

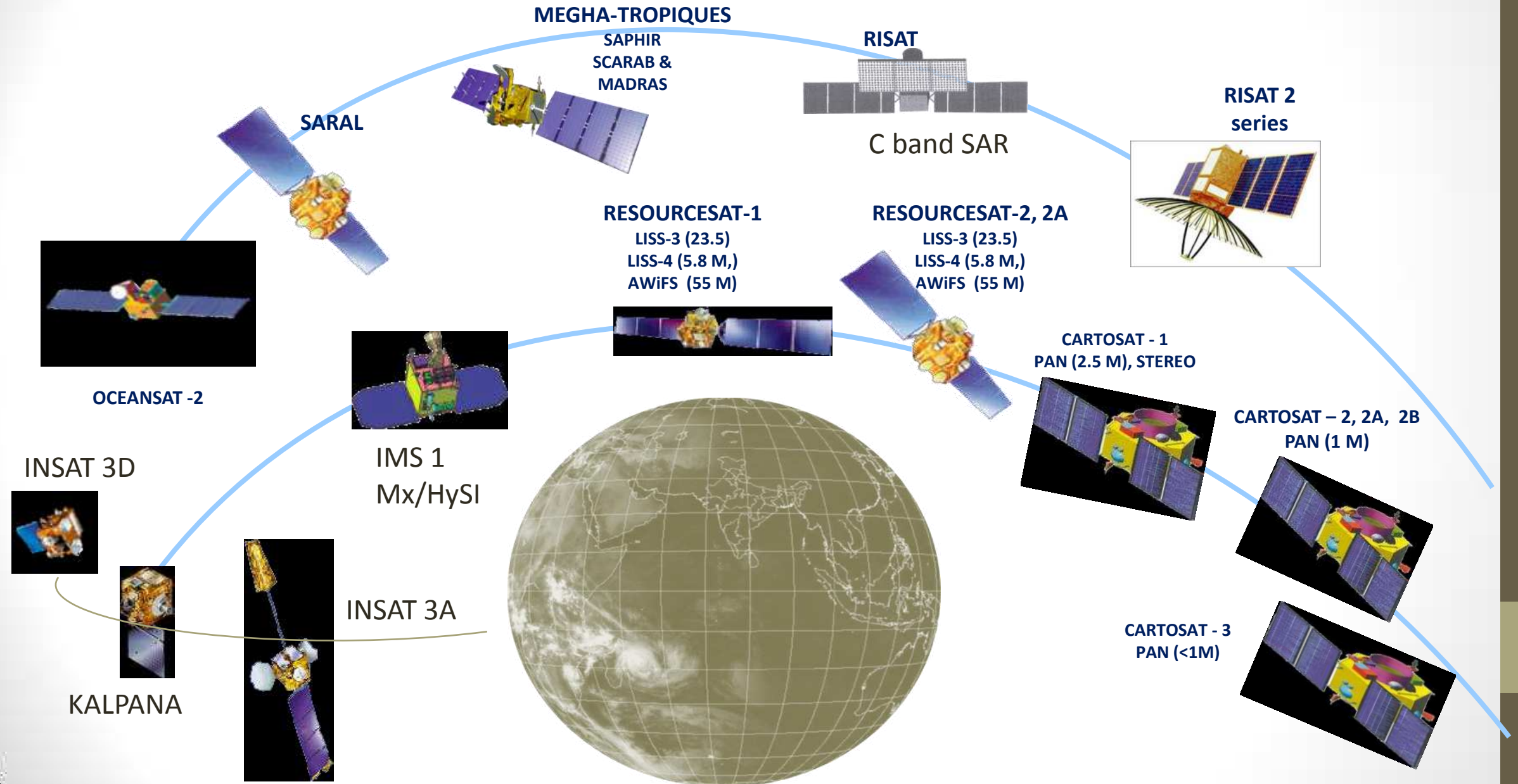
Remote sensing technologies and laws in India

Prof K R Sridhara Murthi

MSTL, NALSAR

III SEM: Laws of Remote Sensing and Geospatial Data

Operational Earth Observation satellites



Indian optical sensors characteristics

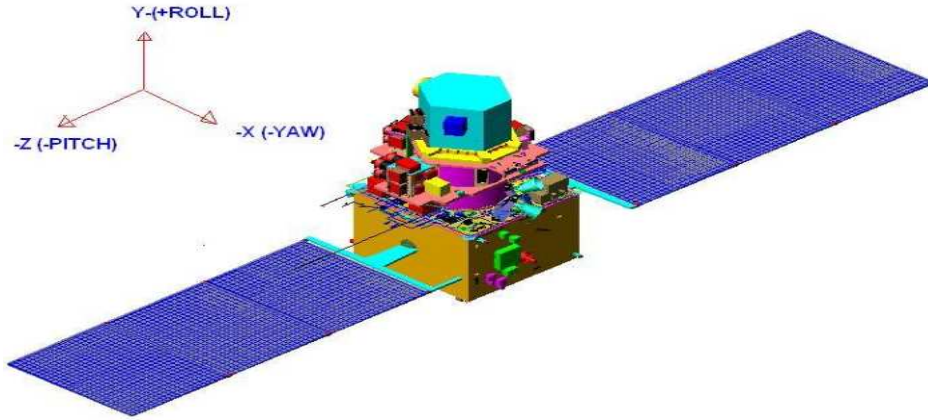
	Payload	Sensors in operation	Spatial Res.	Swath/ Coverage (km)	Radiometry	Spectral bands	Repetivity/ revisit
	CCD	1	1 Km	India & surround	10 bits	3 (B3, B4, B5)	4 times/ day
	VHRR	2	2km VIS 8km WV/IR	Earth disc	10 bits	3	Every 0.5 hr.
	HySI/ IMS	1	500m	128	12 bits	64	24 days
	OCM-2	1	360m	1420	12 bits	8	2days
	AWiFS	2	56m	740	10 bits	4(B2, B3,B4, B5)	5/2.5 days
	MX/ IMS	1	37m	148	10 bits	4(B1, B2,B3, B4)	24 days
	LISS3	2	23m	140	7/10 bits	4(B2, B3,B4, B5)	24/12 days
	LISS4	2	5.3m	23/70	7/10 bits	4(B2, B3,B4)	40/5 days
	PAN (stereo)	1	2.5	30	10 bits	1	100 days
	PAN (mono)	4	0.8/1m	10/16	10 bits	1	5 day revisit
	PAN (Mx)		1.6/1m	10/16	11 bits	4	5 day revisit

Microwave sensors: SAR in C & X bands (upto 1m), Multi frequency radiometers, Ku scatterometers & more

ORBIT PARAMETERS OF IRS 1A/ 1B

Parameter	Value
Semi major axis	7282.277 km
Eccentricity	0.002
Inclination	99.028 deg.
Period	103.192 min
Westward longitudinal shift of successive orbits	25.798 deg
Longitudinal shift in successive days	1.17264 deg (130.54 km)
Number of orbits/day	14
Number of orbits / cycle	307
Repetitivity	22 days

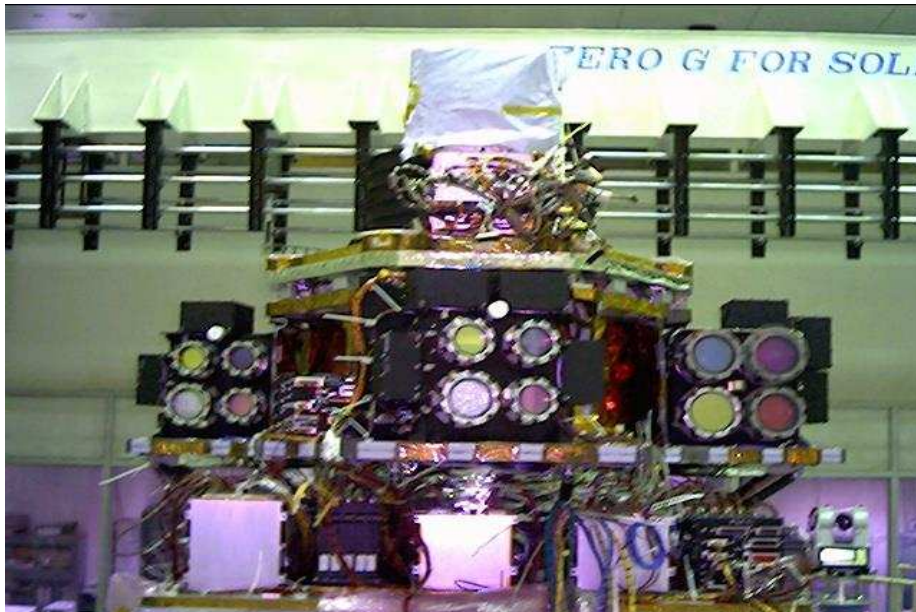
RESOURCESAT-2

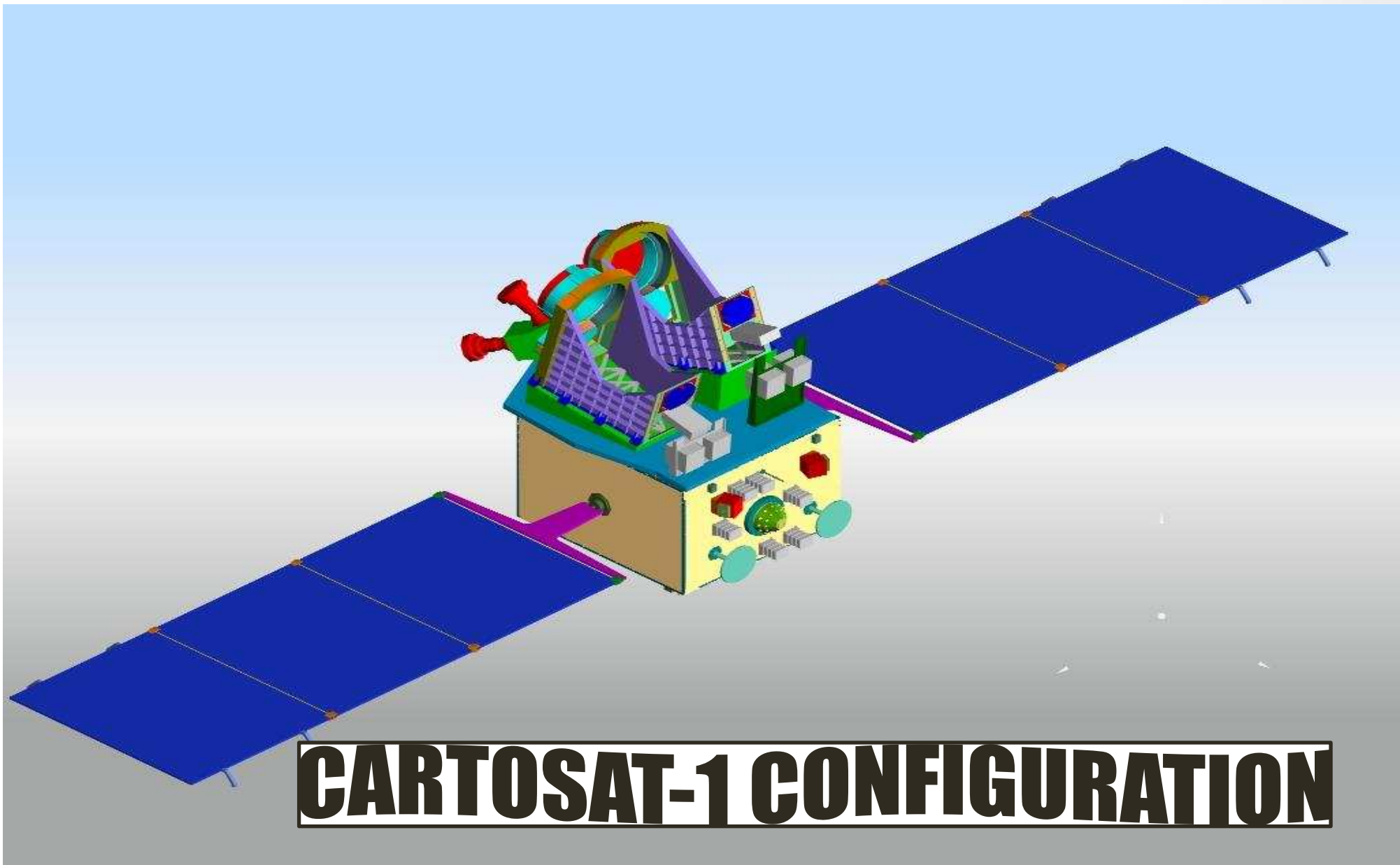


- Mass: 1500 kg.
- Power: 920 watts
- Altitude : 817 km
- Inclination : < 97 deg.
- Vehicle: PSLV-C
- Operational life: 5 years

- Payloads

- LISS-4 Mx camera: 5.8m Resolution and 70 Kms swath
- LISS-3: 23.5m 141 Km Swath
- AWiFS: 56 /70m 740km Swath



