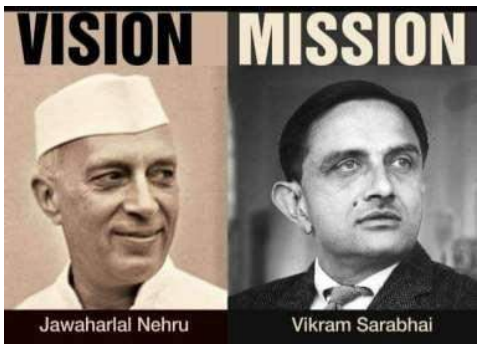
INDIAN REMOTE SENSING SATELLITES

FACTS ABOUT INDIA

- India is officially known as the Republic of India.
- India has the second largest population in the world, with over 1.2 billion people.
- India is the seventh largest country by total area.
- India belongs to the continent of Asia, it is bordered by the countries of Bangladesh, Bhutan, Burma, China, Nepal, and Pakistan.
- A nuclear weapons state and regional power, it has the third largest standing army in the world and ranks fifth in military expenditure among nations.
- India has launched more than 80 spacecraft since its maiden satellite launch in 1975.
- It has one of the six largest space agencies in the world called ***ISRO***.

About ISRO

- Indian space research organization (ISRO).
- Established by India's first PM, Jawaharlal Nehru, and his close friend and scientist Vikram Sarabhai in 1969.
- ISRO's mission is to bring space to the service of the common man and to the service of the Nation.
- One of the Six largest Space agencies in the world.
- ISRO maintains one of the largest fleet of remote sensing (IRS) satellites.



INDIAN REMOTE SENSING SATELLITES

Indian Remote Sensing Satellites (IRS) are a series of Earth observation satellites, built, launched and maintained by Indian Space Research Organization (ISRO).

- The IRS provides many remote sensing services to India.
- The IRS system is the largest constellation of remote sensing satellites for civilian use in operation today in the world.
- Starting with IRS-1A in 1988, ISRO has launched many operational remote sensing satellites.
- Currently, *13* operational satellites are in Sun-synchronous orbit and *4* in Geostationary orbit.

Overview

- The IRS program started in the mid 1980s.
- IRS data is used for the observation and management of the country's natural resources applications in agriculture, hydrology, geology, drought and flood monitoring, snow studies, and land use etc.
- To utilize the Earth's resources in more meaningful ways.
- A continuous supply of synoptic, repetitive, multispectral data of the Earth's land surfaces is obtained.
- The initial program of Earth-surface imaging was extended by the addition of sensors for complementary environmental applications.

- Note: The availability of Landsat imagery created a lot of interest in the science community. The Landsat program with its design and potentials was certainly a great model and yardstick for the IRS program.

IRS Satellites

Serial No.	Satellite	Date of Launch	Launch Vehicle	Status
1	IRS-1A	17 March 1988	Vostok, USSR	Mission Completed
2	IRS-1B	29 August 1991	Vostok, USSR	Mission Completed
3	IRS-P1 (also IE)	20 September 1993	PSLV-D1	Crashed, due to launch failure of PSLV
4	IRS-P2	15 October 1994	PSLV-D2	Mission Completed
5	IRS-1C	28 December 1995	Molniya, Russia	Mission Completed
6	IRS-P3	21 March 1996	PSLV-D3	Mission Completed
7	IRS 1D	29 September 1997	PSLV-C1	Mission Completed
8	IRS-P4 (Oceansat-1)	27 May 1999	PSLV-C2	Mission Completed
9	Technology Experiment Satellite (TES)	22 October 2001	PSLV-C3	Mission Completed
10	IRS P6 (Resourcesat-1)	17 October 2003	PSLV-C5	In Service
11	IRS P5 (Cartosat 1)	5 May 2005	PSLV-C6	In Service

