

# Indian Remote Sensing Satellites

- *Current and Future Missions* -

Presented by:  
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- Who is EOTec
- Current IRS Satellite Missions
  - Second Generation
    - IRS-1C/1D
    - IRS-P4
  - Third Generation
    - Resourcesat-1/2
    - Cartosat-1
  - Fourth Generation
    - Cartosat-2
- Future IRS Satellite Missions
- Conclusions

- Earth Observation Technologies LLC (EOTec) now serves as **Managing Agents** for ANTRIX Corporation Ltd.
  - ANTRIX is the commercial arm of ISRO
  - EOTec's role is to help identify, qualify and seek purchase agreements on behalf of ANTRIX with prospective customers and resellers worldwide for:
    - IRS satellite access
    - IRS ground station equipment
    - IRS data sales
    - Launch Services
    - Manufacturing Services
    - Other Services



# Current IRS Satellite Missions

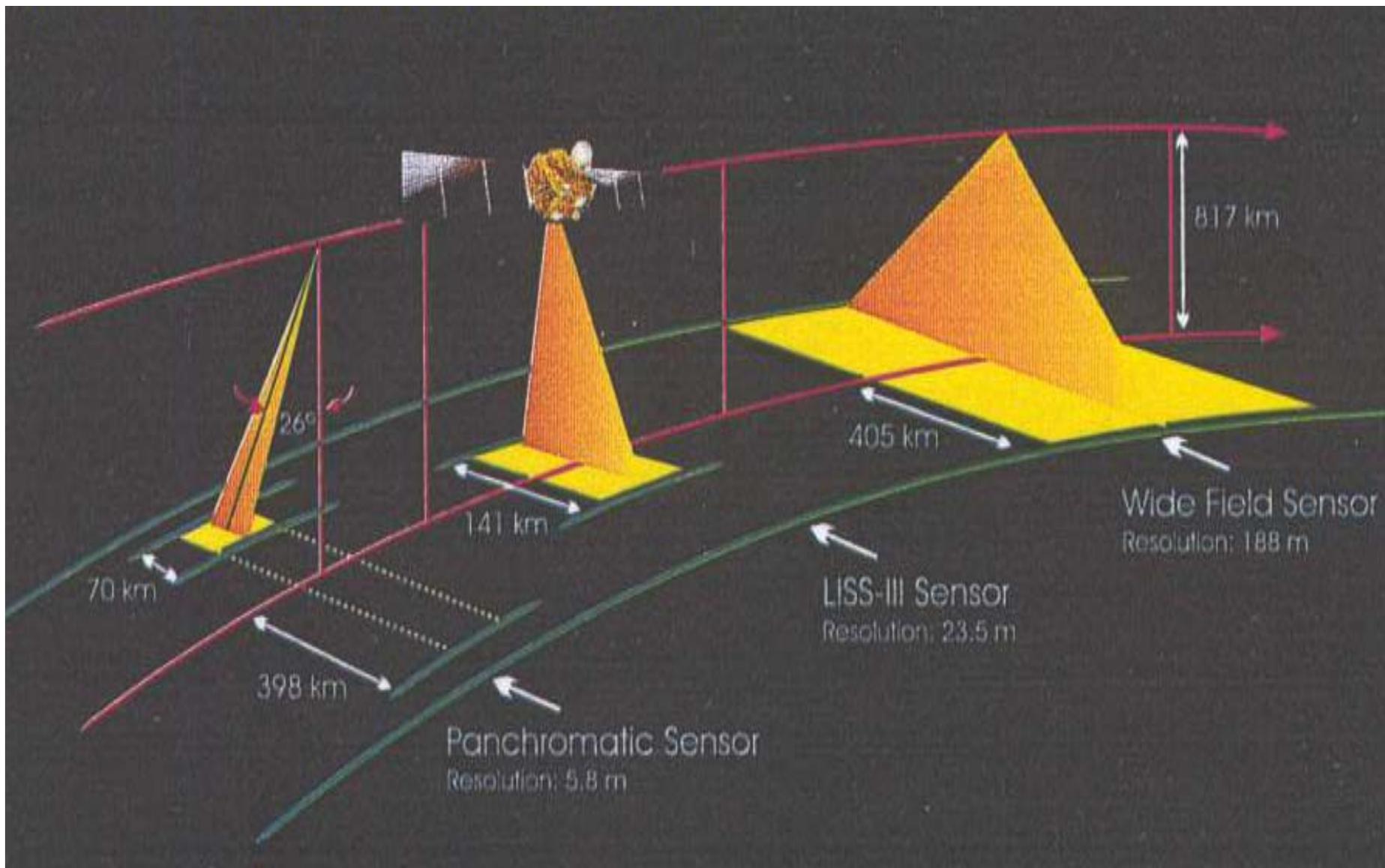
IRS – 1C

IRS – 1D

IRS – P5 (“Cartosat-1”)