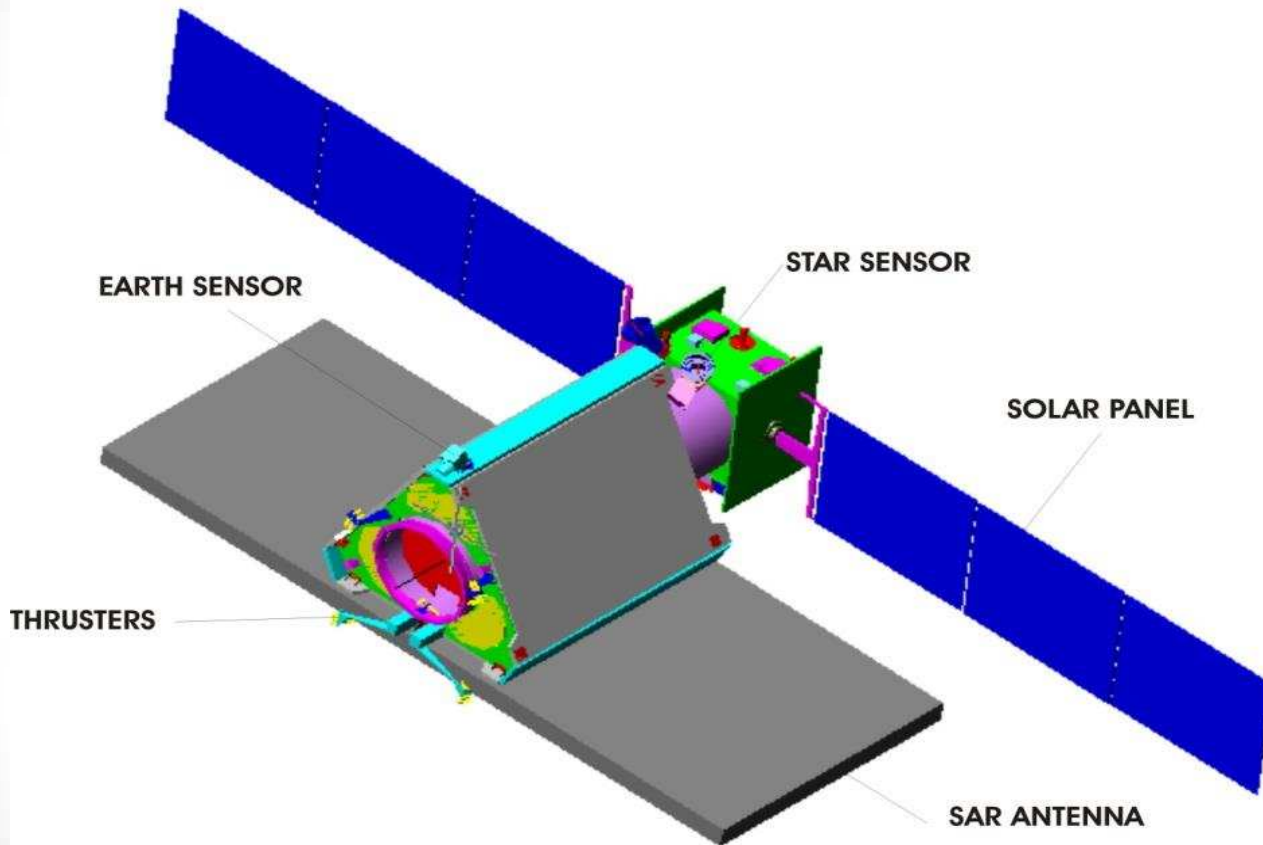


CARTOSAT-1 CONFIGURATION

Stereo camera payload chain

- Two PANCHROMATIC cameras with 2.5m resolution and ~30km swath
- Off axis reflective optics
- 12k CCD- 7x7micron- 8port device
- 10 bit digitization – full dynamic range coverage
- Data Compression, Data Encryption, Data storage, & X band Transmission

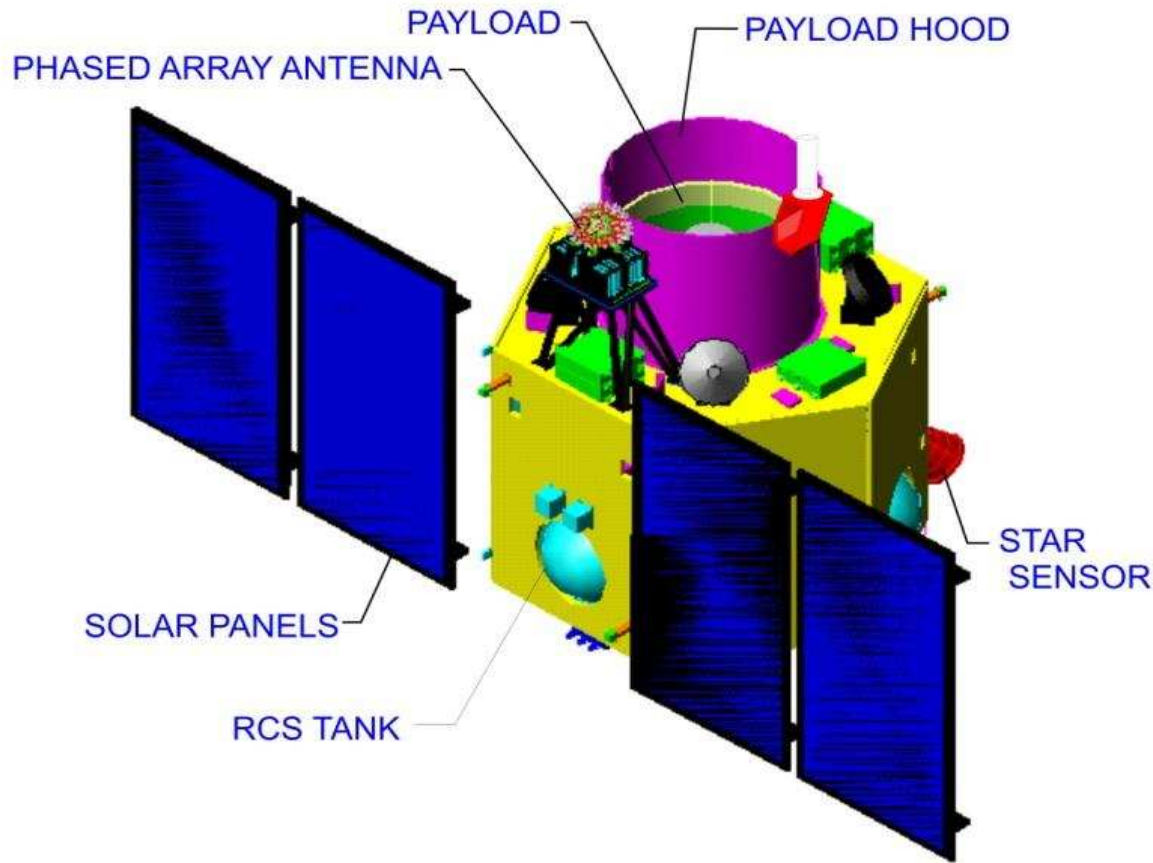
RISAT-1



RISAT DEPLOYED CONFIGURATION (-Ve YAW VIEW)

- **Mass** : 1800 kg.
- **Power** : 4500 watts
- **Altitude** : 586 km
- **Inclination** : < 97.75 deg.
- **Local Time** : 6AM
- **vehicle** : PSLV-XL
- **Launch**: Q1, 2010
- **Operational life**: 5 years

CARTOSAT-2 CONTINUATION



Deployed configuration of Spacecraft

Payloads:

- PAN: 0.6m Resolution,
- 7.2 Km SWATH
- MX: 2.4m Resolution, 30km SWATH
- S/C BUS similar to Carto-2

Remote Sensing Applications in India

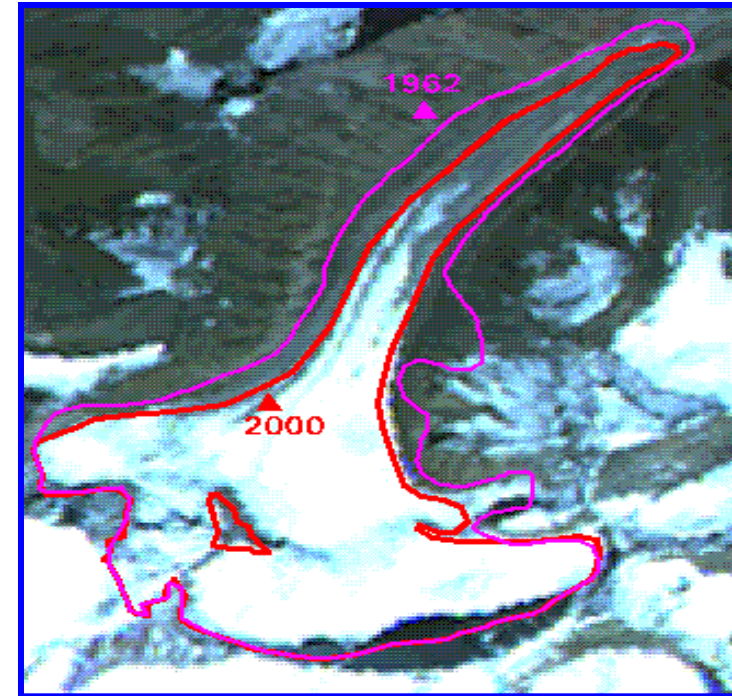
- The major applications include Agricultural crop inventories (in participation with Mahalanobis National Crop Forecasting Centre under the Ministry of Agriculture),
- Agricultural Drought Monitoring, forest fires,
- Landslides, flood mapping and monitoring,
- Gas pipeline monitoring,
- ground water prospects mapping,
- Periodic Land Use/Land Cover mapping, Monitoring of Glaciers, lakes and water bodies
- GI support and operations of Decision Support Centre for disaster management; assessment of irrigation potential;
- Space based Information Support for Decentralized Planning;
- City GIS for infrastructure development in 500 cities (AMRUT); Integrated watershed management program extending over 86000 watersheds; tracking the progress and asset creation monitoring for Mahatma Gandhi National Rural Employment Guarantee Act scheme; maintaining Geospatial database for Emergencies Management ; medium range flood forecast modelling and many others.

Remote sensing advantages (in geology)

- Synoptic coverage and visualisation of earth on a regional basis
- Digital and multi spectral analysis to discern and enhance certain compositional properties of Earth materials
- Capability of combining different types of RS data products (radar, optical, thermal) for deriving additional information and solutions
- Rapid response in disaster response, early warning of hazards and assessments

WATER RESOURCES

- GLACIER INVENTORY, RETREAT
- SNOW MELT RUN-OFF, SNOW PHYSICS
- INVENTORY OF SURFACE WATER BODIES (TANKS, RESERVOIRS)
- SITE SUITABILITY
- PERFORMANCE EVALUATION OF IRRIGATION COMMANDS
- GROUND WATER PROSPECTING/ RECHARGE STRUCTURES



BASPA BASIN, H.P.

GLACIER NO: 11

GLACIER AREA

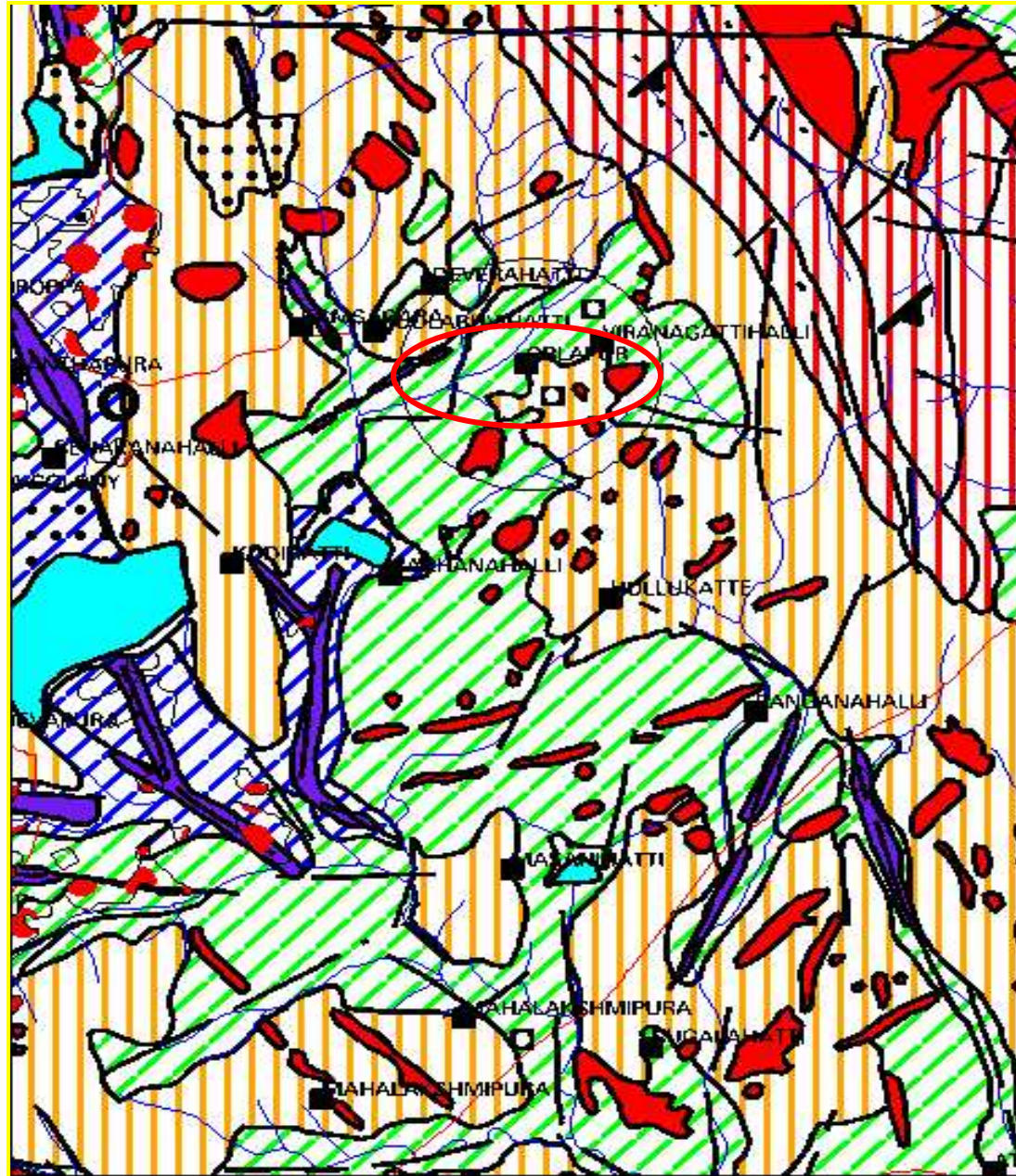
1962: 7.1 sq. km.

