Disaster Management Support Programme of ISRO

Earth Observation Applications & Disaster Management Support Programme
ISRO HQ., Bangalore

Disaster Profile of India and Disaster Risk Reduction Approach

- Recurrent incidences of **Floods, Cyclones, Earthquakes, Landslides, Drought, GLOFs, Forest Fire** etc.

15% of land (49.8mha)

~7500km coast

25% of area, Seismic Zones IV & V

65% of land under cultivation

36% of forest area

12.6% of land

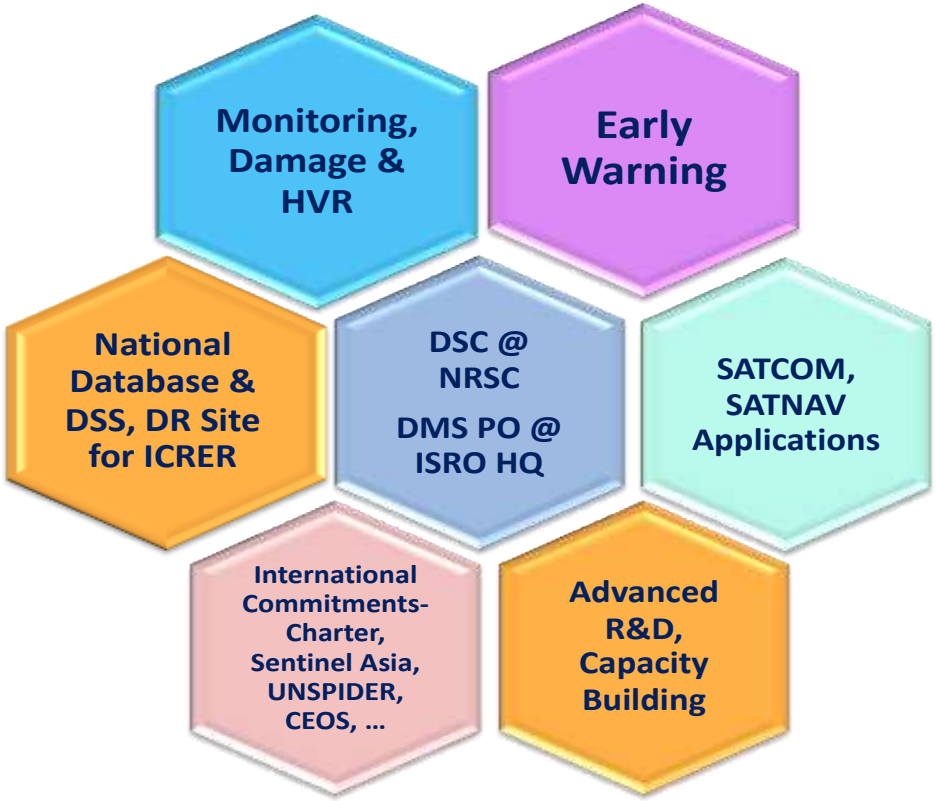
- **Since 2000, >13.5 lakh crores of economic loss**
- **Flood, Cyclone, Drought and EQ, are major cause of economic distress**

Source: EM-DAT, CRED / UCLouvain, Brussels, Belgium

- **Mitigation & preparedness-driven approach by GoI– NDMP 2019 & 2016**
- **Guided by**
  - **Prime Minister's Ten Point Agenda for DRR, Sendai Frame Work on DRR, SDGs, Paris Agreement on Climate Change**
  - **National Policy on DM 2009, DM Act 2005 & amendment 2024**
- **Aapda Mitra, CAP based Integrated Alert System**

Disaster Management Support Programme of ISRO

Enable space-based inputs for effective disaster management by respective nodal departments/ ministries



HVR
Early warning
Monitoring
Damage assmnt.

Monitoring
Vulnerability
Damage assmnt.

Early Warning
Monitoring
Damage assmnt.

HVR
Damage assmnt.

HVR
Detection
Progression
Burnt Area

HVR
Detection
Early warning (Exp.)

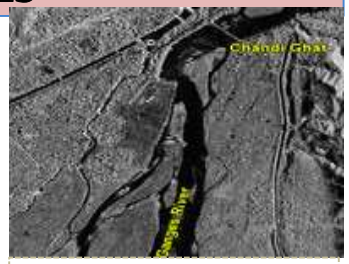
HVR
Early warning (Exp.)
Inventory
Damage assmnt.

Liaison with Cabinet Secretariat, MHA, NDMA, SDMAs, Nodal Departments

National Infrastructure Supporting Disaster Risk Reduction

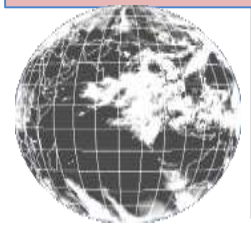
RESOURCESAT & RISAT SERIES

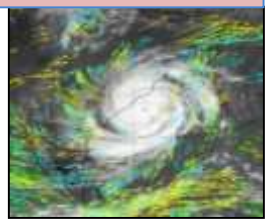
3-Tier Imaging, 56 / 23 / 5.8 m Resolution



All weather, Day & Night Imaging, 50/ 33/ 3 m Resoln.

