

Agency Report: Indian Earth Observation Programme



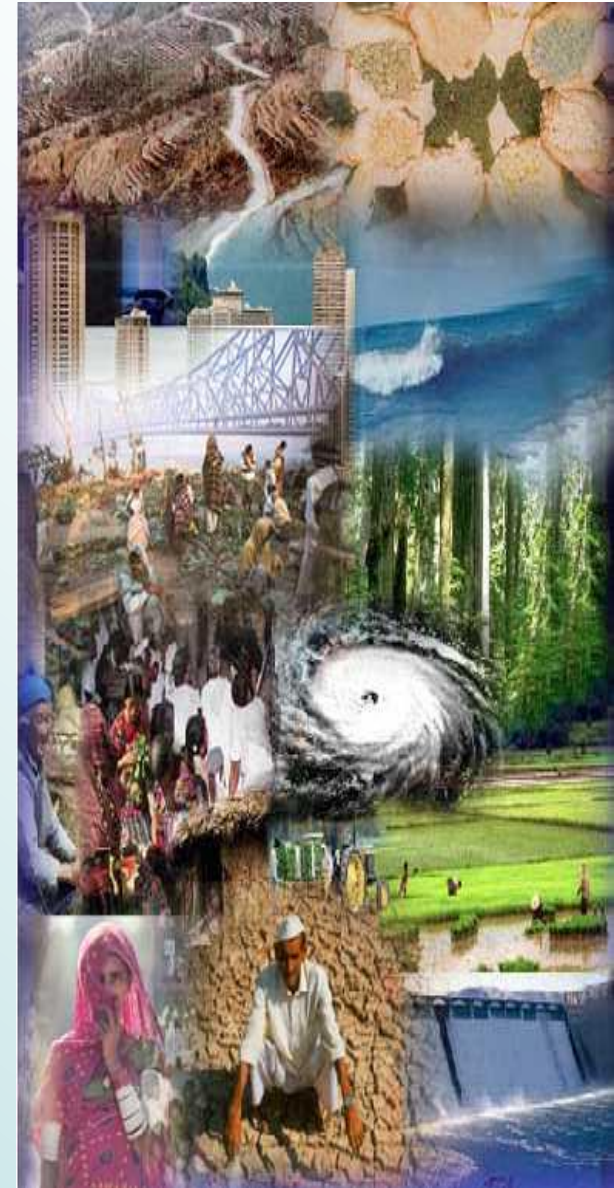
Nitant Dube

Space Applications Centre
Indian Space Research Organisation

Presentation to CEOS – WGISS-41, Canberra Australia, March 2016

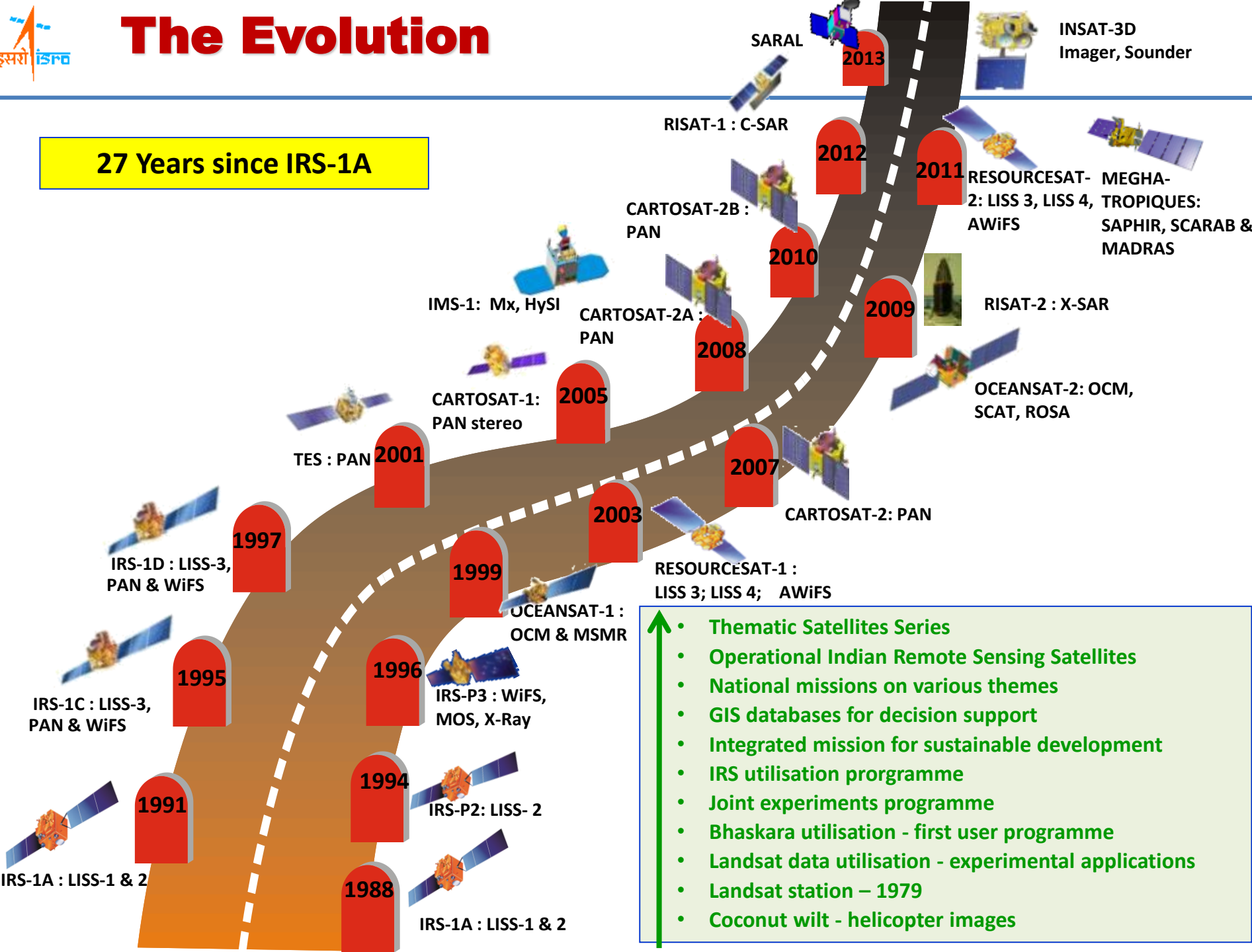
Indian EO Programme: The Uniqueness

- **Vibrant Space Segment: Constellation of Satellites**
 - Resourcesat, Cartosat, Oceansat
- **Strong Ground Mechanisms**
 - Effective Institutional Framework - NNRMS
 - Enabling infrastructure – Processing, Generation and dissemination of information
 - Observational Network
- **Goals**
 - Provide continuity of data, also with enhanced capabilities
 - Conduct periodic natural resources inventory & enable the national spatial data infrastructure
 - Maximize outreach of natural resources information
 - Enable ocean state forecasting and improved weather forecasting; information needs for disaster monitoring and mitigation



The Evolution

27 Years since IRS-1A



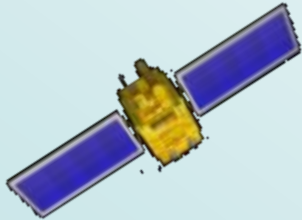
- Thematic Satellites Series
- Operational Indian Remote Sensing Satellites
- National missions on various themes
- GIS databases for decision support
- Integrated mission for sustainable development
- IRS utilisation programme
- Joint experiments programme
- Bhaskara utilisation - first user programme
- Landsat data utilisation - experimental applications
- Landsat station – 1979
- Coconut wilt - helicopter images