2001: 5.0 sq .

LOSS: 2.1 .

RAJIV GANDHI NATIONAL DRINKING WATER MISSION

GROUND WATER PROSPECTS MAP - PARTS OF CHITRADURGA DISTRICT, KARNATAKA



YIELD RANGE	DEPTH RANGE		
	SHALLOW <20 m	MODERATE 20-80 m	DEEP >80 m
EXCELLENT >200 lpm			
GOOD 100-200 lpm			
MODERATE 50-100 lpm			
LIMITED 20-50 lpm			
POOR <20 lpm			
NIL			

PROBLEM
AREA

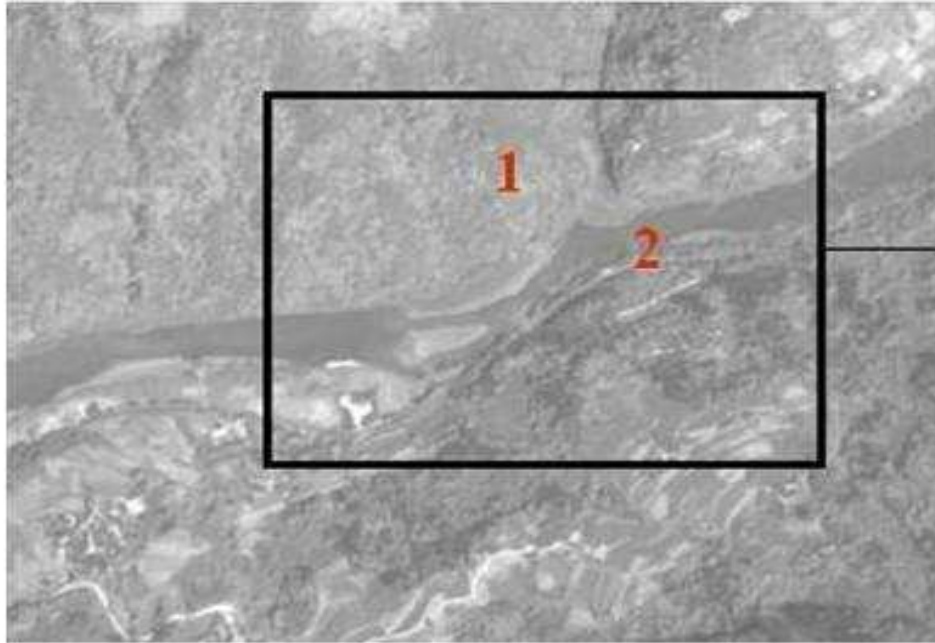
- FRACTURE ZONES
- GROUND WATER IRRIGATED AREA
- FRACTURE/LINEAMENT
- GEOLOGICAL/GEOMORPHOLOGICAL BOUNDARIES
- RUNOFF ZONES
- NC VILLAGE

INFORMATION CONTENT IN THE MAP

- MAP UNIT
- ROCK TYPE & GEOLOGICAL SEQUENCE
- GEOMORPHIC UNIT/LANDFORM
- RECHARGE CONDITIONS
- NATURE OF THE UNIT
- TYPE OF WELLS SUITABLE
- PROBABLE DEPTH RANGE OF WELLS
- EXPECTED YIELD RANGE OF WELLS
- PROBABLE SUCCESS RATE OF WELLS
- REFERENCE NO. OF OBSERVATION WELLS
- GROUND WATER IRRIGATED AREA
- RECHARGE STRUCTURE SUITABLE
- PROBLEMS/LIMITATIONS /REMARKS

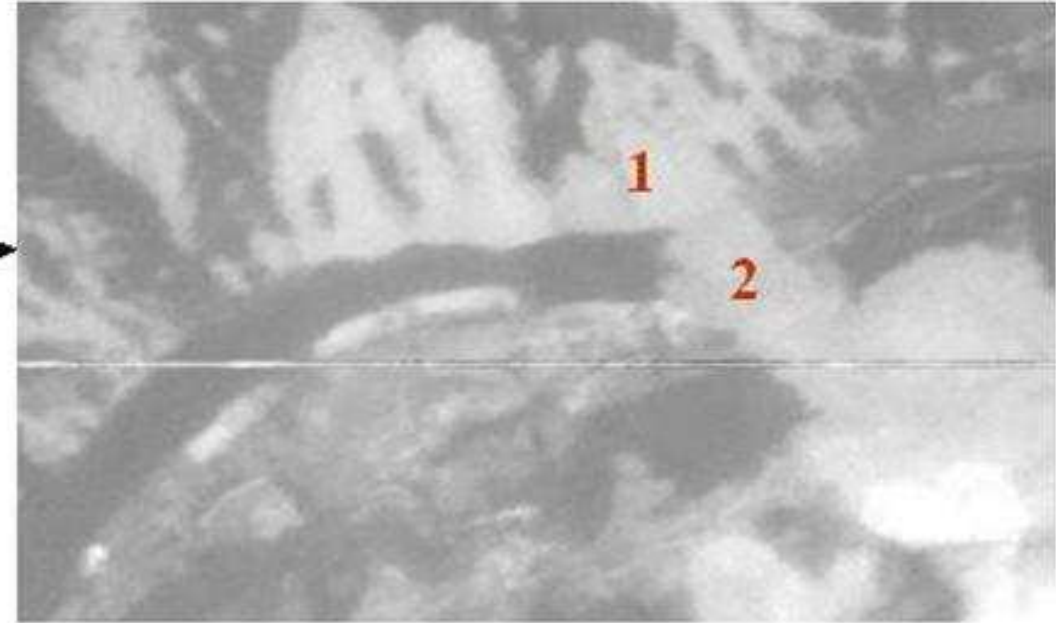
Terrain changes after 12, May, 2008 China Earthquake

Pre earthquake



IRS-P5 CARTOSAT -1
(19, April, 2007)

Post earthquake



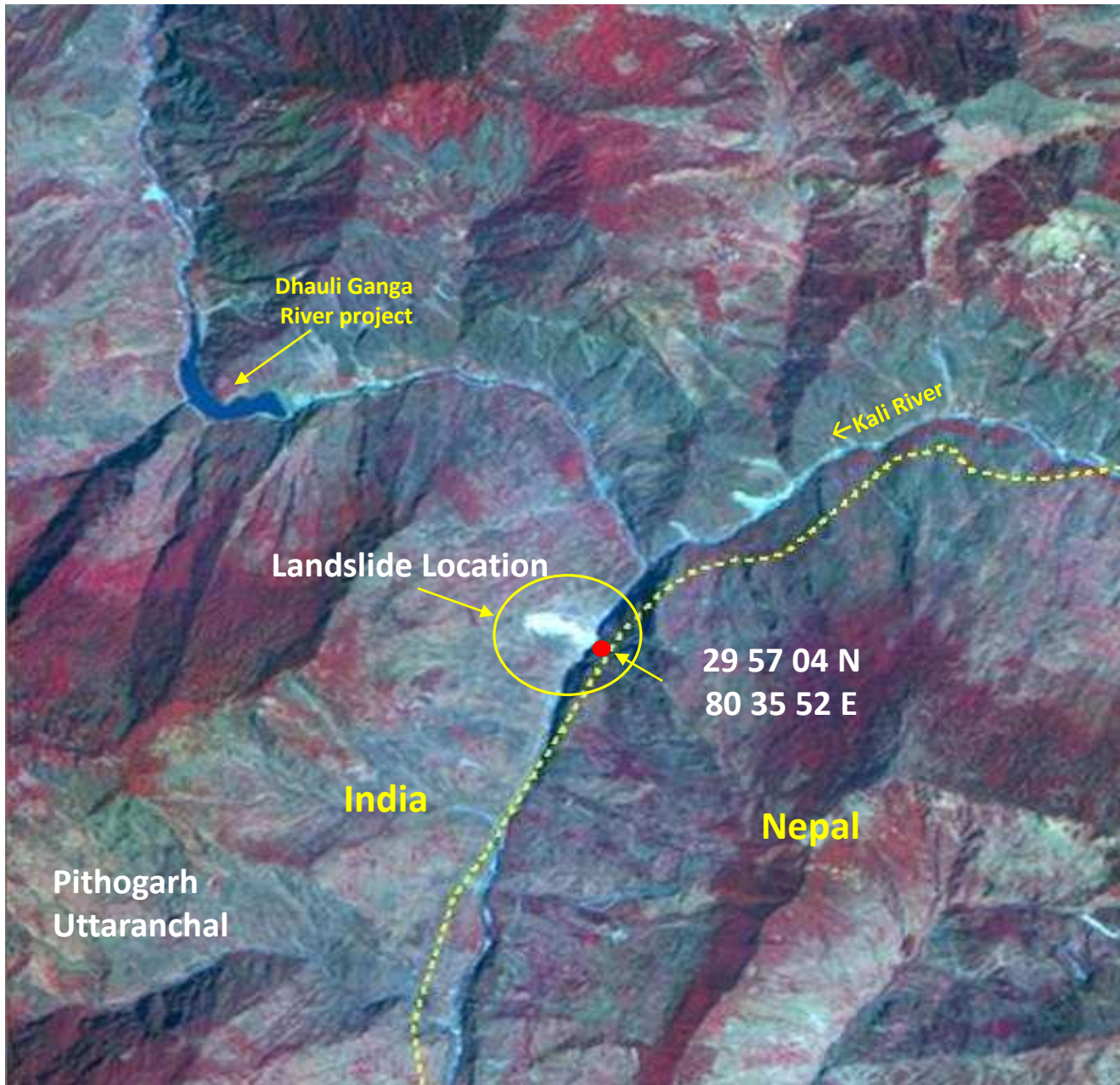
IRS-P6 LISS-IV Mono
(18, May, 2008)

1: Landslide

2. River blocking

Space technology inputs in Landslide Studies

- Identification and mapping of Landslides
- Landslide hazard zonation, through integration of information on lithology, structure, landforms, slope, landuse, drainage and meteorological data
- Damage assessment
- Communication infrastructure in highly vulnerable areas



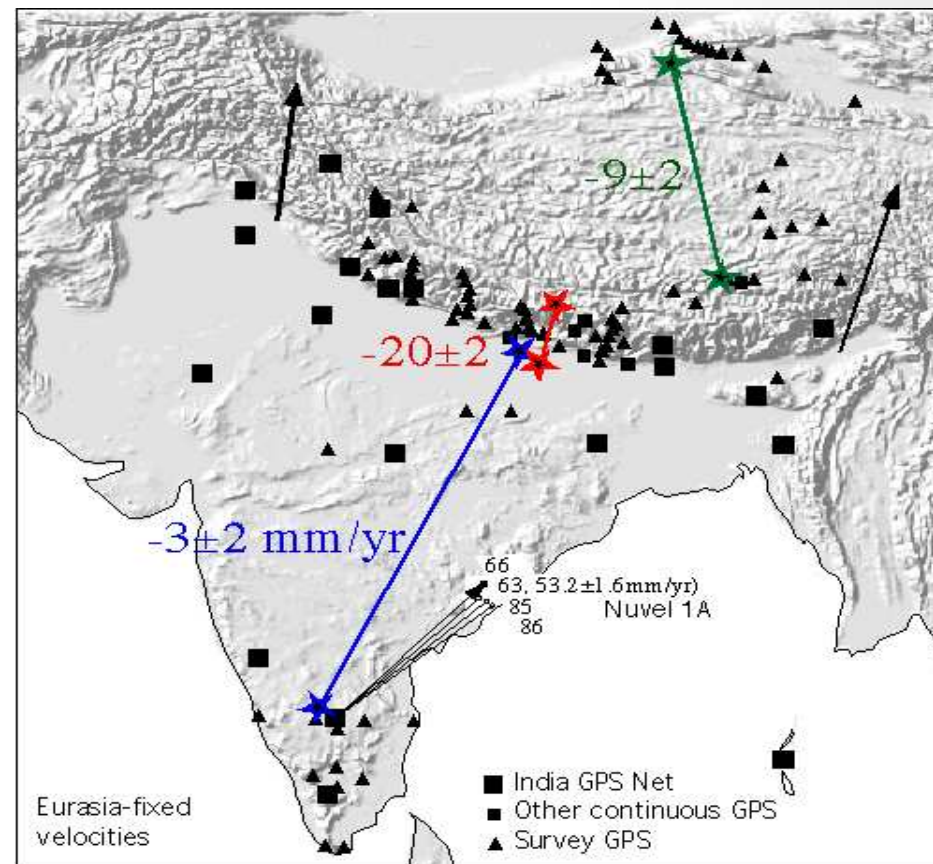
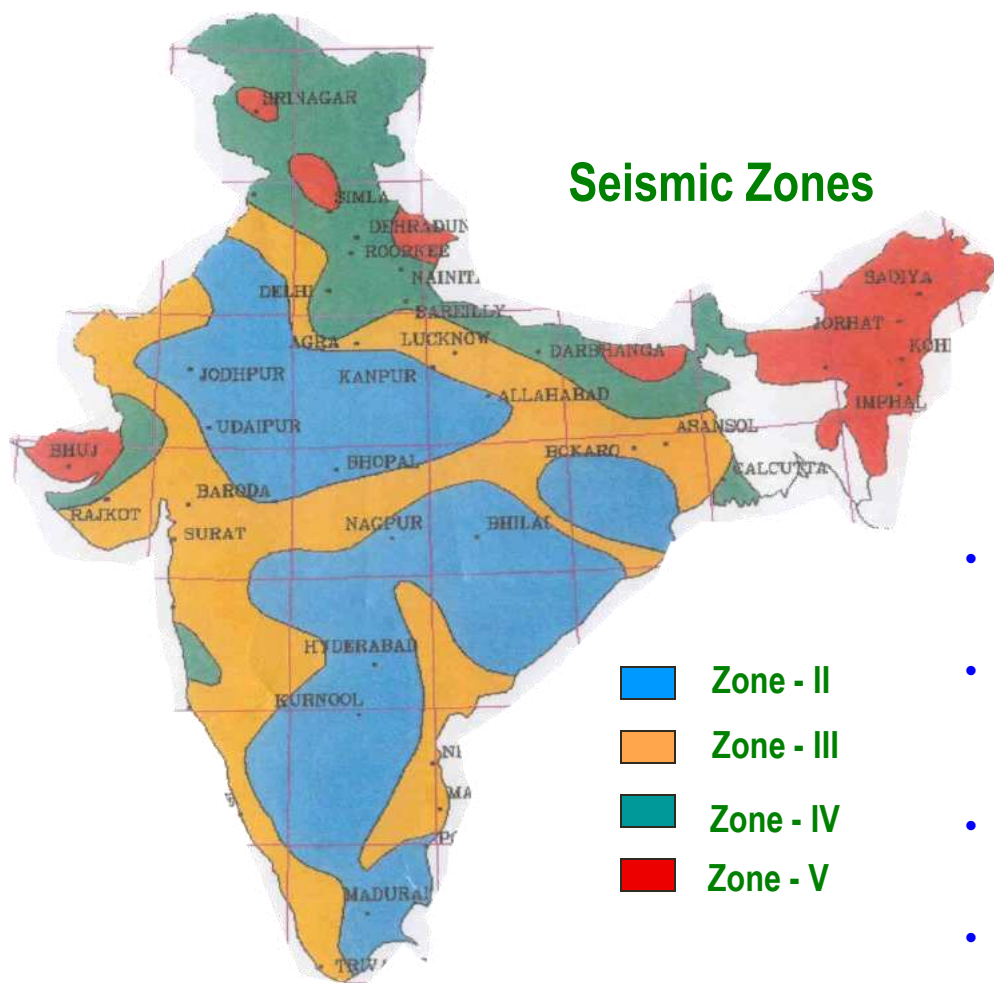
Landslide on Kali River In Pithoragarh District, Uttarakhand

