



25 Years of Indian Remote Sensing Satellite (IRS) Series

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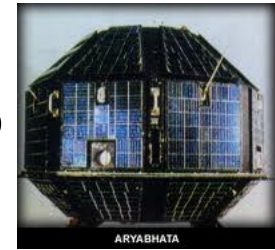
Hyderabad, INDIA



The Beginning

- 1962 : Indian National Committee on Space Research (INCOSPAR), at PRL, Ahmedabad
- 1963 : First Sounding Rocket launch from Thumba (Nov 21, 1963)
- 1967 : Experimental Satellite Communication Earth Station (ESCES) established at Ahmedabad
- 1969 : Indian Space Research Organisation (ISRO) established (15 August)

Pre IRS-1A Satellites



- ARYABHATTA, first Indian satellite launched in April 1975
- Ten satellites before IRS-1A (7 for EO; 2 Met)
- 5 Procured & 5 SLV / ASLV launch

Apr 19, 1975	ARYABHATTA		First Satellite
Jun 07, 1979	BHASKARA – 1	TV (1km 2 band), SAMIR	First EO Satellite
Nov 20, 1981	BHASKARA – 2	(Repeat)	(Repeat)
Aug 10, 1979	ROHINI		For SLV Exptl Flight
Jul 18, 1980	RS - 1		
May 31, 1981	RS – D1		For SLV Dev. Flight
Apr 11, 1983	RS – D2		
Mar 24, 1987	SROSS - 1		For ASLV Dev. Flight
Apr 10, 1981	INSAT-1A	VHRR (2.75/11 km VIS/TIR)	Geostationary
Aug 30, 1983	INSAT-1B	(Repeat)	Meteorological

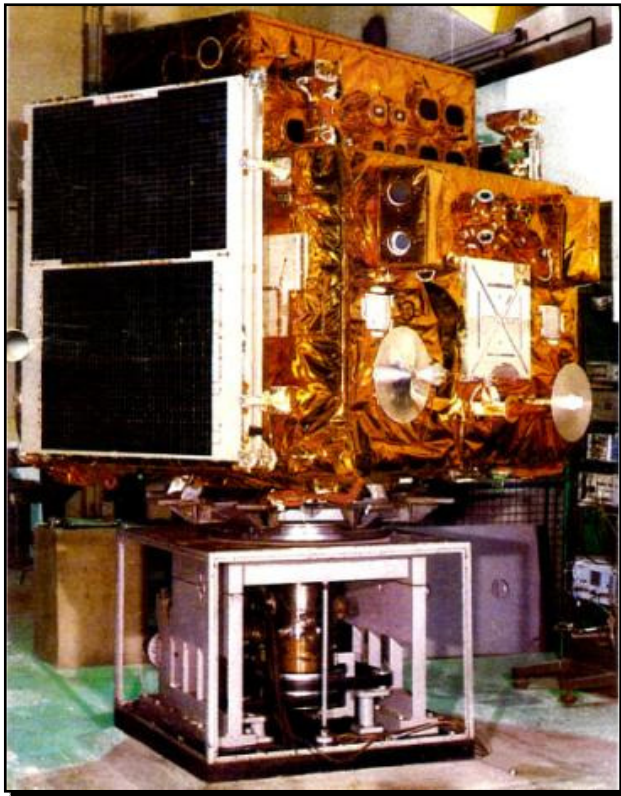


SAMIR : 3 band MW Radiometer
 SROSS : Stretched Rohini Series Satellite



Indian Remote Sensing Satellite (IRS) – 1A

- First Operational EO Application satellite, built in India, launch USSR
- Carried 4-band multispectral camera (3 nos), 72m & 36m resolution



Satellite Launch: March 17, 1988

Baikonur Cosmodrome Kazakhstan



Since IRS-1A

- **Established of operational EO activities for**
 - *EO data acquisition, processing & archival*
 - *Applications & institutionalization*
 - *Public services in resource & disaster management*
 - *PSLV Launch Program to support EO missions*
 - *International partnership, cooperation & global data sets*