Currently Operational EO Missions

LAND & WATER

RESOURCESAT-2

LISS-3, LISS-4, AWiFS



RISAT-1

C-Band SAR



HIGH RESOLUTION

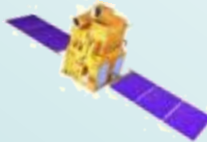
CARTOSAT-2

0.8 m PAN



CARTOSAT-1

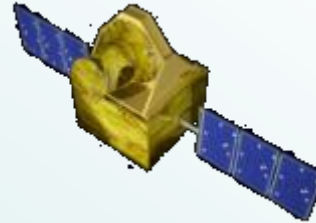
2.5m PAN stereo



OCEAN

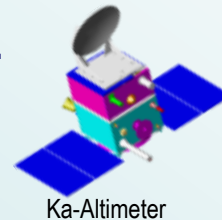
OCEANSAT-2

OCM, Scat, Rosa



SARAL

Ka-Altimeter



WEATHER; CLIMATE

INSAT-3A

VHRR, CCD



KALPANA

VHRR

INSAT-3D

Imager, Sounder

MEGHA-TROPIQUES

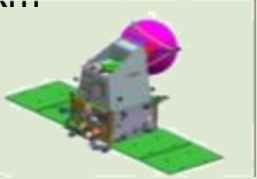


MADRAS, SCARAB, SAPHIR, ROSA





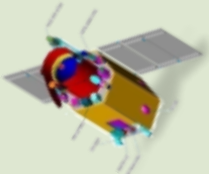
CRITERIA FOR PLANNING EO MISSIONS

- Ensuring Data Continuity for Operational Applications
- Improvements in Observations/ Data Services based on User's feedback
- Enabling R&D Applications by providing newer observational capability
- Technology Development / Demonstration
- Collaboration through International Cooperation


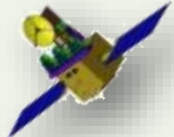

Future EO Missions

Mission Expected Launch	Specifications	Applications
<p>SCATSAT-1</p> <p>Orbit : 720 km Jun 2016</p> 	<p>Ku-band Scatterometer (SCAT)</p> <p>Frequency: 13.51 GHz</p> <p>Swath: 1400 km swath</p> <p>Products: 50 km x 50 km</p>	<ul style="list-style-type: none"> ▪ Weather forecasting ▪ Ocean State Forecast ▪ Cyclone detection and tracking services
<p>RESOURCESAT-2A</p> <p>Orbit : 817 km ECT: 1030 July 2016</p> 	<p>LISS-4 (3 Xs) – 5.8 m, 70 km swath</p> <p>LISS-3 (4 Xs) – 23.5m , 141 km swath</p> <p>AWiFS (4 Xs) – 56 m, 700 km swath</p>	<ul style="list-style-type: none"> ▪ Continuity for Resourcesat-2 ▪ Natural resources Management & monitoring ▪ Disaster Management Support
<p>INSAT-3DR</p> <p>Orbit : 36000 km (GEO) Every 30 min July 2016</p> 	<p>6 channel Imager (Visible, MIR, WV, TIR and SWIR)</p> <p>19 channel Sounder (18 narrow spectral channels in 3 IR bands, 1 channel in visible band)</p>	<ul style="list-style-type: none"> ▪ Ensuring Data Continuity for operational weather forecast ▪ Cloud motion vector, improved SST, vertical profile of temperature and humidity.

Future EO Missions

Mission Expected Launch	Specifications	Applications
<p>CARTOSAT-2E</p> <p>Orbit : 500 km ECT: 0930 Mar 2017</p> 	<p>Panchromatic: 0.65m/ 10 km swath Multispectral (4 Xs), 2.0 m/10km swath</p>	<ul style="list-style-type: none"> ▪ Cartography and Large Scale Mapping ▪ Urban Planning & Infrastructure Development ▪ Micro watershed Development ▪ Cadastral level applications
<p>GISAT-1</p> <p>Orbit : 36000 km (GEO) Every 30 min Dec 2017</p> 	<p>MX (4 Xs VNIR), 50 m/ 470km swath HySi (60 Xs VNIR), 320m/ 160 km swath HySi (150 Xs SWIR), 192m/ 190 km swath MX (3 Xs TIR), 1.5 km/ 470 km Swath</p>	<ul style="list-style-type: none"> ▪ Quick monitoring of Events, Disasters, natural hazards and calamities & episodic events
<p>CARTOSAT-3</p> <p>Orbit : 450 km ECT: 1030 Mar 2018</p> 	<p>Panchromatic: 0.25m/ 16 km swath Multispectral (4 Xs), 1.0 m/16km swath</p>	<ul style="list-style-type: none"> ▪ Cartography and Large Scale Mapping at 1:2000 scale ▪ Urban Planning & Infrastructure Development ▪ Micro watershed Development ▪ Cadastral level applications

