

CEOS WGCV - 35 & WGISS - 34 Joint Meet Hyderabad (India) September 24-28, 2012

Agency Report

INDIAN SPACE RESEARCH ORGANISATION

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- **With regard to QA4EO compliance of ISRO's Optical Sensors, they are subjected to extensive characterisation of spatial, spectral and radiometric characterisation through different stages of their development and independent means of verifications**
- **We have the best practices and equipment/ reference standards in place with their traceability to NIST (USA) / PTB (Germany) since they have been procured from reputed vendors in USA or in Germany based on competitive price considerations**
- **Data product and geophysical retrieval algorithms go through extensive Data Quality Evaluation (DQE) process**
- **Stability of sensor performance is taken as prime driver during design of hardware and is evaluated through onboard LEDs/ Blackbody/ Deep Space look/ Lunar observations/ Stellar objects**
- **What is lacking is probably insufficient publication of our laboratory efforts in international journals**



For the first time during this Meet
ISRO has placed its nominees to
CEOS Working Group on Information Systems and
Services (WGISS) and
Working Group on Calibration and Validation
(WGCV)

Activities related to these Working Groups were
presented on 26-Sept-2012

Hence this report presents ISRO growth story on
earth observation missions

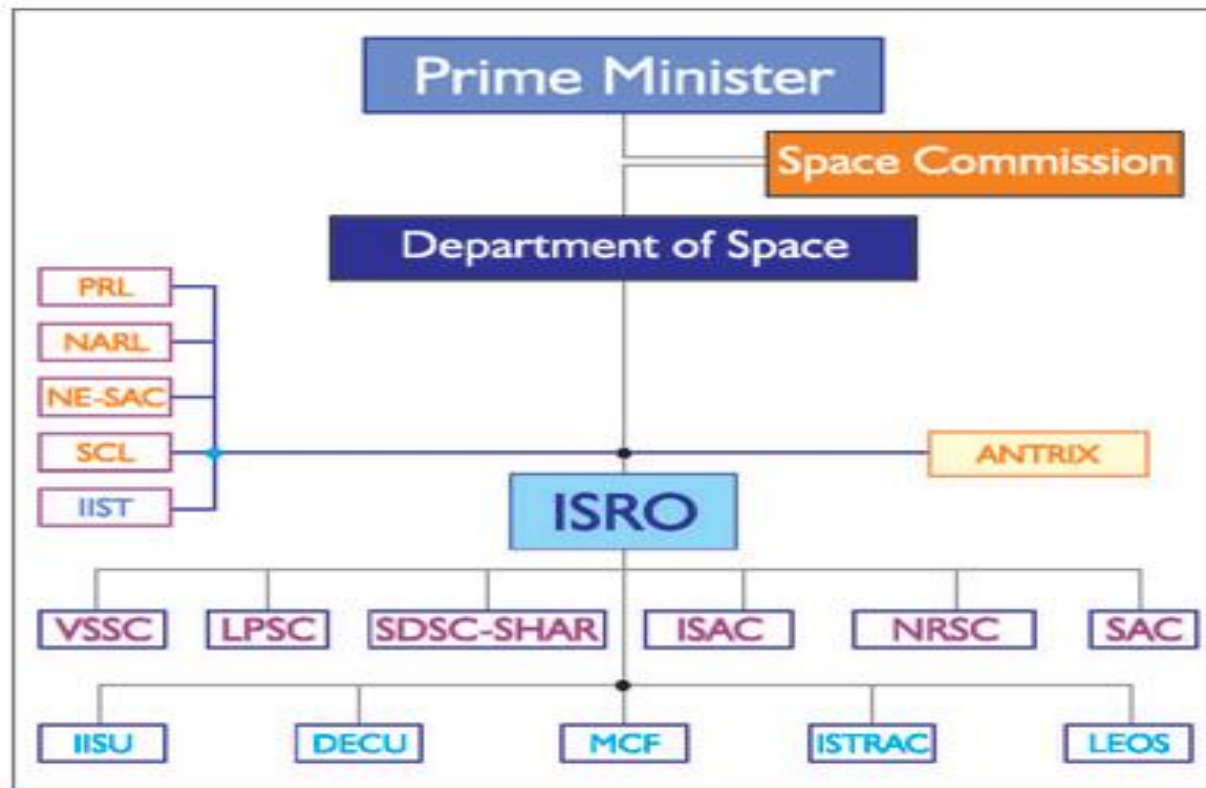


- **Started** in early 1960's
- **Early activities:**
 - Balloon experiments for scientific investigations of upper atmosphere over magnetic equator
- **Objective:** Space Technology in solving problems of common man
- **Major operational satellite systems:**
 - Indian National Satellite (INSAT)
 - Indian Remote Sensing Satellite (IRS)
 - Geo-synchronous Satellite for Telcom & Navigation (GSAT)
- **Major Launch Vehicle Programmes:**
 - Geo-synchronous Satellite Launch Vehicle (GSLV)
 - Polar Satellite Launch Vehicle (PSLV)



	PSLV-Std PSLV-CA & PSLV-XL	GSLV	GSLV MkIII
Weight (T)	294	400	629
Payload (Kgs)	1,500 SSO	2,250 GTO	4,000 to 4,500 GTO
Launches	15 (1994 - 2009)	5 (2001-2007)	--

Organization Structure



NRSC: National Remote Sensing Centre **PRL:** Physical Research Laboratory
NARL: National Atmospheric Research Laboratory **NE-SAC:** North Eastern Space Applications Centre **SCL:** Semi-Conductor Laboratory **ISRO:** Indian Space Research Organisation **Antrix:** Antrix Corporation Limited **VSSC:** Vikram Sarabhai Space Centre
LPSC: Liquid Propulsion Systems Centre **SDSC:** Satish Dhawan Space Centre **ISAC:** ISRO Satellite Centre **SAC:** Space Applications Centre **IISU:** ISRO Inertial Systems Unit
DECU: Development and Educational Communication Unit **MCF:** Master Control Facility **ISTRAC:** ISRO Telemetry Tracking and Command Network **LEOS:** Laboratory for Electro-optic Systems **IIST:** Indian Institute of Space Science and Technology



ISRO provides

Tangible benefits of space technology to

- The policy makers and
- Common man

through

A national level inter-agency system for integrated natural resources management in the country (NNRMS)



Established in 1983

Objective:

- National level inter-agency system that supports optimal utilization of country's natural resources
- Provides for a proper and systematic inventory of natural resources available using remote sensing data in conjunction with conventional data/techniques.
- Supports Planning Commission of Govt of India

Adopts various advanced technologies of

- Satellite and aerial remote sensing
- Geographical Information Systems (GIS)
- Precise Geo-Positioning Systems
- Database and networking infrastructure and advanced ground-based survey techniques.



