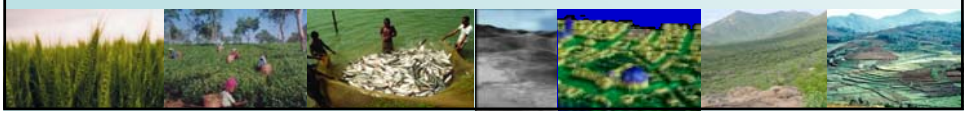
17th Session of the Intergovernmental Consultative Committee (ICC)

Regional cooperative Mechanism for Disaster Monitoring and Early Warning, Particularly the Drought

PG Diwakar
National Remote Sensing Centre
Indian Space Research Organisation
India
pgdiwakar@nrsc.gov.in

26 – 28 November, 2013



INDIAN SPACE ENDEAVOUR

..we must be second to none in the applications of advanced technologies to the real problems of man and society.

VIKRAM A. SARABHAI

IRS

LAUNCHER

INSAT

APPLICATIONS LEADERSHIP

LARGE USER BASE

INDUSTRY

SPACE COMMERCE

HUMAN RESOURCES EXPERTISE
16500 strong

INTERNATIONAL COOPERATION

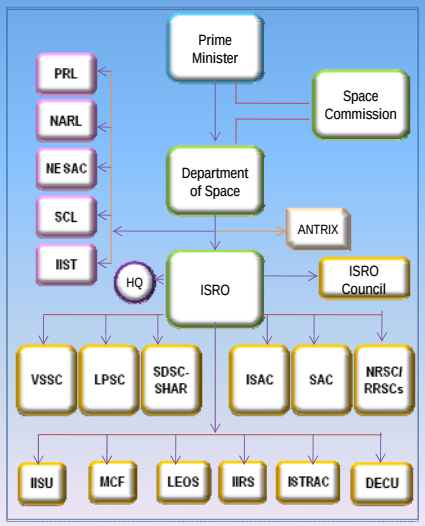
SPACE ASSETS
Remote sensing & Telecom satellite Constellations

INFRASTRUCTURE
End- to- end capability

STATE OF THE ART TECHNOLOGY

The Organisation

- **Initiated in 1960's** (1962 – INCOSPAR; 1969 – ISRO; 1972 - Space Commission & DOS)
- **3 National committees coordinate space system establishment and applications:**
  - INSAT Coordination Committee (ICC)
  - Planning Committee on National Natural Resources Management System (PC-NNRMS)
  - Advisory Committee for Space Sciences (ADCOS)
- **The DOS Secretariat and ISRO Headquarters (with programme offices) at Bangalore.**

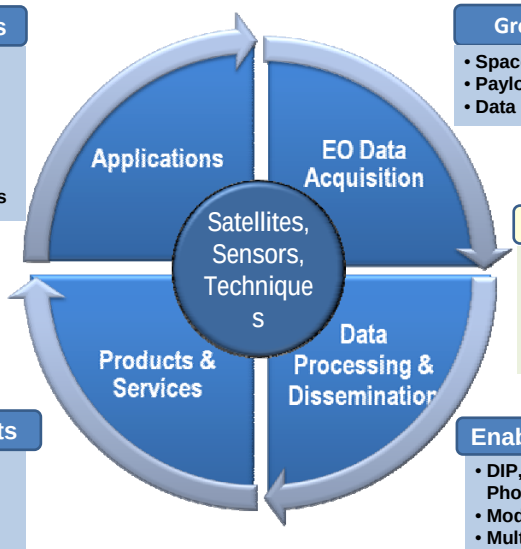


Earth Observation System: Components

EO Applications
- Natural Resources
- Cartography
- Disaster support
- Environmental monitoring
- Ocean & Atmospheric studies

Institutionalization
- MoES MoEF
- MoA MoWR
- MRD DST

EO Data Products
- Standard Products
- Value added products
- Data Archival



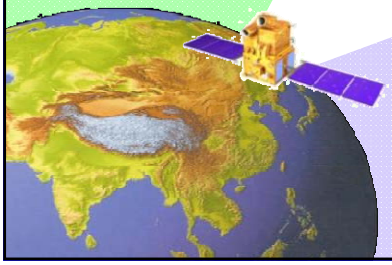
Ground Segments
- Spacecraft Control
- Payload Programming
- Data Acquisition

