

Indian Earth Observations & Space Science Missions : Status 2013

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ISRO / India

ISRO EO SATELLITES

ISRO: 1975-2013
103 Missions
(69 Sat/ 34 Launch)

Year	Launch Vehicle	Satellite Name	Category
1975	Aryabhata		
1976			
1977			
1978			
1979	BSK1, ROHINI		
1980	RS-1		
1981	BSK2, RS-D1		
1982		INSAT-1A	GEO / MET
1983	RS-D2	INSAT-1B	GEO / MET
1984			
1985			
1986			
1987			
1988	SROSS-2@	IRS-1A	
1989			
1990		INSAT-1C	GEO / MET
1991		INSAT-1D	GEO / MET
1992		IRS-1B	
1993		INSAT-2A	GEO / MET
1993		IRS-1E@	
1994		INSAT-2B	GEO / MET
1994		IRS-P2	
1995		INSAT-2C	GEO / MET
1995		IRS-1C	
1996		IRS-P3	
1997		INSAT-2D	GEO / MET
1997		IRS-1D	
1998			
1999		P4/ OCEANSAT1	
1999		INSAT-2E	GEO / MET
2000			
2001		TES	
2002			
2003		P6/ RESOURCESAT-1	
2004			
2005		P5/ CARTOSAT-1	
2006			
2007		CARTOSAT-2	
2008		CARTOSAT-2A	
2008		IMS-1	
2009		OCEANSAT2 ; RISAT2	
2010		CARTOSAT-2B	
2011		RESOURCESAT-2, MEGHATROPIQUES	
2012		RISAT-1	
2013		SARAL	
2013		INSAT-3D***	GEO / MET

METEOROLOGICAL SATELLITES :

OCEANOGRAPHIC APPLICATION SATELLITES :

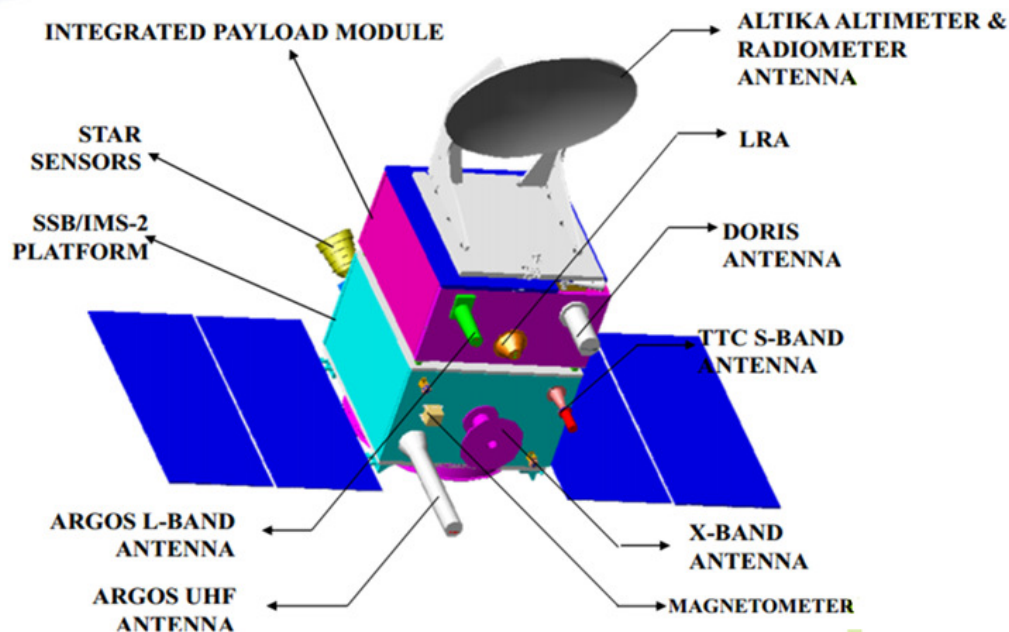
CARTOGRAPHIC SATELLITES :

EO Missions : Current

- **Cartosat -1/2 (2005/2007)**
 - Cartography applications (incl in-track stereo imaging)
- **Oceansat-2 (2008)**
 - Global ocean wind vector in near real time & global ocean color
- **Resourcesat-2 (2011)**
 - Operational optical data 3-tier (AWiFS/56m; LISS-3/23m; LISS-4/5.8m)
- **Megha-Tropiques (2011)** *[ISRO-CNES]*
 - Energy & water cycle in tropics
- **RISAT-1 (2012)**
 - C-band SAR, being used for flood mapping, rice inventory & new applications
- **SARAL (2013)** *[ISRO-CNES]*
 - Altimeter & ARGOS DCS