IRS – P6 (Resourcesat-1)

- IRS 1C and 1D
  - 1995 to 2006
    - Large ground station network
- Sensors
  - WiFS
    - 188m resolution, 810 km swath, 2 spectral bands, 5 day revisit
  - LISS III
    - 23.5m and 70m resolution, 3 spectral bands VNIR (23.5m resolution), SWIR band (70m resolution), 24 day repeat cycle
  - LISS IV
    - 5.8m resolution (Pan only), 5 day revisit



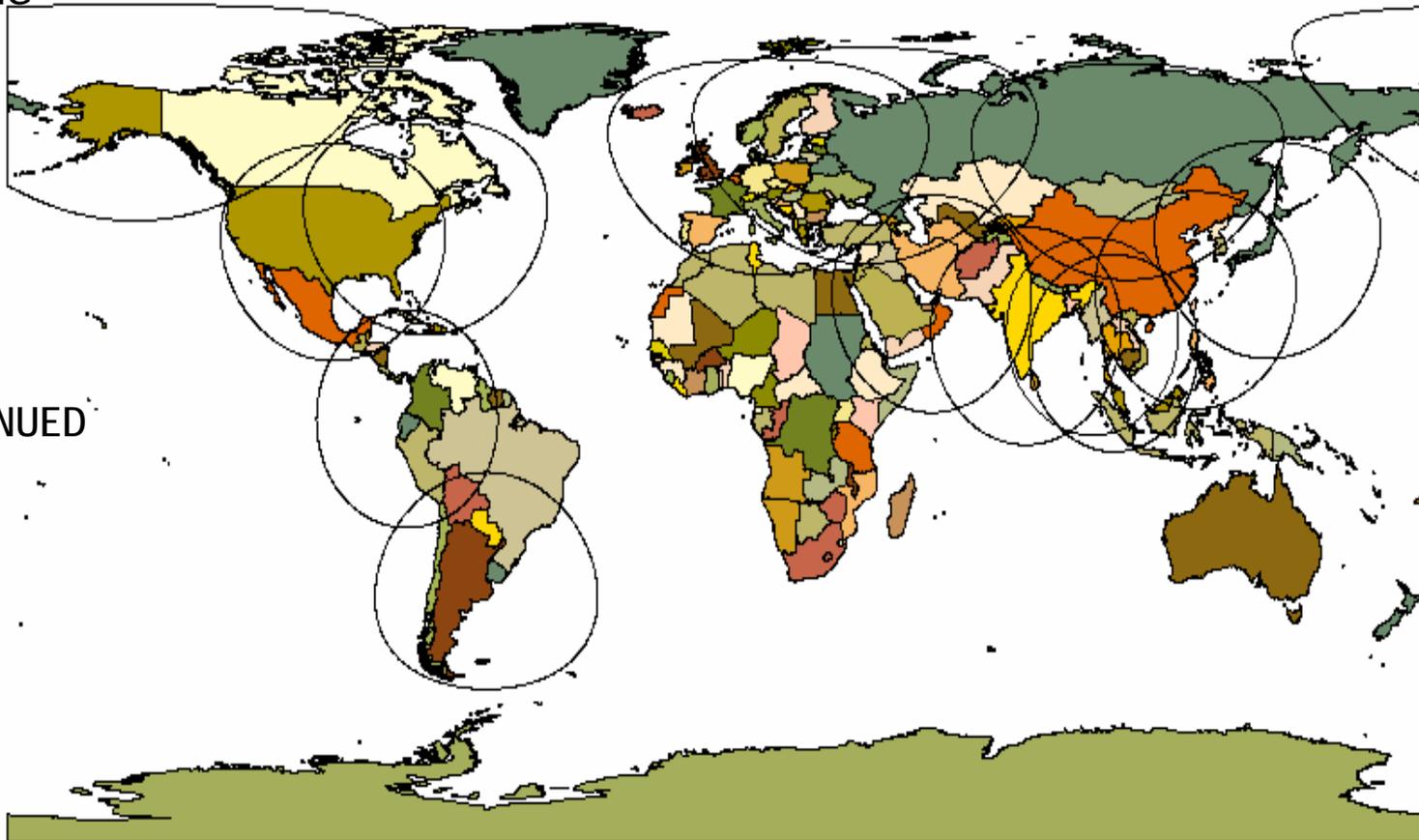
### CURRENTLY OPERATING

- Union of Myanmar
- Eagle Vision 1, 2 & 5
- Scannex (Russia)
  - Moscow
  - Eastern Siberia
  - Kazakhstan

### RECENTLY DISCONTINUED MIGRATED TO IRS-P6

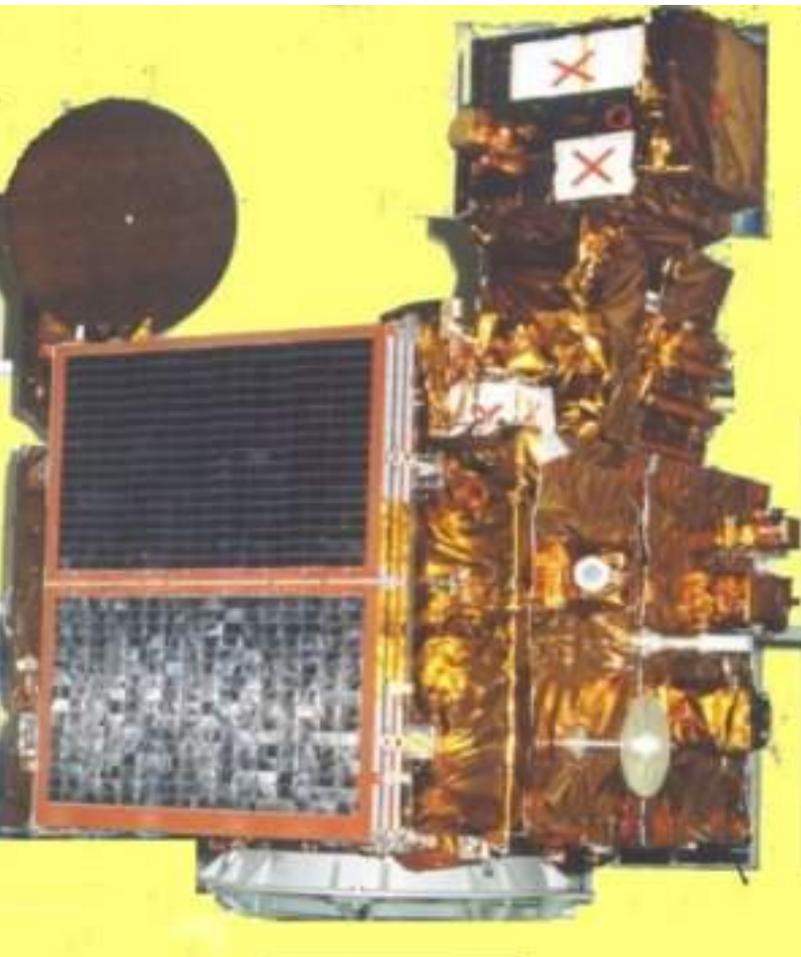
- Taiwan (FRSC)
- Germany (NSG)
- Thailand (GISTDA)
- UAE (UAEAF)
- Japan (RESTEC)
- Argentina (CONAE)
- Ecuador (CLIRSEN)

