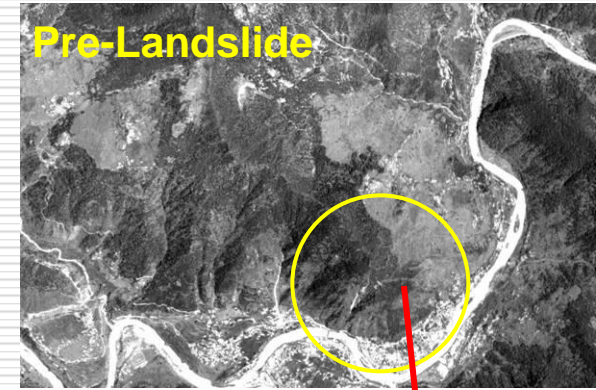
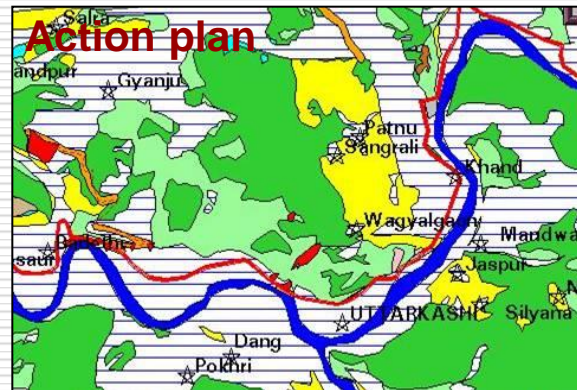
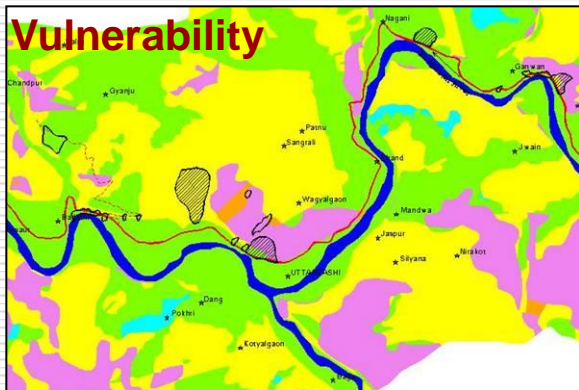