NNRMS Standing Committees chaired by Secretaries - GOI

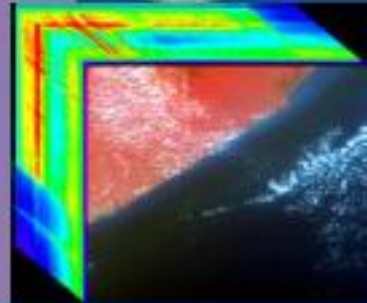
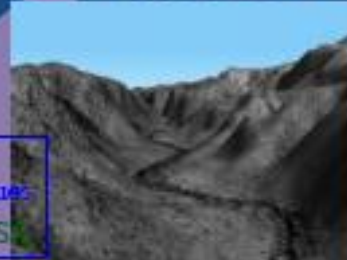
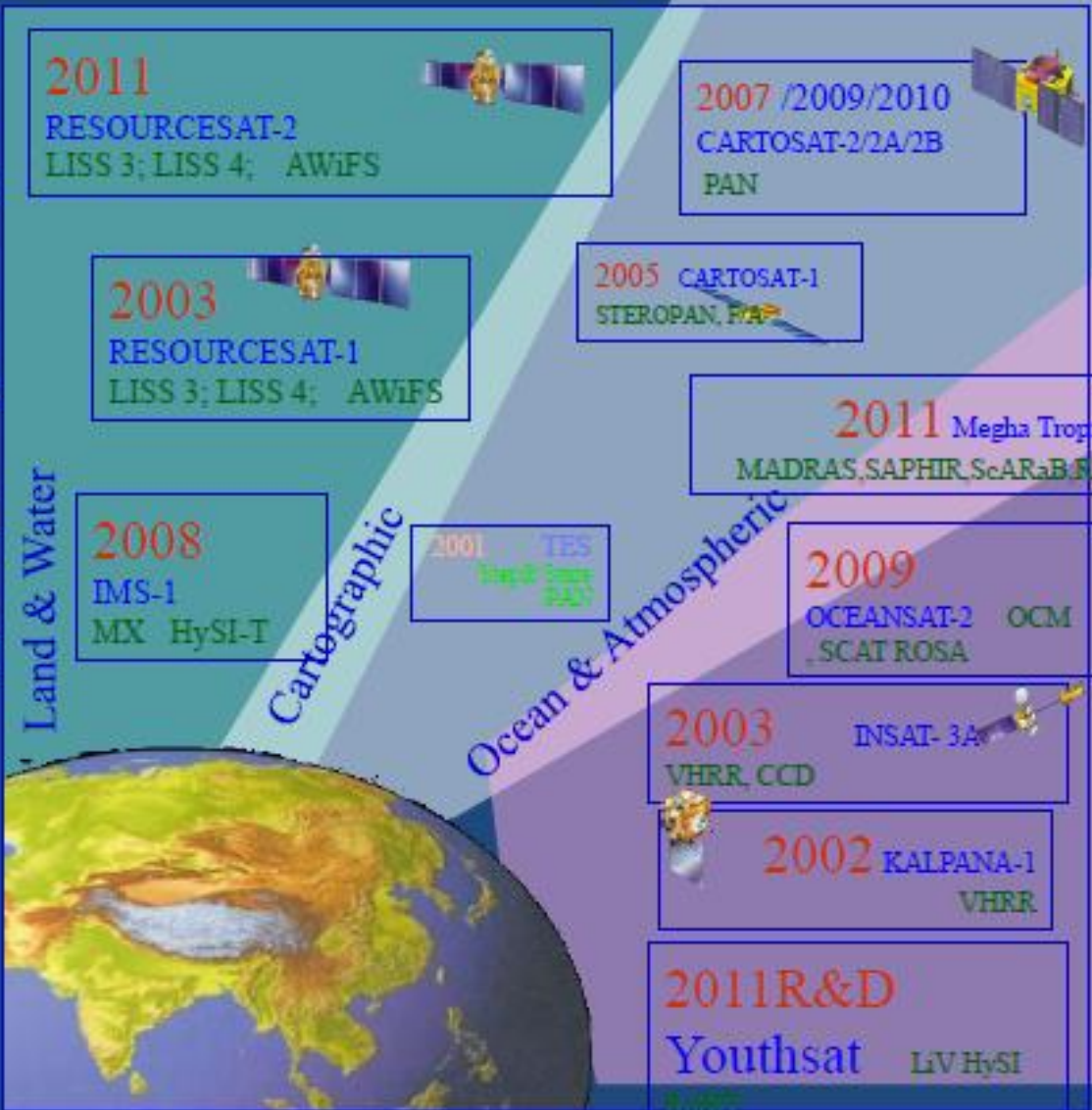
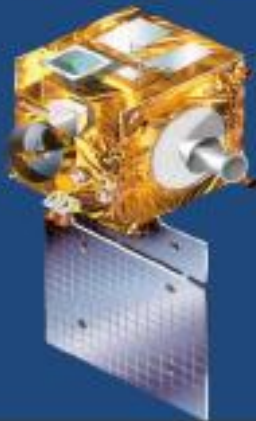
- 1. Agriculture & Soils**
- 2. Bio-Resources**
- 3. Geology and Mineral resources**
- 4. Water Resources**
- 5. Ocean Resources and Meteorology**
- 6. Cartography & Mapping**
- 7. Urban Management**
- 8. Rural Development**
- 9. Training & Technology**

Each consists of experts from major user departments.