Based on the satellite observations it was discerned, the landslide occurred during 4-15 Feb 2009

IKONOS Image Showing Damage Caused by Bhuj Earthquake

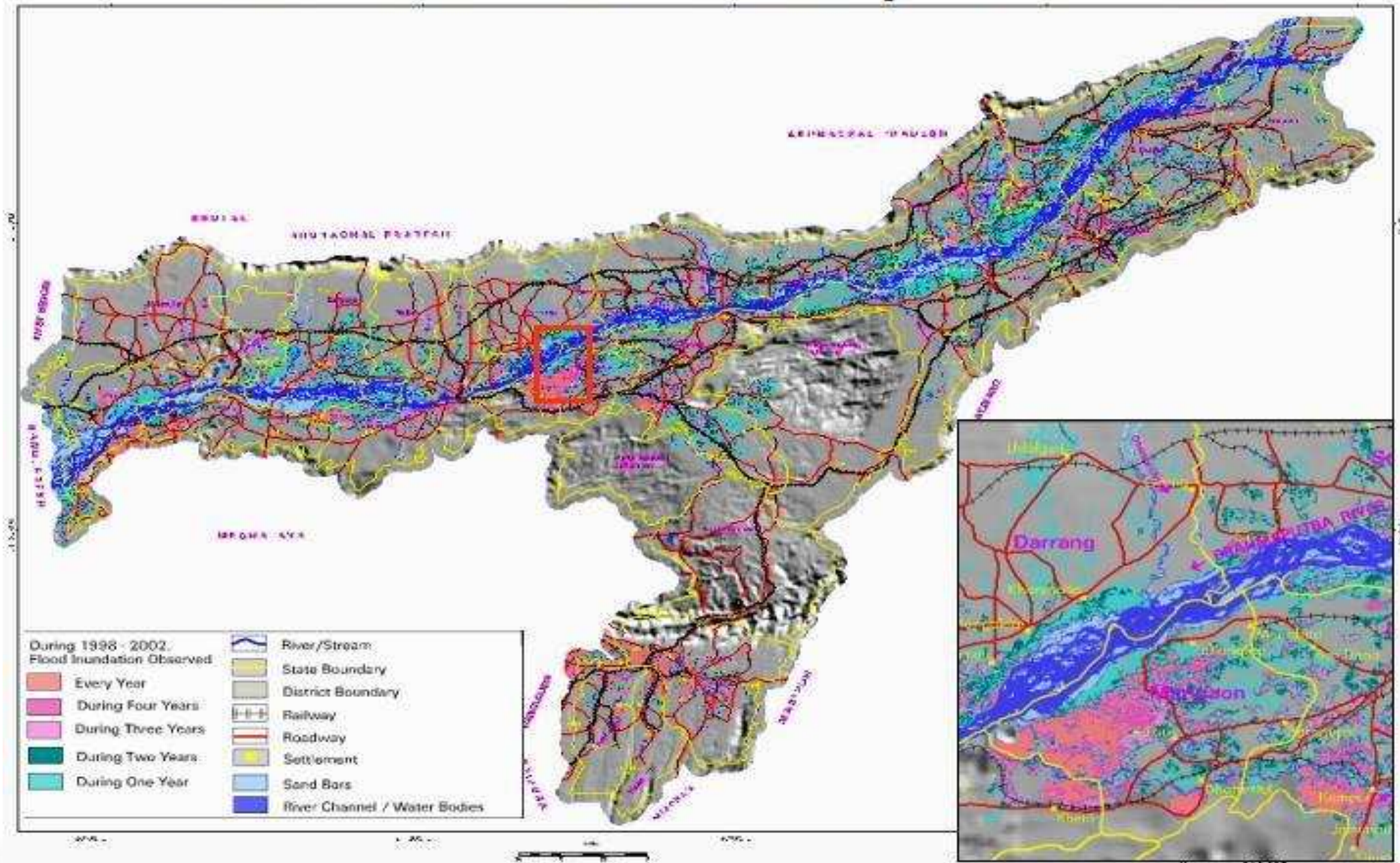


Earthquake Prediction Studies - India



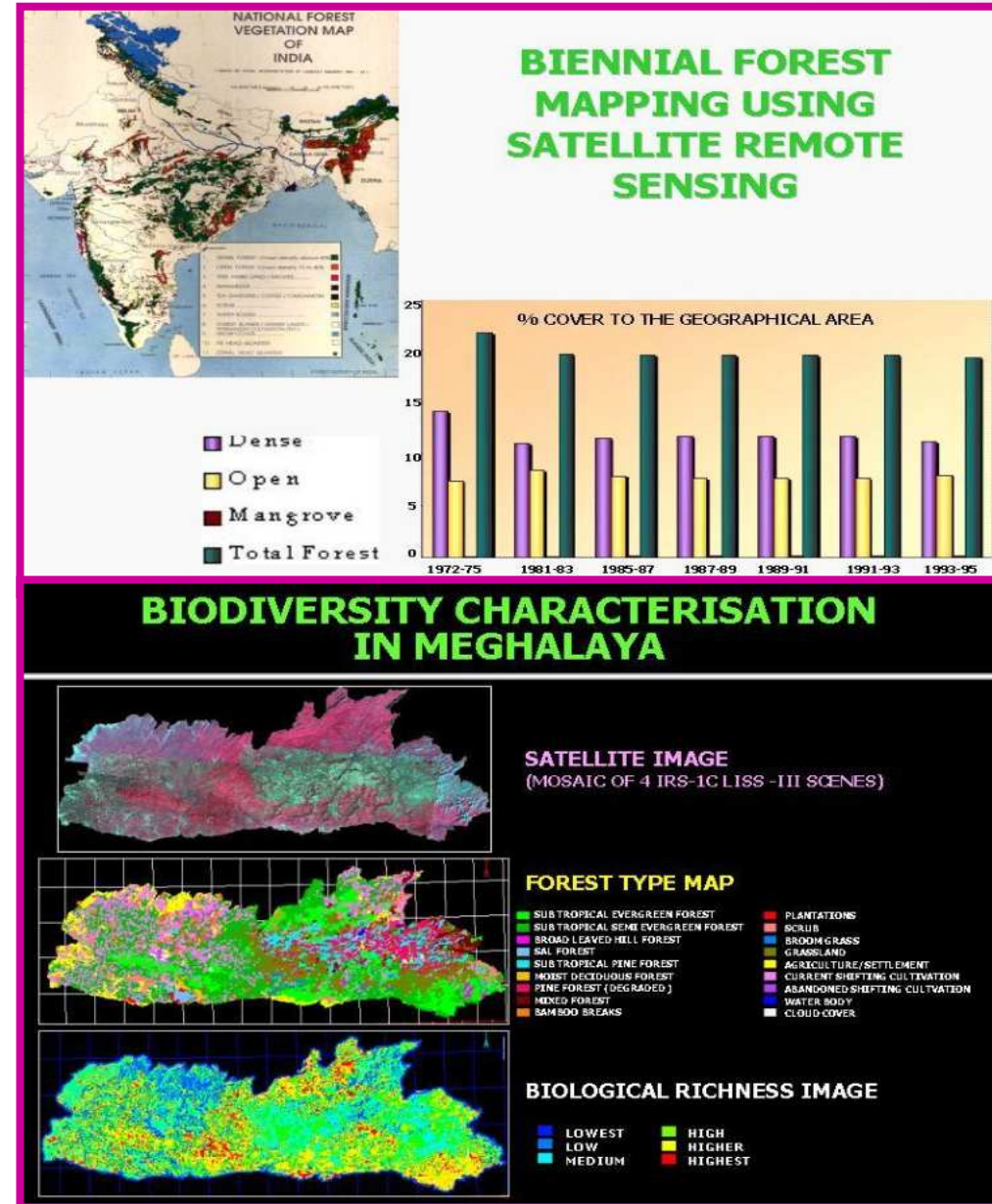
- **Identification of seismically active areas and stress assessment through SLR,SRS,InSAR, GPS**
- **Constant monitoring of deformation/movement along/across plate boundaries/faults using InSAR, GPS, Thermal Data**
- **Study of EMR,ES, Thermal Anomalies, Earthquake Clouds etc. towards prediction/warning**
- **Satellite Missions with payloads to study the above parameters. International Cooperation**

Flood Hazard Zone Map of Assam

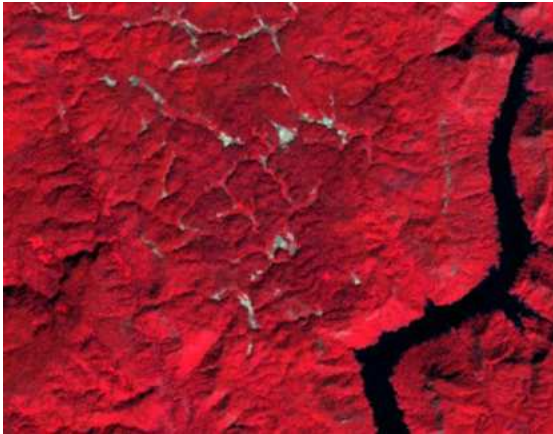


FORESTRY AND ENVIRONMENT

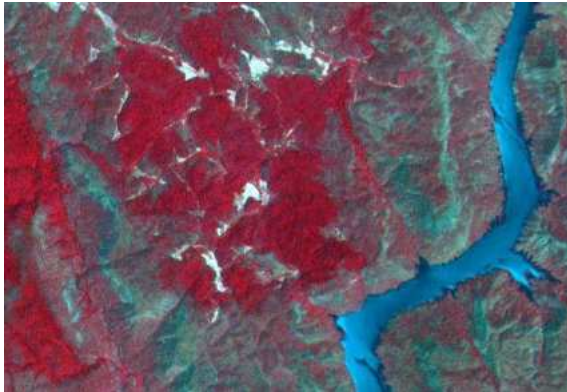
- EXTENT, TYPE AND DENSITY
- MONITORING
AFFORESTATION/
DEFORESTATION
- ENCROACHMENT: JUDICIAL
ACCEPTANCE
- BIODIVERSITY AT LANDSCAPE
LEVEL
- GRASS LANDS
- WETLAND INVENTORY/
CONSERVATION
- ENVIRONMENTAL IMPACT
ASSESSMENT



Differentiation of Evergreen and Moist Deciduous patches in Anshi National Park, North Canara.