INSAT 3DR & 3DS





6 Band Imager, 19 Ch. Sounder
15 Min. images, 1 / 4 km

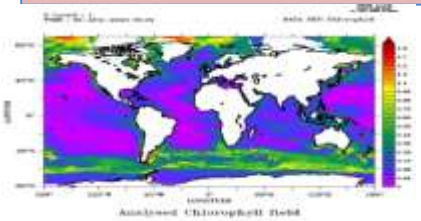
CARTOSAT SERIES

Digital Terrain Model @5m

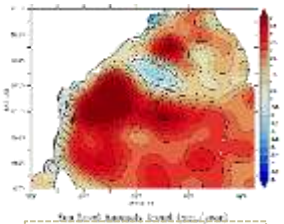
C2- 0.6m PAN, 1.5m Mx

C3- 0.28m PAN, 1.12m Mx

OCEANSAT SERIES, SARAL



360m, Ocean Color Monitor, Ocean Surface Wind @ 12.5km



Ocean Altimetry

In-Situ Observations

DWR, AWS, LDSN, CORS, Buoys

SatCom & SatNav

- INSAT-3DR/3DS, GSAT-17,6
- NavIC & Gagan

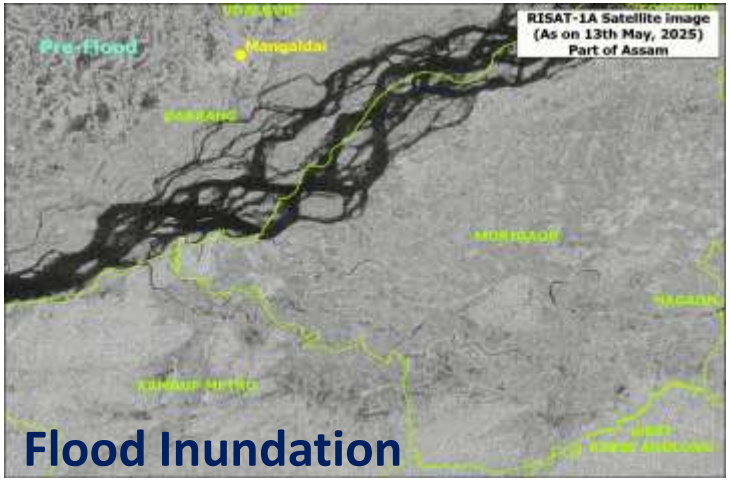
Aircrafts/ UAVs

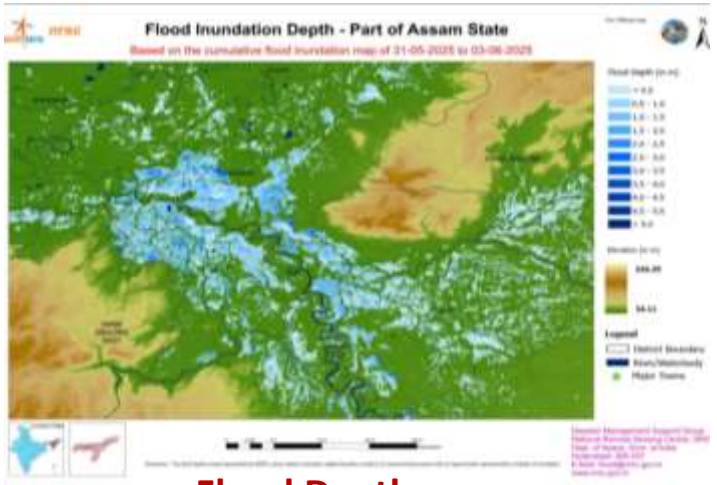
- Beechcraft Aircrafts
- Hexa/ Quad

Flood Disaster Management Support

Flood Mapping / Monitoring

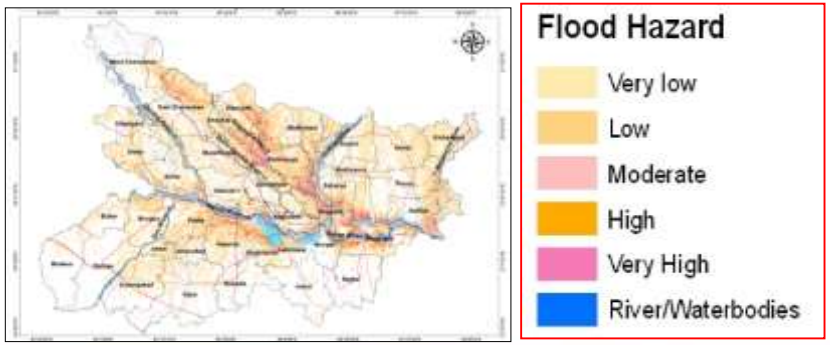
Major floods in 15 States in 2024



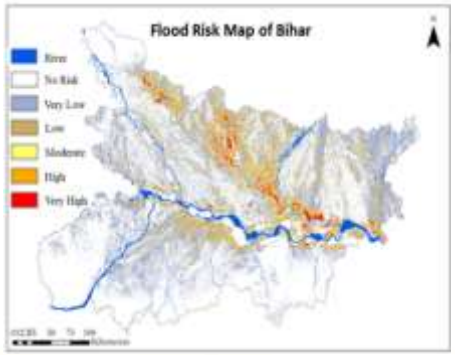


Flood Depth

Flood Hazard Zonation (Assam, Bihar, Odisha, AP, WB & UP)