Continued

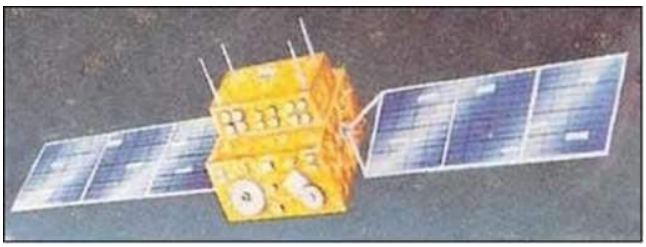
12	IRS P7 (Cartosat 2)	10 January 2007	PSLV-C7	In Service
13	Cartosat 2A	28 April 2008	PSLV-C9	In Service
14	IMS 1	28 April 2008	PSLV-C9	In Service
15	Oceansat-2	23 September 2009	PSLV-C14	In Service
16	Cartosat-2B	12 July 2010	PSLV-C15	In Service
17	Resourcesat-2	20 April 2011	PSLV-C16	In Service
18	Megha-Tropiques	12 October 2011	PSLV-C18	In Service
19	RISAT-1	26 April 2012	PSLV-C19	In Service
20	SARAL	25 Feb 2013	PSLV-C20	In Service
21	RESOURCESAT-2A	07 Dec 2016	PSLV-C36	In Service
22	Cartosat-2D	15 Feb 2017	PSLV-C37	In Service
23	Cartosat-2E	23 June 2017	PSLV-C38	In Service
24	Cartosat-2F	12 Jan 2018	PSLV-C40	In Service

IRS-1A

- First Indian Remote sensing satellite.
- It was a part-operational, part-experimental mission to develop Indian expertise in satellite imagery.
- The data from the satellite was used for various applications in the areas of agriculture, forestry, flood mapping, wasteland mapping, land use/land cover mapping, locating water source etc.

Specifications

Mission Category	Operational Remote Sensing
Launch Date	March 17, 1988
Launch Site	Baikanur Cosmodrome Kazakhstan
Weight	975 kg
Orbit	Polar Sun Synchronous
Mission Completed	July 1996
Repetivity	22 days



IRS-1A

Sensors Of IRS-1A

It carried two **'Linear Imaging Self-Scanning System'** cameras, LISS-I and LISS-II.

LISS-1:
Spatial Resolution: 73 meters
Swath Width: 140 Km
Bands: 3 visible and 1 near infrared (NIR)

Illustration of the LISS-I camera

LISS-2:
Spatial Resolution: 36.25
Swath Width: 140 Km
Bands: 3 visible and 1 near infrared (NIR)

Illustration of the LISS-II camera

IRS-1C

- Fourth remote sensing Indian satellite
- The satellite had enhanced capabilities like better Spatial resolution, additional spectral band, improved repetivity than it's previously existing satellites.

Specifications

Mission Category	Operational Remote Sensing
Launch Date	December 28, 1995
Launch Site	Baikanur Cosmodrome Kazakhstan
Weight	1250 kg
Orbit	Polar Sun Synchronous
Mission Completed	September 21, 2007
Repetivity	24 days

Illustration of IRS-1C

IRS-1C SENSORS

Linear Imaging Self Scanning Sensor - 3 (LISS-3):

- Three visible bands as well as in short-wave infrared band.
- Spatial Resolution 23.5 m
- Swath width 142 km.

Illustration of the LISS-3 camera
(image credit: ISRO)

Panchromatic sensor (PAN):

- Provide the imageries of the Earth in visible spectrum, in a panchromatic band (0.5-0.75 m).
- Resolution greater than 10m
- Swath: 70 km.

Illustration of the PAN camera
(image credit: ISRO)

Wide Field Sensor (WiFS):

- Two bands B3: 0.62 µm to 0.68 µm (Red) and B4: 0.77 µm to 0.86 µm (NIR).
- Swath: 770 km
- Spatial resolution of 188 m.

The WiFS camera illustration
(image credit: ISRO)

RESOURCESAT-1

- Tenth satellite of ISRO in IRS series.
- The overall objectives of the ResourceSat-1 are to provide continued remote sensing data services on an operational basis for integrated land and water resources management.
- This satellite is the continuation of the IRS-1C missions with considerably enhanced capabilities.