SARAL : Satellite with ARGOS and ALTIKA

- ISRO CNES Joint Project for Oceanography
- Launched by PSLV C-20, Feb 25, 2013 [ISRO]
- PAYLOADS
 - Ka Band altimeter (enhanced frequency 500 MHz)
 - Dual Frequency Radiometer (27, 37 GHz)
 - Laser Retroreflector Array
 - DORIS
 - Solid State C-band Transponder (SCBT) [ISRO]
- SPACECRAFT : IMS BUS [ISRO]



President of India with ISRO & CNES Chiefs
SARAL Launch, MCC, SHAR, 23 Feb 2013

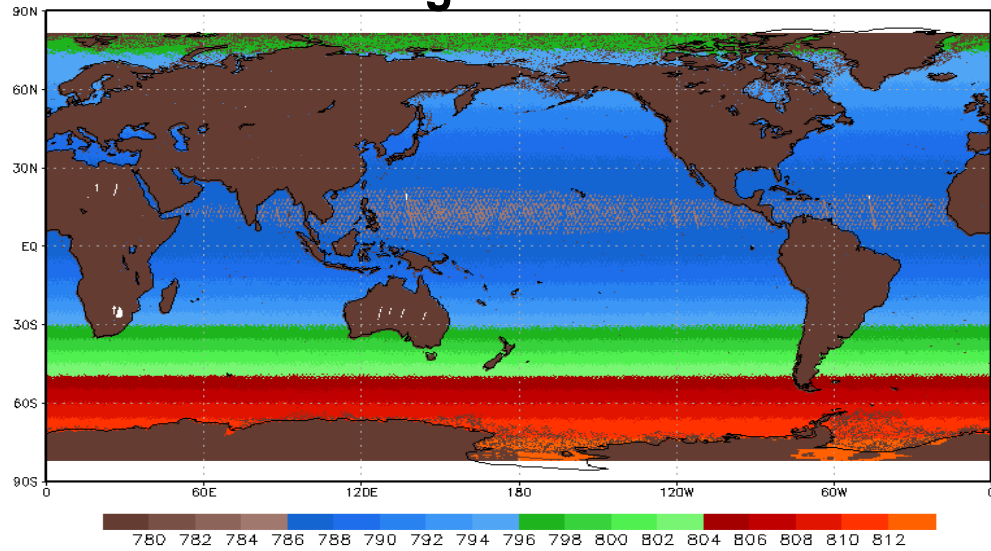
SARAL : Mission & Applications

Parameter	Specification
Apogee Altitude	814 kms