Nepal Earthquake, April 2015

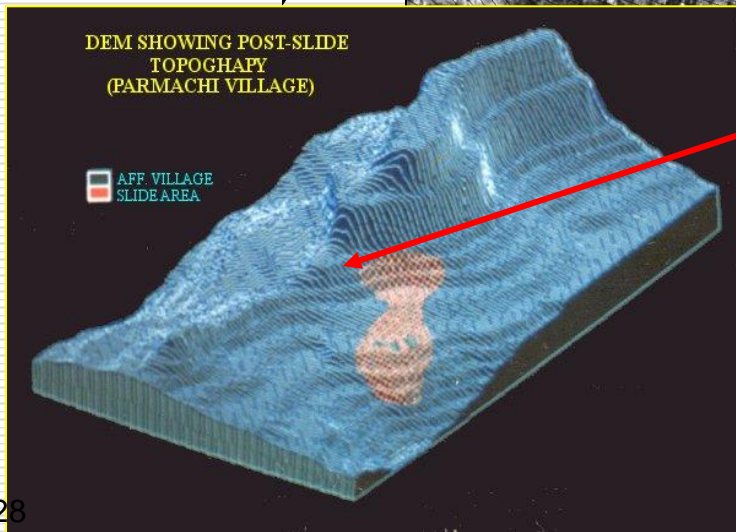
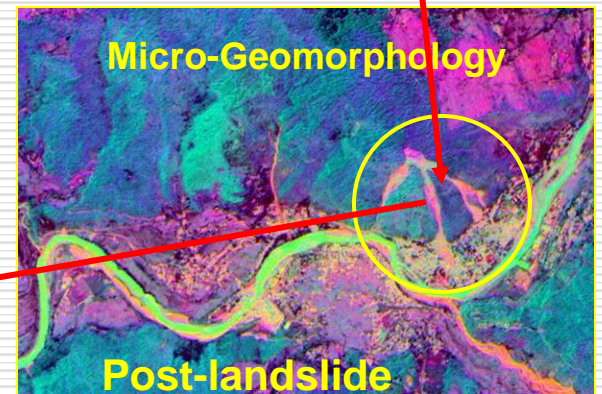
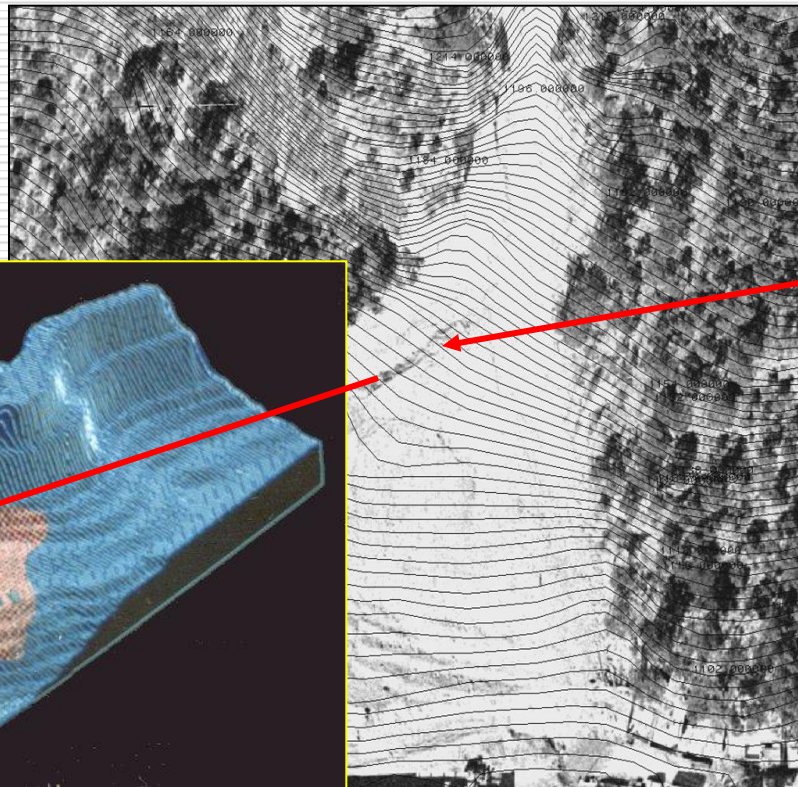


DMSP Activities

- Landslide Hazard Zonation



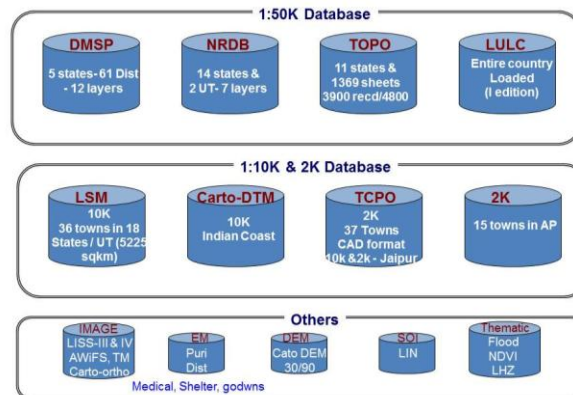
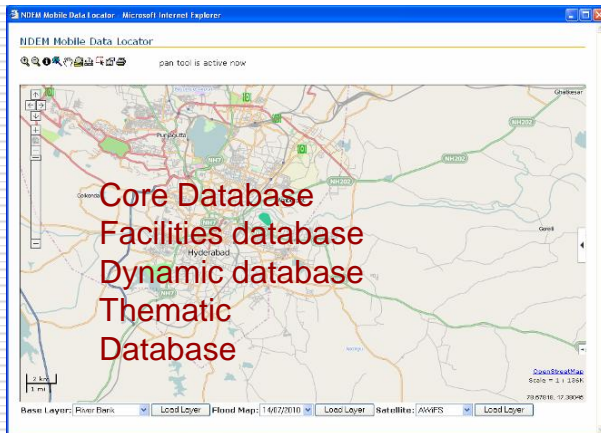
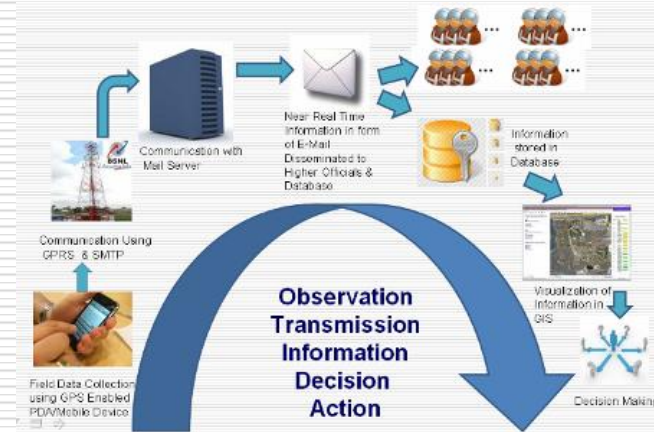
RISK ASSESMENT