Users
- Cent./ State Govt.
- Researcher/ Academia
- Private/ Industry
- International

Enabling Techniques
- DIP, GIS, GPS, DSS, Photogrammetry,
- Model Outputs
- Multi-sensor Products
- Visualisation

…in sync with country's priorities…

Indian Earth Observation Satellites



2009 RISAT-2 X-SAR

2012 RISAT-1 C-SAR

2007 CARTOSAT-2 PAN

2011 RESOURCESAT-2 LISS 3; LISS 4; AWiFS

2005 CARTOSAT-1 Stereo PAN, F/A

2003 RESOURCESAT-1 LISS 3; LISS 4; AWiFS

Land & Water

Cartography

Ocean & Atmosphere

- One of the largest constellations
- Provides remote sensing data in a variety of spatial, spectral and temporal resolutions
- Both Optical and Microwave

2009 OCEANSAT-2 OCM , SCAT ROSA

2013 SARAL AILTIKA, ARGOS

2003 INSAT- 3A VHRR, CCD

2013 INSAT- 3D Imgr, Sounder

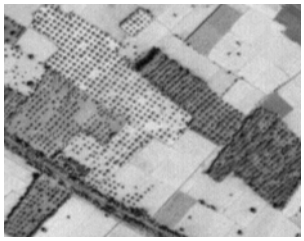
2011 Megha-Tropiques MADRAS, SAPHIR SCaRaB

2002 KALPANA-1 VHRR

Cartosat -1 and 2

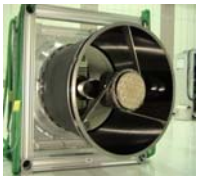
Cartosat-1 launched 2005

- 2.5 m resolution, 30 km Swath
- Stereo mission; +26° / -5° forward/ Aft view
- Revisit : 5 days
- Along Track Stereo viewing



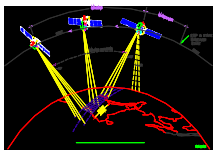
Cartosat-2 launched 2007

- Swath (km) : 10
- Panchromatic
- Spatial Res : 0 .8m

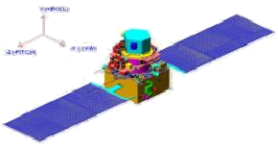


Cartosat-2 Data Products - Handling of unique imaging modes

- *paint brush*
- *multi-view in step and stare*
- *spot scenes*



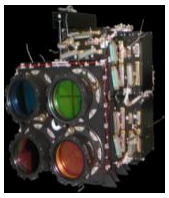
Resourcesat-2



Linear Imaging Self Scanner (LISS-4)

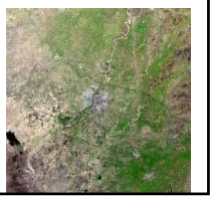
- LISS-4 Mx camera: 5.8m Resolution and 70 Km swath
- LISS-3: 23.5m Resolution and 141 Km Swath
- AWiFS: 56m Resolution and 740km Swath
- Repetitivity: 5 days (AWiFS) to 24 days (LISS 3) &
- Revisit: 5 days (LISS 4) with tilting 26 deg tilt

Linear Imaging Self Scanner (LISS-3)



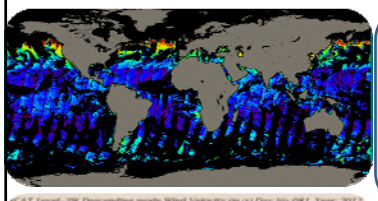
SENSORS	SPECTRAL BANDS	Ground Resolution (meters)	Swath (km)	Radiometric Resolution (bits)	Repetivity (days)
LISS-III	B2 B3 B4 B5	23.5	141	10	24
LISS-IV Mono	B2 or B3 or B4	5.8	70	10	24
LISS-IV MX	B2 B3 B4	5.8	23.5 or 70	10	24
AWiFS	B2 B3 B4 B5	56	740	12	5

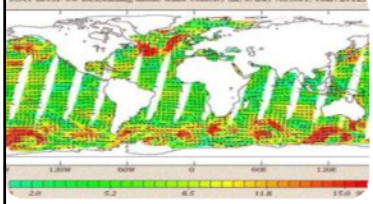
Advanced Wide Field Sensor (AWiFS)



Oceansat-2

A global mission, providing continuity of Ocean Colour data and Wind Vector in addition characterization of lower atmosphere and ionosphere from ROSA payload.