Orbit inclination	98.55 Deg
Repeat period	35 days
No. orbits/cycle	501
Orbit Type	Sun-synchronous
LAT	06:00
Nodal Period	100.59 mn
No of Orbits/day	14 +11/345
Path to path distance	75 km
Consecutive track	2800 km
Pointing Accuracy	0.1 Deg
Attitude Sensors	Star, Magnetometer, DTG , 4 pi sensors
Life Time	~ 5 years

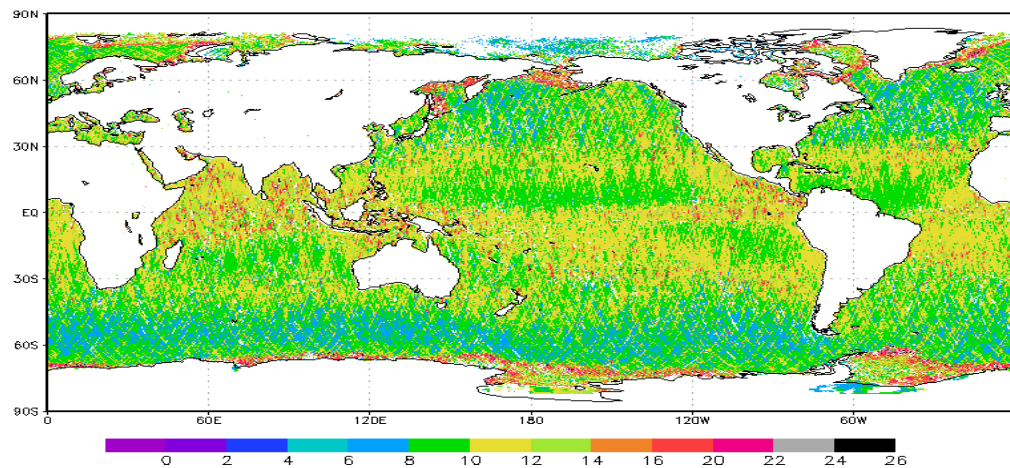
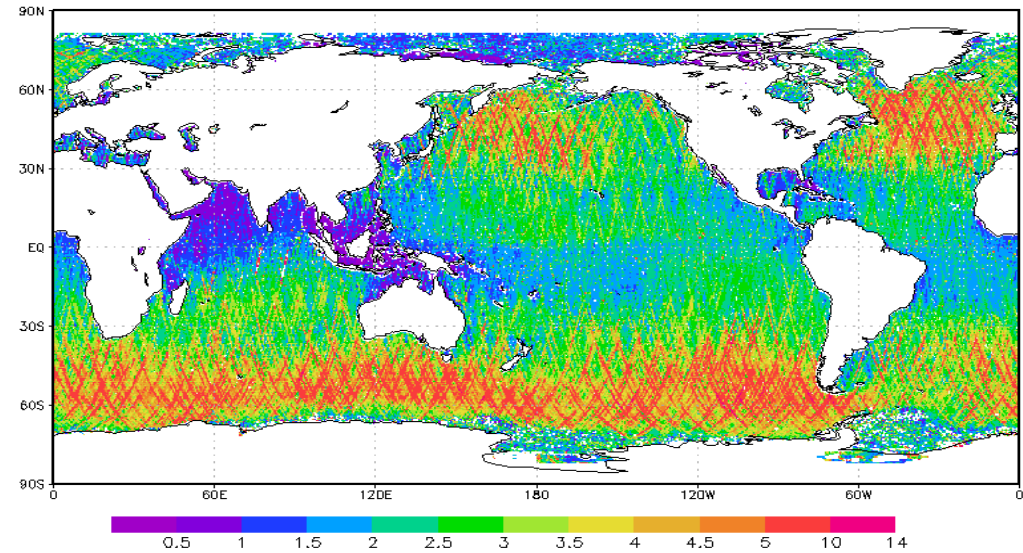
- Oceanography Geophysical Products
- Improved Sea State Forecast with assimilated products
- Near-coast data
- Inland water levels (large bodies)
- Polar sea ice