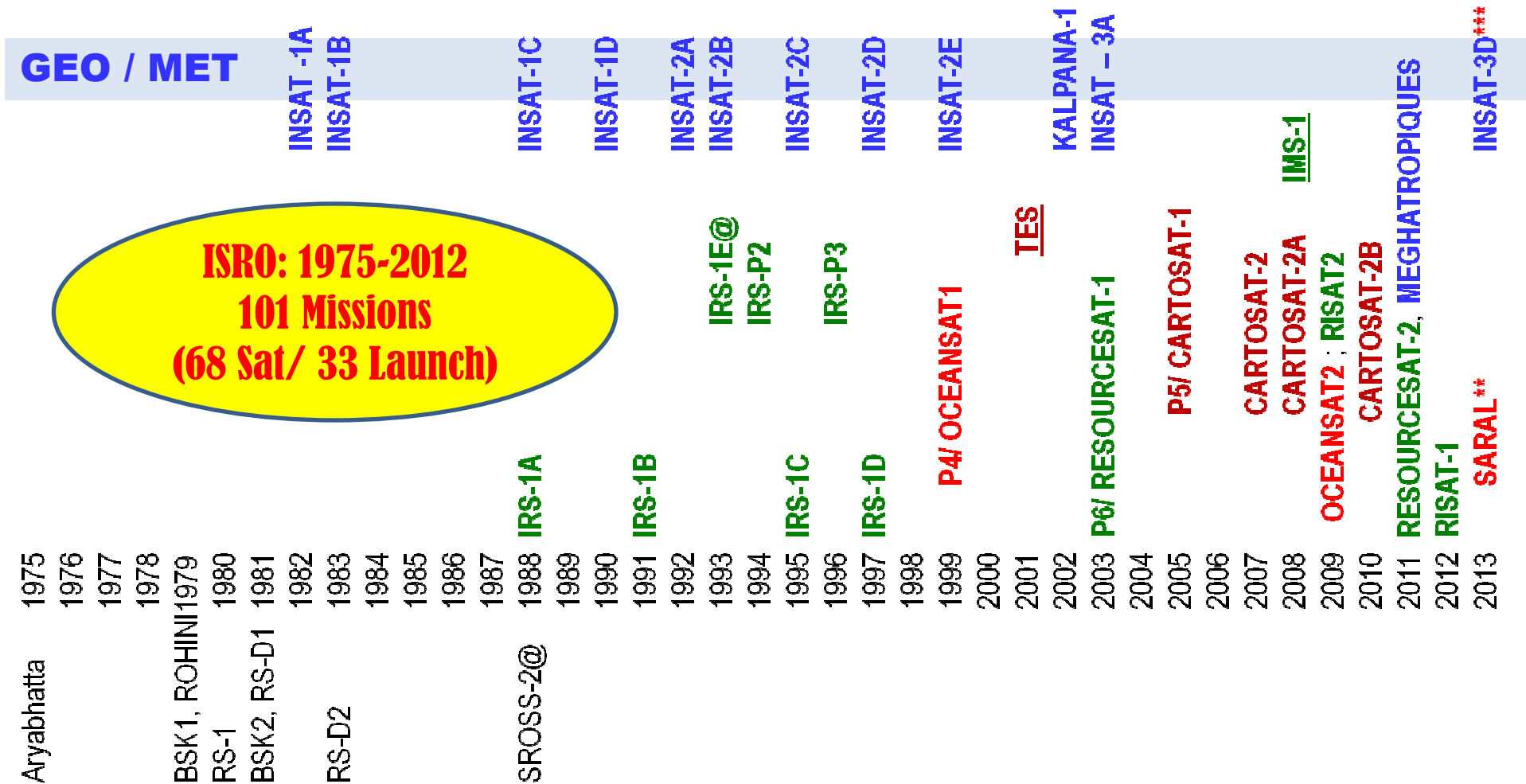


Early IRS Multispectral Sensors

- 1st Generation : IRS-1A, IRS-1B
- 2nd Generation : 3 tier image (WiFS/AWiFS), SWIR band ; IRS-1C/1D, Resourcesat-1/2

Mission	IRS-1A	IRS-1B	IRS-1C	IRS-1D
Weight (kg)	975 kg	975 kg	1250 kg	1250 kg
Onboard power@	600 Watts		809 Watts/(9.6 sqm)	
Payloads, (Solid State Push Broom Camera)	LISS-1 (72.5 m)		WiFS (189 m)	
	LISS-2A , 2B (36.25 m)		LISS-3 (23.6m) & PAN (<6m)	
Onboard TapeRecorder	-	-	62 Gb	62 Gb
Launch / Mission Completion	Mar 17,1988/ Jul 1996	Aug29,1991/ Dec20,2003	Dec 28, 1995/ Sep 21, 2007	27 Sep 1997/ Jan 2010
Launch Vehicle/ Site	Vostok,Baikanur, Kazakhstan		Molniya,Baikanur , Kazakhstan	PSLV C1, SHAR India
Orbit # (ht km)	904 km	904 km	817 km	740 x 817 km
Inclination	99.08°	99.08°	98.69°	98.69°
Repetivity/ (Orbits)	22 days / (307 orbits)			24 days

ISRO EO SATELLITES



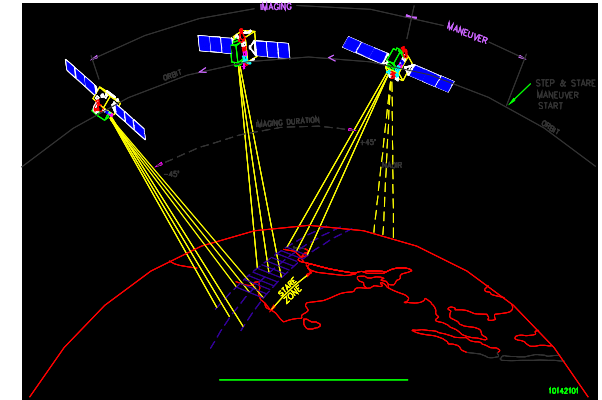
METEOROLOGICAL SATELLITES :

OCEANOGRAPHIC APPLICATION SATELLITES :

CARTOGRAPHIC SATELLITES :