Major Activities of NNRMS:

- Determining user/application needs for remote sensing
- Conceptualization and implementing remote sensing space segments with necessary ground-based data reception, processing and interpretation facilities
- Establishing utilization systems for using remote sensing images and conventional data for various applications and resource management activities.





Payload	No. of 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	2 km VIS 8 km WV/IR	Earth Disc	10 bits	3	Every ½ hrs
HySI/ IMS	1	500 m	128	12 bits	64	24 days
OCM-2	1	360m	1420	12 bits	8	Two days
AWiFS	2	56 m	740	10/12 bits	4(B2,B3, B4, B5)	5 / 2.5 days
MX/ IMS	1	37 m	148	10 bits	4(B1, B2,B3, B4)	24 days
LISS3	2	23 m	140	7/10 bits	4(B2,B3, B4, B5)	24/ 12 days
LISS4	2	5.8 m	23/70	7/10 bits	3(B2,B3, B4)	40 days/ 5 day revisit
PAN (stereo)	1	2.5 m	30	10 bits	1	100 days
PAN (mono)	4	0.8/ 1 m	10 / 16	10 bits	1	5 day revisit

Observation Capabilities: Microwave Sensors



Payload	Spatial Res.	Swath km	Radiometry	Frequency	Repetivity/revisit
Scatterometer	50 Km	1400	10 bits	Ku band	2 days

Scatterometer data is made available to global community through NRSC web and Eumetcast .

Payload	Spatial Res.	Swath/	Frequency bands	Repetivity/revisit
MADRAS	6km to 40 km	1700	5 (18.7 to 157GHz)	Multiple observations per day
SAPHIR	10 km	1700	6 @183 GHz	
ScARaB	40 km	2240	4	
ROSA			L1,L2	~400 occultations per day



- Resourcesat-2 Carries 3 Sensors:

- ◆ Same as Resourcesat-1
- ◆ Advanced Wide Field Sensor (**AWiFS**)
- ◆ Medium Resolution Linear Imaging Self-Scanner (**LISS-III**)
- ◆ High-Resolution Linear Imaging Self-Scanner (**LISS-IV**)
 - Wider swath for MX mode (from 23Km x 70Km)



Resourcesat-2

- All Sensors are “push broom” scanners using linear arrays of CCDs
 - ◆ Same as Resourcesat-1
- Resourcesat-2 also carries a larger On-Board Solid State Recorder (OBSSR)
 - ◆ 400 Gigabits Capacity
 - 280 Gigabits more than Resourcesat-1
 - More capacity for wider swath of LISS-IV MX mode



Orbit :	Circular Polar Sun Synchronous
Orbit Height :	821 km (same as Resourcesat-1)
Orbit Inclination :	98.731
Orbit Period :	101.35 min
Number of Orbits per Day :	14
Equatorial Crossing Time :	10.30 a.m.
Repetivity (LISS-3) :	24 days (341 orbits)
Repetivity (AWiFS) :	5 days
Lift-off Mass :	1,200 kg (lighter than Resourcesat-1)
Distance Between Paths :	117.5 Km
Ground Track Velocity :	6.65km/sec.
Attitude and Orbit Control :	3-axis body stabilized using Reaction Wheels, Magnetic Torquers and Hydrazine Thrusters
Mission Life :	5-10 years



	Standard Products	Value Added Products
1	Path/Row Based	Ortho Products
2	Shift Along Track	
3	Quadrant Products	
4	Georeferenced Products	

Level	Type of Correction Applied
Level 0	No correction (not available for sale)
Level 1	Radiometric Correction only
Level 2 (Standard)	Radiometric and Geometric Correction
Level 3	Precision Correction (using GCPs)

Resampling Options	Map Projections	Earth Ellipsoids	Data Formats
Cubic Convolution	Polyconic	Clark 1866	LGSOWG Superstructure Format
Nearest Neighbor	Lambert Conformal Conical	Int'l 1909	Fast Format
Bilinear	Universal Transverse Mercator	GRS 1980	GeoTIFF (Gray Scale)
16 Point Sinc	Space Oblique Mercator	Everest	GeoTIFF (RGB)
Kaiser -16		WGS 84	HDF
4 Point Sinc		Bessel	
		Krassovsky	



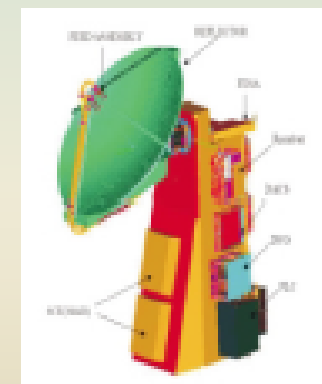
OCEANSAT-2 is a global mission and is configured to cover global oceans and provide continuity of ocean colour data with global wind vector and characterization of lower atmosphere and ionosphere.

INSTRUMENTS

- An 8-band Ocean Colour Monitor (**OCM**) with 360 m spatial resolution
- A Ku-Band Pencil beam **SCATTEROMETER** with a ground resolution of 50 km x 50 km
- Radio Occultation Sounder for Atmospheric studies (**ROSA**) - Developed by the Italian Space Agency (ASI)

APPLICATIONS:

- Potential Fishing Zone Advisories
- Ocean State Forecasting
- Ocean and coastal studies



LAUNCH: September 23, 2009 by PSLV-C14



Oceansat-2 OCM Data Products

LEVEL-1 Product: Basic Data Products

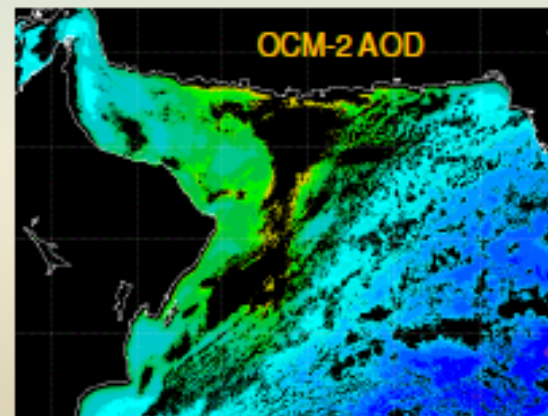
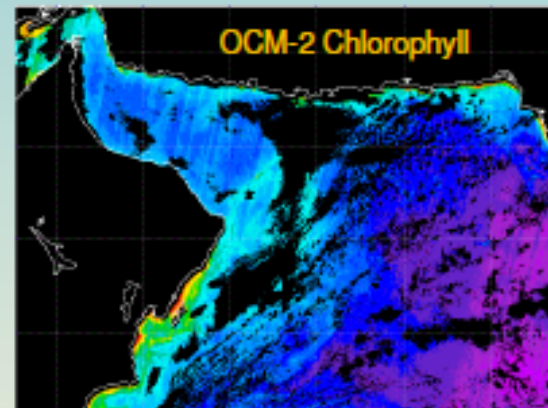
- L1A RAW Products
- L1B Radiance Product
- L1C Radiometrically and Geometrically corrected