- Output Products:**
- Hazard Zonation Mapping
 - Inventory Mapping
 - Management and Risk Analysis

National Database on Emergency Management (NDEM)

- Multi-scale database Organization (Core & Hazard specific database)
- Development of Decision support tools for addressing emergency management
- Institutional mechanism for sharing & updating database on continuous basis
- Mirroring / Replica of databases at MHA with suitable access/security mechanism.
- Dissemination through NEOC & SEOC during Emergency



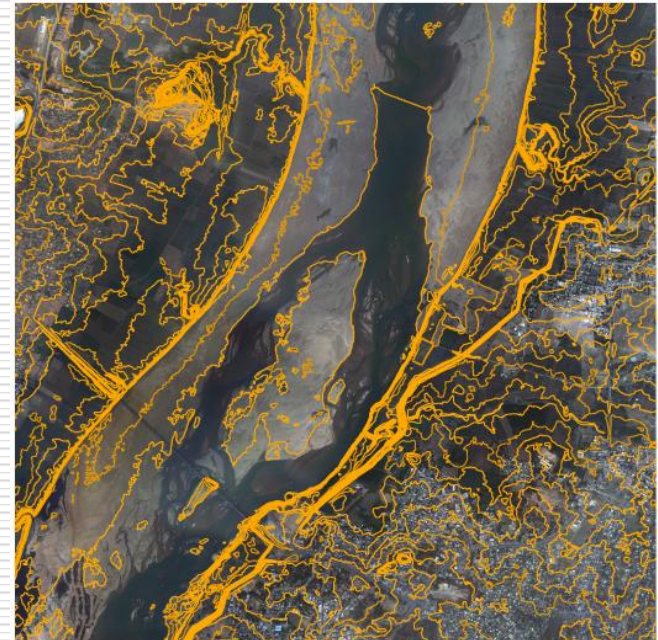
Aerial Surveys



- **Aerial Laser Terrain Mapper (ALTM) produces orthomaps of 1:5000 scale and 0.5 m contours.**
- **Overall plan is to cover flood prone area of the country falling in the Brahmaputra, Ganga, Mahanadi and Godavari basins**
- **Already ~70,000 sq. kms of parts of Orissa, Bihar, Assam and AP completed.**
- **Annually ~12,000 sq. kms are being covered systematically.**
- **The LFDC is used in rapid assessment of damages during major disasters**