Specifications:

Mission Category	Operational Remote Sensing
Launch Date	December 17, 2003
Launch Site	Satish Dhavan Space center, Sriharikota
Weight	1360 kg
Orbit	Polar Sun Synchronous
Mission Status	In Service

Illustration of IRS-P6

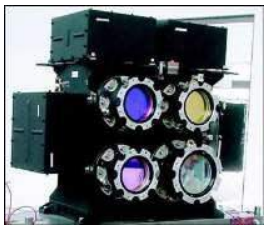
RESOURCESAT-1 SENSORS

LISS-4

- **Linear Imaging Self Scanner (LISS-4):**
  Operating in three spectral bands in the visible and Near Infrared Region
  Spatial resolution: 5.8m
  Swath: 23.9km

LISS-3

- **LISS-3:**
  Operating in three spectral bands in NIR and one in Short Wave Infrared (SWIR) band.
  Spatial resolution:23.5m
  Swath: 140km



AWiFS

- **Advanced Wide Field Sensor (AWiFS):**
  Operating in three spectral bands in NIR and one band in SWIR
  Spatial Resolution: 56m
  Swath: 740km

Figure 5: AwiFS image of Lake Manasarovar (right) with a surface area of 320 km^2 located in the Tibet Autonomous Region of China (image credit: ISRO)

Cartosat-1

- A stereoscopic Earth observation satellite and the first one of the Cartosat series of satellites.

- The objectives of the Cartosat-1 mission are directed at geo-engineering (mapping) applications, calling for high-resolution panchromatic imagery with high pointing accuracies

CartoSat-1 assembly and testing (image credit: ISRO)

Specifications

Mission Category	Operational Remote Sensing
Launch Date	May 5, 2005
Launch Site	Satish Dhavan Space center, Sriharikota
Weight	1560 kg
Orbit	Polar Sun Synchronous
Mission Status	In Service

Sensors of Cartosat-1

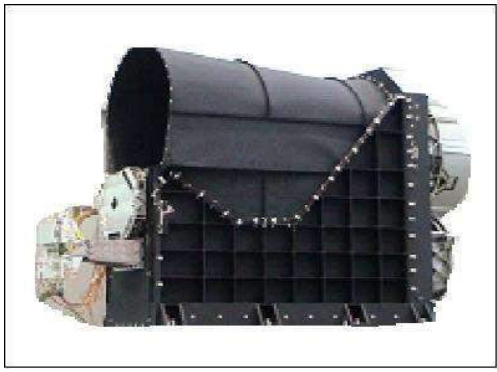
Cartosat-1 carries two state-of-the art panchromatic (PAN) cameras.

- **PAN-F** i(Panchromatic Forward-pointing Camera) featuring a fixed forward tilt of 26º.
- **PAN-A** (Panchromatic Aft-pointing Camera), it is fixed at an aft tilt of -5

- **Spectral range 0.5 - 0.85 µm**

- **Swath 30km**

- **spatial resolution: 2.5 metres**.



View of the Pan camera (image credit: ISRO)

Image taken by Cartosat-1

Adana, Turkey

Radar Imaging Satellite 1

- Radar Imaging Satellite 1, or RISAT-1, is the heaviest earth observation satellite to be launched by India.
- It has the capability to take images of Earth during day and night, as well as in cloudy conditions.
- The satellite has applications in fields such as agriculture, forestry, soil moisture, geology, sea ice, coastal monitoring, object identification, and flood monitoring.

Illustration of the deployed RISAT-1 spacecraft (image credit: ISRO)

Specifications

Mission Category	Operational Remote Sensing
Launch Date	April 26, 2012
Launch Site	Satish Dhavan Space center, Sriharikota
Weight	1858 kg
Orbit	Polar Sun Synchronous
Mission Status	In Service

Sensors of RISAT-1

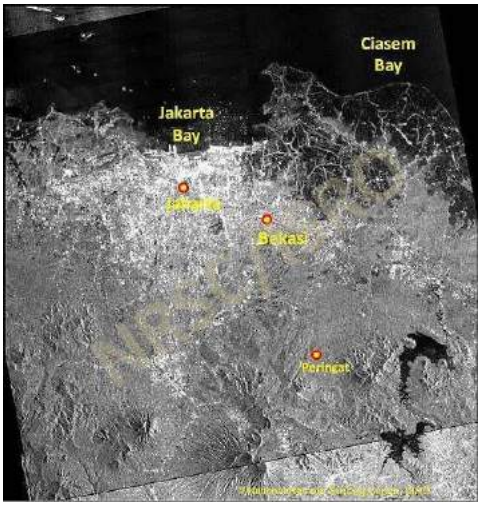
The payload consists of the single Synthetic Aperture Radar (SAR) instrument.