LEVEL-2 Product: Geo-Physical Parameters

- Chlorophyll-*a* concentration
- Total Suspended Matter (TSM)
- Diffused Attenuation Coefficients (K_d -490 nm)
- Aerosol Optical Depth (AOD) at 865 nm

LEVEL-3 Product: Binned Products (4 km)

- Weekly
- Monthly
- Yearly



Oceansat-2 OCM LAC Coverage
360 m Spatial Resolution
Real time transmission

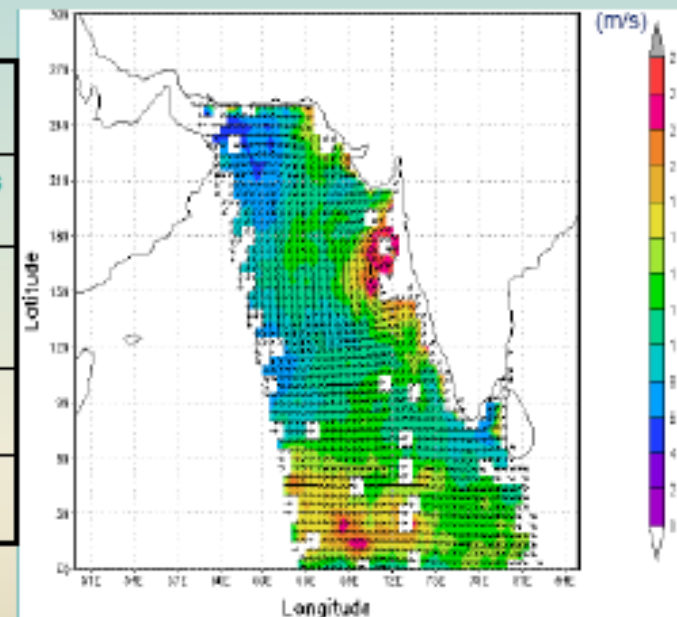
Oceansat-2 OCM GAC Coverage
1 Km Spatial resolution
Onboard recording and Playback



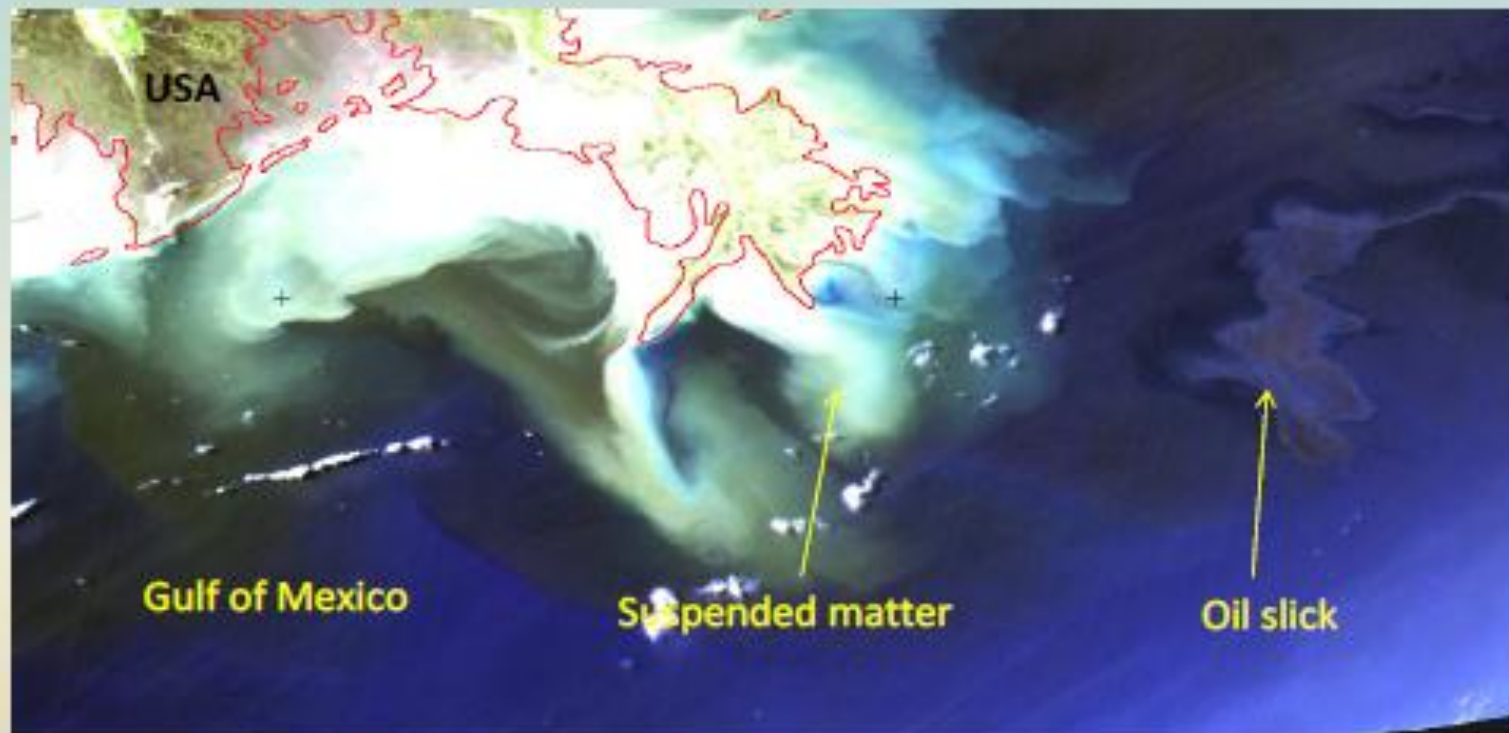
OCEANSAT-2 Scatterometer Data Products

Processing Level	Parameter	Cell Size	Availability
Level 2A	Sigma-0 (for each orbit)	50 x 50 km ²	Selected users
Level 2B	Wind vector (for each orbit)	50 x 50 km ²	Global users through Web
Level 3S	Sigma-0 (Global)	0.5° x 0.5°	Global users through Web
Level 3W	Wind vector (Global)	0.5° x 0.5°	Global users through Web