SARAL Geophysical Products

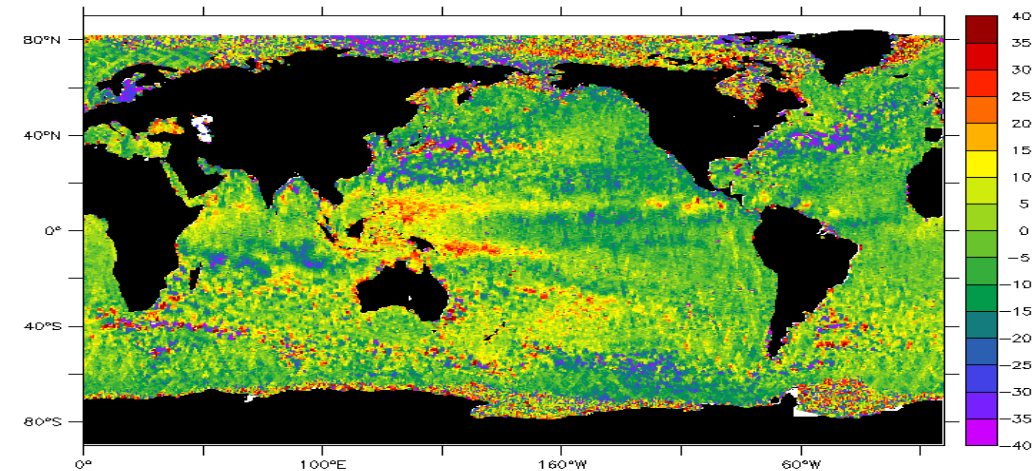
Range



Significant Wave Height, SWH



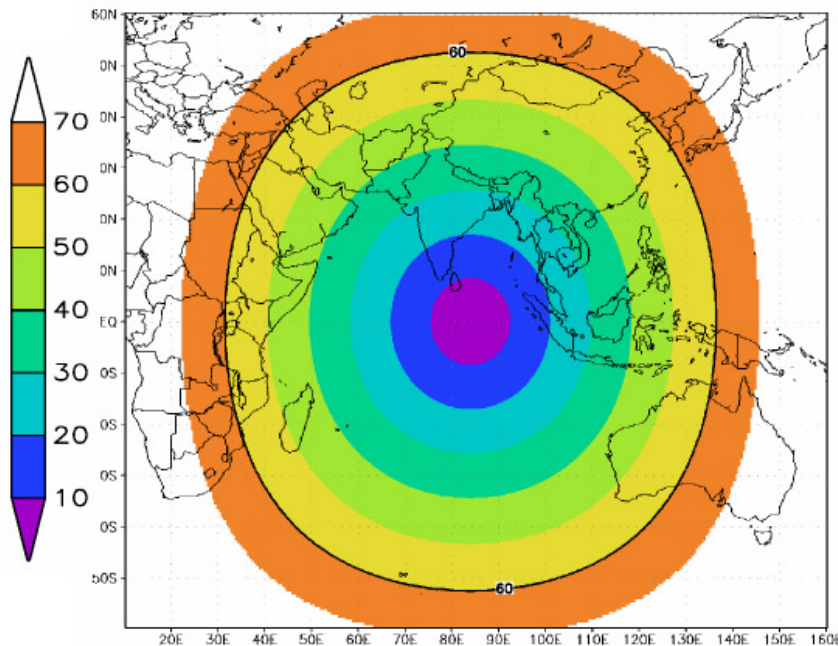
Sigma-0



Sea Surface Height Anomaly

Future EO Missions : INSAT-3D

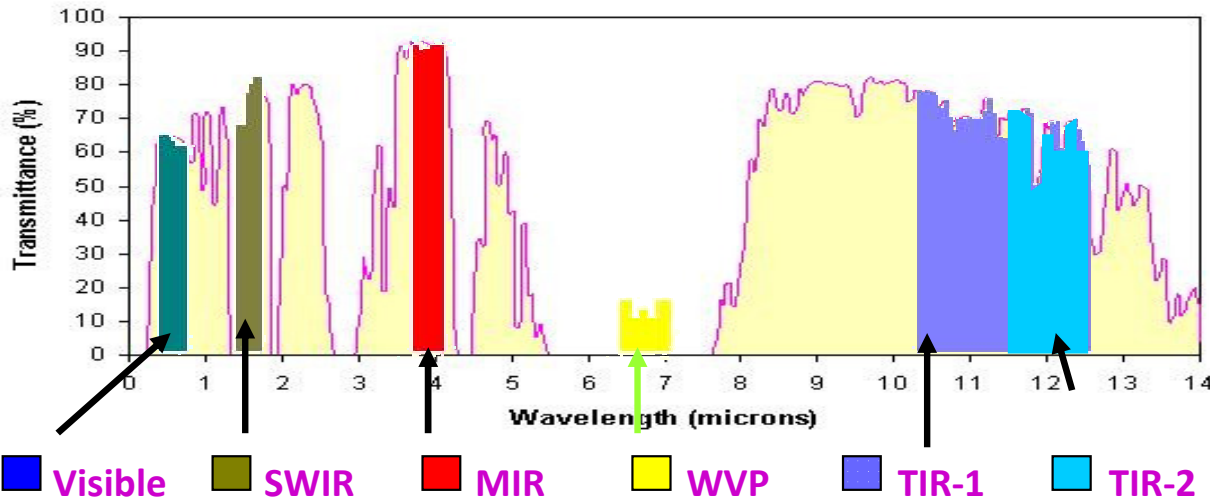
- New Generation geostationary weather satellite, continuity and new observations over & around Indian region
- 6 channel imager, 19 channel sounder
- Launch : July 2013 (likely)
- Applications
 - *Nowcasting; Data Assimilation for NWP; Tropical Convection & Cyclogenesis*
 - *Indian Monsoon; Cloud Microphysics; Land Surface; Hydrology; Agrometeorology*



6000 km x 6000 km scan takes 160 minutes; Indian Landmass can be scanned in ~40 minutes