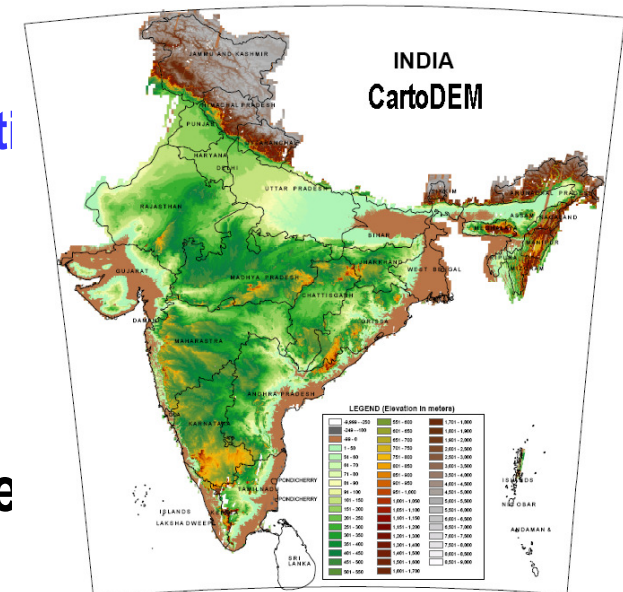
Cartographic Application Satellites

- PAN Camera (5.8m) onboard IRS-1C/1D (1995/1997) was forerunner to Cartographic series
- TES (2001) experimental satellites for HR images
 - Step & stare imaging



Step and Stare imaging

- IRS-P5/Cartosat-1 (2005) in-track stereo imaging
 - Spatial Res 2.5m, Fore & Aft cameras
 - Global Acquisition, Indian CARTODEM, many IGS
 - Input to creation of Orthoimages for 1:10,000 thematic mapping



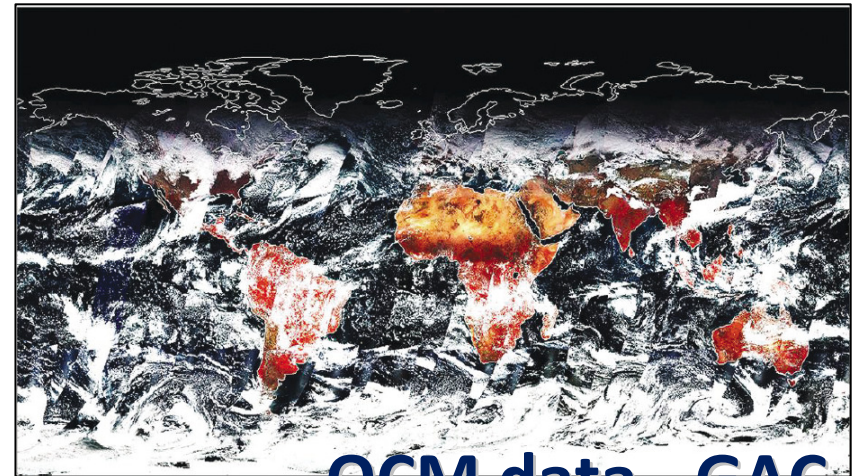
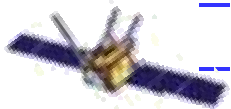
- Cartosat 2 (2007), 2A (2008), 2B (2010) continue panchromatic HR imaging (< 1m resolution)

Ocean Satellites & Sensors

- IRS-P3 (Mar 21, 1996)
 - Experimental, MOS (DLR), WiFS
- IRS-P4/Oceansat-1 (May 26, 1999)
 - Ocean Color Monitor (8#, 360m)
 - MSMR Microwave Radiometer



- Oceansat-2 (Sep 23, 2009)
 - OCM,
 - Scatterometer
 - ROSA

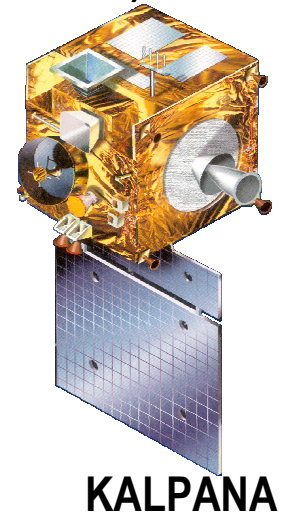


OCM data - GAC

- **FUTURE & PLANS**
 - SARAL : Altimeter (Feb 2013 Launch)
 - Oceansat-3 : Improved OCM (with TIR), Scatterometer