Oceansat-2 Scatterometer derived
Wind vectors



November 10, 2009 : 19 GMT
(Phyan Cyclone)



OCEAN-2



Ocean-surface wind speeds and directions for Hurricane Irene six hours prior to the storm's landfall in North Carolina on Aug. 27, 2011.

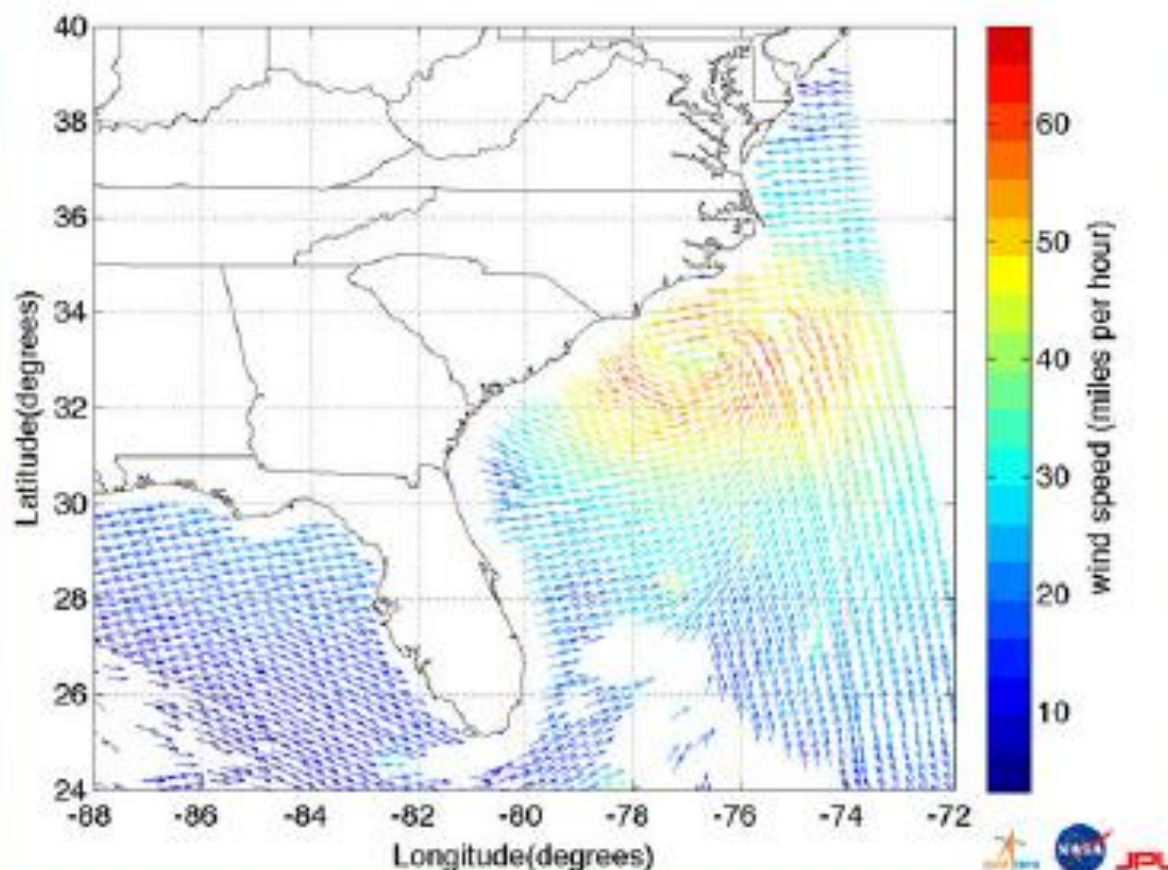
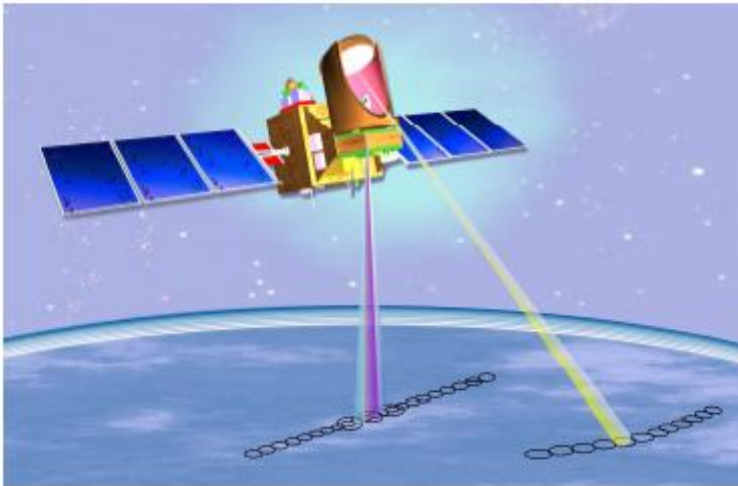