### IRS-1C/D Network

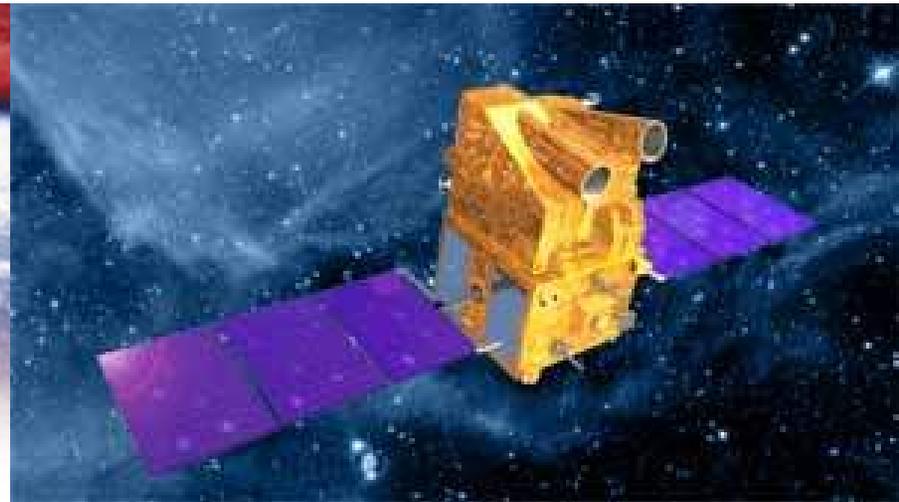


- Both satellites have exceeded design life
- Resourcesat-1 replaces IRS-1C/D series
- Missions will end soon (end of '07 latest)

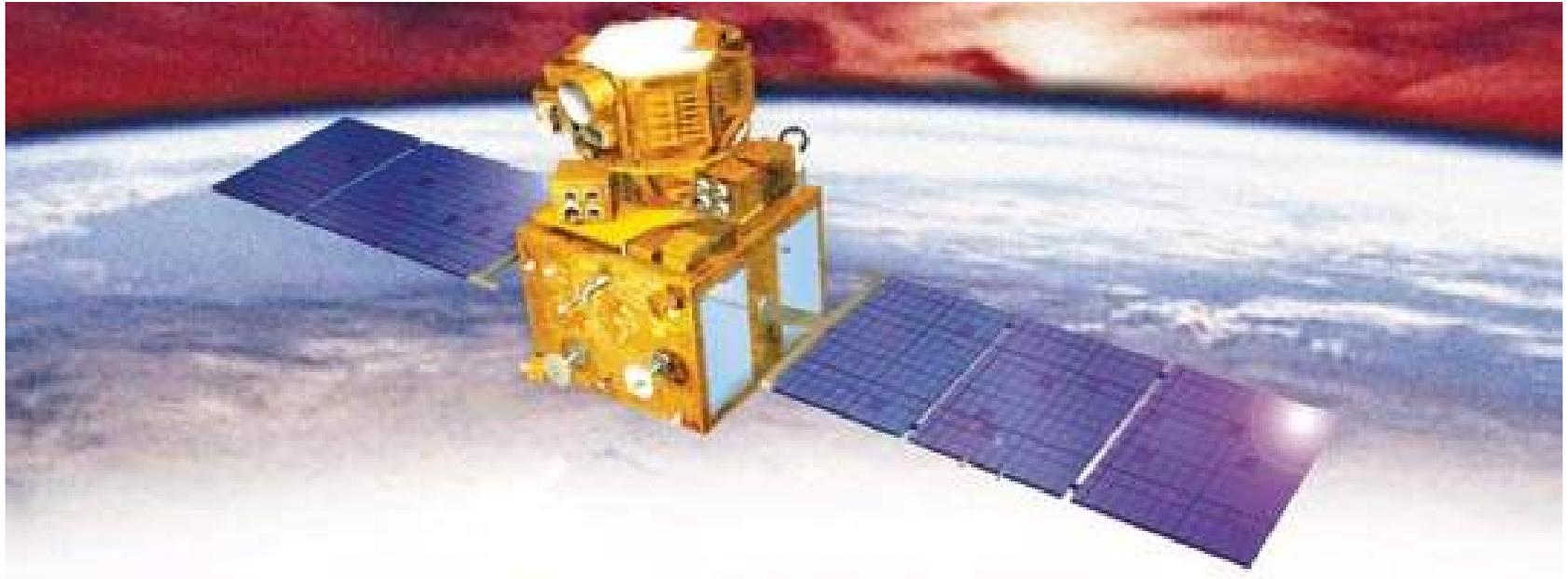
The IRS-P4 (Oceansat), the eighth satellite built in India under the indigenous Indian Remote Sensing Satellite program was successfully launched on 26 May 1999 carrying two payloads Ocean Color Monitor (OCM) and Multifrequency Scanning Microwave Radiometer (MSMR).



