

INDIAN REMOTE SENSING PROGRAMME

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IRS Satellite Series

The Indian Space programme has the goal of harnessing space technology for application in the areas of communications, broadcasting, meteorology and remote sensing.

The important milestones crossed so far are Bhaskara-1 and 2 (1979) the experimental satellites, which carried TV Cameras and Microwave Radiometers.

The **Indian Remote Sensing Satellite (IRS)** was the next logical step towards the National operational satellites, which directly generates resources information in a variety of application areas such as forestry, geology, agriculture and hydrology. IRS -1A/1B, carried Linear Imaging Self Scanning sensors LISS-I & LISS-II. IRS-P2 was launched in October 1994 on PSLV-D2, an indigenous launch vehicle. IRS-1C was launched on December 28, 1995, which carried improved sensors like LISS-III, WiFS, PAN Camera, etc. IRS-P3 was launched into the sun synchronous orbit by another indigenous launch vehicle PSLV - D3 on 21.3.1996 from Indian launching station Sriharikota (SHAR). IRS-1D was launched on 29 September, 1997 and IRS-P4 was launched on 26 – 5 1999 onboard PSLV from Sriharikota.

Earth Observation Satellites

Starting with IRS-1A, in 1988, ISRO has launched many operational remote sensing satellites in operation. Currently 13 operational satellites are in sun-synchronous orbit – Resourcesat -1, 2, 2A, Cartosat-1, 2, 2A, 2B, RISAT and 2, Oceansat-2, Megha-Tropiques, SARAL and SCATSAT-1, and four in Geostationary orbit-INSAT-3D, Kalpana and INSAT-3A, INSAT-3DR. Varieties of instrument has been sent onboard these satellites are used to provide necessary data in diversified spectral, spatial, and temporal resolution for country and global usage. The data from these satellites are used for several applications covering agriculture, water resources, urban planning, rural development, mineral prospecting, environment, forestry, ocean resources and disaster management.

Communication Satellite

The Indian National Satellite (INSAT) system is one of the largest domestic communication satellite system in Asia-Pacific region with nine operational communication satellites placed in GSAT-6,7,8,9,10, 12, 14, 15, 16 and 18. The INSAT system provides services to telecommunications, television broadcasting, satellite newsgathering, societal applications, weather forecasting, disaster warning and Search and rescue operations.

Launching Vehicles

- The Geosynchronous Satellite Launch Vehicle usually known by its abbreviation, GSLV operated by the Indian Space Research Organization (ISRO). It was developed to enable India to launch INSAT –type satellites into the geostationary orbit and to make India less dependent on foreign rockets.
- The Polar Satellite Launch Vehicle commonly known by its abbreviation PSLV, developed to allow and operated by the Indian Space Research Organization (ISRO). It was developed to allow India to launch its Indian Remote Sensing satellite into sunsynchronus orbit

Satellite Name	Launch	Sensors Types	Types	No. of Bands	Resolution (meters)	Swath Width (km)	Revisit Time
IRS-1A	1988	LISS-I	Multispectral	4	72.5	148	
		LISS-II	Multispectral	4	36.25	74	
IRS-1B	1991	LISS-I	Multispectral	4	72.5	148	22 days
		LISS-II	Multispectral	4	36.25	74	
IRS-1C	1995	WiFS	Multispectral	2	189	810	5 day
		LISS-III	Multispectral	3	23.6	142	24-25 days
				1	70.8	148	
PAN	PAN	PAN	1	5.8	70		
IRS-1D	September - 1997	WiFS	Multispectral	2	189	810	5 day
		LISS-III	Multispectral	3	23.6	142	24-25 days
				1	70	148	
		PAN	PAN	PAN	1	6	
IRS-P4 (Oceansat)	26 May, 1999	OCM	Multispectral	8	360 m	1420 km	2 days
		MSMR	RADAR	4	120, 80, 40 and 40 kms	1360 km	
IRS – P6 (Resourcesat-1)	17 Oct, 2003	AWiFS	Multispectral	4	56	740	5 days
		LISS-III	Multispectral	4	23	142	24 days
		LISS-IV	Multispectral	3	5.8	23.9 MX mode 70 PAN mode	24 days

Satellite Name	Launch	Sensors Types	Types	No. of Bands	Resolution (meters)	Swath Width (km)	Revisit Time
CARTOSAT-1 (IRS-P5)	5 May 2005	PAN	PAN	1	2.5	30	5 days
IMS-1 28	April 2008	MX	Multispectral	4	37	151	
		HySI	Hyperspectral Imager	64	505.6	125	
CARTOSAT-2A (IRS P8)	28 April 2008	PAN	PAN	1	0.8	16	
RISAT-2	April 2009	SAR-X			3-8 m	10 km, 50 km [Max Swath: 650 km]	
IRS 2B (Oceansat 2)	24 Sept, 2009	OCM	Multispectral		236m	1440	2 days
		SCAT				1400	
CARTOSAT-2B	12 July 2010	PAN	PAN	1	1	9.6	5 days
RESOURCESAT 2	20 April 2011	AWiFS	Multispectral	4	56	740	5 days
		LISS-III	Multispectral	4	23.5	141	24 days
		LISS-III 4	Multispectral	4	23.5	141	