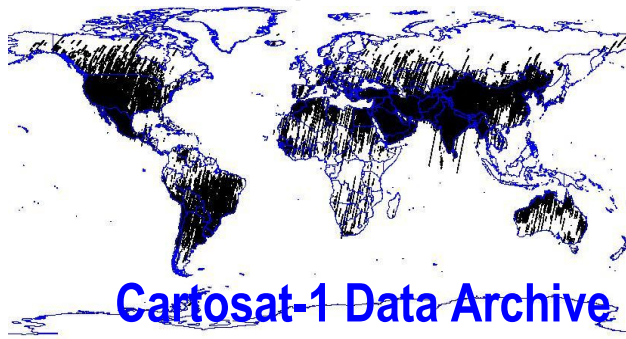
Atmospheric & Meteorological Sensors

- Experimental Sensors
 - MICROWAVE RADIOMETER : SAMIR [BHASKAR 1, 1979; BHASKAR 2, 1981], MSMR (Oceansat-1, 1999)
 - SCATTEROMETER : OSCAT (Oceansat 2, 1999)
 - RADIO OCCULTATION : ROSA (Oceansat 2, 1999)
- Operational Meteorology Sensors Geostationary (Since 1981)
 - VHRR (2.75/11km VIS/TIR) : INSAT 1A/1B/1C/1D; INSAT 2A/2B/2C
 - VHRR (2/8/8km VIS/WV/TIR) : INSAT 3A, KALPANA
 - CCD (1km) : INSAT 2E/3A
- Scientific Missions
 - ISRO-CNES : Megha-tropiques (2011)
 - MADRAS, SAPHIR, SCARAB
- **FUTURE**
 - INSAT 3D : 6 Channel Imager & 19 Channel Sounder (Launch Mid 2013)

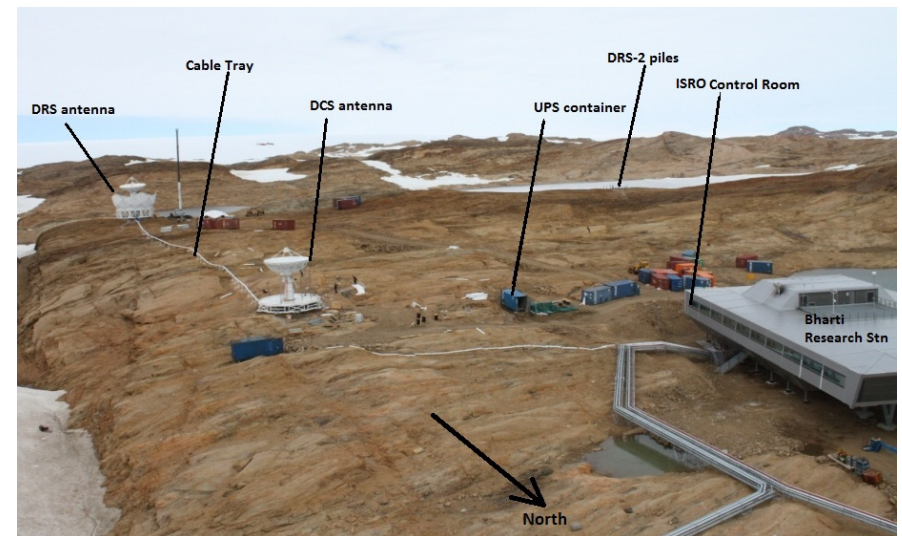
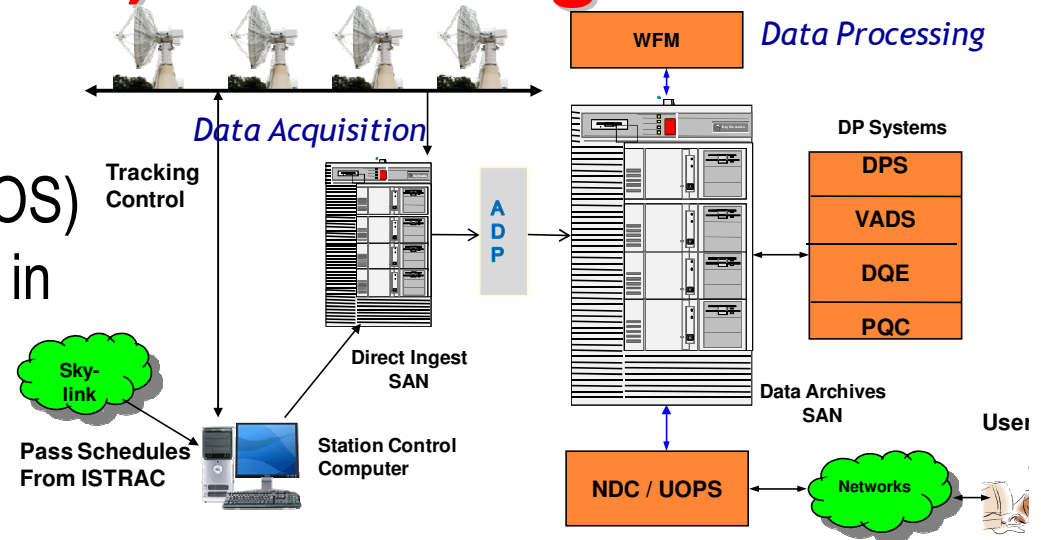


Data Acquisition, Processing & Archive

- Integrated Multi-mission Ground Segment for EO Satellites (IMGEOS) established at Shadnagar (NRSC) in 2011
- Antarctica Ground Station for EO Satellites (AGEOS) at Larsemann Hills, 2013
- Many IGS has acquired IRS Data