December 2001

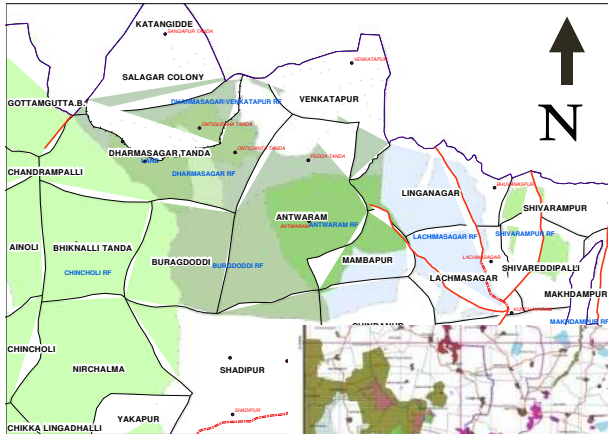


March 2001

Forest Fire Monitoring

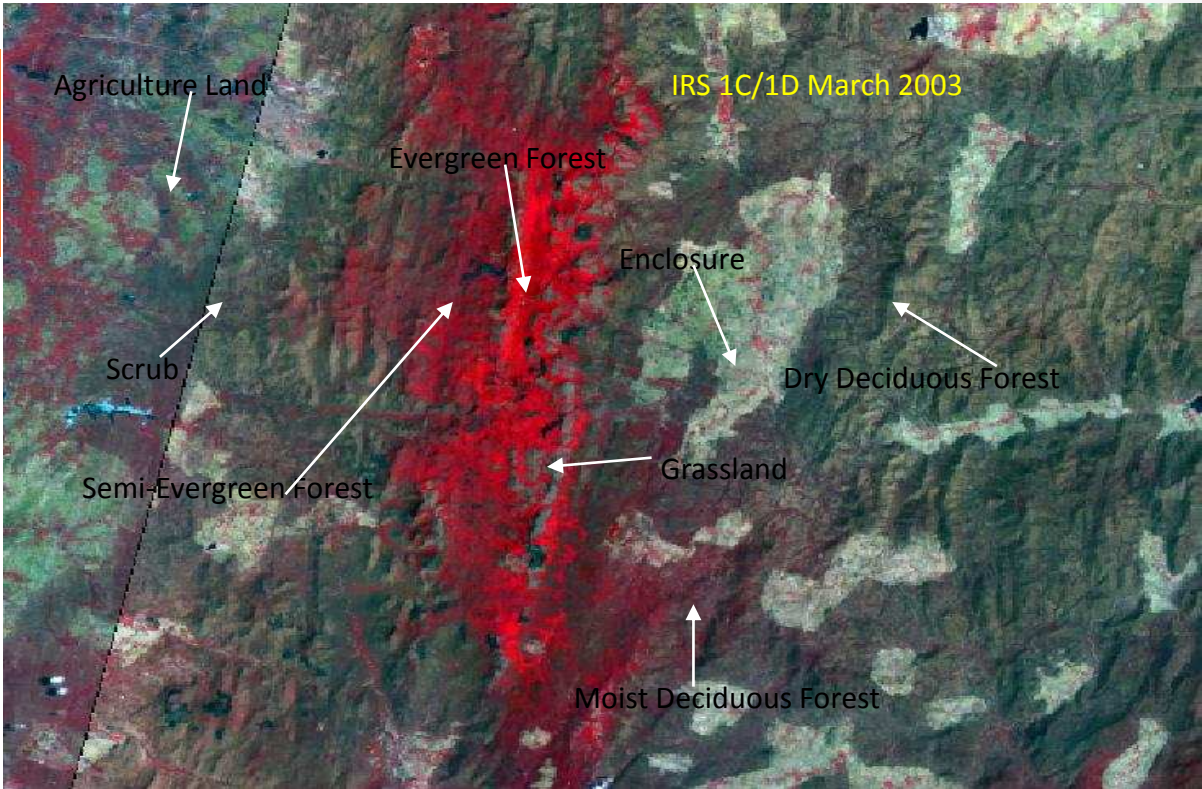
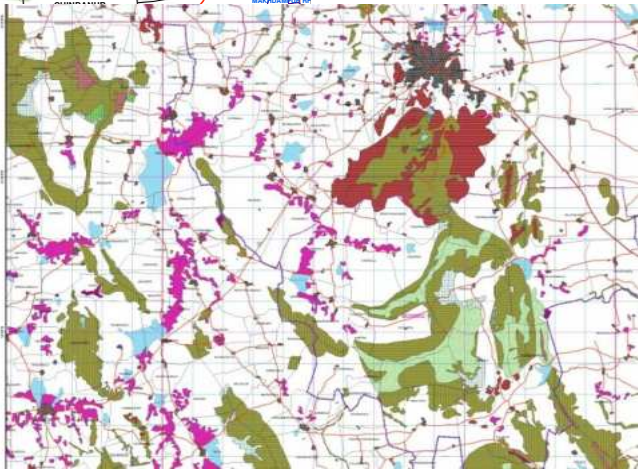


A Typical Forest in Chamraj nagar District (BRT HILLS)



Administrative
Maps

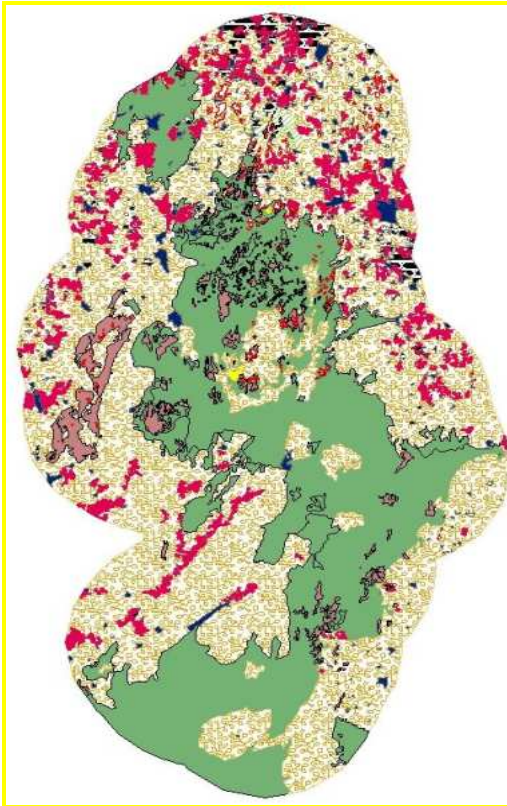
Vegetation
maps



Studies in Wildlife Areas (Vegetation Change Detection)

Bannerghatta National Park

Classified Output of December 2000

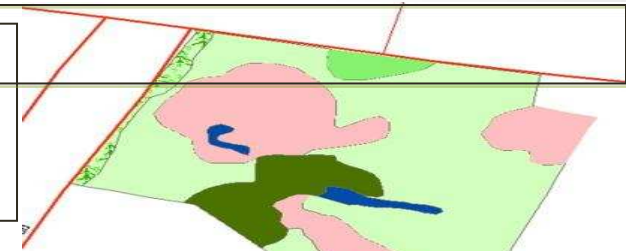


Legend

CLASS

	Agril. Plantation
	Built up land
	Cropland
	Dry Deciduous Forest
	Forest Plantation
	Quarry area
	Scrub Forest
	Stony Waste
	Water Body

GPS Surveyed and RS
Interpreted Map for a
Proposed
Biodiversity Park
In Gulbarga district



Land Use	Area
Nursery	0.90
Barren land	12.80
Botanical Garden	3.40
Road side Plantation	1.09
Scrub	20.83
Water body	0.70
total	39.72 ha

Land use / Land cover

	Nursery
	Barren land
	Botanical Garden
	Road side plantation
	Scrub

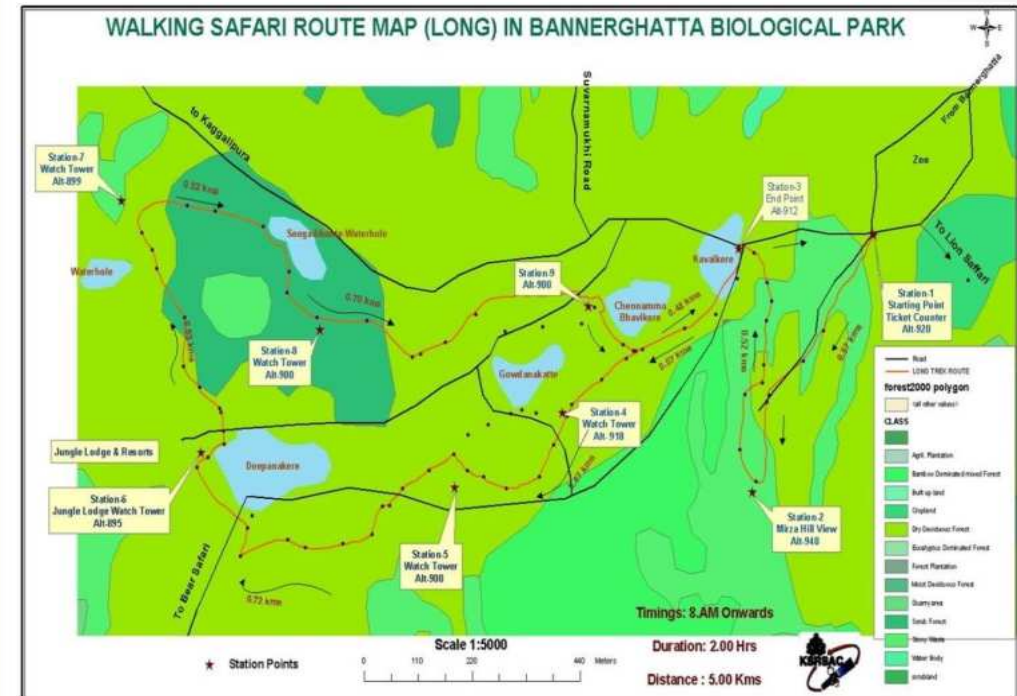
Mapping Trekking Routes

Classified Output of December 2007



Legend

	Agril. Plantation
	Built up land
	Cropland
	Dry Deciduous Forest
	Forest Plantation
	Quarry area
	Scrub Forest
	Stony Waste
	Water Body



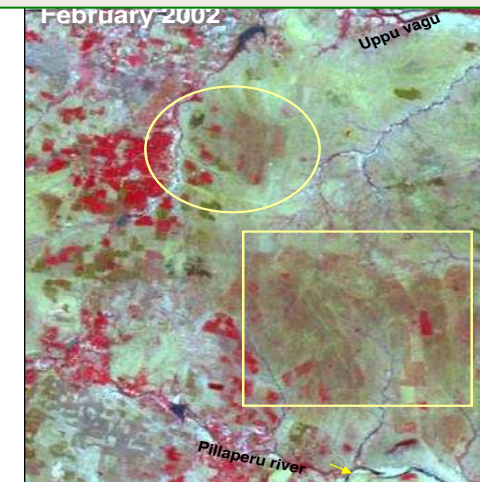
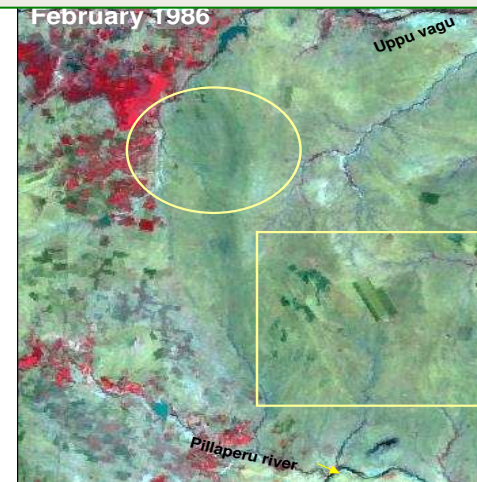
Wasteland Inventory & Monitoring

National Wastelands Monitoring Project on 1:50,000 scale

- National Wasteland Inventory Project (1986 - 2000)
- National Wasteland Updation Mission (2003 - 2004)
- Monitoring of the wasteland areas (2005-06)
- Wasteland Change Analysis - using three season LISS-III data of 2008-2009



Atlas on 'Wastelands of India'.