OCM		MSMR
•Spectral bands (in nanometres):		•Frequencies:(GHz)
1	402-422	06.60
2	433-453	10.65
3	480-500	18
4	500-520	21
5	545-565	
6	660-680	
7	745-785	
8	845-885	
Spatial resolution: 360m x 236m •FOV: +/- 43 deg. •Swath: 1420 km •Radiometric Quantisation: 12 bits Along track steering +/-20 deg. in steps of 5 deg. to avoid sun glint		Polarization: V&H for all frequencies •Spatial resolution: 120,80,40 and 40 Km •Swath: 1360 km •Radiometric Resolution: 12 bits



- Resourcesat-1 & 2
- Cartosat-1
  - 2003 to 2013



### **Mission Objectives:**

- To provide continued remote sensing data services on an operational basis for integrated land and water resource management with enhanced multi-spectral / spatial coverage and stereo imaging.
- To further carry out studies in advanced areas of user applications such as improved urban planning, national security, crop discrimination, crop yield, forestry and disaster management.

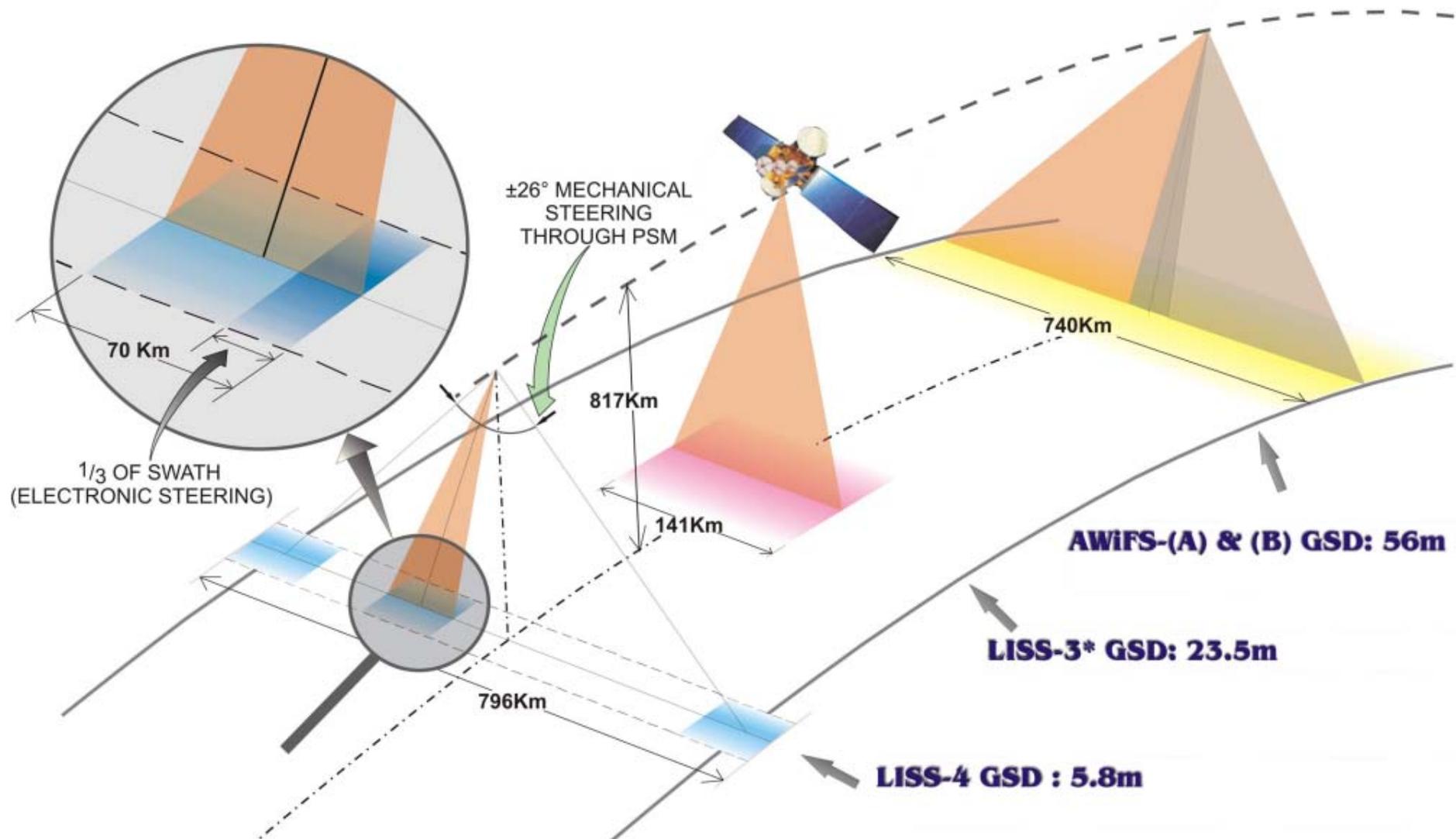
<b>Orbit :</b>	<b>Circular Polar Sun Synchronous</b>
<b>Orbit height :</b>	<b>821 km</b>
<b>Orbit inclination :</b>	<b>98.76°</b>
<b>Orbit period :</b>	<b>101.35 min</b>
<b>Number of Orbits per day :</b>	<b>14</b>
<b>Local Time of Equator crossing :</b>	<b>10.30 a.m.</b>
<b>Repetivity (LISS-3) :</b>	<b>24 days (341 orbits)</b>
<b>Revisit (LISS-4) :</b>	<b>5 days</b>
<b>Lift-off Mass :</b>	<b>1,360 kg</b>
<b>Attitude and Orbit Control :</b>	<b>3-axis body stabilized using Reaction Wheels, Magnetic Torquers and Hydrazine Thrusters</b>
<b>Power :</b>	<b>Solar Array generating 1250 W (at EOL), Two 24 Ah Ni-Cd batteries</b>
<b>Mission Life :</b>	<b>5 years (launched 10/17/03)</b>
<b>Launch Dates :</b>	<b>Resourcesat-1 launched on 10-17-03 Resourcesat-2 scheduled for <b>mid 2009</b></b>