Cumulative Flood Affected Area, Flood Risk

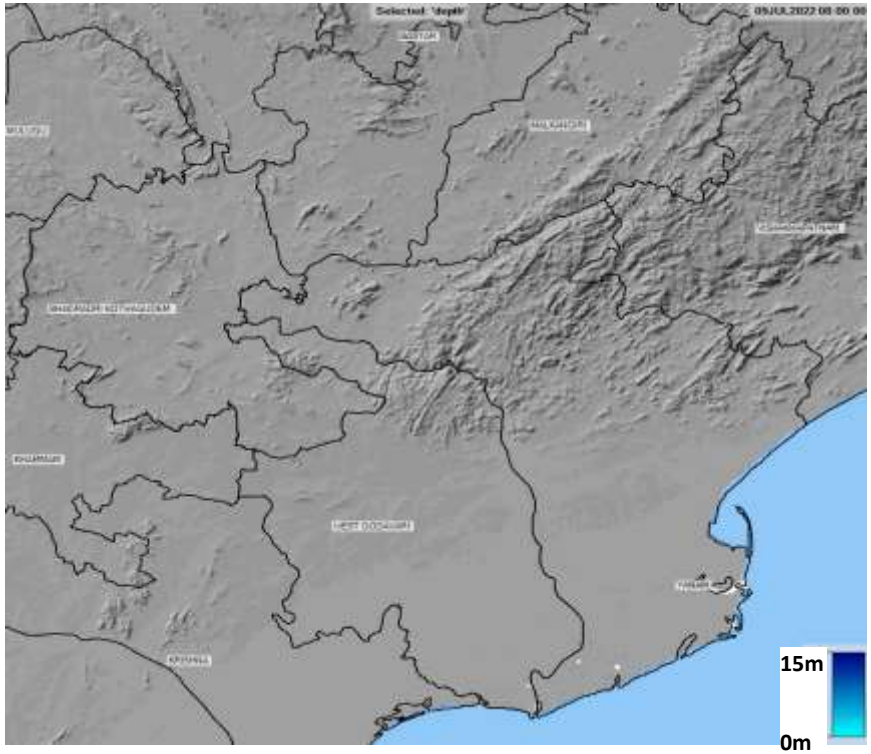


Value Addition

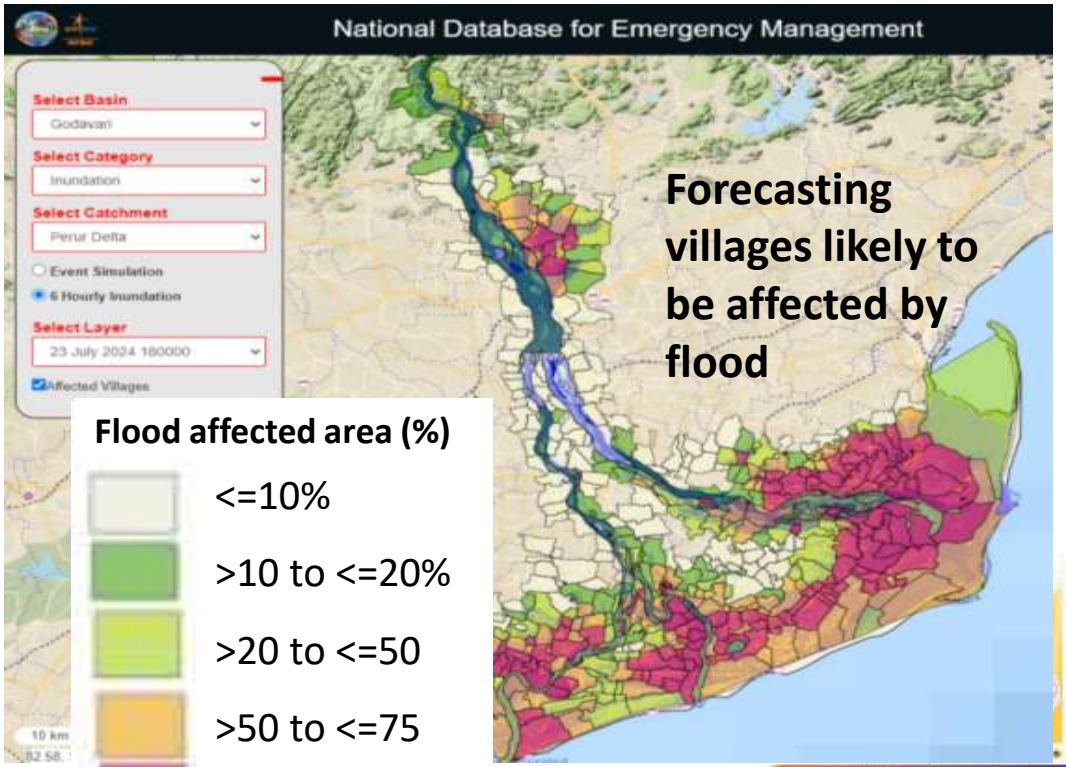
Damage (infra., crop), Progression & Recession, River Morphology Changes etc.

Flood Disaster Management Support- Early Warning

- Fully automated spatial flood early warning systems are developed for the **Godavari & Tapi Rivers**
- Flood forecast accuracy is > 85% with 36 to 52 hours lead time
- Operational deployment by CWC



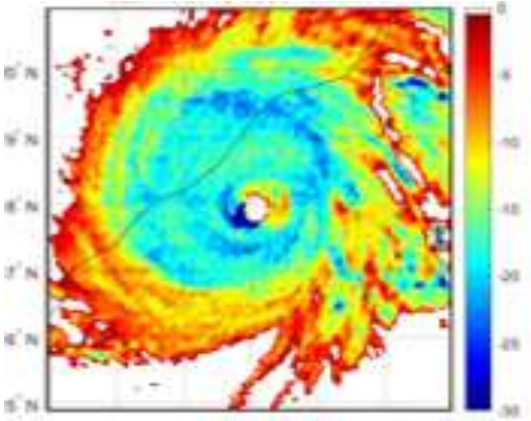
Spatial flood inundation simulation- Godawari basin



Space inputs for Managing Tropical Cyclone Hazard

- **INSAT-3D, 3DR & 3DS data**
  - Real-time monitoring
  - Forecast intensity, landfall location & time
  - Cyclone structural information
- **Scatterometer data**
  - Cyclogenesis prediction, geolocation estimation
  - Radius of maximum winds & wind speed
  - Cyclone size estimation
- **Microwave Humidity Sounder data**
  - For understanding the TC structure

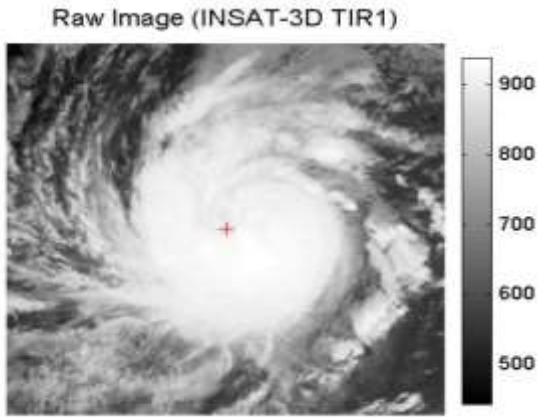
TC rapid intensification



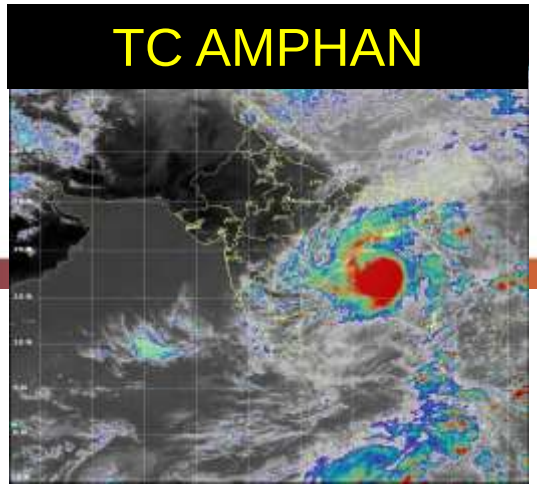
INSAT rapid scan every 4-minutes, showing structural changes in inner core of TCs

Prediction of cyclogenesis in North Indian Ocean with mean lead time of 72 hours

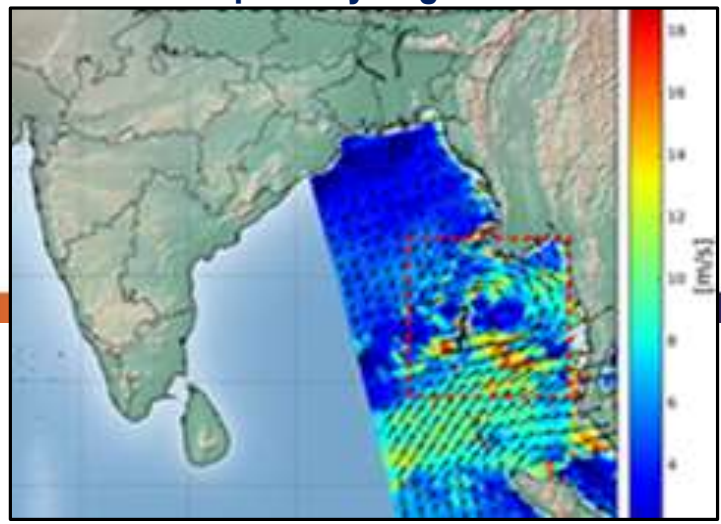
Probability of Detection : 100% False Alarm Rate (FAR): 3.8 % Success Rate: 96.5 %