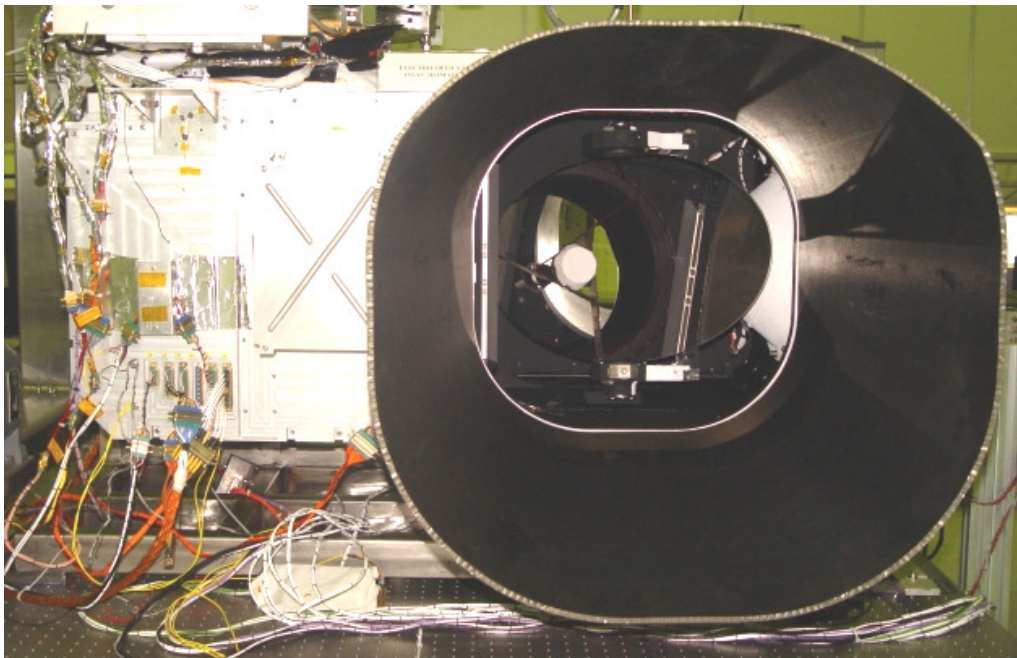
INSAT 3D : IMAGER Payload

Six Spectral Channels from Visible to Thermal IR



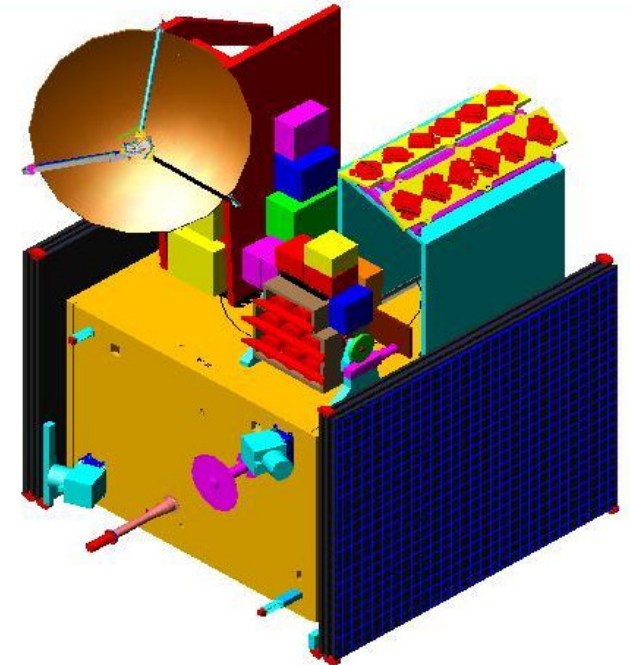
Channel (NE σ T@300K)	Spectral Band (μ m)	Nadir Spatial Res.
VIS#	0.55-0.75	1 km
SWIR	1.55-1.70	1 km
MIR / (1.4K)	3.80-4.00	4 km
WV (1.0K@230K)	6.5-7.1	8 km
TIR-1 / (0.35K)	10.3-11.3	4 km
TIR-2 / (0.35K)	11.5-12.5	4 km

#(SNR>150);

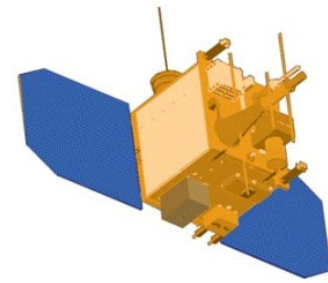


Future EO Missions : Oceansat-3

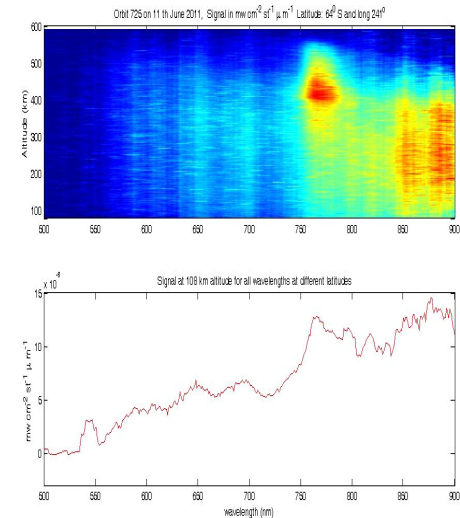
- Polar Sun Synchronous global mission continuing ocean colour (OCM) and wind (Scatterometer) of Oceansat 2
- 15 (13 VNIR + 2 LWIR) Channel Ocean Colour Monitor, 360m (local) /1080 (global), 1080m LWIR, 1400 km swath
- OCM has 5 new channels at 566 & 670 nm (algal bloom), 681 (Chl fluorescence), 780 & 1010 nm (atmospheric correction)
- Ku band (13.515 GHz) pencil scatterometer, 50 x 50 km
- Launch : Likely 2016



