

INDIAN REMOTE SENSING SATELLITES CURRENT AND FUTURE MISSIONS

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Discussion Topics



- India's Space Program
 - The Mandate
- Current IRS Satellite Missions
 - Resourcesat-1/2
 - Cartosat-1
 - Cartosat-2
- Future IRS Satellite Missions
- Conclusions

THE STORY BEGINS

FIRST ROCKET LAUNCH IN 21st
NOVEMBER 1963



THERE ARE SOME WHO
QUESTION THE RELEVANCE OF
SPACE ACTIVITIES IN A
DEVELOPING NATION

.....IF WE ARE TO PLAY A
MEANINGFUL ROLE
NATIONALLY, AND IN THE
COMITY OF NATIONS, WE MUST
BE SECOND TO NONE IN THE
APPLICATION OF ADVANCED
TECHNOLOGIES TO THE REAL
PROBLEMS OF MAN AND

THUMBA

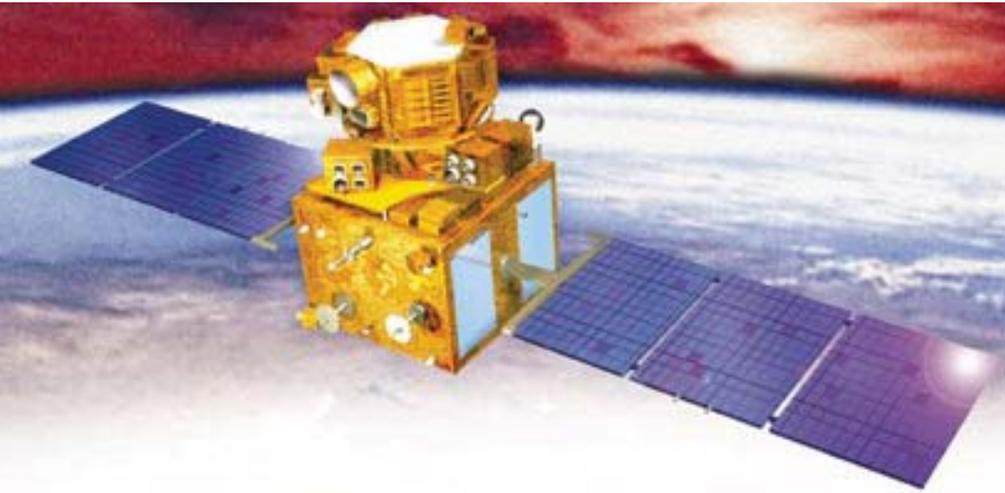
AND THE VISION...
SOCIETY."