Global data acquisition of Ocean colour

- High Resolution Data - NRSC and INCOIS
- 1km resolution global products through NRSC Website
- Global Chlorophyll, Aerosol Optical Depth through NRSC Website
- OCM data are being downloaded from NRSC Website

Scatterometer Wind Products

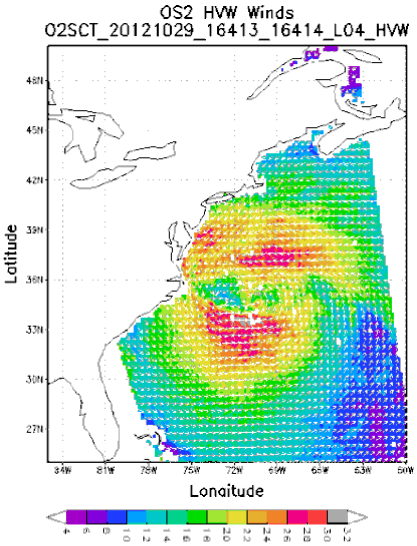
- Reception Station at Svalbard
- Real time transfer and processing
- Uploading to Web within 3 hrs through EUMETCAST
- Lakhs of data sets are downloaded from NRSC Website

Data Dissemination Mechanism

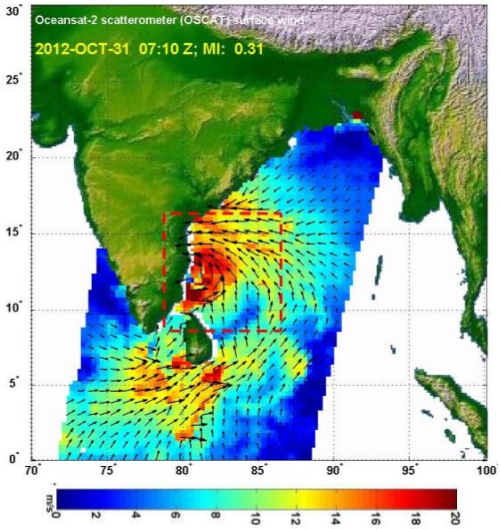
- Established Ground station at INCOIS
- Ground station at Bharti, Antarctica is commissioned.
- EUMETCAST, NRSC Website for data and products

Monitoring of Two recent Cyclones (Using Oscat)

SANDY - 29 October 2012

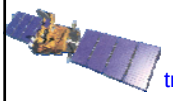


NILAM - 31 October 2012



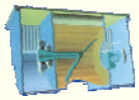
OSCAT product is available to the global community through EUMETSAT & NRSC

Megha-Tropiques



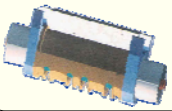
For studying water cycle and energy exchanges to better understand the life cycles of the tropical convective system. The satellite is contributing to Global Precipitation Mission (GPM)

SAPHIR



- Water vapour profile
- Six atmospheric layers upto 12 km height
- 10 km Horizontal Resolution

SCARAB



- Outgoing fluxes at TOA
- 40 km Horizontal Resolution

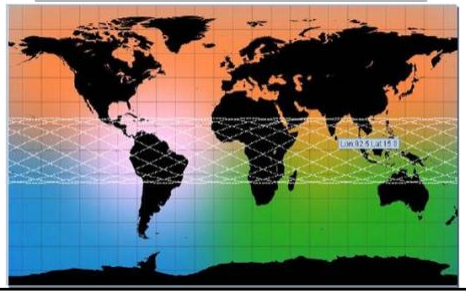
MADRAS

- Precipitation and Cloud properties
- 89 &157 GHz: Ice particles in cloud top
- 18 &37 GHz: Cloud Liquid Water and precipitation; Sea Surface Wind speed
- 24 GHz : Integrated water vapour

Applications:

Observations of tropics for

- Water vapour
- Clouds
- Cloud condensed water
- Precipitation
- Evaporation

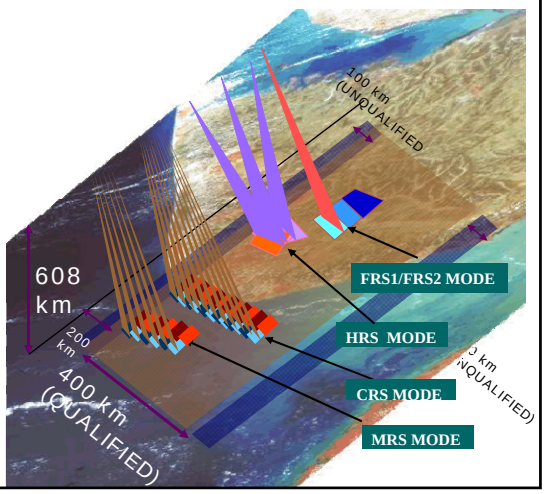


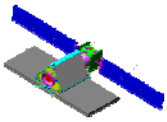
Radar Imaging Satellite (RISAT-1)

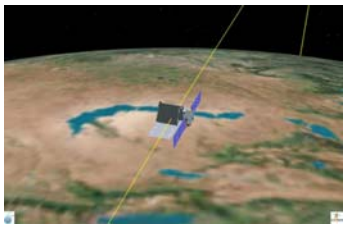
Space borne SAR in C-band at 5.35 GHz

- Stripmap FRS-1 / FRS-2 (Range Doppler/ Chirp Scaling)
- ScanSAR MRS & CRS (Range Doppler/Specan)
- Spotlight (modified sub-aperture) modes.

Single/ Dual / Quad Polarisation imaging with 3 - 50 m Resolution & 10 - 240 km Swath



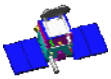




SARAL: Satellite with Argos and Altimeter

Altika/SARAL mission belongs to the Global Altimetry system for the precise and accurate observations of **ocean topography, circulation and sea surface monitoring**

ISRO & CNES Collaboration

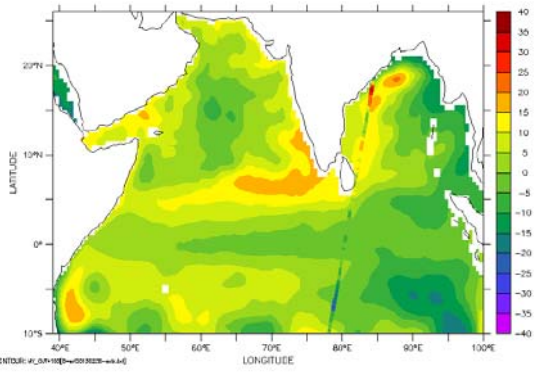


Mission:

- Sun-synchronous, polar orbiting satellite
- Inclination: 98.38 Deg.
- Altitude: ~800 km
- Repeat cycle: 35 days

Altika Payload:

- Ka-band (35.75 GHz, BW 500 MHz) radar altimeter
- Dual-frequency microwave radiometer (23.8 & 37 GHz)
- DORIS
- Laser Retro-reflector Array

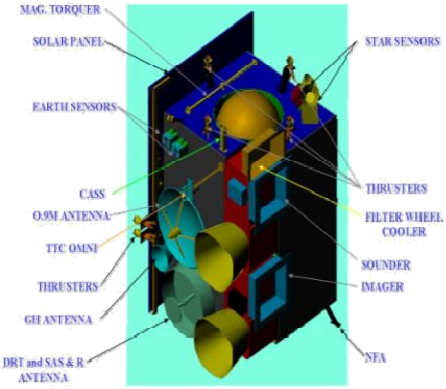


Typical SARAL/AltiKA SSHA observation overpass over Indian Ocean and SLA from POM model at 0.5 degree resolution.

INSAT-3D

A Followon Mission to Kalpana

INSAT 3D S/C (STOWED VIEW)



Payloads:

IMAGER

- Spectral Bands (6): VIS, SWIR, MWIR, WV, TIR- 1 &2
- Spatial Resolution: 1 km for VIS & SWIR
  4 km for MIR & TIR
  8 km for WV

SOUNDER – Water Vapour & Temperature profiles

- Spectral Bands (19): SWIR (6), MWIR (5), LWIR (7), Vis (1)
- Resolution (km): 10 X 10 for all bands
- No of simultaneous sounding : 4 per band

Data relay Transponder; Search & Rescue Payloads

Potential Applications

Quantitative precipitation estimation, vertical temperature and moisture profile of the atmosphere, surface and cloud top temperatures, ozone distribution, Sea Surface Temperature (SST), fire, smoke, fog detection, etc.