Real-time Cyclone Center Estimation Using TIR Data



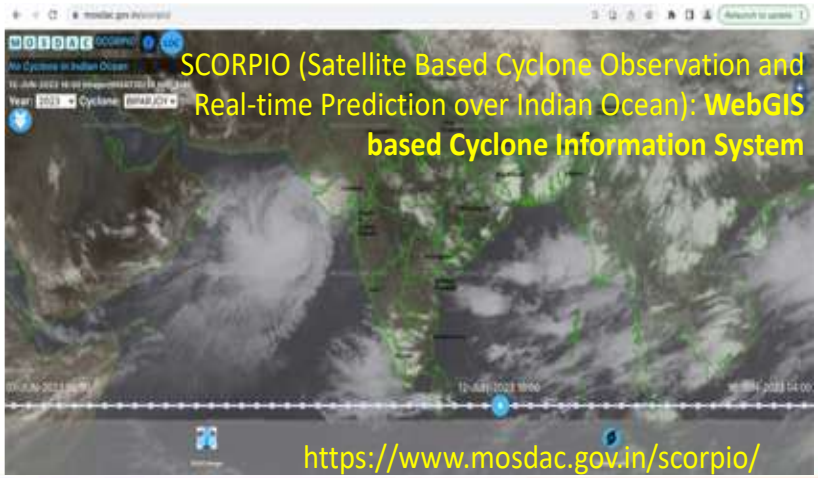
Wind vectors - Scatterometer Showing Tropical Cyclogenesis

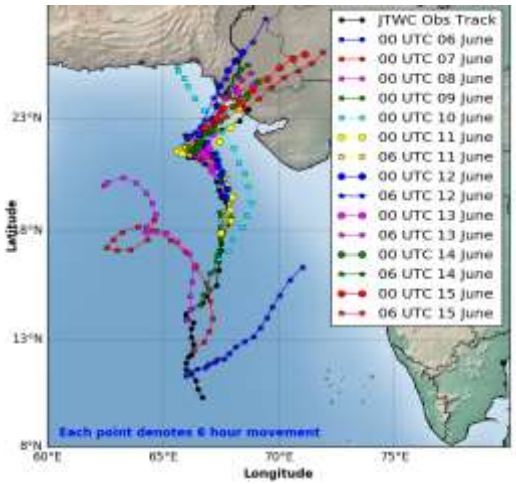


Space inputs for Managing Tropical Cyclone Hazard (cont.)

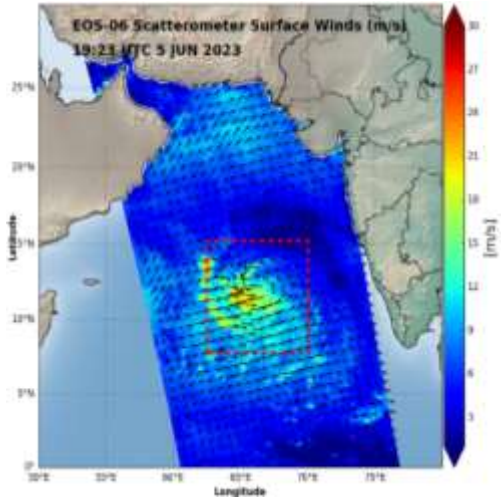
Research & Development: New models & algorithms for assimilating space inputs for early warning, track, intensity and landfall prediction

- Prediction of development of cyclone system in the NIO, using the in-house developed algorithms
- Cyclogenesis forecast using EOS-06 Scatterometer data
- Algorithm for forecasting Track, intensity, surge and inundation





Real-time predicted tracks of TC Biparjoy at 00 UTC during 06-15 June 2023 by SAC Model, and comparison with the observed track

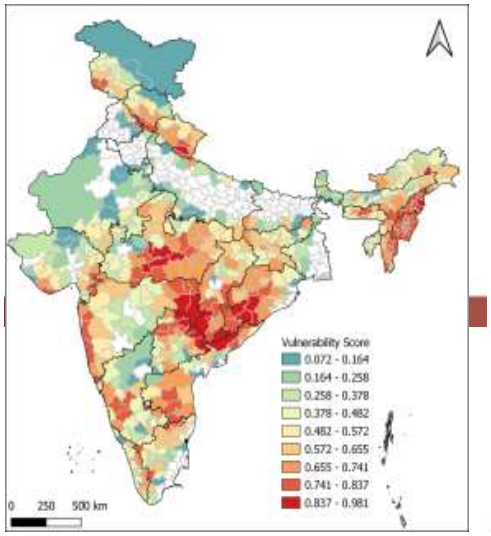


Cyclogenesis of TC Biparjoy was predicted 18 hours before its formation.

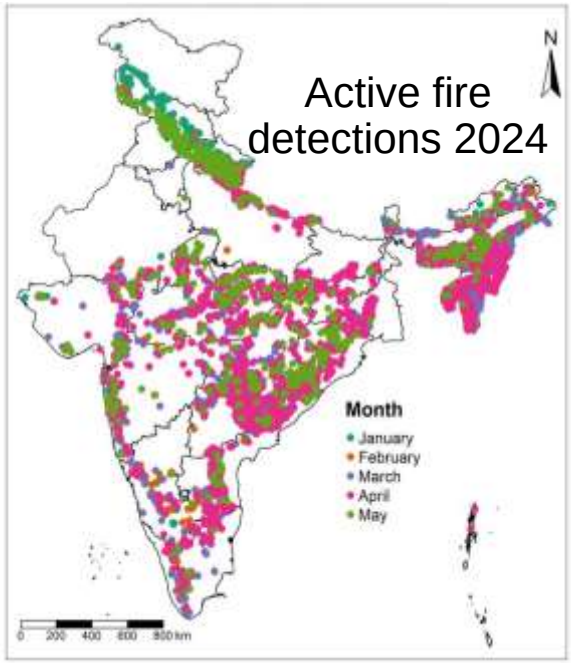
Error of 19 km in location and 0 hour in time, for 24-hour lead time-cyclone landfall location & time forecast

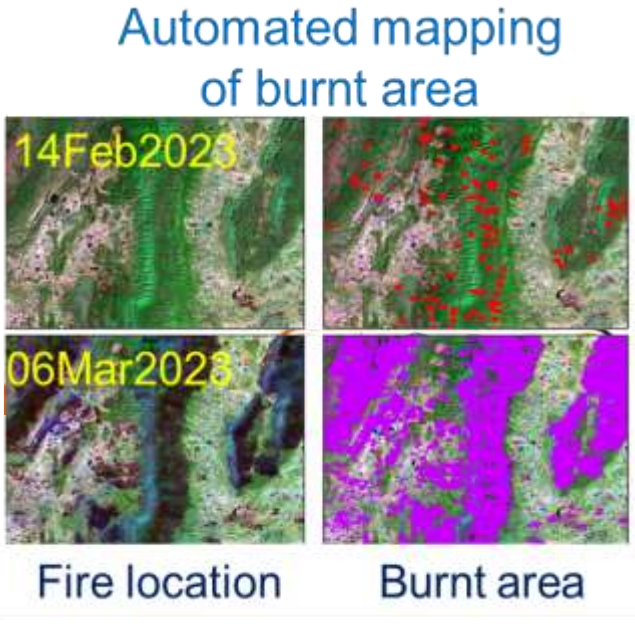
Space inputs for Managing Forest Fire

- **Near Real-time Forest fire detection & dissemination**
  - Upto 8 detections daily, ~ 30 - 60 min TAT
- **Burnt area assessment –** Seasonal & Decadal
- **Mobile App for validation**
- **Fire Risk Index –Dynamic** (T, H, wind, RF) **& Static Indices** (fuel, topography, vegetation type, etc.)
- **Support for Mexico, Bhutan**