Damages during Hudhud cyclone

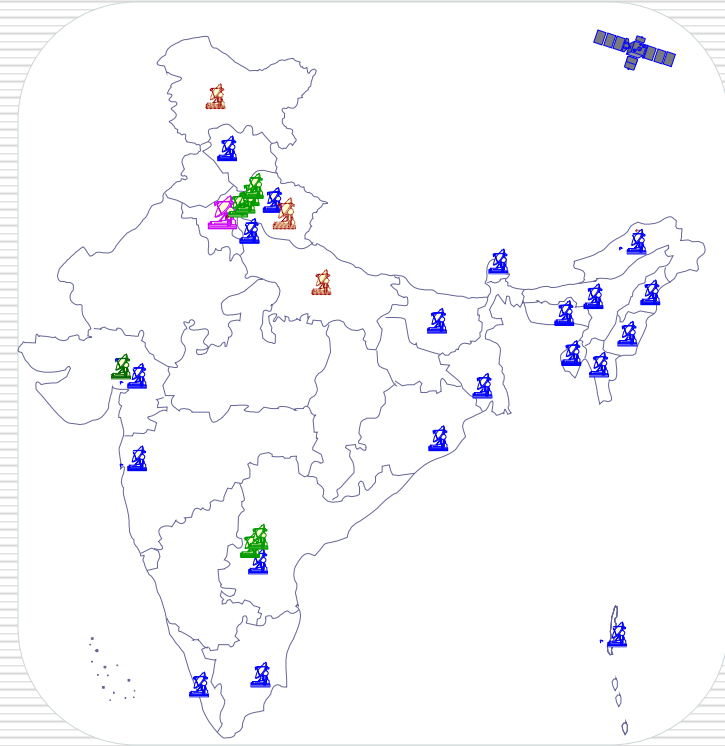


0.5 m countours of part of Godavari basin

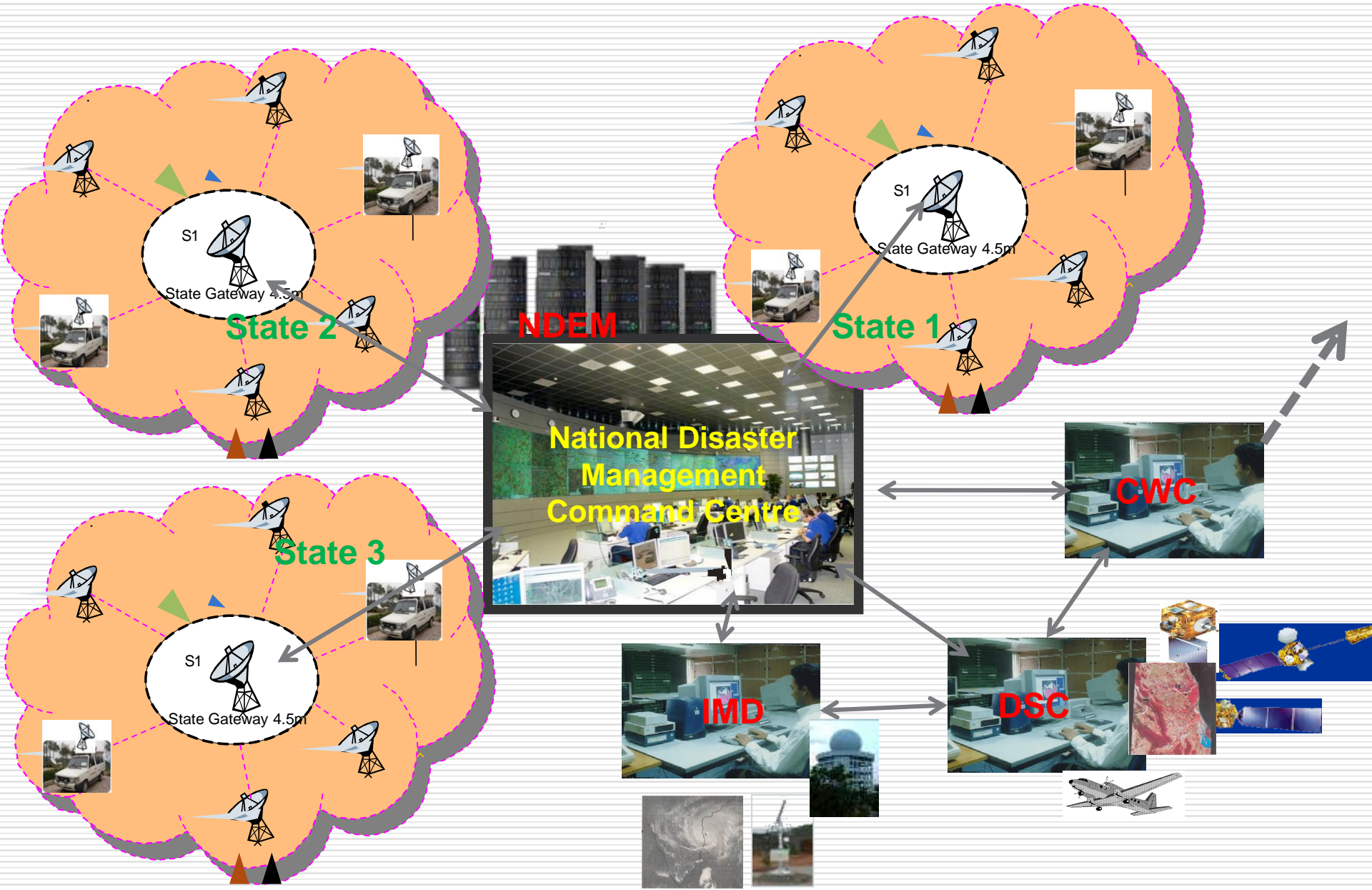
Communication Network (VPN)