Mandate and Priority

Application of Technology for the benefit of the common man

Current Satellite Missions

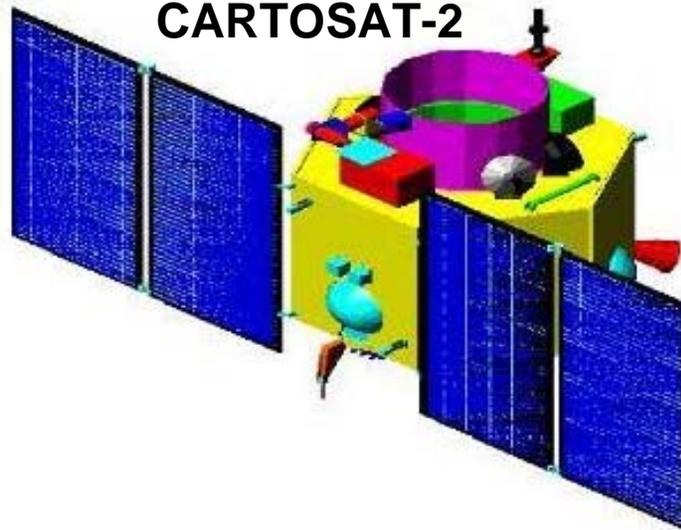
RESOURCESAT-1



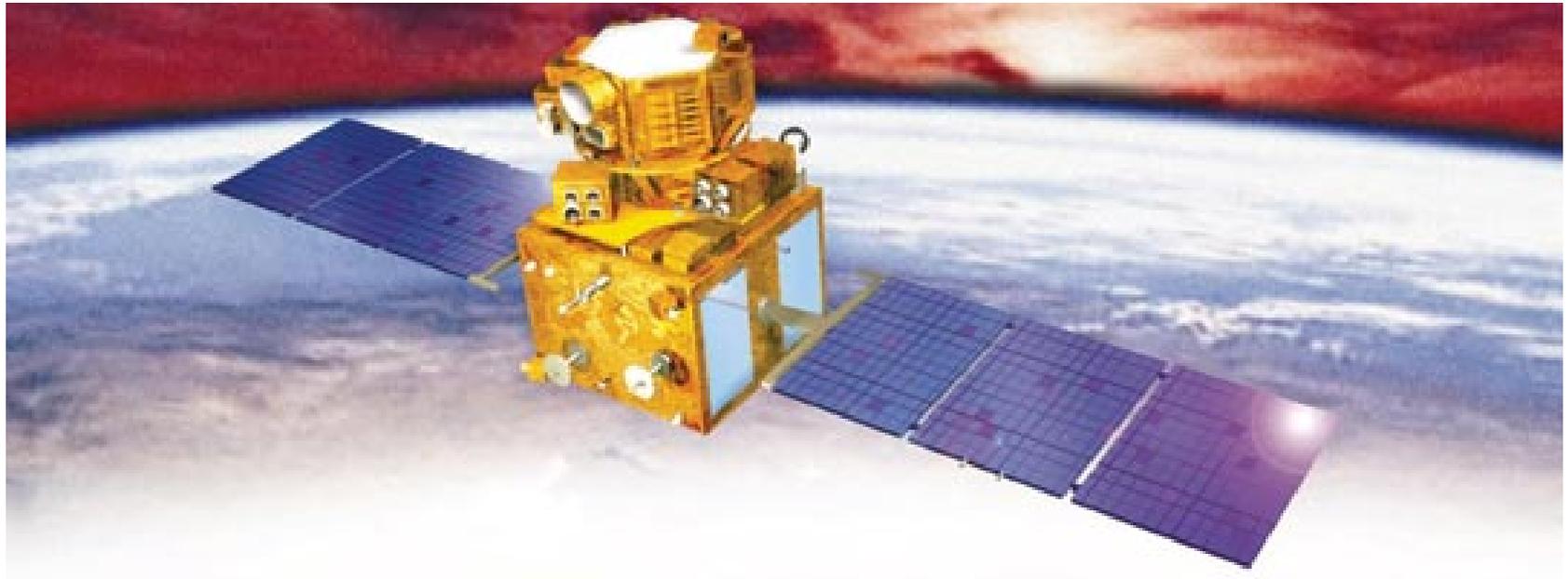
CARTOSAT-1



CARTOSAT-2



Resourcesat-1 & 2



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.