Image credit: ISRO/NASA/JPL-Caltech



Orbit

Inclination : 20 deg

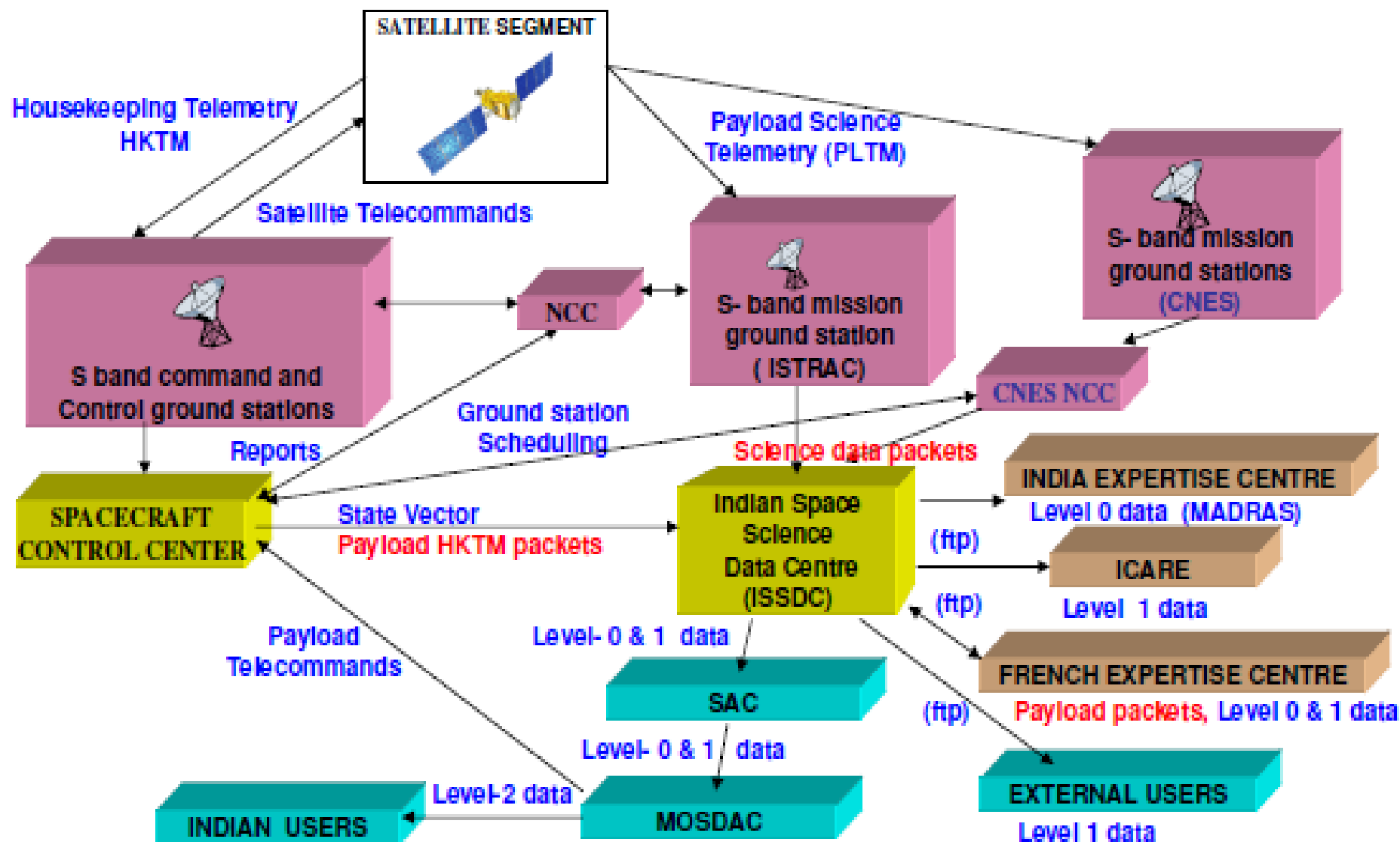
Swath : 1700 – 2200 km

Repeativity : six times a day
(over 10 -

20 deg
latitude)

Sensors:

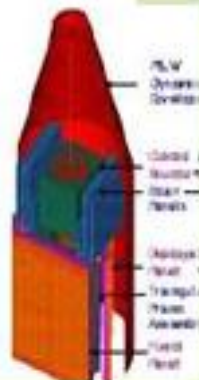
- **MADRAS** (Microwave Analysis & Detection of Rain and Atmospheric Structure)
- **SAPHIR** (Sounder for Atmospheric Profiling of Humidity in Inter-tropical Regions)
- **SCARAB** (Scanner for Radiation Budget)
- **ROSA** (Radio Occultation Sounder for Atmosphere)
(procured from Italy)





Applications:

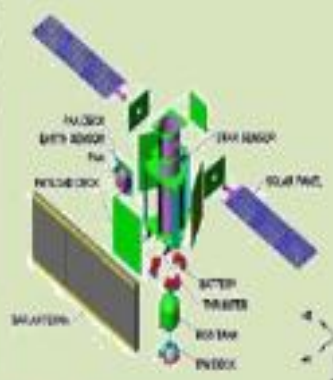
- **Collect data sets and measurements over tropical latitudes with good sampling and coverage**
- **Understand processes related to tropical convective systems and their life cycles**
- **Improve determination of atmospheric energy and water budget in the tropical area at different times and in different space**
- **Study tropical events: droughts, monsoon variability, floods, tropical climates and their predictability**



STOWED
CONFIGURATION
MODEL

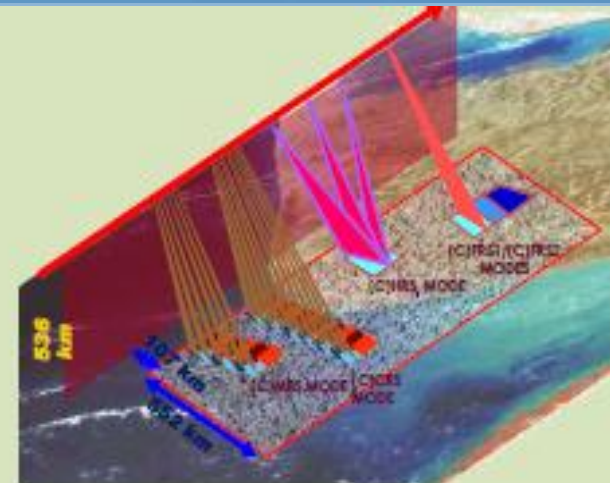


STOWED IN
INTEGRATION LAB



SATELLITE EXPLODED
VIEW

RISAT IMAGING
ALONG WITH
DIFFERENT MODES



FEATURES

- First Spaceborne SAR developed indigenously
- C-band SAR catering to diverse applications from Agriculture to high resolution land-mapping
- Resolution from 1m to 50m
- Swath from 10km to 220km
- State-of-the-art Active Antenna with 576 TRMs
- Electronic beam steering covering 107-659km range