Future EO Missions

Mission Expected Launch	Specifications	Applications
<p>RISAT-1A</p> <p>Orbit : 536 km ECT: 0600 Sep 2018</p> 	<p>C-BAND SAR (5.35 GHz frequency)</p> <p>Imaging Modes:</p> <p>Stripmap: 3-6m / 25km Swath</p> <p>ScanSAR: 25m/50m, 120/ 240 km Swath,</p> <p>Spotlight: 10x100km or 10x 10km spot; Resolution of 1m x 0.7m;</p> <p>Single, dual, hybrid Polarization</p>	<ul style="list-style-type: none"> ▪ Imaging during all weather conditions ▪ Crop acreage and production estimate ▪ Disaster Management Support
<p>Oceansat 3 & 3A</p> <p>Orbit : 720 km ECT: 1200 July 2018 & Aug 2019</p> 	<p>Ocean Color Monitor (OCM), 13 Band, 360m resolution, 1400 km swath</p> <p>2 Band Long Wave Infrared, 1080m resolution, 1400km swath</p> <p>Ku-band Scatterometer; 13.51 GHz, 1400 km swath</p>	<ul style="list-style-type: none"> ▪ Oceanographic applications like PFZ, Ocean State Forecast, Total suspended sediments ▪ Wind vector data
<p>RS Sampler – 3S & 3SA</p> <p>Orbit : 637 km ECT: 1030 Jan 2019 & July 2019</p> 	<p>Two number of Pan cameras 1.25m/ 60km swath</p> <p>Multispectral (4 Xs), 2.5 m, 60km</p>	<ul style="list-style-type: none"> ▪ HR DEM for contour generation ▪ Design of Rail / Road alignments ▪ Drainage Network ▪ Landslide zonation

DUAL FREQUENCY(L&S BAND) RADAR IMAGING SATELLITE

- Design & Development of Dual frequency Radar Imaging Satellite jointly by ISRO & NASA;
- Explore newer application areas using L and S band microwave data;
- Launch by India's GSLV in 2020.

ISRO's responsibilities:

- Design and development of S-band SAR
- Satellite bus
- Ka band data transmission system
- Integration of the payload with satellite
- Launch of the satellite
- In-orbit operations of the satellite

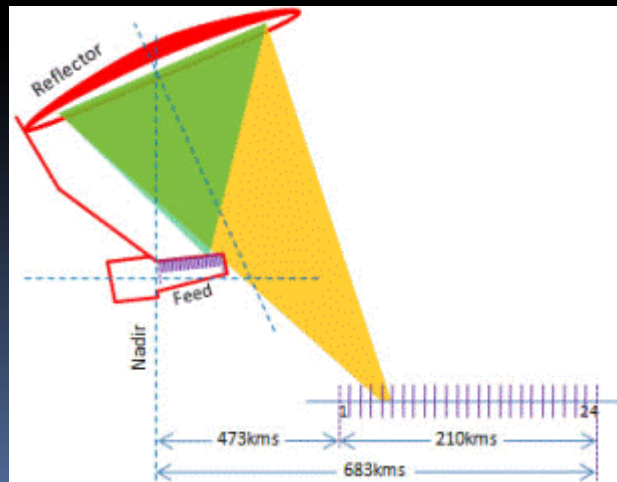
JPL responsibilities:

- Design and development of L-band SAR
- 12 m antenna with deployment mechanism
- Ultra-precision GPS system
- Navigation support and GPS data analysis
- 4 Terabits capacity Solid State Recorder
- Integration of antenna & transmitter

LAUNCH
2019 – 2020
On board GSLV

MAJOR SCIENCE APPLICATION

- Agriculture Biomass and Forest Biomass estimation
- Soil Moisture
- Mountain / glacier snow; Mountain Glacier dynamics
- Land Subsidence & Landslide
- Coastal erosion & High tide lines
- Floods, Oil slick, Forest fires
- Inter seismic strain; Co-seismic deformation
- Ice sheet dynamics; Sea Ice thickness & dynamics



SWEEP SAR SYSTEM

Space Applications in Diversified Areas

Agriculture

Area & Production estimation for 8 major crops

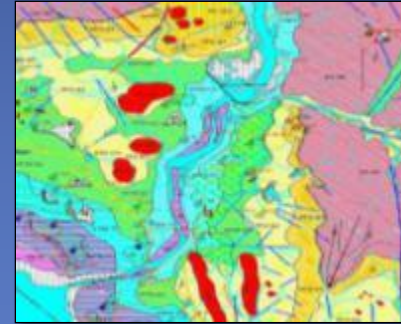
- In-season multiple forecast
- Satellite data + agro-meteorology + market economics