PAYLOADS	LISS-4	LISS-3	AWiFS
Spatial Resolution (m)	5.8	23.5	56
Swath (km)	23.9 (MX mode) 70.3 (PAN mode)	141	740
Spectral Bands (micron)	0.52-0.59 0.62-0.68 0.77-0.86	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70
Quantisation (bits)	7	7	10
Square Wave Response (at Nyquist)	>0.20	B2 > 0.40 B3 > 0.40 B4 > 0.35 B5 > 0.20	B2 > 0.40 B3 > 0.40 B4 > 0.35 B5 > 0.20
Power (W)	216	70	114
Weight (kg)	169.5	106.1	103.6
Data Rate (MBPS)	105	52.5	52.5

**NOTE:** Some miniaturization of systems will occur on Resourcesat-2

## IRS-P6 THREE TIER IMAGING



# Manasarovar Lake, Tibet



IRS-P6 AWiFS

# Part of Myanmar coast

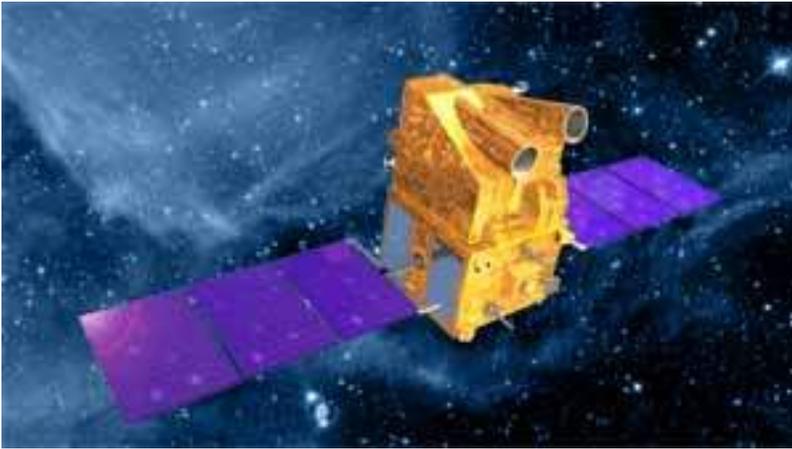


IRS-P6 LISS-III

# San Francisco, CA



IRS-P6 LISS-IV (Mono)



### Mission Objectives:

- To design and develop an advanced 3-axis body stabilized remote sensing satellite for stereo imaging and cartographic applications.
- To further stimulate new areas of user applications in the areas of cartographic applications, urban management, national security, and disaster management.