- Indian data archive now exceeds 1000 TB

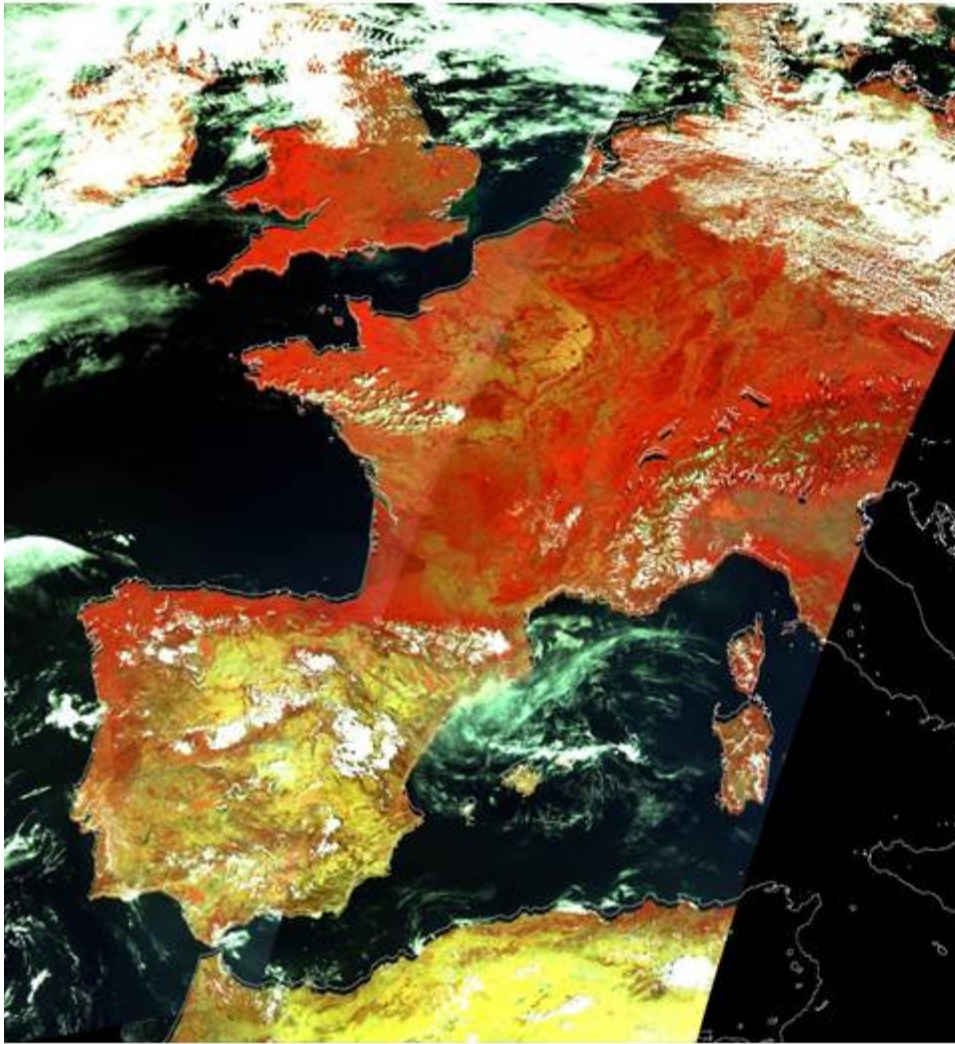




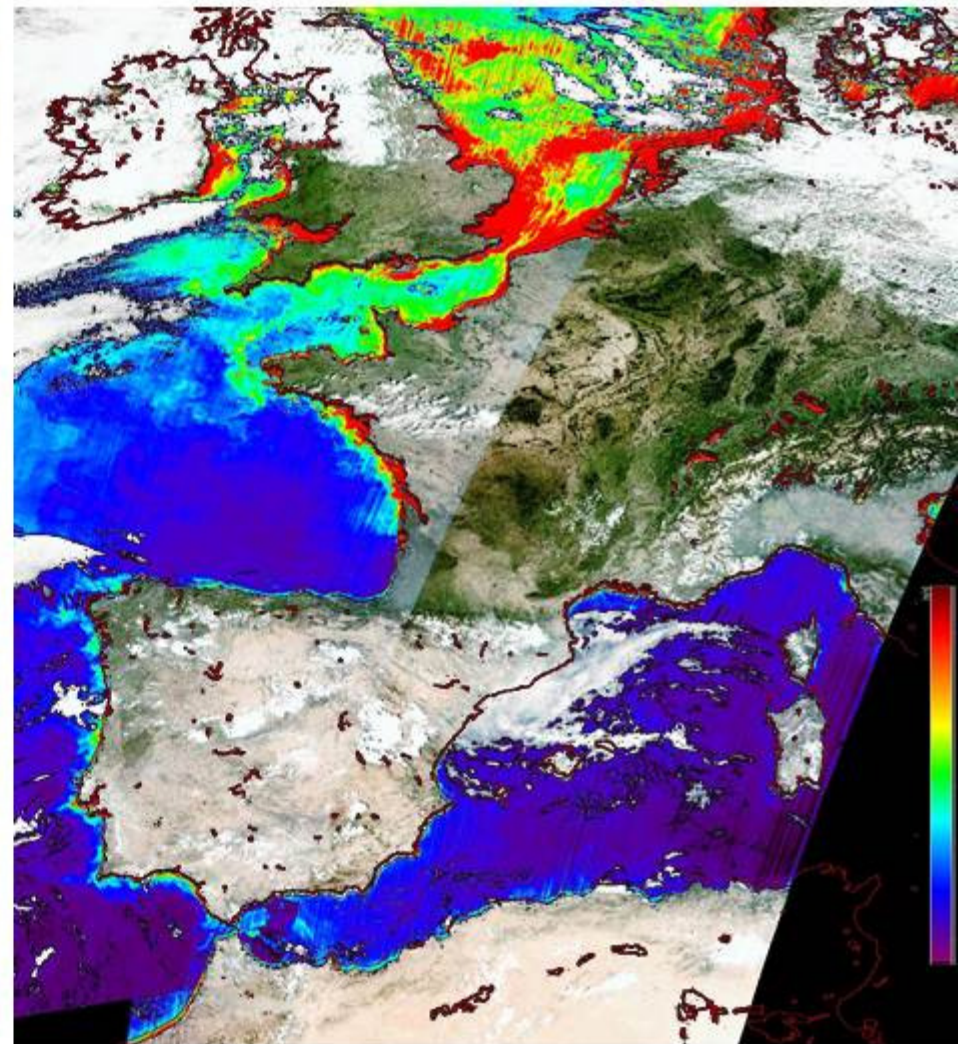
International Partnerships & Cooperation