Drinking Water

Groundwater prospect zones & Recharge Sites

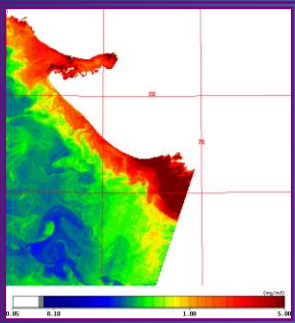
- 90 -95% Success rate for Bore wells
- Increased Water level



Fisheries

Potential Fisheries Zone (PFZ) Forecast

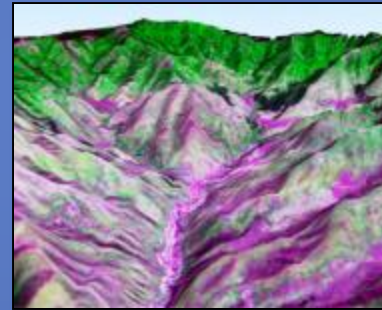
- Fish catch doubled,
- Reduced search time by 60%
- fuel cost by about 30%



Watershed Development

Better productivity potential & improved livelihood

- Soil & Water Conservation
- Enhanced cropping yield
- Decrease in fallow lands



Monitoring Irrigation Infrastructure

Inventory & Mapping of Irrigation Infrastructure

- Assessment of gaps in irrigation potential created and its utilization at the ground level.



NR Census

Periodic Inventory of Natural Resources

Land use , Soil, Geomorphology
Wetland, Land degradation ,
Snow & Glaciers , Vegetation



Space Applications in Diversified Areas

Forestry



Assessment of forest cover on a two-year cycle

- Plan conservation measures
- Rapid Forest Mapping to identify hot spot areas

Decentralized Planning at Panchayats



- Geospatial database
- Asset mapping & Activity Planning
- Implementation & Monitoring
- Decision Making at local level

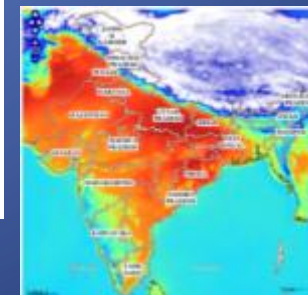
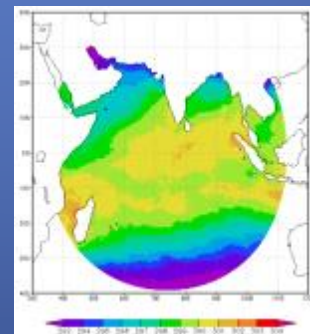
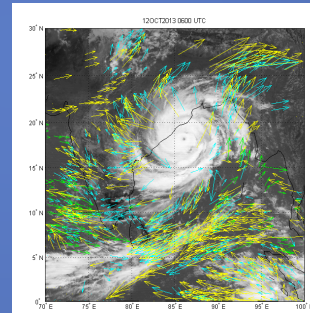
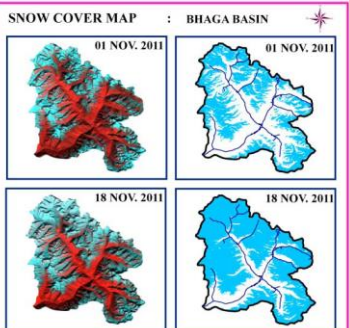
Snow & Glaciers

Monitoring of Glaciers and Snow cover area

- Glacier Retreat
- Snow-melt Runoff Forecasting
- Input to Climate Change

Weather & Climate

- Space based Weather parameters & Essential Climate Variables
- Assimilation into model for improved weather prediction.
- Ocean State forecast
- Sea Surface Temperature
- Sea Surface Heights
- Heat wave predictions



• National Urban Info. System

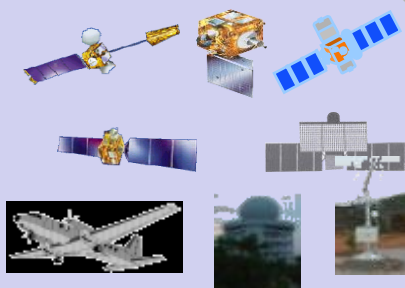


Multi scale (10K, 2K) hierarchical Urban Geospatial database

- In support of Urban Planning, Infrastructure development, e-governance.