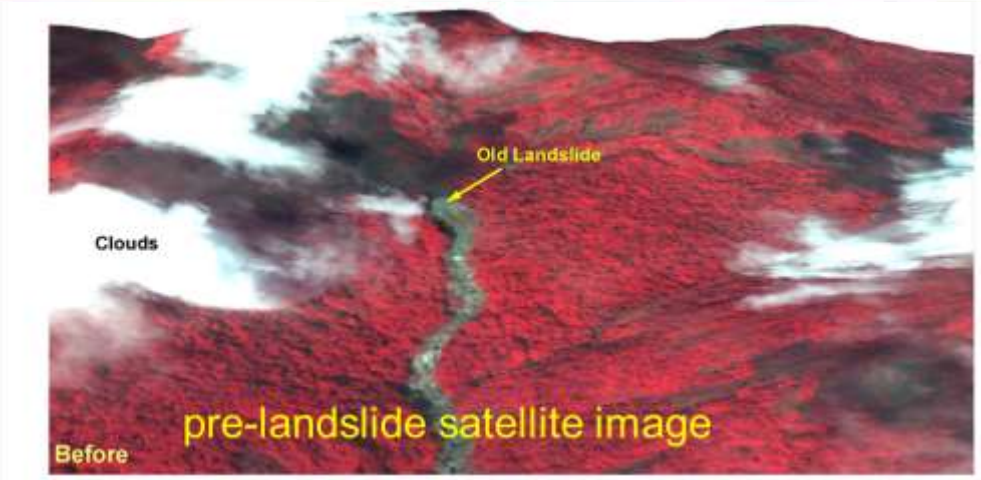
Fire vulnerability using active fire locations and burnt area (2003-2020)

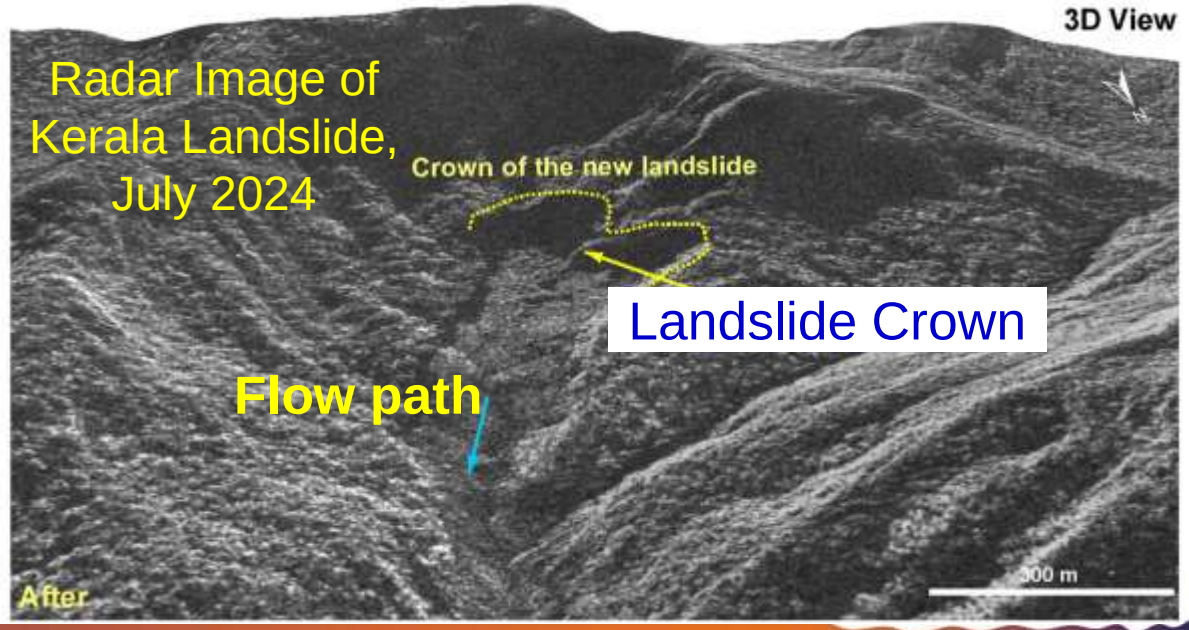




Space inputs for Managing Landslide Hazard

- **Landslide Inventory:** Seasonal & after major triggers
- **Landslide Atlas:** ~80,000 LS, database for 1998-2022
- **Susceptibility Mapping:** along pilgrimage/ tourist road corridors in HP, UK & NER
- **Experimental Landslide Early Warning:** Pilgrimage/ tourist route corridors in UK, HP, NER (RF threshold, slope stability)
- **SILAAS** – integrating InSAR derived movement & RF Threshold for early warning – National Initiative