- *Linking States with data providers*

- Satellite based Virtual Private Network (VPN) provides failsafe connectivity to DSC.
- The network connects 20 multi-hazard prone State Emergency Operation Centres with 10 Primary Nodes and 5 observation nodes
- 5 nodes were added in Uttarakhand, 4 in J&K and 2 at Kutchch.
- The network is enabled using Extended C transponder in the GSAT-12 satellite.
- Expansion of the network to multi-hazard prone districts is planned
- Development of Emergency Communication equipments



Proposed expansion of Network



Disaster Reduction - Global Response

ISDR, 2005

International Strategy for Disaster Reduction

- To develop robust, practical methods sound enough to withstand critical scientific scrutiny

Intl. Disaster Charter



Sendai Framework

- Strengthen disaster risk reduction to reduce disaster losses of lives and assets
- implement the framework for building the Resilience of Nations and Communities to Disasters

UN SPIDER



UNOOSA

Sentinel Asia

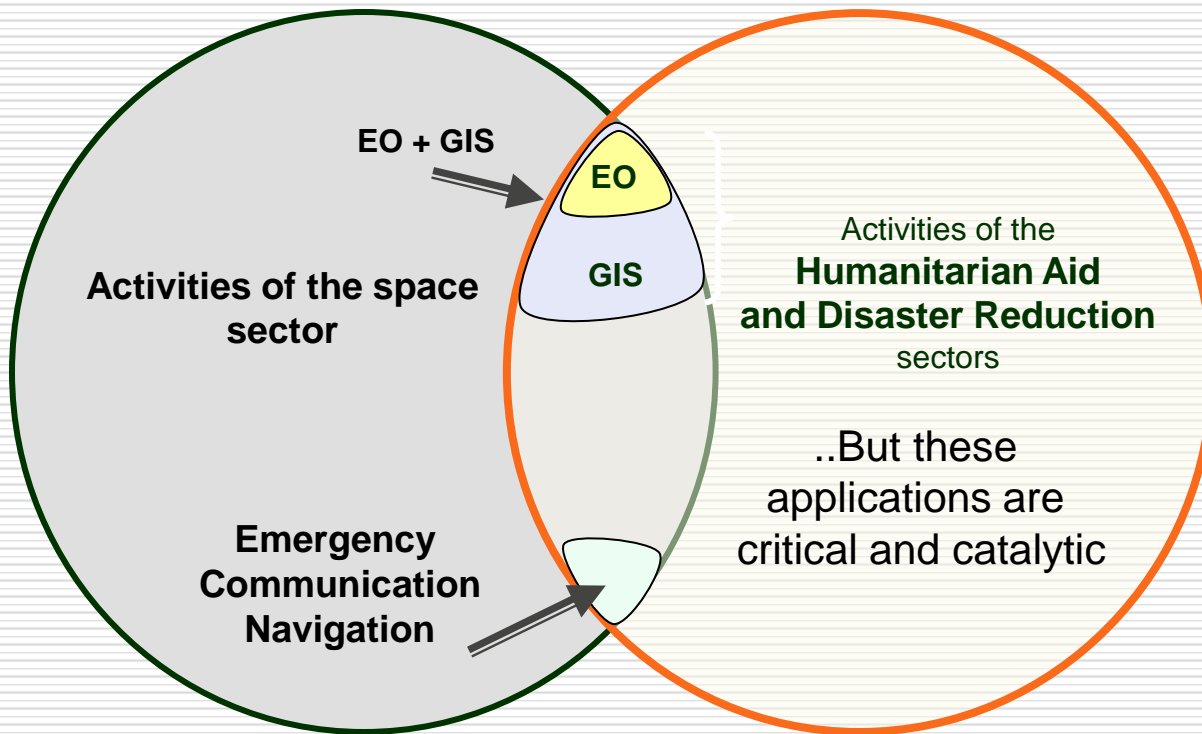


...plus GEOSS & CEOS initiatives



Space Technology Utilisation in DMS

Advanced measurement technologies, electronic communications, and exploitation methods are creating a new disaster information paradigm



The Focus

- Observational Needs
- Science Questions
- Key Observation systems
- Data Management
- Integration and Modelling
- Actionable Products & Services

DMSP is constantly striving to provide the required services through improving the observation mechanism, information generation, R&D efforts and delivery mechanism

Thank you...

jvthomas@isro.gov.in