Disaster Management Support System

Space Technology in mitigating Disasters

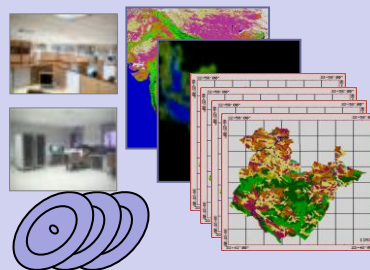


Observational Systems
Satellite (GEO, LEO, All-weather), Aerial, Ground



Single-Window for Services Delivery
DMS-DSC

Multi-tier databases with query/ decision tools



Secured Comm Fixed/ VPN, Mobile



Disasters - Operationally addressed

Flood



Inundation monitoring
Damage assessment
Hazard zonation
Bank erosion studies



Cyclone

Inundation mapping
Damage assessment

Drought



Monthly & End-of-Season Agri Drought Assessment



Forest Fire

Active fire detection
Damage assessment

Earthquake

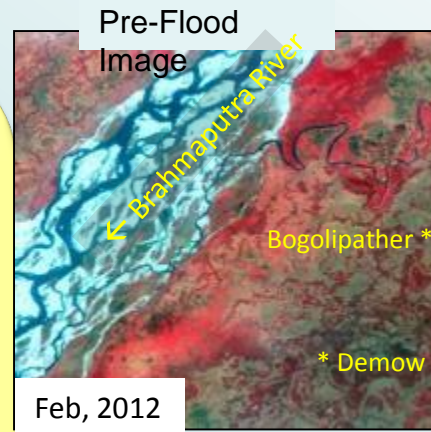


Damage Assessment

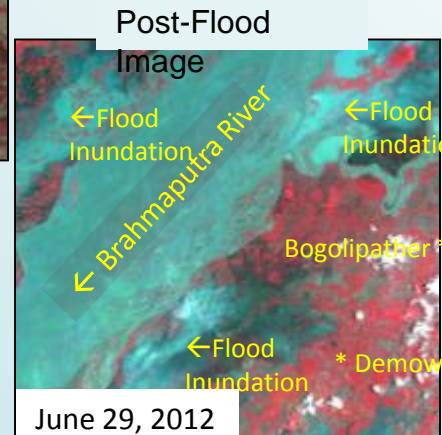


Landslide

Damage Assessment
Hazard zonation



Monitoring of Flood



EO - Information Services



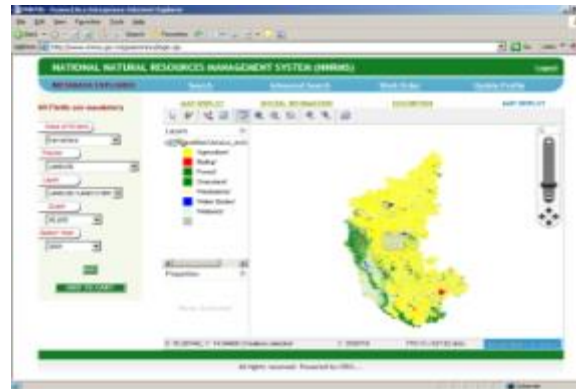
Bhuvan



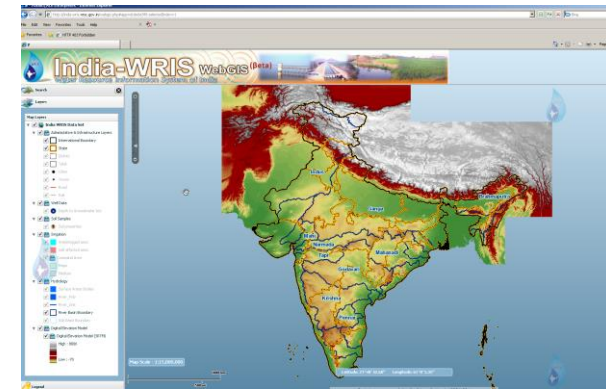
NRSC EO Open Data Archive



www.dataportal.isro.gov.in



Natural Resources Database



Water Resource Information

www.nrsc.gov.in



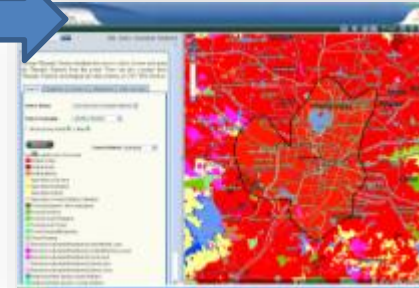
www.bhuvan.nrsc.gov.in



Data Archive



Visualization



Thematic Services



Projects

Uniqueness of Bhuvan

- ✓ Online Shape file Creation
- ✓ Terrain Profile & 3D Fly Through
- ✓ Urban Design Tools
- ✓ Multi-Lingual (English | Hindi | Tamil | Telugu | Gujarati | Marati | Kannada)
- ✓ Downloads (CartoDEM, AWiFS, LISS III Ortho)

- ✓ Availability of Seamless High Resolution & Multi-Sensor Data from IRS Satellites
- ✓ 2D and 3D Visualisation tools
- ✓ Rich Thematic Information
- ✓ Weather & Ocean Services
- ✓ Collaboration /Community Participation
- ✓ OGC Web Services