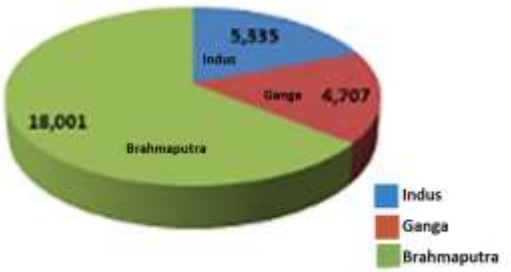


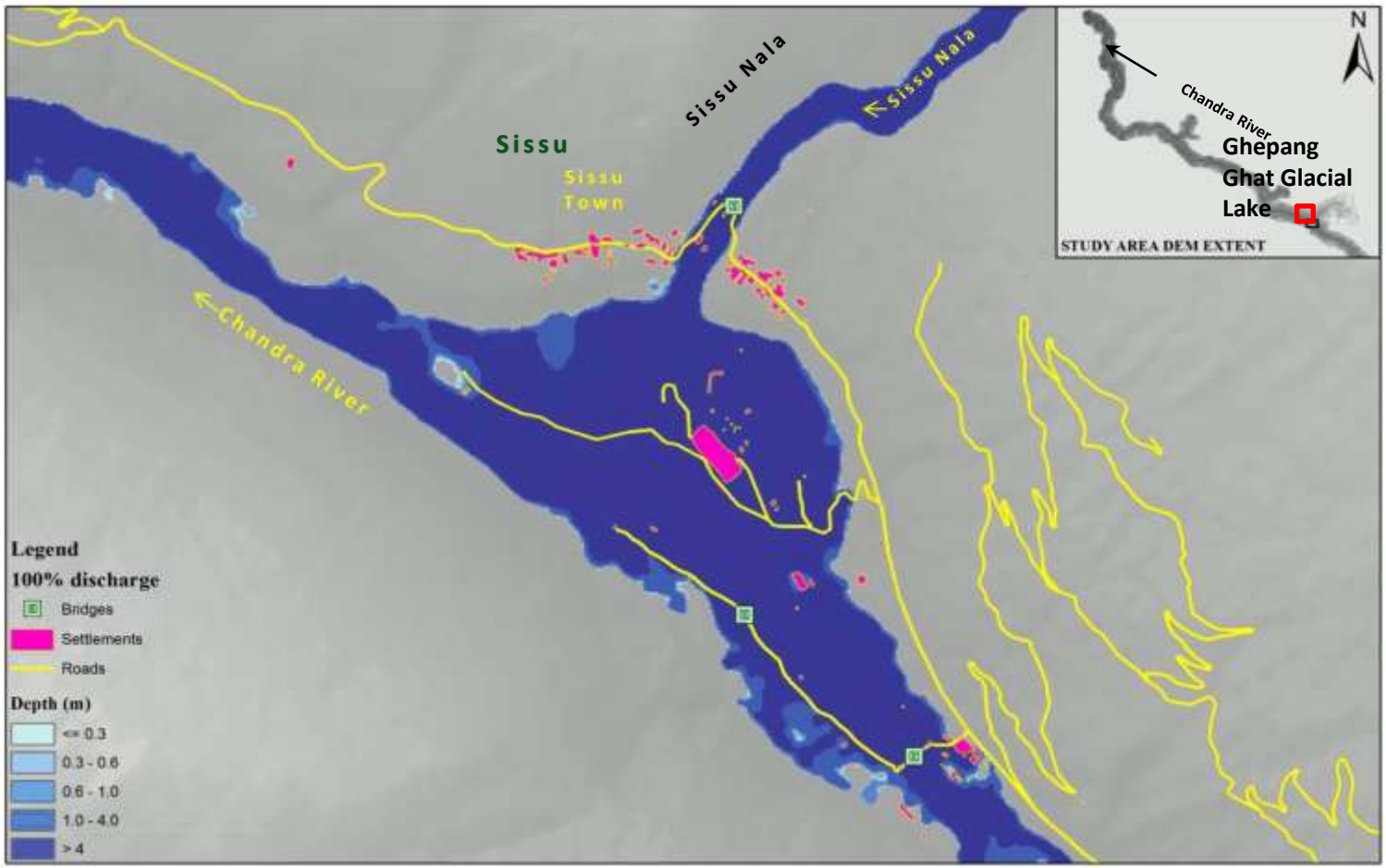


Glacial Lakes Outburst Flood Risk Modelling

GLOF Simulation of Ghepang Ghat Glacial Lake, HP State

- Inventory, Monitoring, Prioritization, Inundation Modelling
  - Glacial Lakes of size ≥ 0.25 ha (28,043), along with 22 attributes
- GLOF Hazard & Risk Mapping