Resourcesat-1 & 2 Features



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

Resourcesat-1 & 2 Payload



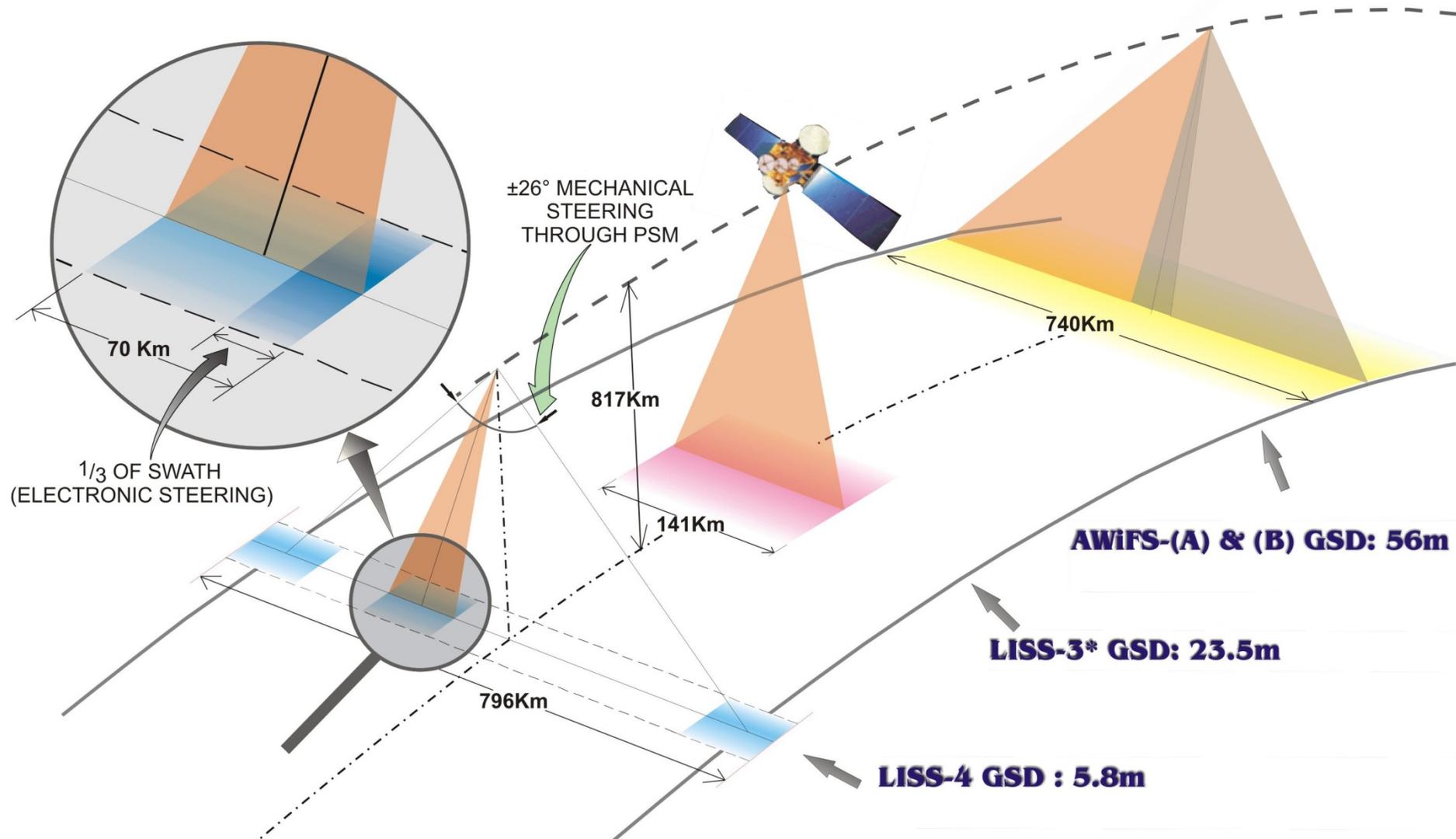
PAYLOADS	LISS-4	LISS-3	AWiFS
Spatial Resolution (m)	5.8	23.5	56
Swath (km)	23.9 (MX mode) 70.3 (PAN mode)	141	740
Spectral Bands (micron)	0.52-0.59 0.62-0.68 0.77-0.86	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70
Quantisation (bits)	7	7	10
Square Wave Response (at Nyquist)	>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