- Data exchange & support for disaster management
- Indian EO satellite data reception at International Ground Stations (IGS)
- International sensors on Indian EO satellites
 - *MOS (Germany), ROSA (Italy), AIS (Canada)*
- Piggy-back launch on PSLV
 - *On 11 PSLV missions, 29 foreign satellites from 18 countries*
- Joint Missions
 - *ISRO CNES : Megha-tropiques, SARAL*
- Global Data Sets
- Contribute to CEOS Global Virtual Constellation

Ocean Color Monitor (GAC) : Ocean & Land



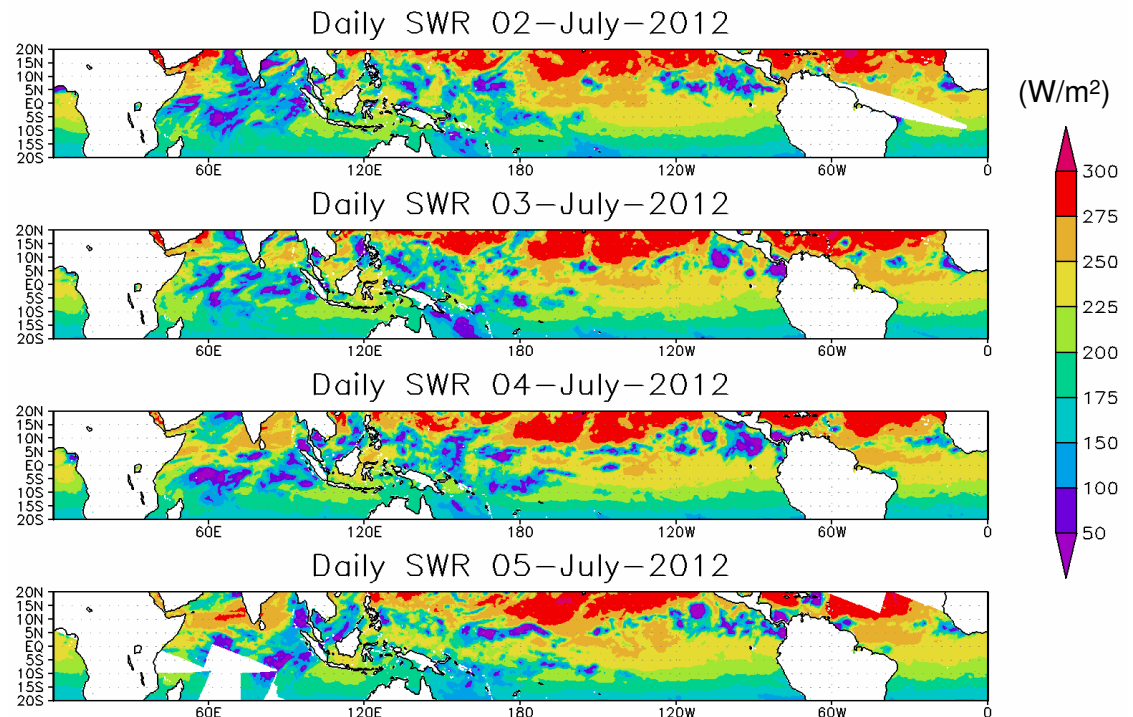
OCEANSAT-2 OCM
Image Mosaic Sep 7-8, 2012