<b>Orbit :</b>	<b>Circular Polar Sun Synchronous</b>
<b>Orbit height :</b>	<b>~618 km</b>
<b>Orbit inclination :</b>	<b>98.87°</b>
<b>Orbit period :</b>	<b>97 min</b>
<b>Number of Orbits per day :</b>	<b>15</b>
<b>Local Time of Equator crossing :</b>	<b>10.30 a.m.</b>
<b>Orbital Repetivity Cycle :</b>	<b>126 days</b>
<b>Nominal Wait Time to Acquire Adjacent Path :</b>	<b>11 days</b>
<b>Max. Wait Time for Revisit :</b>	<b>5 days</b>
<b>Data Rate :</b>	<b>105 Mb/s</b>
<b>Solid state storage:</b>	<b>120GB</b>
<b>Lift-off Mass :</b>	<b>1,560 kg</b>
<b>Attitude and Orbit Control :</b>	<b>3-axis body stabilized using Reaction Wheels, Magnetic Torquers and Hydrazine Thrusters</b>
<b>Power :</b>	<b>5 sq m Solar Array generating 1100W (End Of Life) Two 24 Ah Ni-Cd batteries</b>
<b>Mission Life :</b>	<b>5 years (launched 05/05/05)</b>

Payloads	: Two PAN Cameras (PAN fore mounted with a tilt of +26 deg and PAN aft mounted with a tilt of - 5 deg from the yaw axis to generate stereoscopic imagery)
Instantaneous Geometric Field of View (IGFOV)	: < 2.5 m
Swath	: 30 km
Spectral Band	: 0.50-0.85 Micron
Data rate	: 105 Mbps for each camera
Solid State Recorder	: 120 GB capacity for image data storage



*CARTOSAT-1  
PAN camera*



# INITIAL IMAGE OF CARTOSAT-1

## 3D PERSPECTIVE VIEWS OF KHED BRAHMA, GUJARAT



NATURAL COLOR COMPOSITE IMAGE OF  
CARTOSAT-1 PAN-AFT + IRS-P6 LISS-IV MX

ACQUIRED ON:

CARTOSAT-1 PAN : 08-MAY-2005  
IRS-P6 LISS-IV MX : 27-MAR-2004

BEST COMPLIMENTS FROM  
NRSA / DOS



- CARTOSAT-2 is an advanced agile remote sensing satellite capable of providing scene-specific spot imagery.
- Imagery from Cartosat-2 will be used for detailed mapping and other cartographic applications at cadastral level, urban and rural infrastructure development and management, as well as applications in Land Information System (LIS) and Geographical Information System (GIS).



*CARTOSAT-2 Spacecraft with its solar panels in stowed condition*

Launched 1/10/07

Altitude	: 630 km
Inclination	: 97.91 deg
Period	: 97.4 min
Local time at descending node	: 9.30 am
Orbits/day	: 14
Revisit	: 4 days
Repetivity	: 310 days
Lift-off Mass	: 680 kg
Attitude and Orbit Control	: 3-axis body stabilised using high torque Reaction Wheels, Magnetic Torquers and Hydrazine Thrusters
Power	: Solar Array Generating 900 W, Two 18 Ah Ni-Cd batteries
Payload	: Panchromatic camera (PAN)
Operational Life	: 5 years
<b>PAN specifications</b>	
Resolution	: Better than one metre
Swath	: About 9.6 km
Spectral Band	: 0.5 – 0.85 micrometre
Data rate	: 336 MBPS
Solid State Recorder	: 64 GB capacity for imagedata storage