Resourcesat-1 & 2 Acquisition Modes



IRS-P6 THREE TIER IMAGING



Manasarovar Lake, Tibet



IRS-P6 AWiFS

Part of Myanmar coast



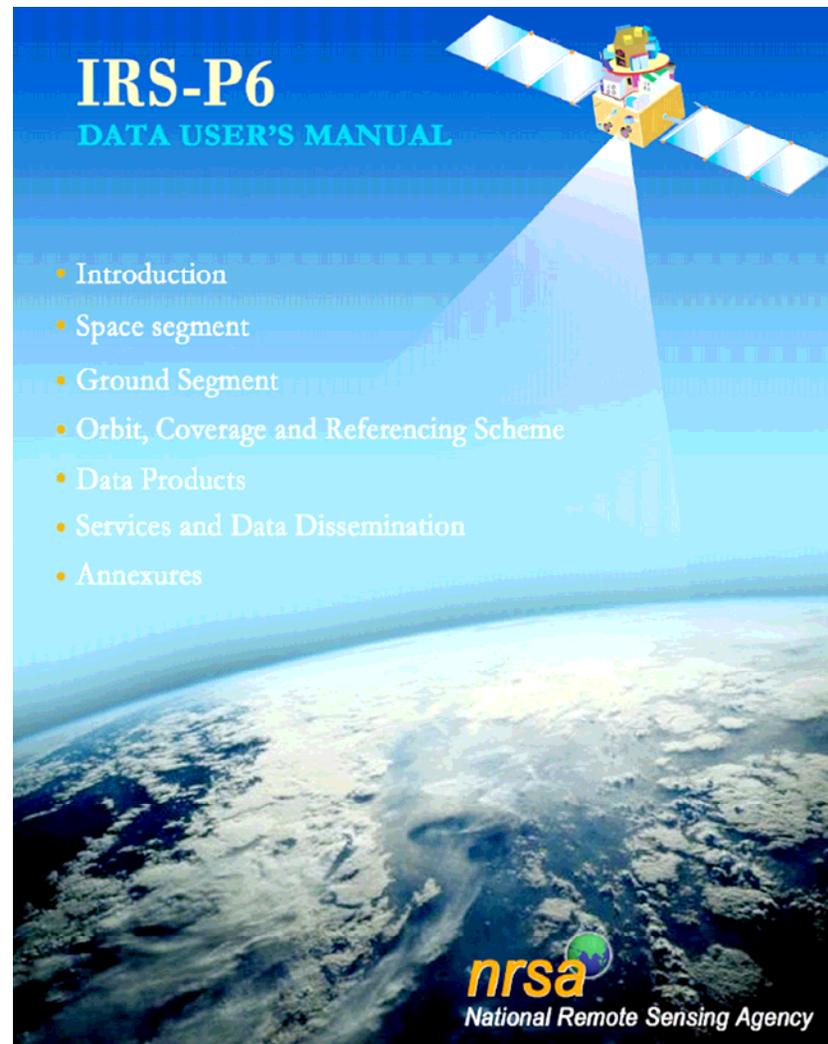
IRS-P6 LISS-III

San Francisco, CA



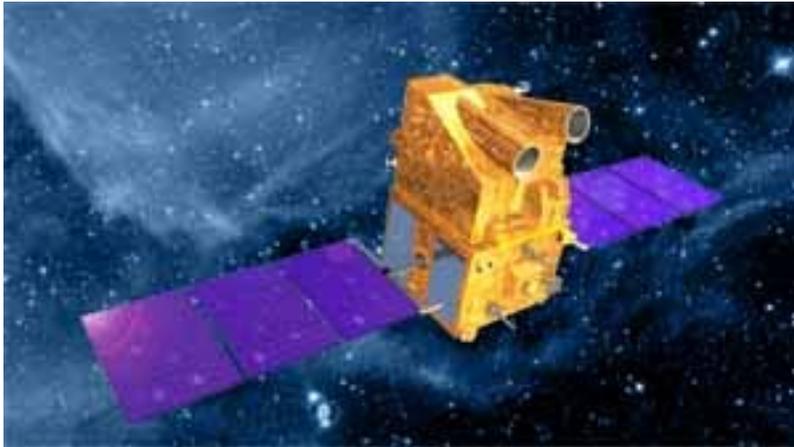
IRS-P6 LISS-IV (Mono)

Resourcesat-1 User Manual



Available at NRSA's web site: www.nrса.org.in

Cartosat-1



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.