Chlorophyll-a OCM-2
Sep 7-8, 2012

Global Products

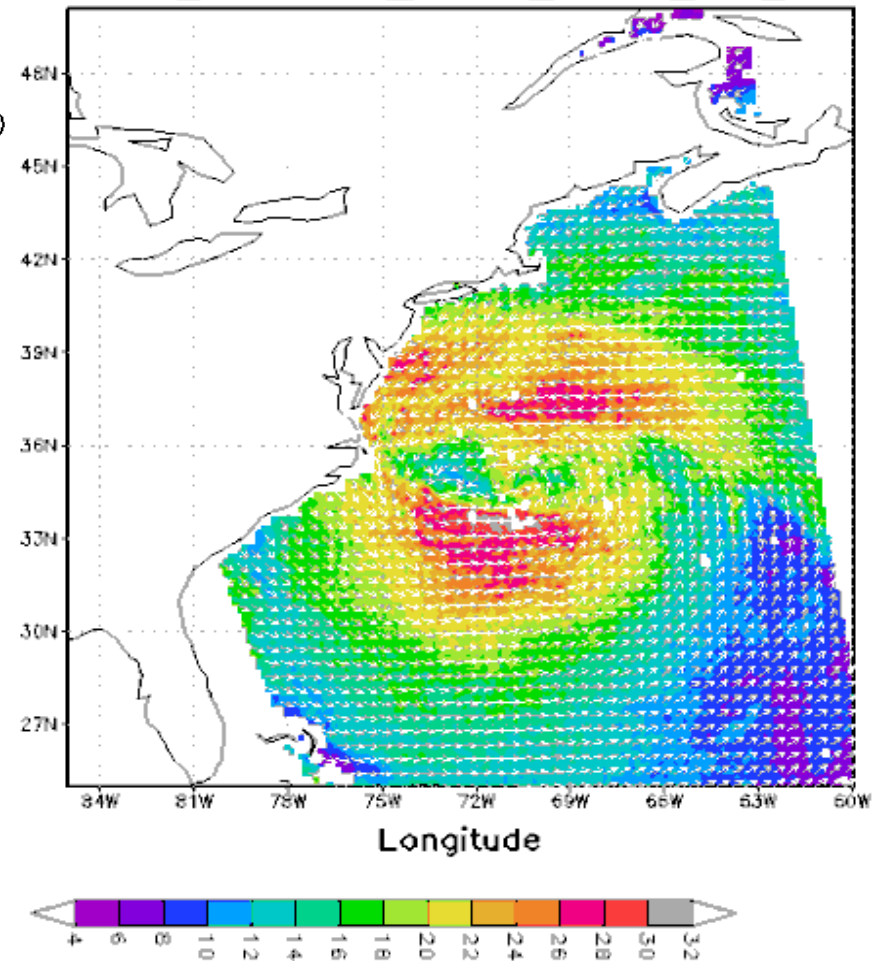
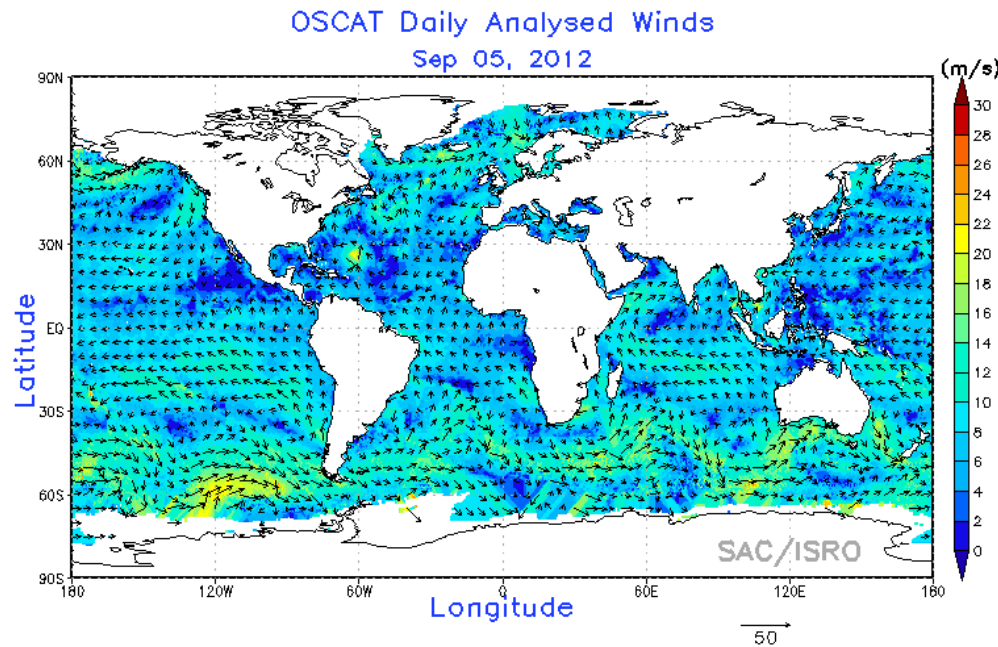
- Global data from OSCAT onboard Oceansat-2 disseminated in near real time
 - *Data acquisition at SVALBARD, NRT processing at Shadnagar (India)*
- OCM Global Area Coverage (GAC) for ocean (8-day) and land (monthly)