# Future IRS Missions

Resourcesat-*n*

Cartosat-*n*

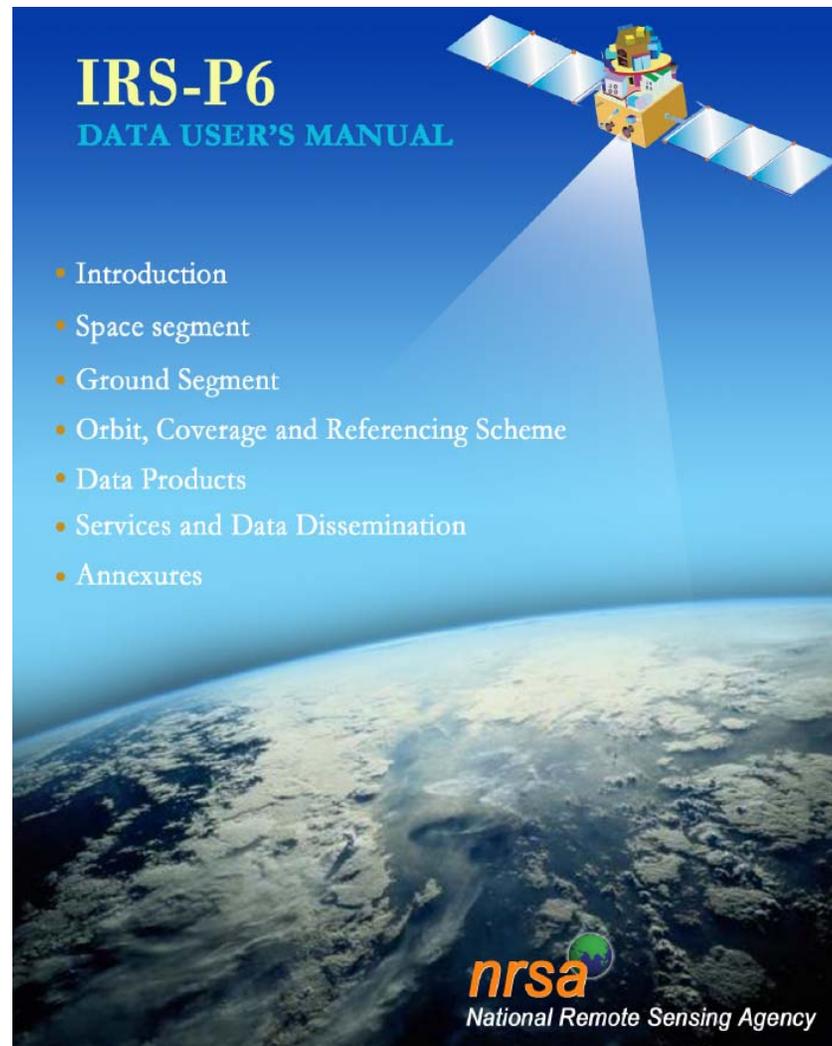
Radar

HSI

- Follow on concepts to existing systems
  - 2009 to 2018
  - Many systems already under development
- Resourcesat-3 series:
  - Increased resolution and more spectral bands:
    - AWiFS (A & B) at 25m resolution, 600km swath
    - Liss-III at 23.5m resolution and 2 additional bands
      - Thermal at 70m resolution under consideration
    - Liss-IV at 5.8m with 1 additional band, 25km swath
  - Addition of new sensors with 25km swath
    - Liss-V (PAN) at 2.5m resolution
    - Hyperspectral at 25m resolution (~200 Bands)
    - 5 day revisit cycle

- Resourcesat-4 series:
  - Addition of new sensors with 12.5km swath based on 500mm optics
    - Liss-IV $n$  at 2.5m, 3-4 bands, 5 day revisit
    - Liss-V $n$  at 1.25m PAN, 5 day revisit
    - HSI $n$  at 12.5m, 200 bands, 5 day revisit
- Increased resolution for Cartosat Series:
  - PAN at 0.5m resolution
  - MSI at 2-4m, 4 bands
  - HSI at 8m, ~200 bands
  - Swath at 8-10km
- RISAT – First IRS SAR system
  - C-Band SAR
  - 10km swath in Spot mode, 240km swath in Scan mode
  - Resolution at 1m to 50m
  - Single/Dual polarization

- Like other long-term remote sensing programs, ISRO and Antrix are dedicated to providing IRS data through 2018
  - Current systems will be operational thru 2012
  - Fourth Generation systems will carry into 2018
- Availability of key components (e.g., optics) was previously a limiting factor
  - ISRO is no longer constrained by DoS / ITAR
  - Advanced international cooperative programs are now underway between ISRO and NASA, DLR (Germany) and others
- Large data users, like USDA, have an opportunity to provide input to ISRO and Antrix
  - Let your voice be heard so the future systems will acquire the remote sensing data sets you require



Available at NRSA's web site: [www.nrса.org.in](http://www.nrса.org.in)



Thank you!

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