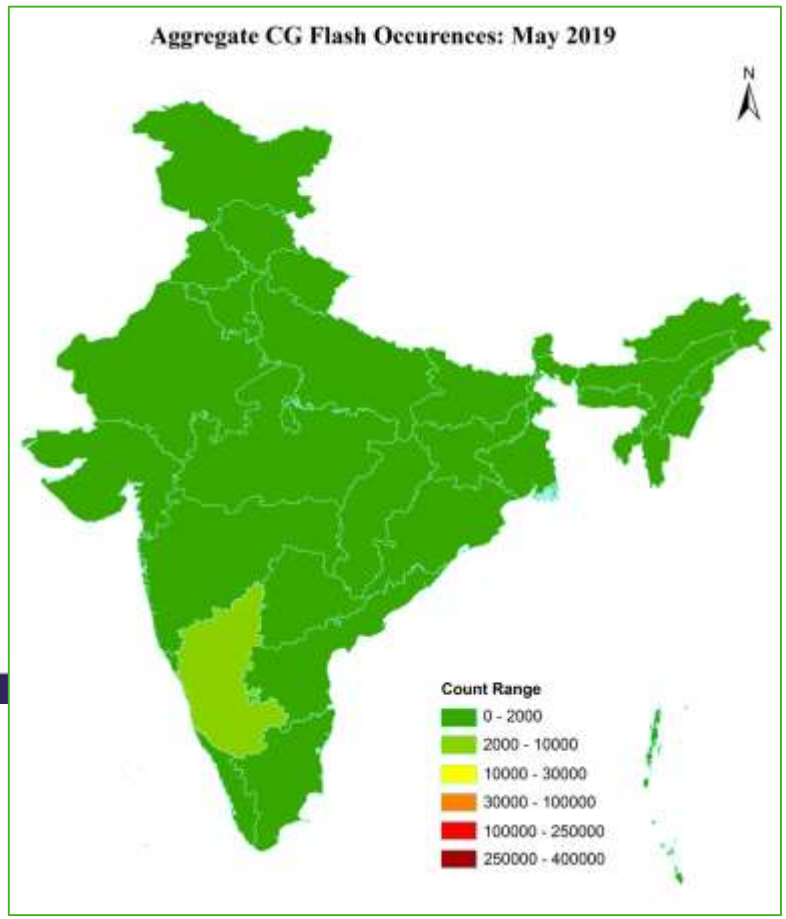


Inventory of Glacial Lakes

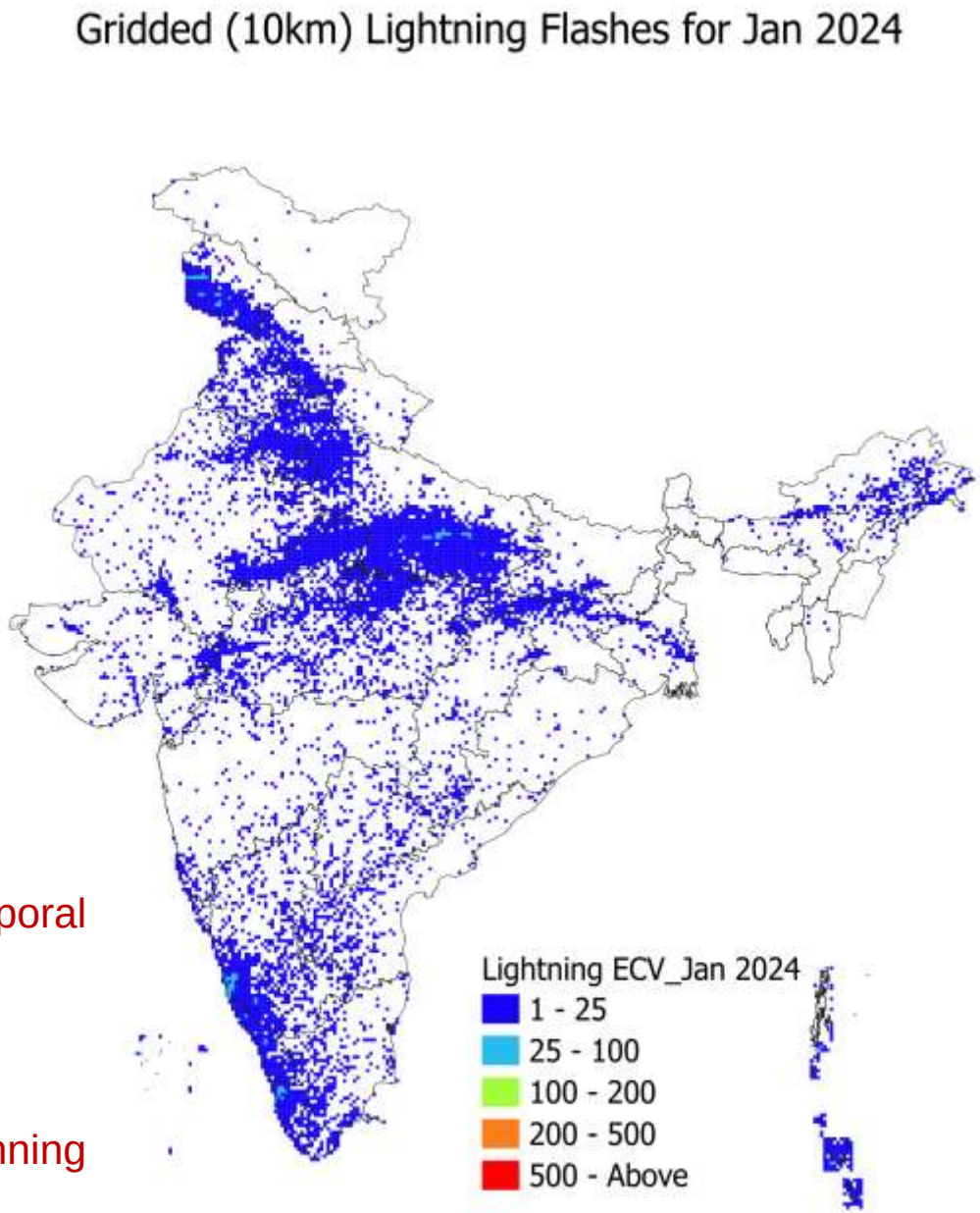
RS-2 LISS-IV Satellite Images covering Himalayas

Lightning Hazard Management

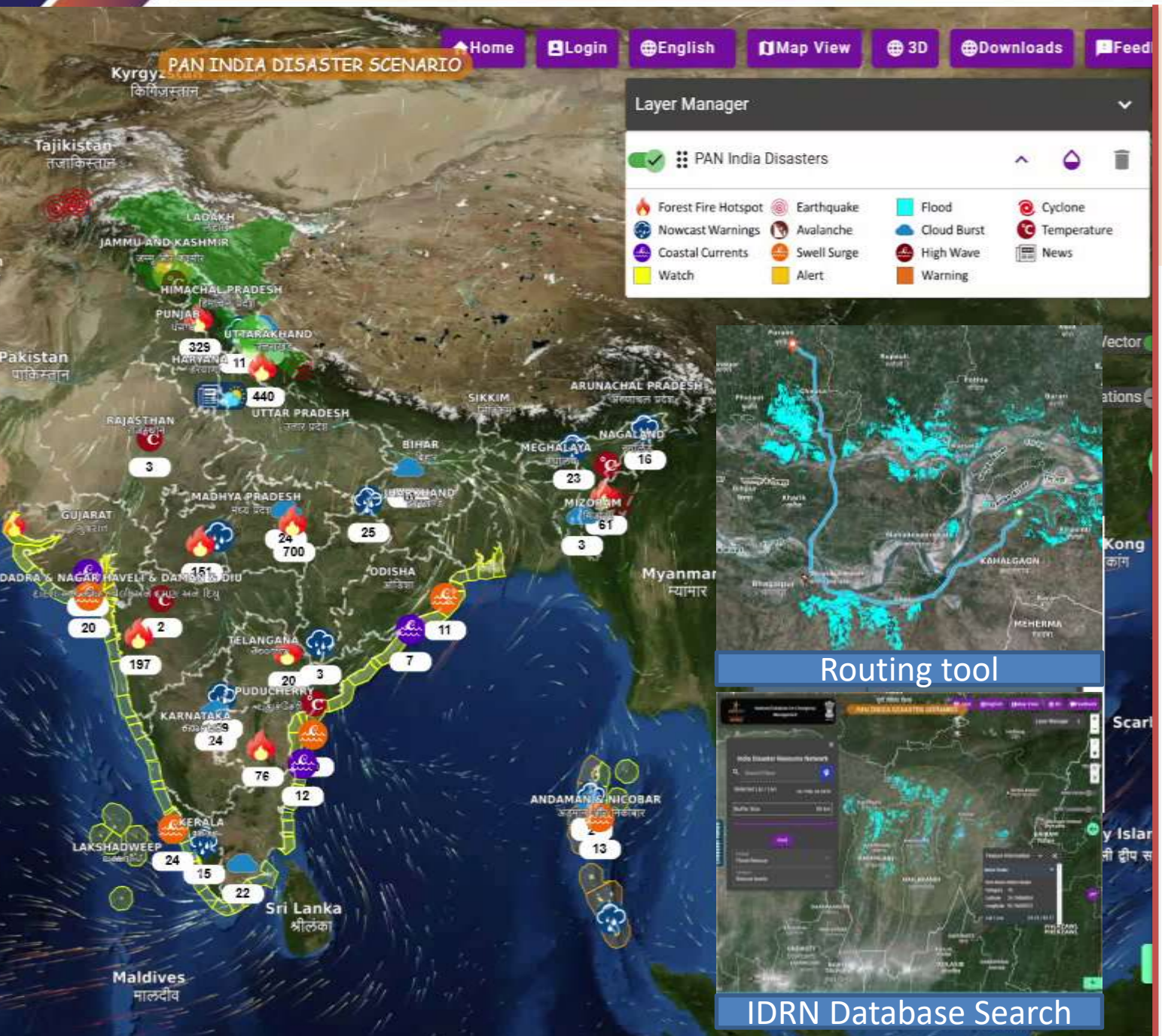
- 49 lightning detection sensors
- Cloud-to-ground lightning data collection since 2020
- State-wise occurrence mapping for identifying vulnerable states
- Day ahead outlook lightning map generation is being evaluated



- for spatio-temporal vulnerability assessment
- Crucial for mitigation planning



National Database for Emergency Management (NDEM)



Geo-portal to disseminate space based inputs along with services of forecasting organizations, addressing major disasters nationally.