- Meghatropiques SCARAB
- SARAL data would be available from ISRO & CNES

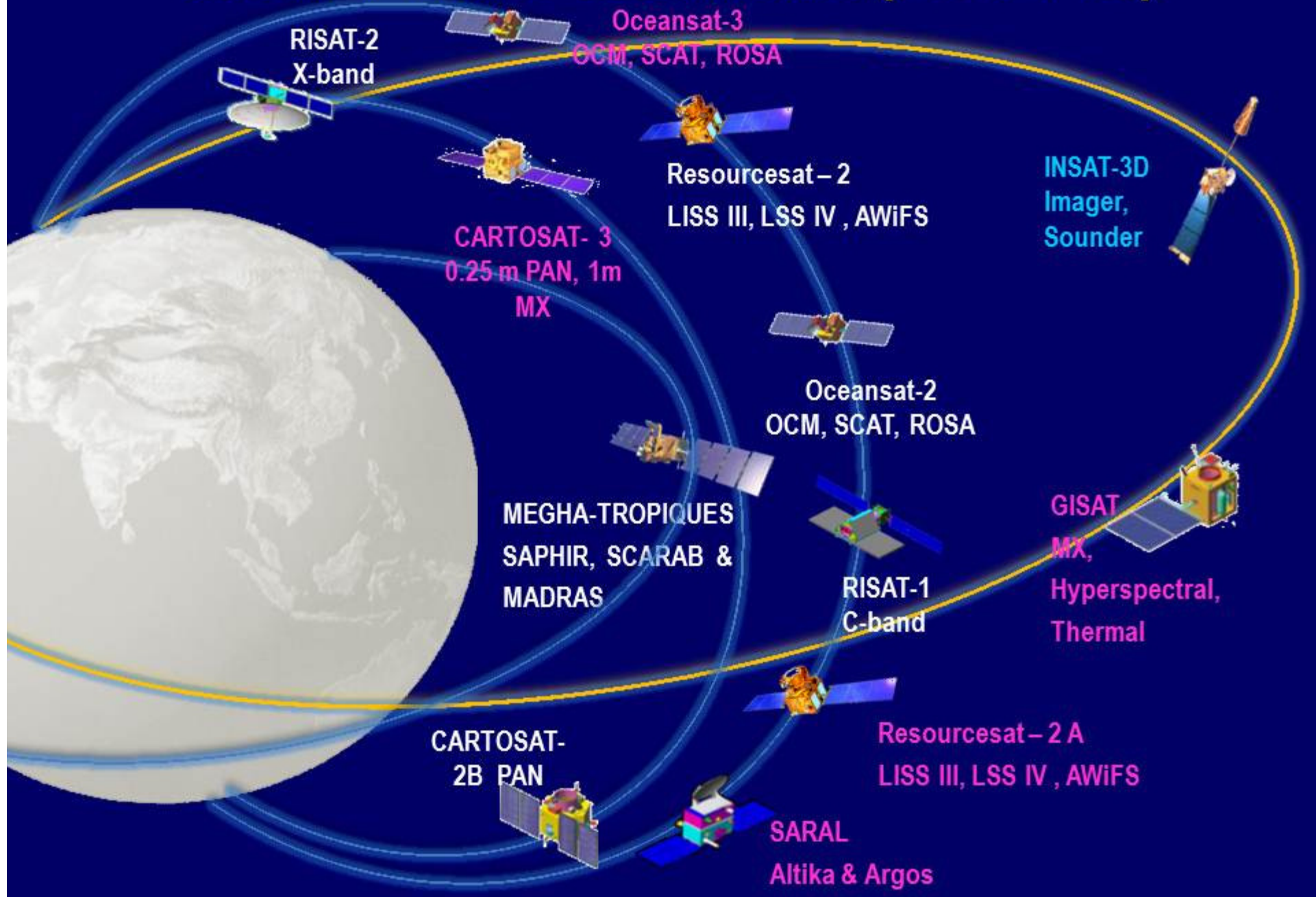
Global Products - OSCAT

SANDY - 29 October 2012
 OS2 HWW Winds
 O2SCT_20121029_16413_16414_L04_HWW



- Global data from OSCAT onboard Oceansat-2 disseminated in near real time

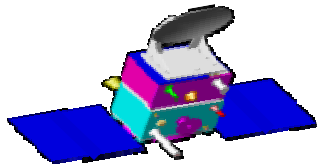
Near-Future Scenario (2012-16)



EO – Near Future Satellites

SARAL

Satellite with ARgos & ALtika
- Joint ISRO-CNES Mission



Payloads

- Ka-band Altimeter (~35.5GHz)
- Dual freq Radiometer (23.8/36.8 GHz)

Status

- PSLV Launch : 25 Feb 2013

GISAT

Multiple acquisition from Geosynchronous Orbit

Payloads

- High resolution MX (50 m) - VNIR (HRMX-VNIR):
- Hyper spectral VNIR & SWIR: 320m and 192m Res.
- TIR 1.5km (HRMX-TIR)

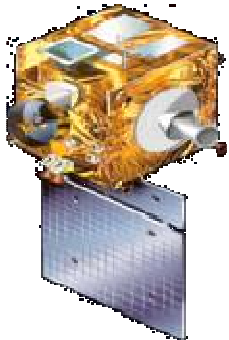


Status

- PSLV Launch 2016/17

INSAT - 3D

For improved understanding of weather systems



Payloads

- 19 channel Sounder
- 6 Channel Imager

Status

- Launch by 2013

Resourcesat-2A

Land and Water Resources Applications – Continuity Mission

Payloads

- LISS IV Mx, LISS III & AWiFS



Status

- PSLV Launch : 2015/16

... Followed by Oceansat-3 & Hyperspectral, Very High Resolution imaging sensors



Cartosat 2-A PAN & P6 LISS-IV

Thank you