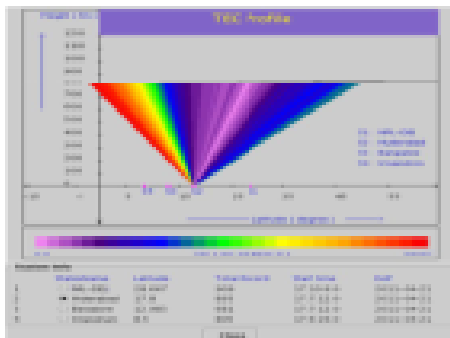
Space Science : Yuthsat



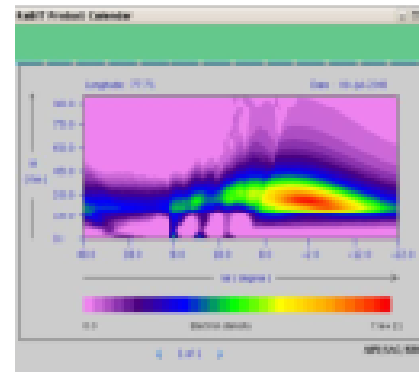
- YOUTHSAT is a joint *Indo-Russian satellite* for stellar and atmospheric studies with the participation of students from Universities at graduate and post graduate level
- Indian Payloads
 - LivHySI camera : Limb Viewing Hyper Spectral Imager to perform airglow measurements of the Earth's upper atmosphere
 - RaBIT : Radio Beacon for Ionospheric Tomography for mapping Total Electron Content
- Russian payload
 - SOLRAD : monitors the solar X- and Y ray fluxes and helps to study solar cosmic ray flux parameters and conditions of the penetration in the Earth's magnetosphere



LivHySI Spectrum



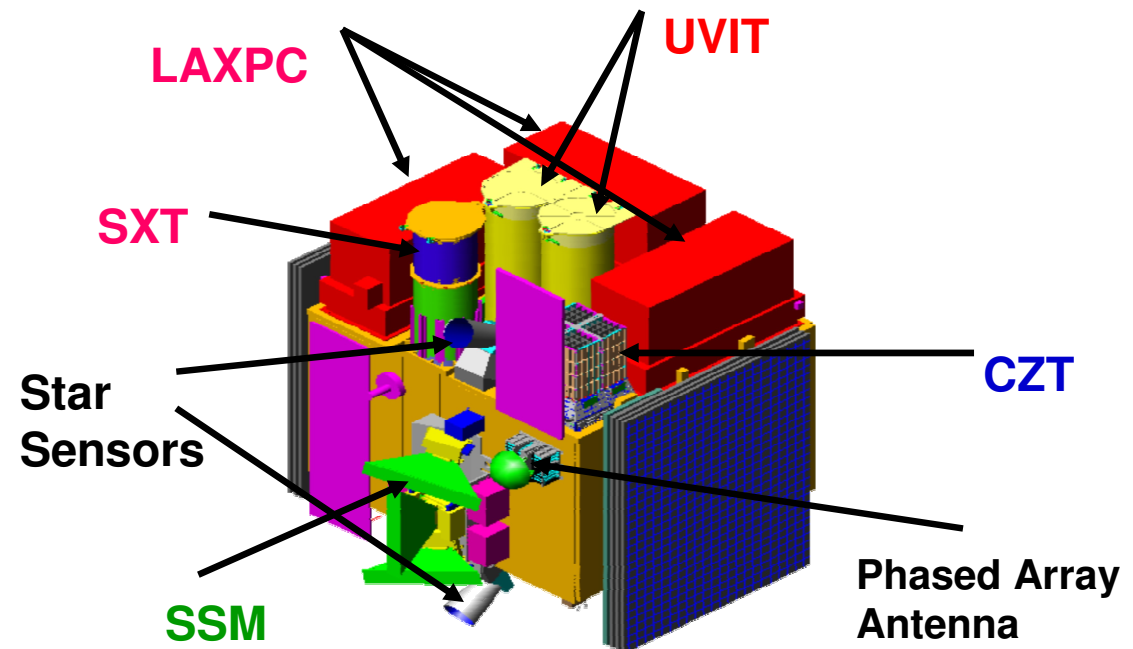
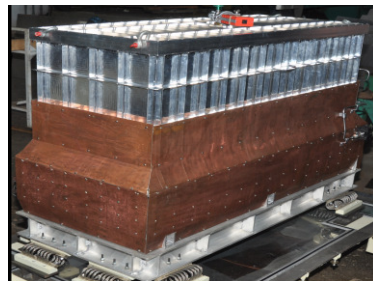
TEC Data



Tomogram

ASTROSAT

- Multi-wavelength observations, UV, optical, high and low energy X rays from a single platform in a coordinated manner along with ground observations
- **Science Payloads**
 - Large Area X-ray Proportional Counter ; Scanning Sky Monitor (SSM) ; UV Imaging Telescope ; Soft X-ray telescope (SXT) ; Cadmium Zinc Telluride Imager ; Charged Particle Monitor
- **Spacecraft & Mission**
 - 680 km altitude ; 8 deg inclination ; launch by PSLV ; 5 year life