Cartosat-1 Features



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

Cartosat-1 Payload



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

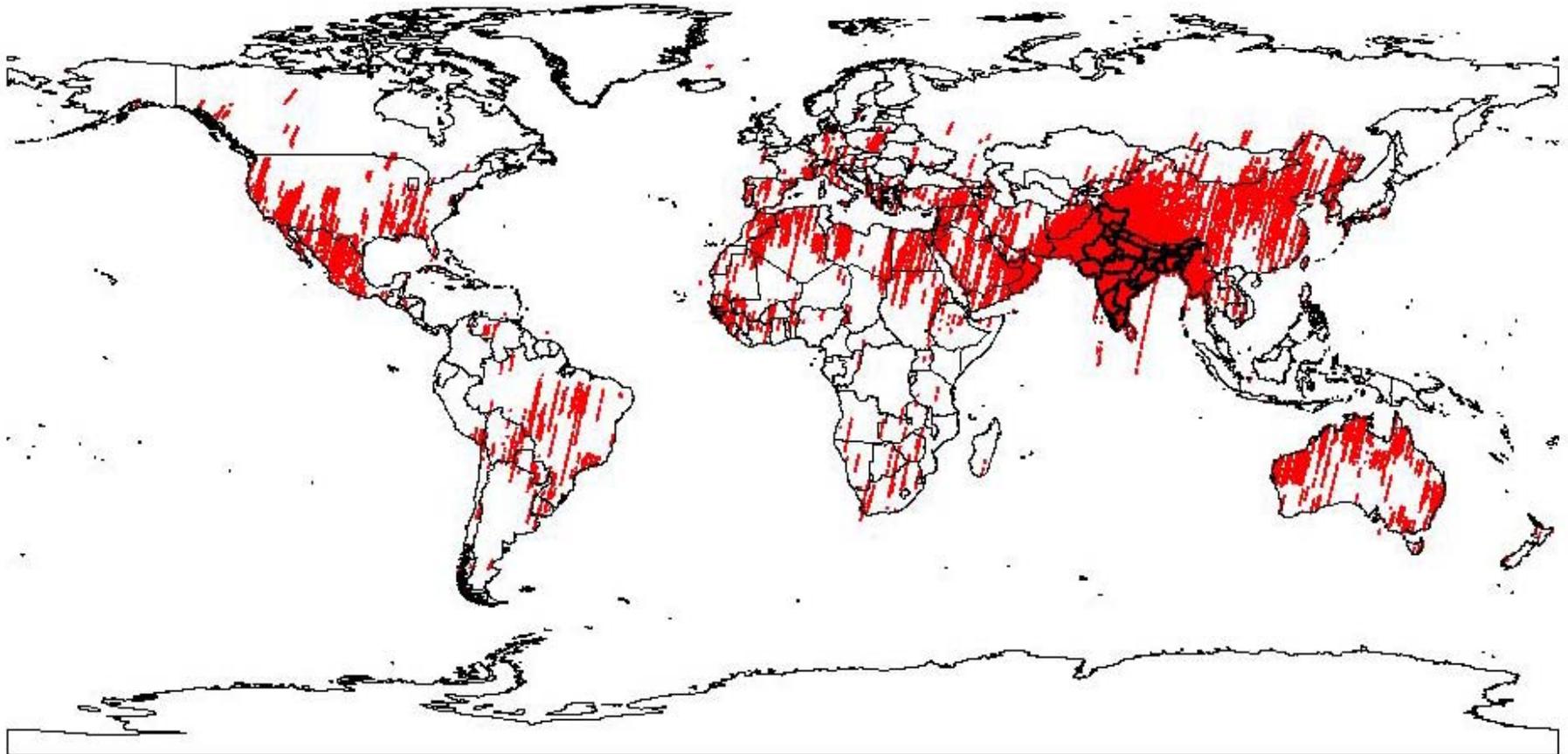


*CARTOSAT-1
PAN camera*

Cartosat-1 Cloud Free Coverage



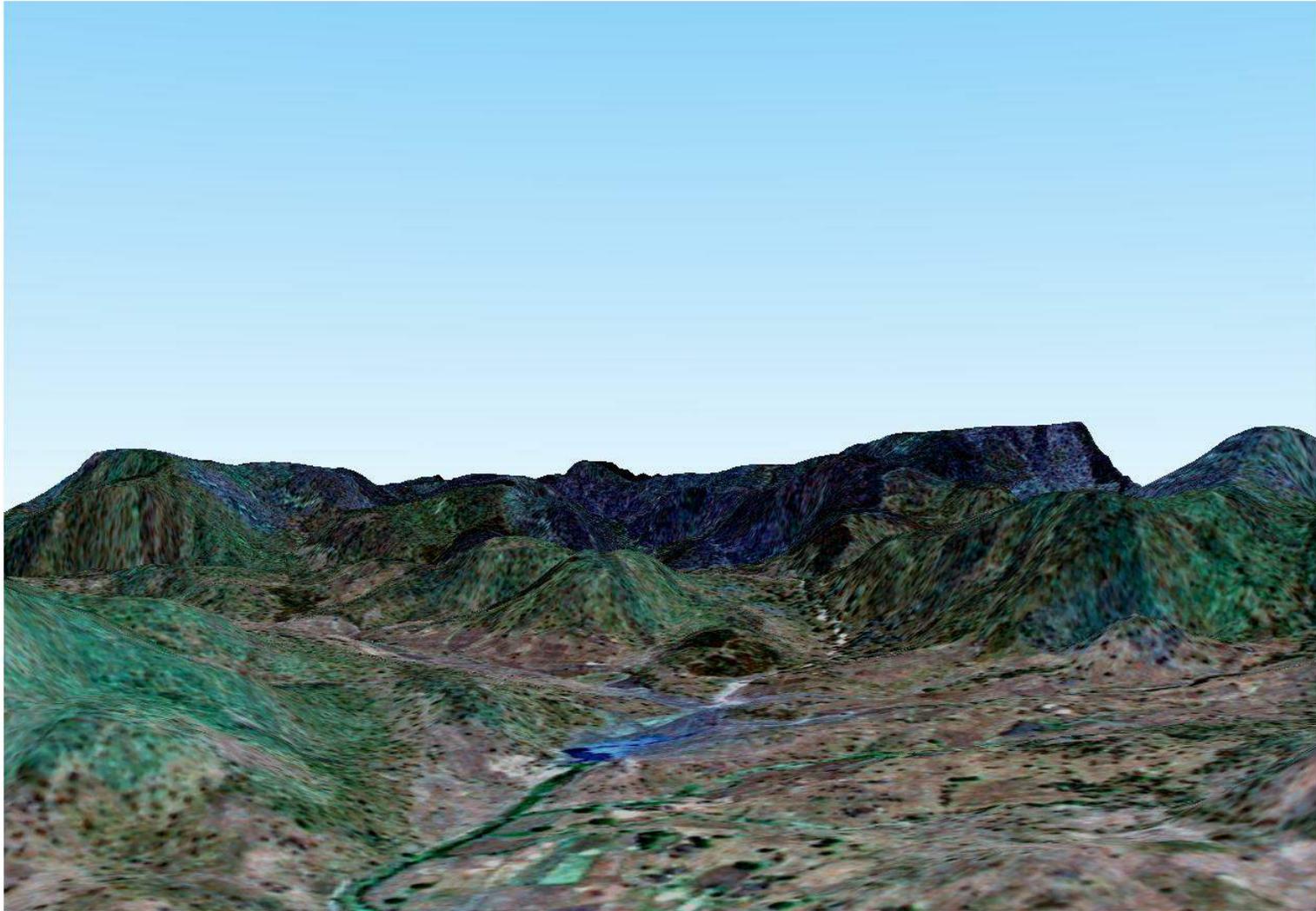
IRS P5 GLOBAL CLOUDFREE COVERAGE





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-1 User's Handbooks



Available at NRSA's web site: www.nrса.org.in

Fourth Generation



- CARTOSAT-2 is an advanced agile remote sensing satellite capable of providing scene-specific spot imagery.
- Imagery from Cartosat-2 is now used for detailed mapping and other cartographic applications such as 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 at a Glance



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

PAN specifications

Resolution	: 0.80m
Swath	: About 9.6 km
Spectral Band	: 0.5 – 0.85 micrometre
Data rate	: 336 MBPS
Solid State Recorder	: 64 GB capacity for image data storage

Cartosat-2 Baseline



Resolution/Swath:

Panchromatic: 0.80m at 9.6km

Solid Stage Recorder:

64 GB; 138 Images of 9.6km X 9.6km

10 Bit Detector Dynamic Range

Max Data Rate:

105 MBPS / X-Band Downlink

Maximum Area Imaged per 12 min Pass:

0.82m GSD (Mono): 8832 km²

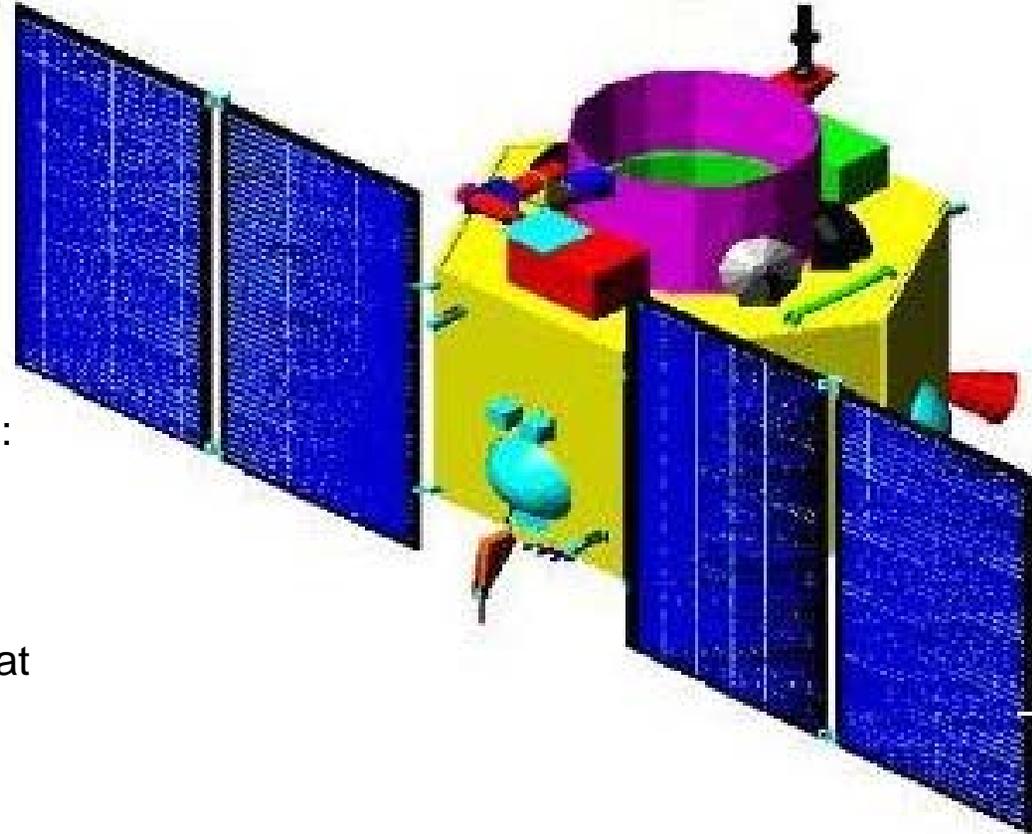
Revisit Time: 4/5 days at equator

Orbit: 630km / 97.922° Sun Synchronous at
9.30 A.M Local time

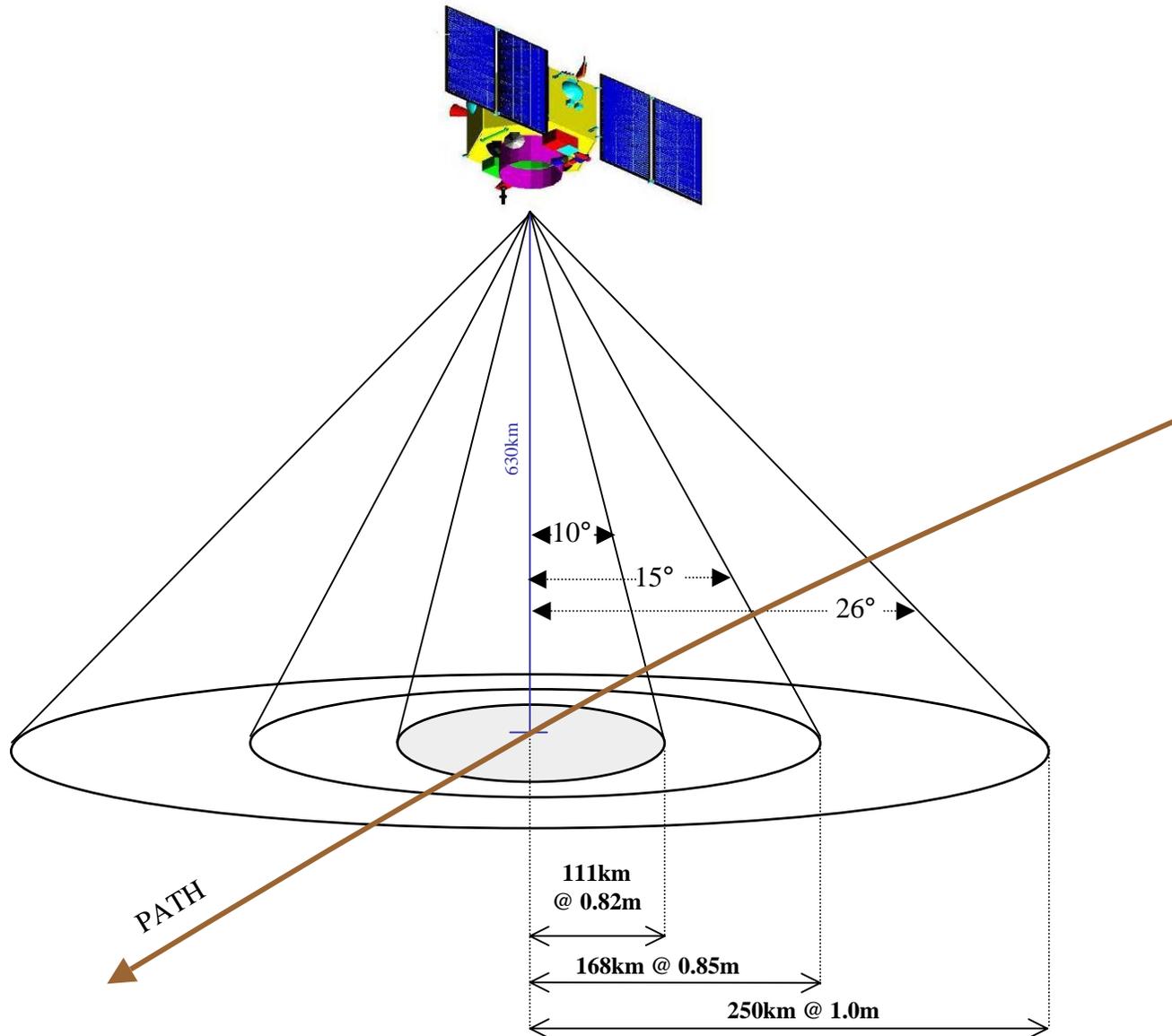
Launch Mass: 680 Kgs

Launched Date: January 10, 2007

Design Life: Minimum 5 years



Cartosat-2 Field of Regard



C2 Sample Imagery (Bangalore)



C2 Sample Imagery (Bangalore)