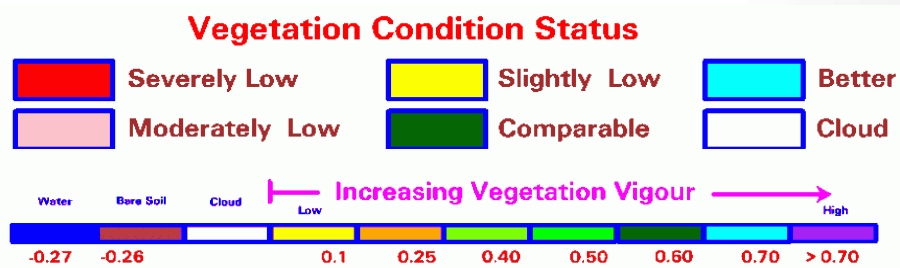
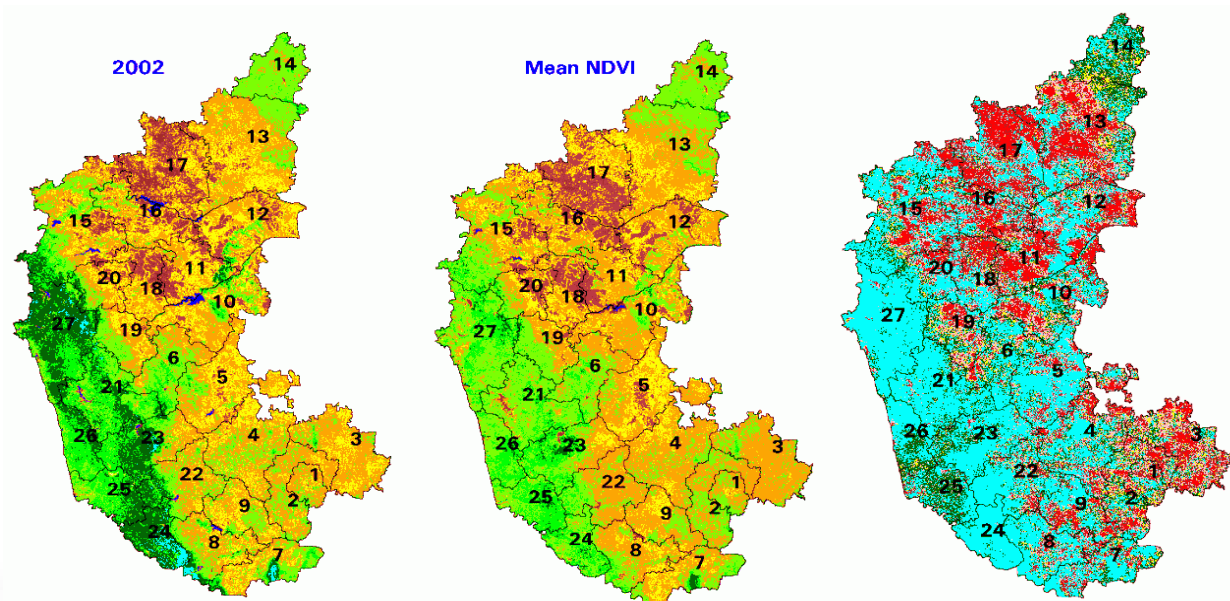
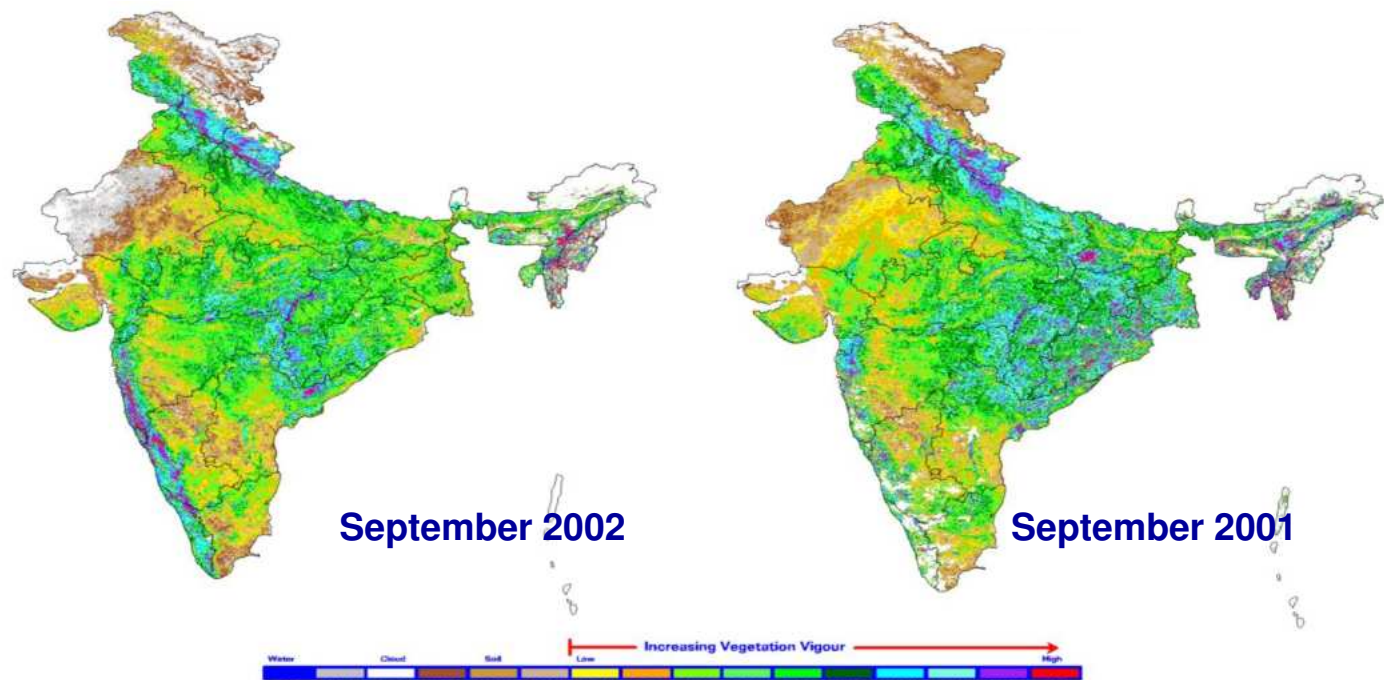


Change in the total wasteland area of the country during 2005-06 and 2008-09

No Change in area (M Ha) in wasteland class(NC)	Change in area (M Ha) from one wasteland class in 2005-06 to another wasteland class in 2008-09 (CC)	Change in area (M Ha) from wasteland class in 2005-06 to non-wasteland class in 2008-09 (+ change)	Change in area (M Ha) from non-wasteland class in 2005-06 to wasteland in 2008-09 (- change)	Net Change in wasteland area (M Ha)
39.60	4.38	3.23 (at 1,12,057 locations)	2.70 (at 42,886 locations)	0.52

Area (Mha)	% of TGA	Year of Data
63.85	20.17%	1986 -2000
55.27	17.45%	2003
47.22	14.91%	2005
46.73	14.76%	2009

Drought Monitoring



Participatory Watershed Development



Ocean Colour Applications

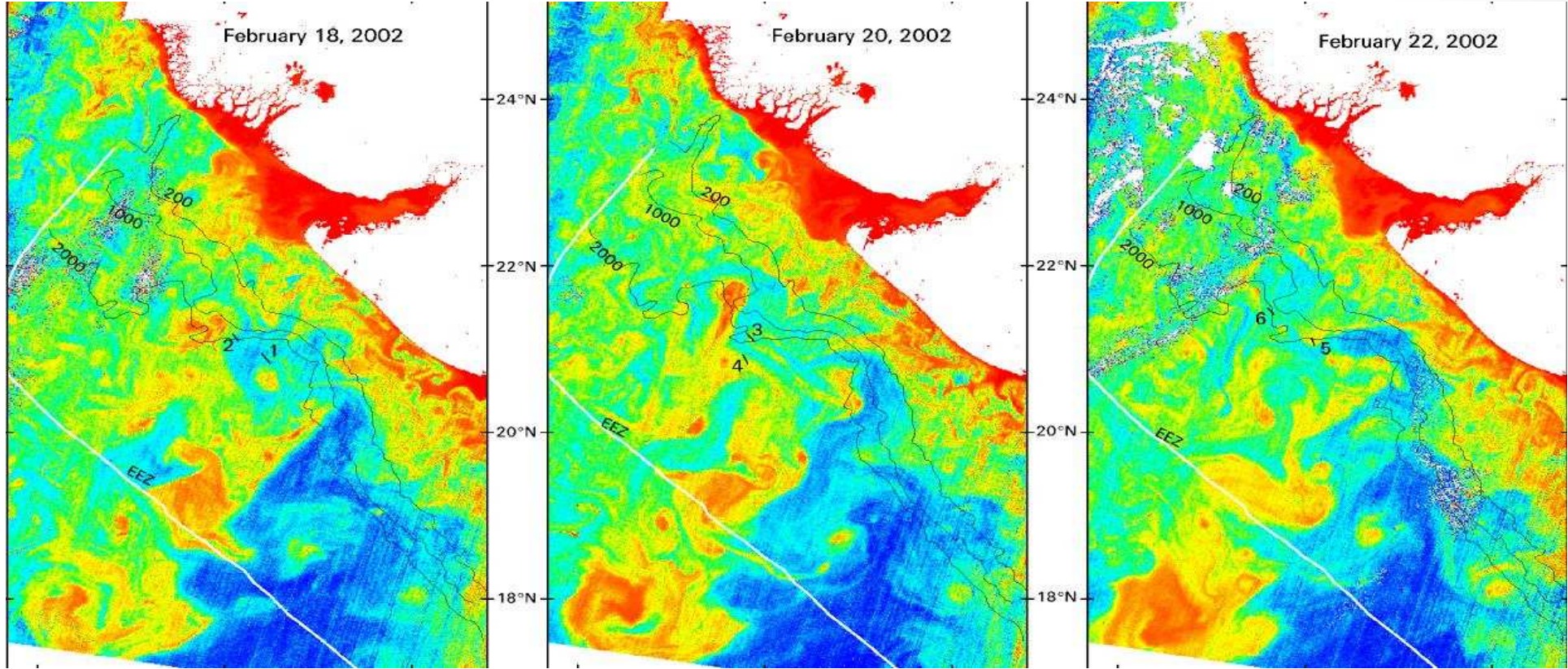
- Potential Fishing Zone Forecast
- Primary Productivity
- Coastal Processes
- Algal bloom detection

MSMR APPLICATIONS

- Sea Surface Winds
- Sea Surface Temperature
- Ocean Circulation
- Onset of Monsoon
- Wave Height
- Soil Moisture
- Antarctic Sea Ice

FISHERY PROSPECT CHARTS

Marine Fishery - Feedback from FSI

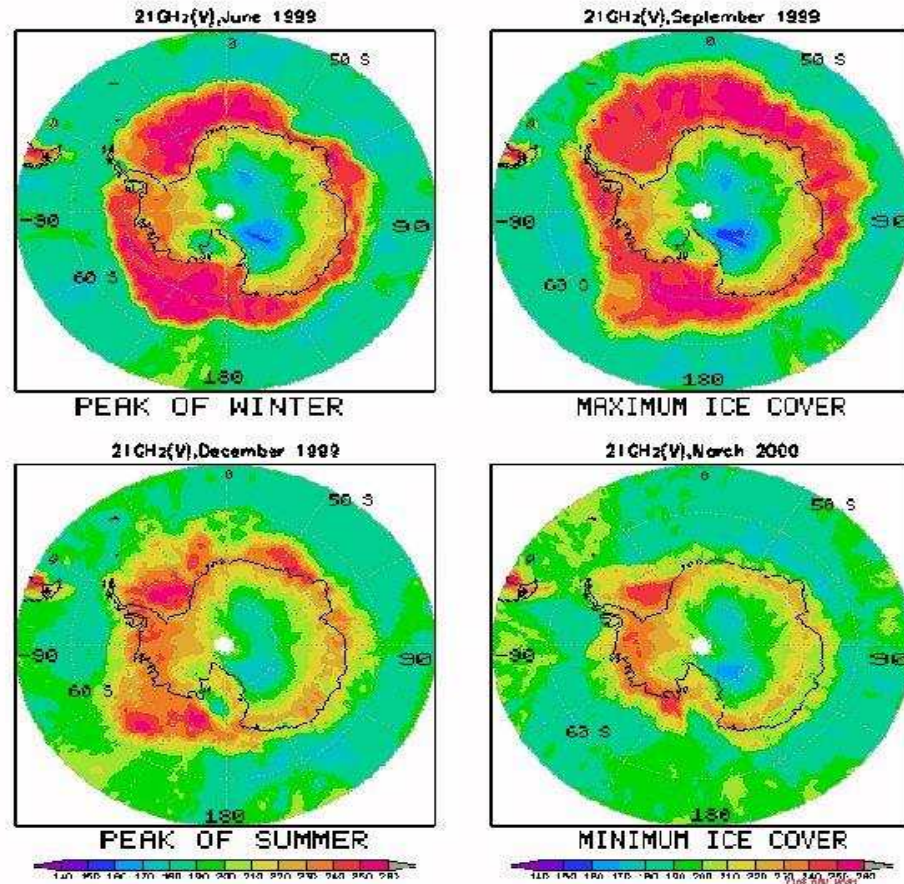


Track No.	Depth(m)	HR (%)	Date	species
1	2589	3.8	18-02-02	Thunus albacore
2	1701	1.9	19-02-02	Thunus albacore, Yel
3	1876	1.0	20-02-02	Thunus albacore
4	2727	1.2	21-02-02	Thunus albacore, S
5	1791	2.1	22-02-02	Thunus albacore, Ye
6	1860	1.9	23-02-02	Thunus albacore, Yellow

Average HR before bloom : 0.2 %

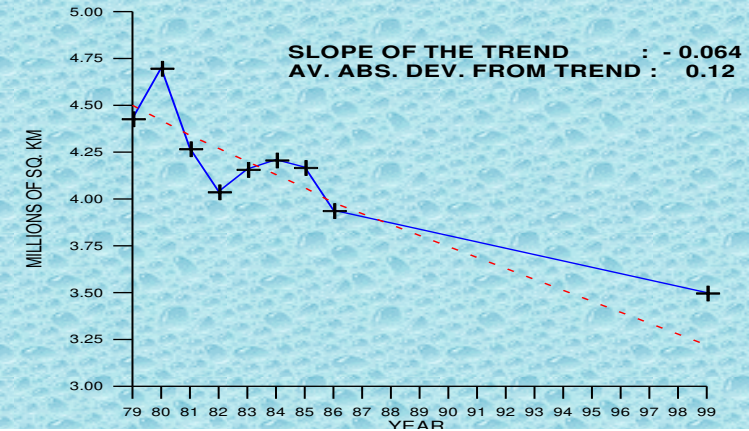
SEA ICE FROM MSMR

BRIGHTNESS TEMPERATURE MAPS OVER ANTARCTICA
FROM 1ST YEAR OF MSMR OPERATIONS
(AT QUARTERLY INTERVAL)



Annual Average Sea Ice Extents For Weddel Sea

(For 1979-86 from SMMR and for 1999 from MSMR)



HIGHLIGHTS OF MSMR APPLICATIONS IN THE FIRST YEAR

ANTARCTIC SEA ICE COVER

Seasonal changes of ice cover in Antarctica monitored.

Secular **change in Weddel Sea ice** extent in 2000 found - bearing on Climate.

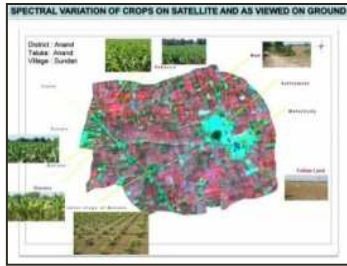
GIS Is Very Valuable to Government



Improving Planning, Management and Decision Making . . .