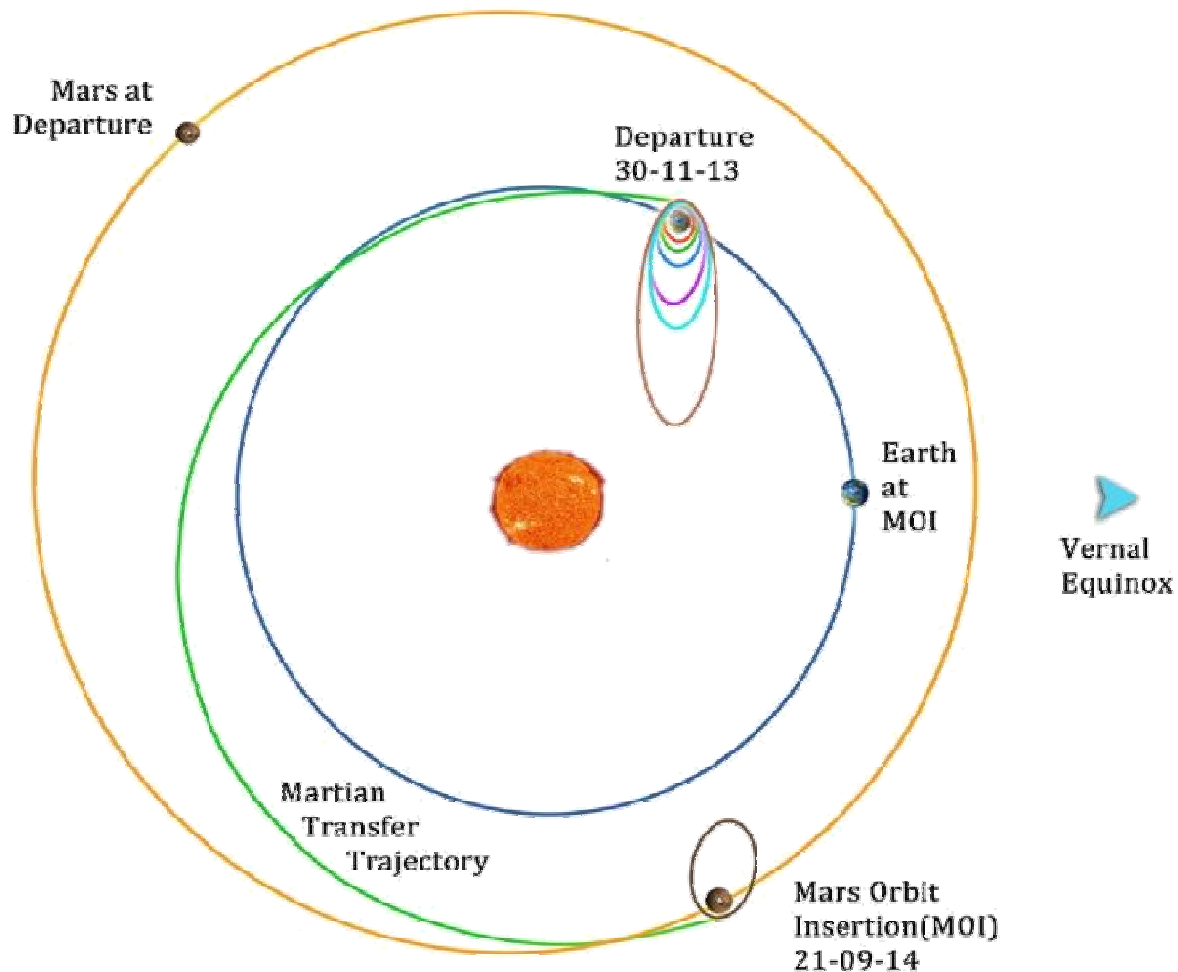


Planetary Exploration

- **Chandrayaan-1, 2008**
- **Mars Orbiter Mission (MOM), 2013 (Planned)**
- **Chandrayaan-2**

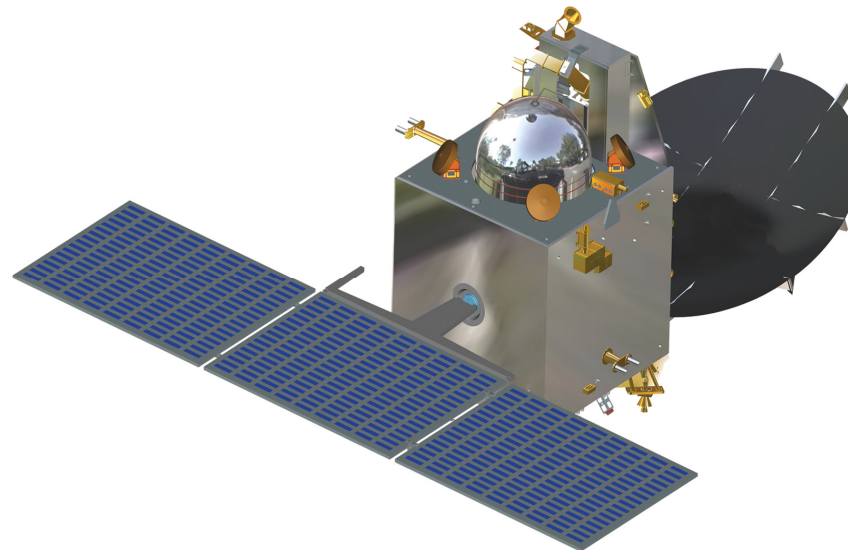
Mars Orbiter Mission (MOM)