Meteorological & Oceanographic Satellite Data Archival Centre (MOSDAC)

<http://www.mosdac.gov.in>



http://mosdac.gov.in/ - Microsoft Internet Explorer

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MOSDAC
METEOROLOGICAL AND OCEANOGRAPHIC SATELLITE DATA ARCHIVAL CENTRE

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Welcome to MOSDAC

The basic objective of MOSDAC is to archive and share Meteorological and Oceanographic geophysical data products from various national and international satellite missions through web based services. The purpose is to provide common platform for data exchange to ISRO, other Research community and Academic users.

Several organizations are involved in these efforts.

Under Meteorology & Oceanography Program (MOP) of ISRO, frontline research work is being conducted on geo-physical retrievals from satellite observations and assimilation of this data in numerical models for atmospheric and oceanic studies. Through this site, this data set is being sought to be shared with other like-minded research & development scientists. Prime responsibility for the data population in MOSDAC rests with MOJ.

For any scientific clarification/query, users can mail at gdmq@mosdac.gov.in

Click Here For [AWS Portal](#)

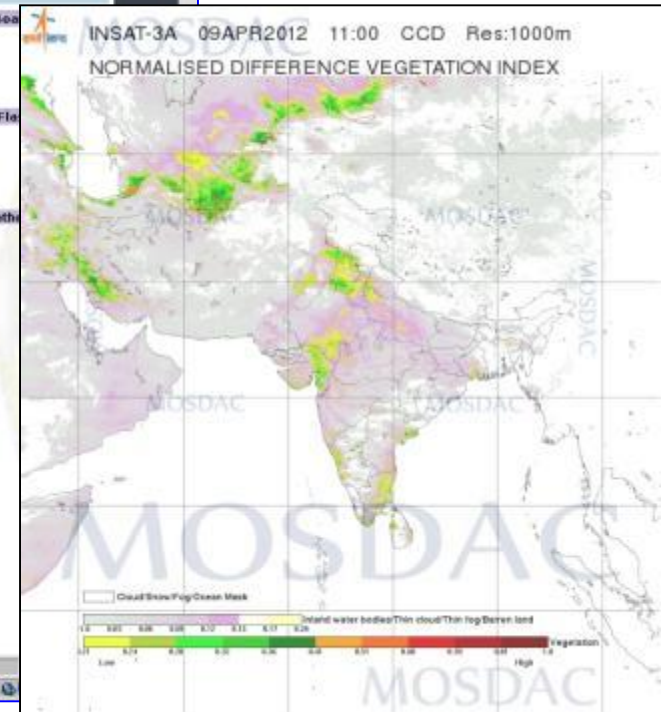
INSAT 3A-VHRR data now available on MOSDAC

New

[North West India Experimental Short Range Weather Forecast](#)

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- Serves Meteorology and oceanography to scientific community with Indian/ International Satellite/ In-situ data.
- INSAT-3A/ Kalpana Satellite data along with metadata. Automatic Weather Stations data are made available to users

Thank You for Your
Kind Attention