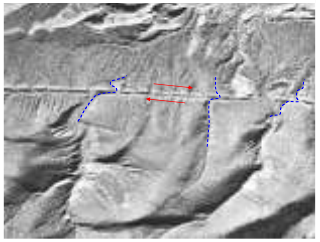
Salient Features:

- Pan India Disaster Scenario
- Multi-scale geospatial database
- Decision support system
- Incident Report Mechanism
- PDNA & IDRN Tools
- Resource Management
- Mobile Apps
- DR site for ICR-ER, as well as data provider node
- Manpower deployed at ICR-ER

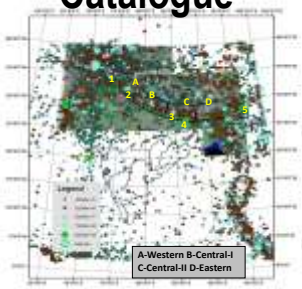
Support for Earthquake Disaster Management

- **Hazard Zonation using spatial modeling**
  - ACTIVE FAULTS/ Regional tectonic features
  - Probabilistic/ Deterministic SHA
- **Liquefaction Potential**
- **Strain rate evaluation**
  - GNSS CORS Observation
  - Inter-seismic deformation using DInSAR
- **Earthquake Precursor Studies**
  - Thermal anomalies
  - Ionospheric disturbances
- **Damage / Deformation Assessment**
  - Co-seismic deformation through DInSAR
  - Damage assessment, Liquefaction
  - Site suitability for reconstruction and rehabilitation

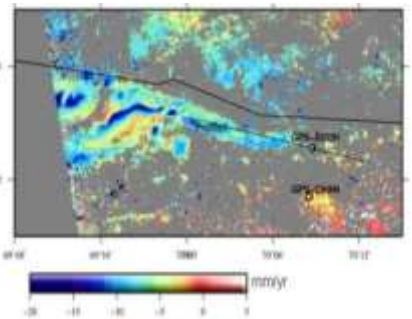
ACTIVE FAULTS



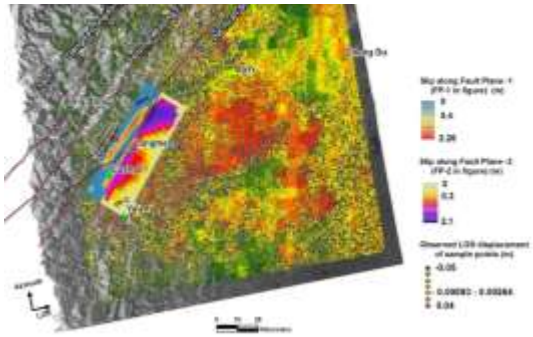
Catalogue

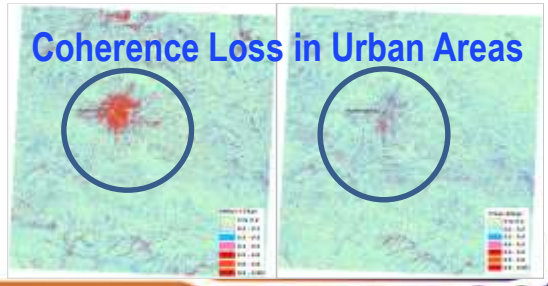


Deformation rate
- Interferograms



Co-Seismic Deformation:
DInSAR





International Cooperation & Capacity Building

International Charter Space and Major Disasters & Sentinel Asia

- ISRO is the Lead for Charter from April to Oct 2025
- 53rd Charter Meeting at Hyderabad from 14-17 Apr2025.
- ISRO has supported 153 disasters Globally since 2021
- ISRO supported 46 disasters in 19 countries in Asia during 2024
- Satellite data support from Sentinel Asia & Charter for major disasters in India

Capacity Building

- Annual DMS training programmes; 5-day programmes
- NDEM training programmes for NDRF and DMS officials
- Workshops in association with NDMA and NIDM
- Regional workshops on DMS applications
- International Workshops (online)

Upcoming Earth Observation Missions

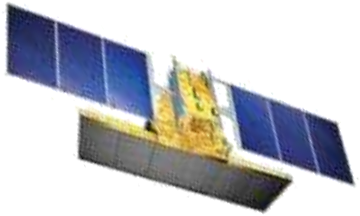
L & S Band SAR

All-weather;
Day & Night Imaging

Oceansat-3A

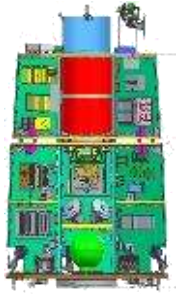
Ocean Color & Wind vector – Continuity + SST

RISAT-1 Constellation



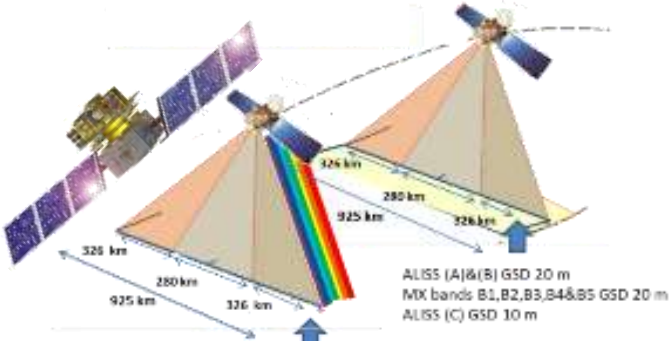
All-weather;
Day& Night Imaging

HRSAT



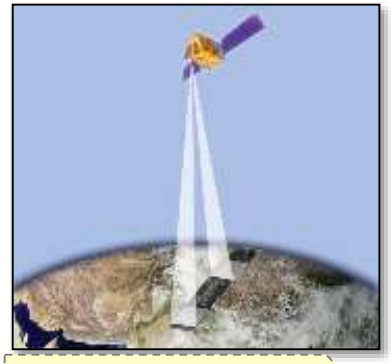
Daily re-visit of Area of Interest

Next Generation Resourcesat



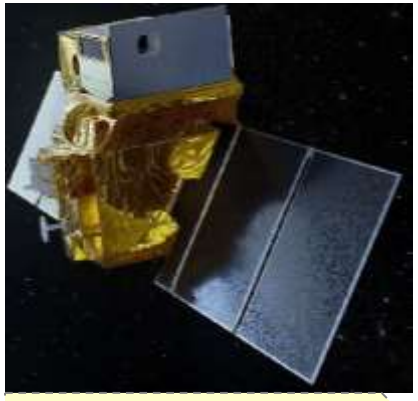
Wide Swath imaging with improved spatial resolution

High resolution Stereo



Concurrent Stereo & MX imaging

High res. TIR & VSNIR



Thermal Imaging

G20 Satellite

Environment & climate change

Way Forward

Strengthening Risk Reduction, Recovery and Resilience

- Reducing risk & building resilience - Retrospective & modeled disaster impact analyses
- Improved vulnerability; exposure and coping capacity assessments

Better Preparedness and Effective Response

- Robust early warning for complex and cascading hazards

Advancing state of the art infrastructure and use of technology

- Event driven sensing, Onboard Information retrieval & dissemination,..

Adopting Best Practices/ International Collaboration

- Training and Capacity building through institutes of excellence
- International collaboration/ Joint studies

thank you