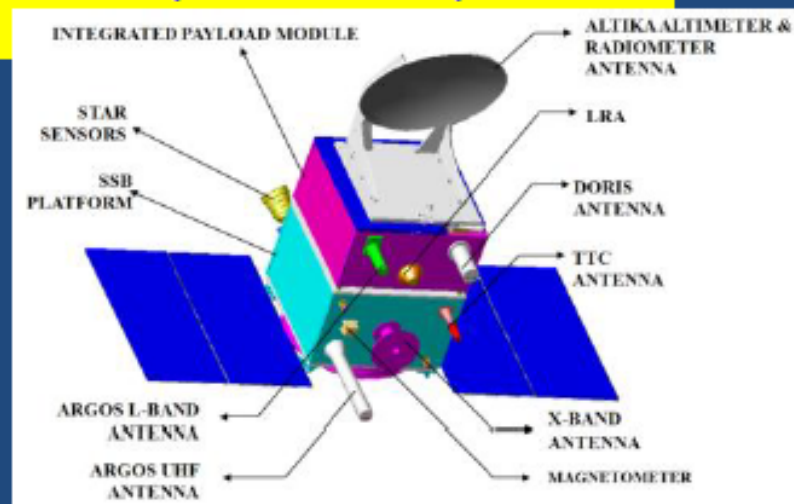
APPLICATIONS

- Forestry, Flood Mapping, Vegetation, Soil Moisture, Oil Spillage, Disaster Management
- Caters to some applications of L and X band SAR also.



SARAL: Satellite For Argos And AltiKa (ISRO-CNES)

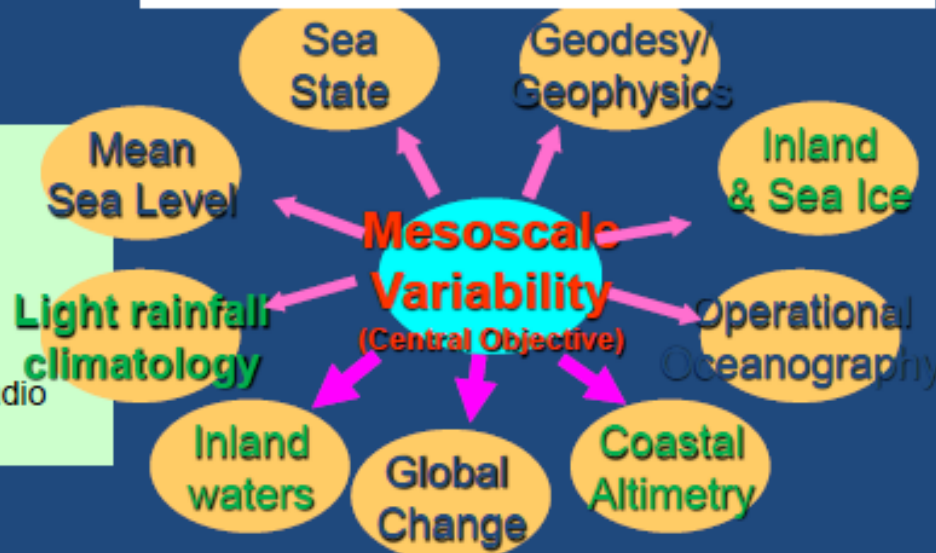
- Provide altimetric measurements designed to study ocean circulation and sea surface elevation.
- Marine meteorology and sea state forecasting, Operational oceanography, seasonal forecasting, climate monitoring and climate research.



Argos

Satellite based system collects environmental data from autonomous platforms

- A Ka Band altimeter (35.5 – 36 GHz)
- A dual frequency radiometer (24 / 37 GHz)
- A common antenna shared by Altimeter & Radiometer (1 meter dia)
- LRA (Laser Retro - Reflector Array)
- DORIS instrument (Doppler Orbitography & Radio positioning Integrated by Satellite)





INSAT 3A

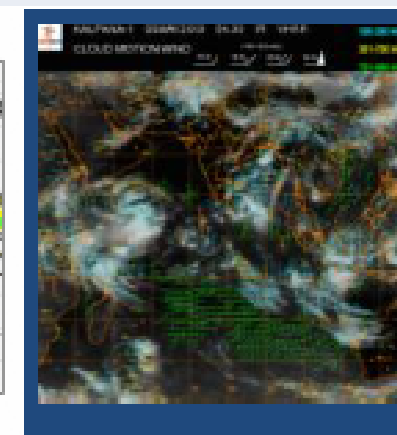
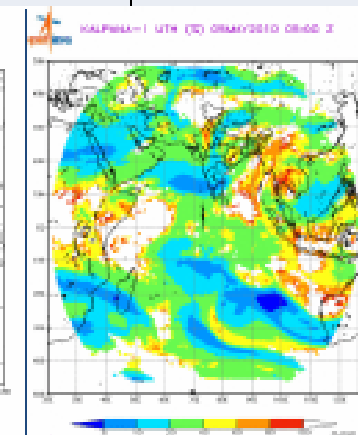
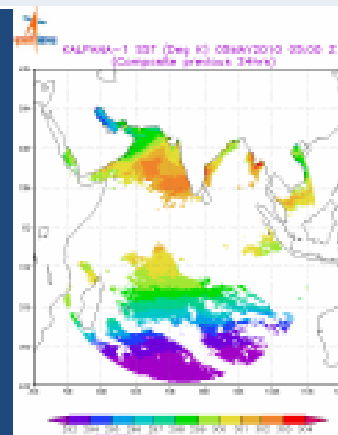
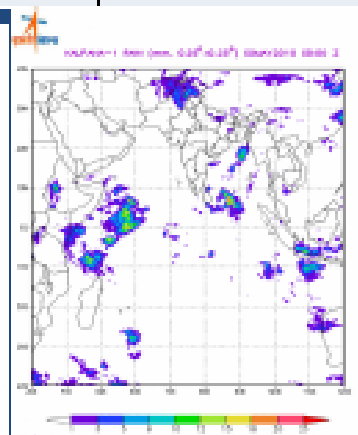
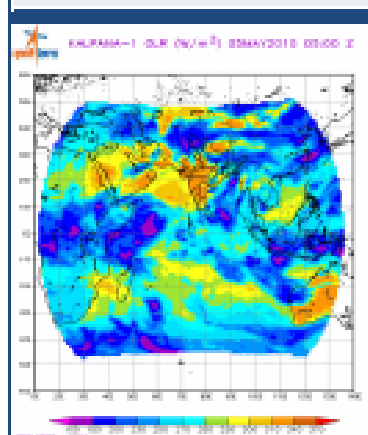