- Realise a Mars orbiter and carry out manouvres, insertion-capture and deep space communication
- Science payloads for topography, minerology & atmosphere

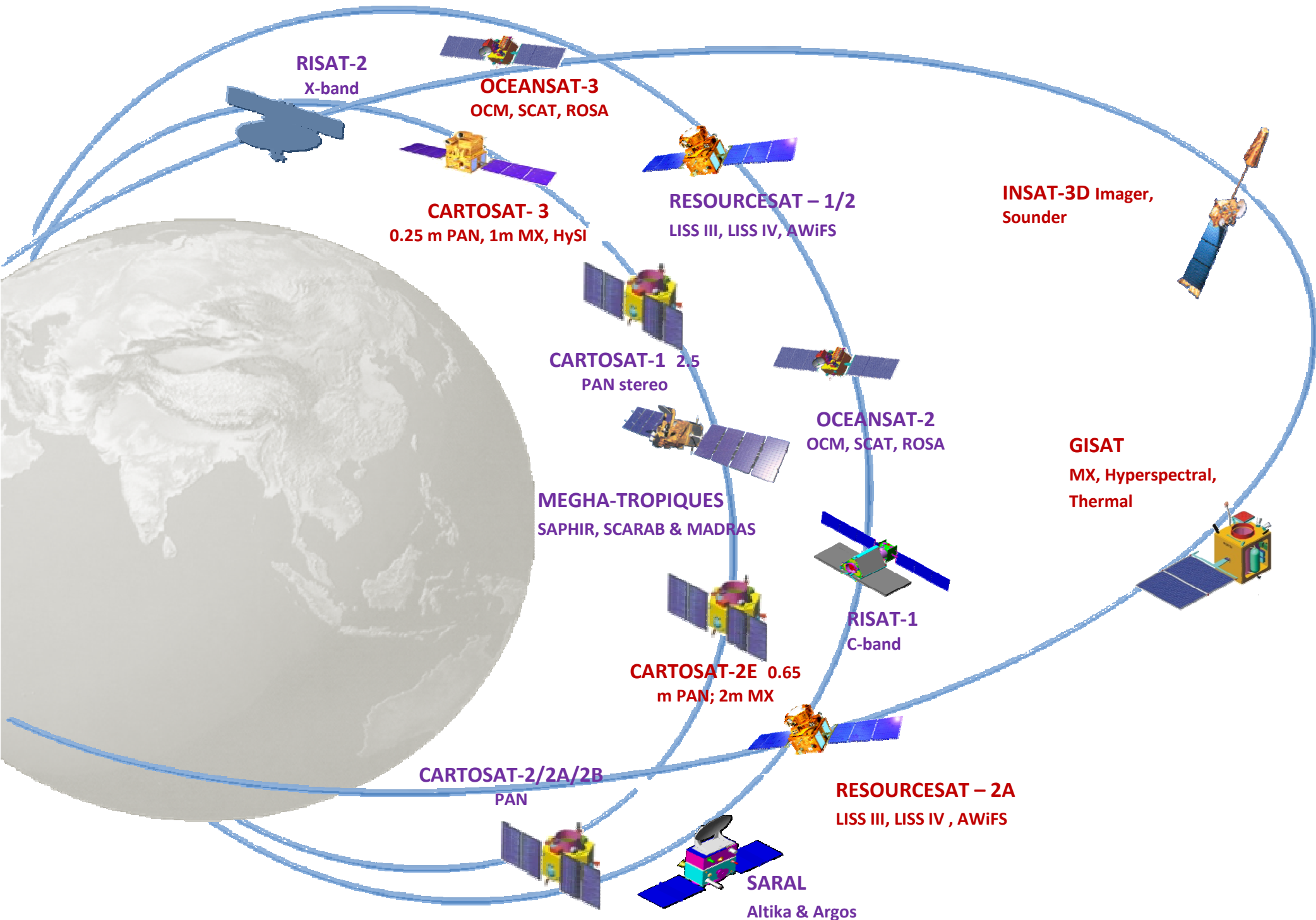


MOM : Launch & Spacecraft

- **Launch by PSLV XL**
- **Spacecraft**
- **Science Payloads**
 - **Layman Alpha Photometer (LAP)**
 - **Methane Sensor for Mars (MSM)**
 - **Mars Exospheric Neutral Composition Analyser (MENCA)**
 - **Mars Color Camera (MCC)**
 - **Thermal Infrared Imaging Spectrometer (TIS)-Backup Payload**
- **Ground Segment**
 - **Indian Deep Space Network (IDSN), 32m antenna**
 - **International ground stations**



Indian EO scenario in near future





*Thank You for
your kind attention*

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