. . . Providing Critical Infrastructure

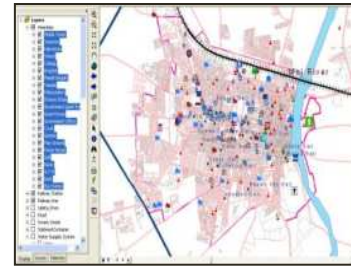
Major GIS Applications- Gujarat example



Agricultural GIS



Canal GIS



Municipal GIS



Water supply GIS



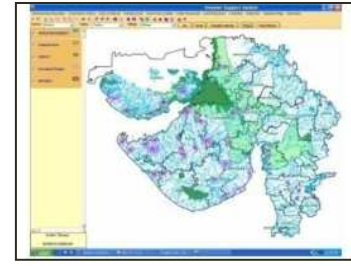
Panchayat GIS



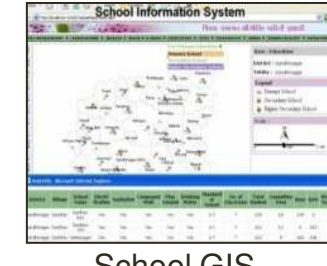
Coastal GIS



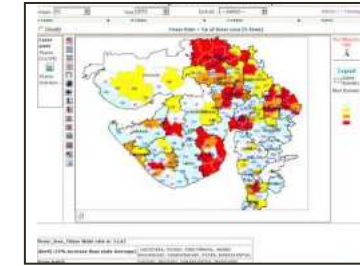
MGNREGA GIS



Investor Support System



School GIS



Health GIS



Irrigation GIS



Road GIS



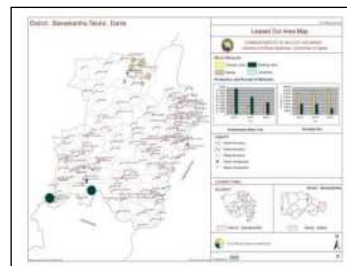
Watershed GIS



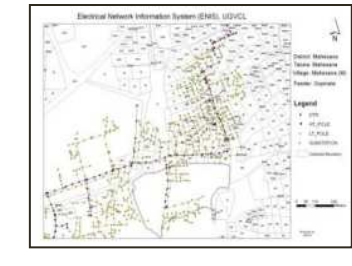
Horticultural GIS



Environmental GIS



Mineral GIS



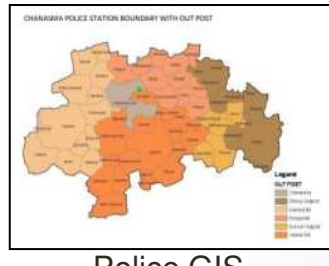
Electricity GIS



Forest GIS



Industrial GIS



Police GIS

India's GIS Industry

- GIS is being **used in many sectors** in India already including agriculture, forestry and environment, urban development, telecommunications, oil & gas, security, infrastructure, land information etc.
- The major segments of GIS industry are hardware, software, data and services. **Leading international companies have presence in India in the hardware and software segments.** A large number of Indian companies including a few Indian IT services companies operate in the services segment.
- International companies based in India provide geospatial data and software development **services for international organizations**, primarily in North America and Western Europe .

- What will drive the future growth of GI services?
 - New technology areas like cloud, new generations of analytics, AI/Machine Learning, IoT, Virtual Reality and mobile communication developments.
 - More knowledge based applications like modelling,
 - auto change detection and triggering corrective actions, assets management,
 - work flow and business process improvement,
 - analytics applications in forecasting, management of large complex systems, and,
 - a host of customized applications at business enterprise level.
- Increasing needs from government as well as markets in the setting of an economically growing resurgent India presents a unique opportunity over the next one to two decades. Policy renewals to create an environment for burgeoning growth of services and capacity building is a priority that needs urgent attention to utilize the full potentials of this opportunity

Indian EO – Way Forward

- ❑ Imaging from geostationary orbit at a resolution of 50 m (new fleet)
- ❑ Third generation Resourcesat systems - vastly improving coverage /revisit
 - Wide-swath 10m and 20m imaging, revisit once in two days, and, 5 Multispectral Bands
 - Thermal imaging and hyper-spectral imaging
- ❑ Microwave imaging capability in C ,L & S bands and even in P-bands.
- ❑ Higher resolutions (beyond 0.8m -1m), constellation approach for frequent revisits (better than a day) and delivery of the products within a few hours.
- ❑ 1.25m stereo mission –improving the DEM coverage
- ❑ Ocean and atmospheric observational satellites ensuring continuity of user services.
 - (8 bands data at 360m and sea surface height daily coverage; densification of wind vectors [6hr], millimetre wave sounder and EO Missions with LIDAR based wind profiler & a precipitation radar etc.
- ❑ Small satellite constellation for higher cadence

Legal & regulatory Aspects

REMOTE SENSING & GIS LAWS

INDIAN REMOTE SENSING POLICY

- Remote Sensing Data Policy was initially introduced in 2001 and was updated in 2011.
- Developments in the global environment were so rapid that policy renewals have become necessary to keep pace with them.
- The Draft Space Based Remote Sensing Policy of India (SpaceRS Policy -2020) released for public consultation in November 2020,
- 2020 Policy states the intent of the Government of India to promote the role of Indian Industries to carry out space based remote sensing activities within and outside India;
- Enable easy access to space based remote sensing data, except for “sensitive data and information”;
- Provide a timely and responsive regulatory environment for the commercial Indian industry to establish and operate space based remote sensing systems and so on.
- While there is significant relaxation on the restricted access for ‘sensitive data’, which is now defined as ‘very high-resolution data having ground sampling distance of better than fifty centimetres’, it still falls short of the limit set by countries like the USA for commercial distribution of images.
- Possibly, all very high-resolution data need not be sensitive though all sensitive data could come under very high-resolution data as a sub set.
- Hence the criterion for sensitive data could be more refined to mitigate competitive disadvantage for Indian industry.
- Further the guidelines are to be extended to cover different modes of commercial arrangements in a global context since in the current environment, it is highly likely that new start-ups in private sector can look for sustenance based on domestic and overseas markets.

https://www.isro.gov.in/sites/default/files/spacers_policy_ngp_2020_draft.pdf

Space Remote Sensing Policy - 2020 Policy Goals

- The Policy states that Government of India shall:
 1. promote Indian Industries to carry out space based remote sensing activities within and outside India.
 2. enable easy access to space based remote sensing data, except for “sensitive data and information”.
 3. concentrate on realisation of space based remote sensing systems to cater to the country’s needs, that cannot be effectively, affordably and reliably satisfied by the commercial entities, either due to national security concerns or economic factors.
 4. provide a timely and responsive regulatory environment for the commercial Indian industry to establish and operate space based remote sensing systems.

Norms, Guidelines and Procedures for Implementation of Space RS Policy - 2020

• 1.Preamble .	1
• 2. SpaceRS Policy - 2020 Norms	2
• 3. Participation of Indian entities in Space based Remote Sensing activities	5
• 4. Authorizations for Space based Remote Sensing	5
• 4.1 Establishment of space asset, owned by an Indian entity, for remote sensing data collection	6
• 4.2. Establishment of ground station within India for monitoring and control of remote sensing satellite and/or data reception	7
• 4.3. Registrations/authorisation of space asset for dissemination of remote sensing data over Indian territory	7
• 4.4 Dissemination of sensitive remote sensing data/services of Indian territory emanating from the space asset	7
• 5. Realization of space based remote sensing systems for societal applications, strategic purpose and research & development	8
• 6. Promotion of usage of space based remote sensing systems	9
• 7. Provision of timely and responsive regulatory environment	10

Promoting RS industry

- **2.1 Promoting Indian Industries to carry out space based remote sensing activities within and outside India.**
- Demand and supply driven.
- Government to promote increased participation of Indian Industries to provide end-to-end space based remote sensing services
- Respect for international Law (UN treaties)
- Realisation of any space asset by an Indian entity, will be permitted through a process of authorization.

Access to data

- **2.2 Enabling easy access of satellite based remote sensing data.**
- Easy dissemination of data and services
- A simple process of registration/authorization of space asset
- Due to national security considerations,' a different mechanism for dissemination of sensitive data.
- Government shall reserve the right to impose/control on the imaging/observation and its data distribution, when national security and/or international obligations and/or foreign policies of the Government, so requires.

Government role for infrastructure and technologies

- **2.3 Concentrate on realisation of space based remote sensing systems to cater to the country's needs that cannot be effectively, affordably and reliably satisfied by the commercial entities, either due to national security concerns or economic factors.**
- For sustainable development initiatives, providing continuity of services, for newer technologies and R&D, remote sensing systems by the Government and shall be pursued by DOS.
- In view of sensitivities involved for strategic observations, the systems that need to be developed with indigenous designs will be under the direct control of Government and shall be pursued by DOS.

Enabling regulatory mechanism

- **2.4 Provision of timely and responsive regulatory environment for the commercial Indian industry to establish and operate space based remote sensing systems.**
- Participation of private entrepreneurs through an enabling regulatory mechanism.
- Space based remote sensing activities shall be authorized by the autonomous body under Department of Space (DOS).
- DOS shall bring out policy guidelines and further regulations, time to time, as necessary and appropriate.

Indian entities in Space based Remote Sensing

- **3. Participation of Indian entities in Space based Remote Sensing activities**
- Indian entities can establish and operate satellite remote sensing systems to provide remote sensing data.
- NGPEs can also undertake design, development and realization of satellites and associated remote sensing systems.
- They can establish satellite system through their own built satellite or procured satellite.
- They can establish Telemetry, Tracking & Command (TT&C) and Satellite data reception stations in or outside India.
- They can offer the capacity to commercial and societal applications within India as well as outside India.
- They can also supply their systems and solutions to international markets.
- Indian entities can avail state-of-the-art facilities of the Government for manufacturing satellite and associated ground segment.
- It can be availed from designated PSU/CPSE under DOS on commercial terms, subject to availability.

4. Authorizations for space based remote sensing

- **Space asset** owned by Indian entity shall **need authorisation**. The remote sensing activities within the Indian territory can be carried out, only with an authorized space asset.
- Any NGPE, intending to set up the **ground station** for satellite data reception, facilities for satellite tracking, controlling and monitoring, within Indian territory, shall **need authorization**.
- A **simple process of registering/authorizing** such space assets is enabled. However, considering the requirements of national security, **a different mechanism** for authorizing the dissemination of **sensitive data** is envisaged.
- Accordingly, following authorizations are spelt out, which need to be obtained from **INSPACe**.

4.1 Establishment of space asset, owned by an Indian entity, for remote sensing data collection

- Indian entities can seek authorisation to establish space asset for remote sensing by providing information on the spacecraft, such as, payload details, spectral bands, orbital parameters, coverage area, etc.
- The NGPEs which owns and operates a space asset for remote sensing shall be liable for any potential damages caused to other space objects in outer space and its environment. This obligation shall be fulfilled by the entity by providing a financial guarantee or insurance cover to a sum, as determined by the authorizing body by taking into account the risks involved in nature and operations of that space object in outer space.
 - a) a prescribed format for authorization, by providing relevant information.
 - b) the financial guarantee or insurance cover by the Indian Entity
 - c) The authorization shall be applicable to a specific Indian Entity
 - d) The authorization shall be applicable to a specific space asset
 - e) Government may impose control on operations of space assets, in case of the national security and/or international obligation and/or foreign policy requires so.

4.2 Establishing ground station within India for monitoring and control of remote sensing satellite and/or data reception.

- Indian entities can seek **authorisation for setting up of ground station** within India for monitoring and control of remote sensing satellite and/or reception of remote sensing data.
- a) An Indian Entity shall submit the proposal in **a prescribed format** for authorization for establishment and operations in Indian territory:
 - i. Telemetry, Tracking and Command (TT&C) station(s)
 - ii. Satellite Data Reception station(s)
- b) The authorization shall be applicable **to a specific Indian Entity**. Any change in ownership requires a fresh authorization.
- c) The authorization shall be **applicable to specific facility** for monitoring and control of specific space asset and/or data reception from specific space asset. Any change in these requires a fresh authorization.

4.3 Registration/authorization of space asset for dissemination of remote sensing data over India

- Remote sensing data over Indian territory shall be made easily accessible to users by Indian entity as long as the source of remote sensing data is originating from a registered/authorized space asset and the remote sensing data is not 'sensitive'.
 - Any service provider shall submit the proposal in a prescribed format (Annexure-C) for registering the space asset, used for acquiring remote sensing data over Indian territory.
 - Such remote sensing data will have ground sampling distance coarser than fifty centimeter (non-sensitive).
 - The registration/authorization shall be applicable to a specific space asset. Any change or replacement of the asset requires a fresh registration/authorization.

4.4 Dissemination of sensitive remote sensing data/services of Indian territory emanating from the space asset.

- Data having Ground Sampling Distance (GSD) less than fifty centimeter will be treated as 'sensitive' and requires specific authorization for dissemination.
- the proposal in a prescribed format for authorization of dissemination of sensitive data of the Indian territory to any user in India.
- The authorization shall be applicable to a specific space asset and any change or replacement of the asset requires a fresh authorization.
- The authorization shall be applicable to a specific entity and any change of ownership requires a fresh authorization.
- Additional authorization is required for disseminating the sensitive data of certain areas following a procedure laid down by the Government.
- Government may impose control on the imaging/observations and data distribution, in case of the national security and/or international obligation and/or foreign policy considerations.