INSAT-4G	2011	C-band communication satellite
Youthsat	2011	Indo-Russian stellar and atmospheric satellite
GSAT-12	2011	Communication satellite
Megha-Tropiques	2011	Indo-French collaborative effort to research on water cycle in the atmosphere
RISAT-1	2012	First indigenous all-weather Radar Imaging Satellite
GSAT-10	2012	Advanced communication satellite
SARAL	2013	Mission for oceanographic studies
IRNSS-1A	2013	Seven spacecraft constituting the IRNSS space segment
INSAT-3	2013	Meteorological Satellite
GSAT-7	2013	Advanced multi-band communication satellite dedicated for military purpose
GSAT-14	2014	Geostationary communication satellite
IRNSS-1B	2014	Second satellite in the Indian Regional Navigation Satellite System
IRNSS- 1C	2014	Third satellite in the Indian Regional Navigation Satellite System
GSAT-16	2014	Communication satellite
IRNSS-1D	2014	Fourth satellites in the Indian Regional Navigation Satellite System
GSAT-6	2014	Communication satellite

Astrosat	2015	India's first dedicated multi-wavelength space Observatory
GSAT-15	2015	Communications satellite, carries GPS Aided GEO Augmented Navigation (GAGAN) payload
IRNSS-1F	2016	Sixth satellite in the Indian Regional Navigation Satellite System
IRNSS-1G	2016	Seventh and final satellite in the Indian Regional Navigation Satellite System
CARTOSAT-2C	2016	Earth observation remote sensing satellite
INSAT-3DR	2016	An advanced meteorological satellite of India configured with an imaging System and an Atmospheric Sounder.
SCATSAT-1	2016	Miniature satellite to give climate anticipating, tornado expectation, and tracking services to India.
CARTOSAT-2D	2017	The highest number of satellites (104 satellites) launched by a single launch vehicle.
MICROSAT- TD	2018	This satellite is a technology demonstrator and the forerunner of future satellites.
INS -1C	2018	This is the third satellite in the Indian Nanosatellite series, which carried a Miniature Multispectral Technology Demonstration (MMX-TD) Payload.
GSAT- 6A	2018	This satellite is a high power S-band communication satellite configured around I-2K bus.

IRNSS -1I	2018	This satellite is the 6th in the series and facilitates GPS navigation.
GSAT-29	2018	This satellite facilitates high-throughput communication.
HySYS	2018	It facilitates Hyperspectral imaging services for agriculture, forestry, and military applications.
GSAT-11	2018	Heaviest spacecraft of India.
GSAT-7A	2018	Facilitates services for Indian Army and Air Force.
Microsat-R	2019	This satellite facilitates Earth imaging for defense purposes.
KalamSAT-V2	2019	It is the world's lightest satellite.
GSAT-31	2019	This is a high-throughput Telecommunication Satellite.
EMISAT	2019	This facilitates Electromagnetic intelligence to track any enemy radars for the IAF.
Chandrayaan-2	2019	India's second lunar exploration mission.
Cartosat-3	2019	Cartosat-3 is one of the optical satellites with the highest resolutions imaging capability
GSAT-30	2020	GSAT-30 is the 41st communication satellite launched by ISRO to replace INSAT-4A. It provides advanced telecommunication services to the nation. India

Sensors

Linear Imaging Self Scanning (LISS) Camera used in IRS-1A & B- It has four spectral bands in the range of 0.45 to 0.86 μm (0.45 to 0.53 μm to 0.59 μm , 0.62 to 0.68 μm and 0.77 to 0.86 μm) in the visible and near infrared range with two different spatial resolution of 72.5 m

(Panchromatic camera (PAN))

The PAN camera is configured to provide the imageries of the earth in visible spectrum, in a panchromatic band (0.5-0.75 μm) with a geometric resolution from altitude of 817 km 5.8 m and a swath of 70 km. The camera uses an off-axis reflective type optics system consisting of three mirror

High Resolution Linear Imaging Self-Scanner (LISS-IV)

LISS-IV sensor onboard IRS – P6 operates in three spectral bands in the visible and near infrared (VNIR) or PAN mode with 5.8 meter spatial resolution's.

Ocean color monitor (OCM)

OCM is a solid state camera operating in eight narrow spectral bands. The camera is used to collect data on chlorophyll concentration, detect and monitor phytoplankton blooms and obtain data on atmospheric aerosols and suspended sediments in the water.

Multi-frequency Scanning Microwave Radiometers (MSMR)

MSMR, which operates in four microwave frequencies both in vertical and horizontal polarisation is used to collect data on sea surface temperature, wind speed, cloud water content and water vapour content in the atmosphere above the ocean.