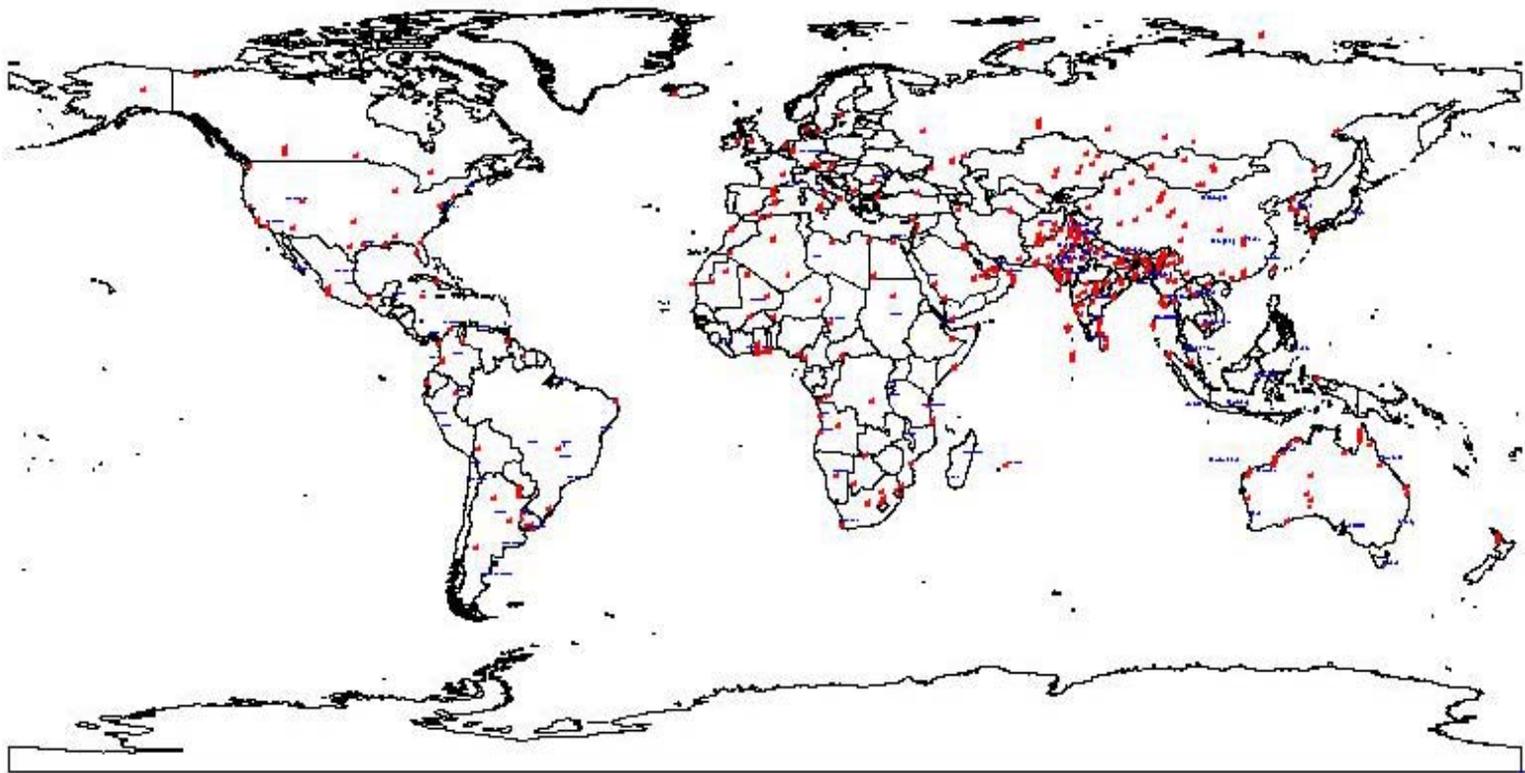


C2 Sample Imagery (Perth)



C2 Global Coverage (YTD)

CARTOSAT 2 - GLOBAL COVERAGE



Total area acquired
2,39,057.4 Sq km

Future IRS Missions

Resourcesat-*n*

Cartosat-*n*

Radar

HSI

Future IRS Missions



- 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

Future Missions (continued)



- Resourcesat-4 series:
 - Addition of new sensors with 12.5km swath based on 500mm optics
 - Liss-IVn at 2.5m, 3-4 bands, 5 day revisit
 - Liss-Vn 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

Conclusions



- 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
 - Advanced international cooperative programs are now underway between ISRO and NASA, DLR (Germany) and others
- Large data users have an opportunity to provide input to ISRO and Antrix
 - *We will have meetings on Wednesday to receive such inputs*

Thank you!