5. Realization of space based remote sensing systems for societal applications, strategic purpose and research & development

- The **emphasis on research and development** shall continue to be under DOS in the areas of (i) implementation of societal programmes aimed at national development, (ii) development of satellites for strategic applications, and (iii) remote sensing satellite technologies including technology demonstration.
- 5.1 DOS shall build, operate and maintain, continuous & improved observing/ imaging capability from its own Indian Remote Sensing Satellites (IRS) programme, in order to fulfill the national commitment and as a **“public good service”**, such space based remote sensing systems shall be realised by DOS, due to reasons of economic viability or sustainability.
- 5.2 Remote sensing **systems with newer technologies**, for carrying out innovative experiments and technology demonstrations, shall be undertaken by DOS.
- 5.3 The satellite **systems for strategic sector** shall be realized using indigenous designs, systems and infrastructure providing the capabilities of secured environment by DOS.
- 5.4 In order to meet the requirements of **national imperatives and priorities of Government**, DOS shall continue to **undertake remote sensing applications** including research and development of algorithms/models, tools and techniques.
- 5.5 DOS shall make IRS satellite data having GSD of 5 meter and coarser, easily **accessible on ‘free and open’ basis**.
- 5.6 IRS satellite data and services which have commercial value, shall be made easily accessible through the designated **PSU/CPSE under DOS**, on commercial terms.
- 5.7 All available **archived satellite data and satellite derived thematic data shall be made available** for further value addition, research and development purposes

6. Promotion of usage of space based remote sensing systems

- DOS shall endeavour to provide the space based remote sensing systems it has established, through its designated PSU/CPSE.
- 6.1 The space assets for satellite remote sensing established hitherto by DOS comprising of satellite systems and associated ground segment shall be transferred at no/notional cost to its designated PSU/CPSE for operational maintenance and commercial utilization, as deemed appropriate.
- systems created upon fructification of R&D shall also be transferred at no/notional cost, to the designated PSU/CPSE
- 6.3 The designated PSU/CPSE under DOS shall be free to adopt suitable pricing and marketing mechanisms
- 6.4 The designated PSU/CPSE under DOS shall bring timely replacements for operational satellites
- 6.5 The designated PSU/CPSE under DOS can avail state-of-the-art facilities of the Government for manufacturing satellite and associated ground segment at no/notional cost, as deemed appropriate.

7. Provision of timely and responsive regulatory environment

- 7.1 Indian National Space Promotion & Authorization Center (IN-SPACe), an independent body constituted by Government of India, under Department of Space (DOS), shall accord necessary authorizations and permissions for all space based remote sensing activities, to or from Indian territory, as per the applicable acts, regulatory provisions & exemptions and statutory guidelines.
- 7.2 The provisions brought out under this Norms, Guidelines and Procedures for Implementation of Space Based Remote Sensing Policy of India - 2020 (SpaceRS NGP - 2020) forms the basis for authorizations and operations of space based remote sensing in India.
- 7.3 DOS through INSPACe shall make available its state-of-the-art facilities for realisation of satellites and on orbit control along with data reception through its designated PSU/CPSE to any Indian entity. While DOS makes these facilities available at no or notional cost, its designated PSU/CPSE shall provide this to any NGPEs on commercial terms.
- 7.4 IN-SPACe shall formulate additional authorizations, bring out detailed guidelines for submission of applications, processing and grant of authorizations, from time to time.
- 7.5 Department of Space (administrative ministry) bring out policy guidelines and additional regulations in respect of space based remote sensing.

Guidelines for acquiring and producing Geospatial Data and Geospatial Data Services including Maps

- Reference: **DST F.No.SM/25/02/2020 (Part-I) dated 15th February, 2021**

SUMMARY

- 1. These guidelines will be applicable to Geospatial Data, Maps, products, solutions and services offered by government agencies, autonomous bodies, academic and research institutions, private organizations, Non-Governmental Organizations and individuals.
- 2. No requirement for prior approval, security clearance, license or any other restrictions on the collection, generation, preparation, dissemination, storage, publication, updating and/or digitization of Geospatial Data and Maps within the territory of India.
- Individuals, companies, organizations, and Government agencies, shall be free to process the acquired Geospatial Data, build applications and develop solutions in relation to such data and use such data products, applications, solutions, etc by way of selling, distributing, sharing, swapping, disseminating, publishing, deprecating and destructing. Self-certification will be used to convey adherence to these guidelines.
- These guidelines shall confer on any individual or an entity a right to physical access
- 3. There shall be a negative list of sensitive attributes that would require regulation before anyone can acquire and/or use such attribute data. The negative lists mentioned above will be specific to very sensitive attributes.

Guidelines for acquiring and producing Geospatial Data and Geospatial Data Services including Maps

- 4. For the purposes of these guidelines, the threshold value for:
 - 1. On-site spatial accuracy shall be one meter for horizontal or Planimetry and three meters for vertical or Elevation.
 - 2. Gravity anomaly shall be 1 milli-gal.
 - 3. Vertical accuracy of Bathymetric data in Territorial Waters shall be 10 meters for up to 500 meters from the shore-line and 100 meters beyond that.
- 5. Indian Entities, whether in Government or outside, will be free to acquire, collect, generate, prepare, disseminate, store, share, publish, distribute, update, digitize and/or create Geospatial Data, including Maps, of any spatial accuracy within the territory of India including underwater within its territorial waters by using any Geospatial Technology, subject to regulations on attributes in the negative lists.
- 6. (a) Ground truthing/verification, access to Indian ground stations and augmentation services for real time positioning (Continuously Operating Reference Stations (CORS), etc) and their data shall be made available without any restrictions and with the ease of access to Indian Entities only.
- (b) Terrestrial Mobile Mapping survey, Street View survey and surveying in Indian territorial waters shall be permitted only for Indian Entities irrespective of accuracy.
- 7. Maps/Geospatial Data of spatial accuracy/value finer than the threshold value can only be created and/or owned by Indian Entities and must be stored and processed in India.

Guidelines for acquiring and producing Geospatial Data and Geospatial Data Services including Maps

- 8. Foreign companies and foreign owned or controlled Indian companies can license from Indian Entities digital Maps/Geospatial Data of spatial accuracy/value finer than the threshold value only for the purpose of serving their customers in India. Access to such Maps/Geospatial Data shall only be made available through APIs that do not allow Maps/Geospatial Data to pass through Licensee Company or its servers. Re-use or resale of such map data by licensees shall be prohibited.
- 9. Digital Maps/Geospatial Data of spatial accuracy/value up to the threshold value can be uploaded to the cloud but those with accuracy finer than the threshold value shall only be stored and processed on a domestic cloud or on servers physically located within territory of India.
- 10. There shall be no restriction on export of Maps/Geospatial Data of spatial accuracy/value up to the threshold value except for attributes in the negative lists. Department of Revenue, Government of India will make necessary amendments in GSR in this regard.

Guidelines for acquiring and producing Geospatial Data and Geospatial Data Services including Maps

- All Geospatial Data produced using public funds, except the classified geospatial data collected by security/law enforcement agencies, shall be made easily accessible for scientific, economic and developmental purposes to all Indian Entities and without any restrictions on their use. Such access shall be given free of any charges to Government agencies and at fair and transparent pricing to others. For attributes in the negative lists, appropriate regulations will be laid down separately. The Government of India shall encourage crowd sourcing efforts to build Maps by allocating public funds towards these efforts as appropriate.
- xii. The Survey of India (Sol) and other government agencies producing or owning Maps and Geospatial Data, shall take immediate measures to simplify procedures, revise/abolish various forms/licenses and use modern techniques such as cloud, open APIs and others to make its data accessible online in a useful format.
- xiii. For political Maps of India of any scale including national, state and other boundaries, Sol published maps or Sol digital boundary data are the standard to be used, which shall be made easily downloadable for free and their digital display and printing shall be permissible. Others may publish such maps that adhere to these standards.
- xiv. All citizens, companies, and organizations including Government agencies, producing Geospatial Data and information shall be encouraged to collaborate in mutually beneficial manner and work towards open-linked Geospatial Data. Government agencies will make all efforts to collaborate for acquiring Geospatial Data.
- xv. Any violation of these guidelines will be dealt with under the applicable laws.

Definitions

- (a) Positional data: Latitude, longitude and elevation/depth of a point or its x, y & z co-ordinates in the territory of the Republic of India.
- (b) Attribute data: Any data that when associated with Positional Data gives any additional meaning to it.
- (c) Geospatial Data: Positional data with or without attribute data tagged, whether in the form of images, videos, vector, voxel and/or raster datasets or any other type of geospatial dataset in digitized or non-digitized form or web-services.
- (d) Map: Symbolic representation of real-world objects, regions or themes on a given scale which was generally published in paper form but now also available as web-map-service.
- (e) Geospatial Technology: Any technology including but not limited to Aerial / UAV Photogrammetry, Aerial / UAV LIDAR, drones, Radar Interferometry, street view or by other means of ground survey, satellite- based remote sensing techniques, AI, underwater mapping, and others.
- (f) Indian Entity: Any Indian citizen, Government entities, Societies registered under applicable statutes, statutory bodies, Autonomous Institutions of the Government, or any Indian company or Indian LLP owned by resident Indian citizens or any Indian company or Indian LLP controlled by resident Indian citizens (as defined in the Explanation to Rule 23 of the Foreign Exchange Management (Non-Debt Instrument) Rules, 2019).

Unmanned Aircraft Systems (Drones) Rules

<http://egazette.nic.in/WriteReadData/2020/219730.pdf>

- Applicability of the Draft UAS Rules has been extended to all UAS registered in India
- Categories
 1. Remotely Piloted Aircraft System (*i.e. UAS piloted from a remote pilot station*)
 2. Model Remotely Piloted Aircraft System (*i.e. UAS operating without payload and used for educational or experimental purposes only within visual line of sight*)
 3. Autonomous Unmanned Aircraft System (*i.e. UAS that does not require pilot intervention in the management of the flight*)
 4. (*Nano drones are exempt provided they do not exceed the stipulated performance parameters based on the maximum speed (i.e. 15 m/s), height (i.e. 15 meters) and range attainable (i.e. 100 meters) (i.e. performance-based classification).*)

UAS Rules

Authorisation Framework

All persons associated with the Drone ecosystem to undertake a registration in the capacity of “**Authorized Person**”, by applying through the digital sky platform in accordance with the conditions prescribed under Schedule I.

Eligibility

1. An individual who is a citizen of India who is an Indian citizen and has attained at least 18 years of age; or
2. A company or a body corporate whose substantial ownership and effective control should vest with Indian nationals and -
 - (a) It is registered and has its principle place of business within India;
 - (b) Its chairman and at least two-thirds of its directors are citizens of India; or,
3. By a firm or an association of persons or body of individuals or a local authority or any legal entity whether incorporated or not (whose substantial ownership and effective control should vest with Indian nationals), Central and State Government or an agency thereof:

UAS Rules

- ***Import of UAS***
- The import procedures under the Draft UAS Rules is a multi-step process where the UAS Importer is required to obtain a Certificate of Manufacture followed by an application to DGCA via the digital sky platform and DGCA, upon its satisfaction, recommending the application for issuance of an import clearance to the Directorate General of Foreign Trade (“**DGFT**”). Also, there are no exemptions for Nano category Drones which is a significant change from the Existing Guidelines.
- **Certificate of Manufacture**
- The Draft UAS Rules proposes a new certification requirement in the form of a ‘Certificate of Manufacture’ which is required to be obtained by an authorised UAS Manufacturer / UAS Importer to certify that the design of the UAS along with its specification meets the requirements as specified under the Draft UAS Rules. Further, the term ‘manufacturer’ has been defined to mean a person who either manufactures or assembles an UAS or any part or component thereof. Certificate of Manufacture will also be required for Nano category Drones.
- **Maintenance of UAS**
- UAS Rules propose to prohibit the operation of any UAS, unless it is maintained as per the Draft UAS Rules. The term ‘maintenance’ includes the performance of tasks required to ensure the continuing airworthiness of an UAS, which may include overhaul, inspection, replacement, defect rectification and embodiment of a modification or repair or test. UAS Manufacturers or UAS Importer are also permitted to establish authorised maintenance centers subject to notification to the DGCA

UAS Rules

- Rules do not permit any UAS to be owned or operated in India unless it has been allotted a UIN. Accordingly, the Draft UAS Rules has put the onus on the authorised UAS Importer or the authorised UAS Manufacturer to obtain a UIN for each UAS before it could be transferred (including by way of sale) to an authorised UAS Trader or authorised UAS Owner.
- **UAS Operations**
 - Authorised UAS Operators will be permitted to operate UAS, except Nano category UAS, only upon obtaining a UAS Operator Permit (“**UAOP**”) from the DGCA via the digital sky platform.
 - Conditions stipulated for obtaining UAOP include, among others, due intimation to the land or property owner or the local authority for takeoff and landing of UAS.
 - After each flight, the operator should also furnish a log of the flight.
 - The UAOP holder will be responsible for ensuring the privacy of individual and their property during operations and it will be required to comply with any other local or state regulatory requirements and/or any other conditions including height and air space restrictions, as may be specified by DGCA.
 - It is also pertinent to note that no UAS shall be operated without having obtained a valid third-party insurance policy to cover the liability that may arise on account of a mishap

UAS Rules

- **Remote piloting** Except for Nano UAS, no person other than qualified remote pilots (“**QRP**”) under the Draft UAS Rules should operate a Micro category UAS.
- **Autonomous & Beyond Visual Line of sight** operations permitted
- **Model RPAS Operations**
 - This is an independent drone category which has been introduced under the Draft UAS Rules. Such Model RPAS are not allowed to carry any payload and should be used only for educational or experimental purposes and must be flown within visual line of sight only. Considering the purpose of such Drones, most of the conditions/compliances under the Draft UAS Rules have been exempted for such Model RPAS (such as Certificate of Manufacture, AUN, UIN, UAOP etc.).
- **Drone Ports**
 - Draft UAS Rules have also introduced the novel concept of licensed Drone Ports. It has been defined under the Draft UAS Rules to mean an area on land or water, including any buildings, installations, and equipment in a permitted area that can be used for the purposes of arrival, departure, surface movement and associated maintenance, along with commercial activities of Drones.
- **UAS Traffic Management System**
 - As per the Draft USA Rules, the Central Government has been given the power to establish an Unmanned Aircraft Traffic Management System (“**UTM System**”) for UAS operations.
- **Penalties**
 - Draft UAS Rules go on to prescribe a separate schedule for penal provision that may apply to specific contraventions, in cases where no punishment is provided for such contravention in the Aircraft Act, 1934.