KALPANA





	VHRR	CCD
Products	Half hourly scans CMV's, OLR , UTH, Rain, SST, WWV	4 Scans per day NDVI
Turn Around Time (TAT)	Within 60 minutes of image acquisition	Within 60 minutes of image acquisition



Available on MOSDAC (<http://www.mosdac.gov.in>)



Joint Meet: WGCV-02 & WGS2 -04
Hyderabad - India
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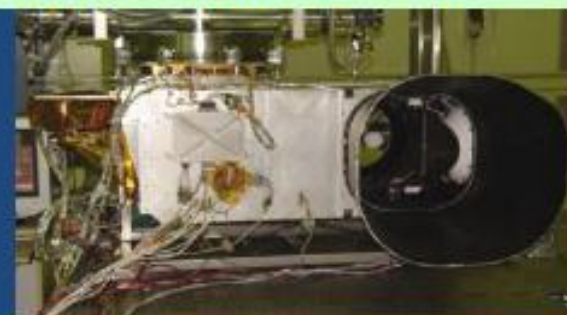
INSAT 3D Met. Payloads

Six channel Imager

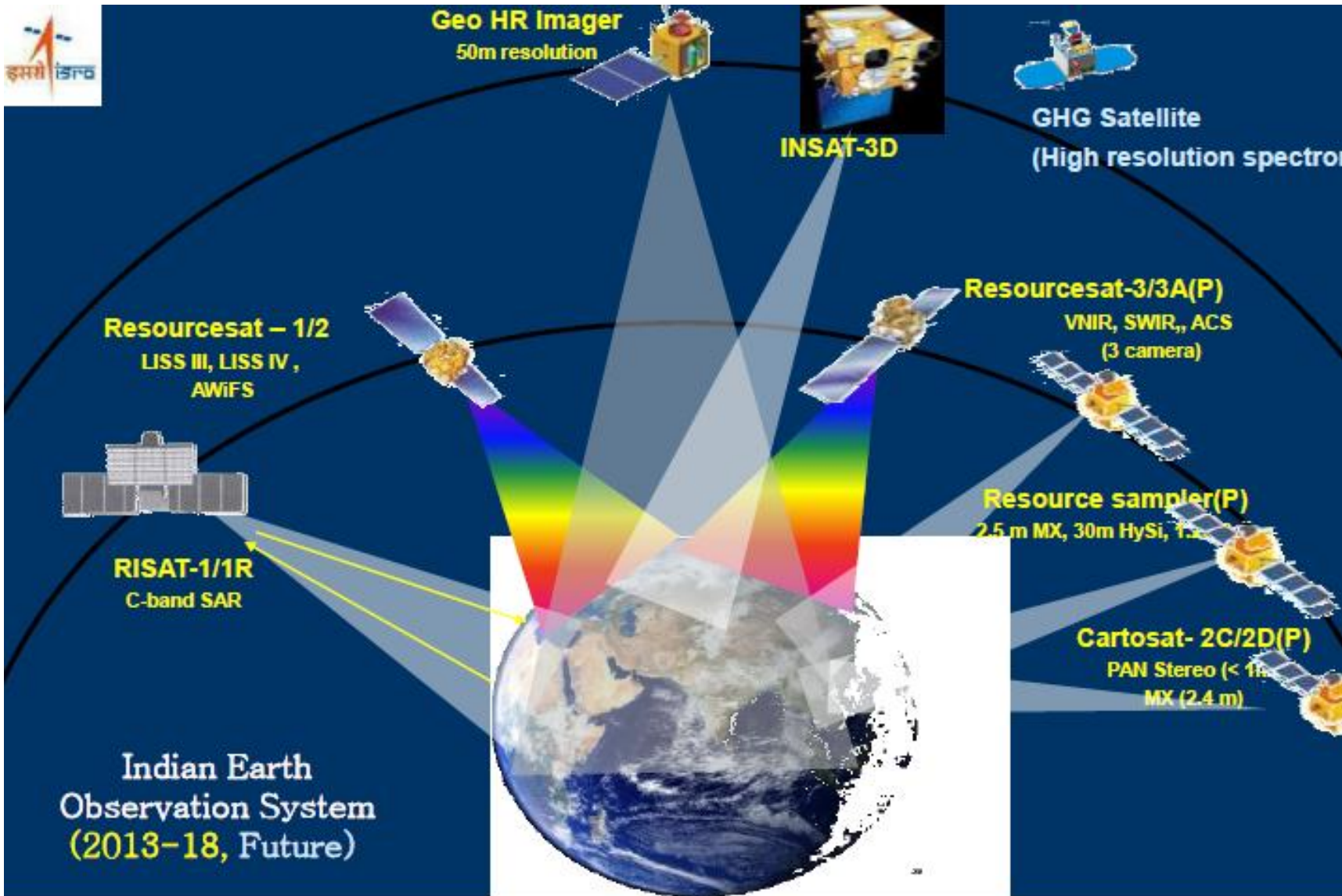


- Visible to Thermal IR
- 1KM to 8KM IGFOV
- Half hourly earth coverage
- Flexible scanning modes
 - Programmable number of lines and frame repeats
- Improved Blackbody calibration scheme
- Image motion & Mirror motion compensation

Nineteen channel Sounder



- Visible to Long Wave IR
- Fully programmable East-West and North-South Scan pattern
- Programmable dwell time for East-West scan step motion
- Automatic space view every 2 min and Blackbody view every 30min.
- 10KM IGFOV, 14bits digitization
- Image motion & Mirror motion compensation





Thanks