The RISAT-SAR instrument supports a variety of resolution and swath requirements.

Spatial Resolutions: 3 to 50 m

Swath ranging: 25 to 223 km.

Images taken by RISAT-1



RISAT-1 MRS (Medium Resolution ScanSAR) data of 12 Feb, 2015 (image credit: ISRO/NRSC)

NRSC Ground Station in Antartica: captured by RISAT-1 in Dual Pol (HH+HV), image credit: ISRO

OCEANSAT-2

- **Oceansat-2** is an Indian satellite designed to provide service continuity for operational users of the Ocean Colour Monitor (OCM) instrument on Oceansat-1.

- The main objectives of OceanSat-2 are to study surface winds and ocean surface strata, observation of chlorophyll concentrations, monitoring of phytoplankton blooms, study of atmospheric aerosols and suspended sediments in the water.

Specifications

Mission Category	Climate & Environment Earth Observation
Launch Date	September 23, 2009
Launch Site	Satish Dhavan Space center, Sriharikota
Weight	960kg
Orbit	Polar Sun Synchronous
Mission Status	In Service

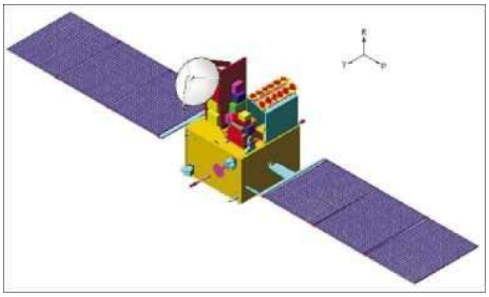
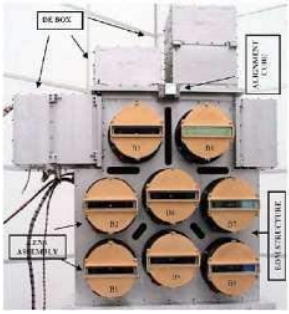


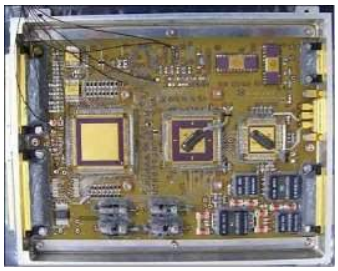
Illustration of the deployed OceanSat-2 spacecraft (image credit: ISRO)

PAYLOADS OF OCEANSAT



Ocean Colour Monitor (OCM):

- OCM is an 8-band multi-spectral camera operating in the Visible – Near IR spectral range.
- Swath:1420 km.
- Spectral Resolution:360 m (cross-track) x 236 m (along-track)



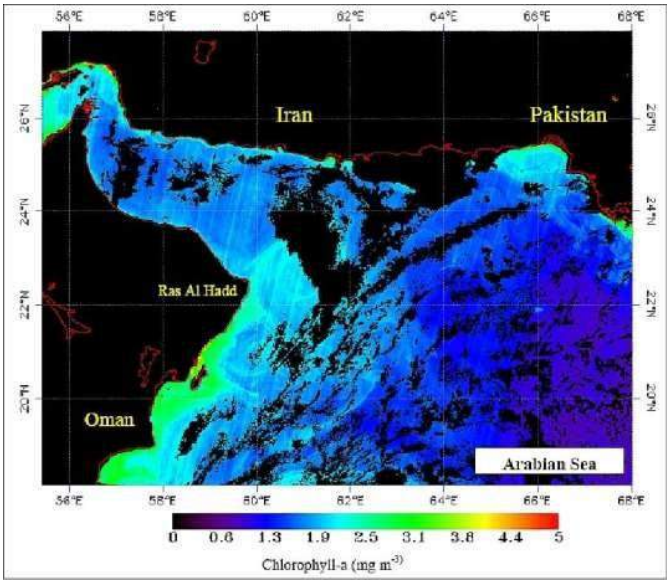
Digital receiver/processor of OSCAT (image credit: ISRO)

Scanning Scatterometer (SCAT):

- SCAT is an active microwave device designed and developed at ISRO.
- Swath: 1400km
- Resolution: 50km x 50km

Image taken by Oceansat-2

OCEANSAT-2 OCM Feb 6, 2017 Irrawaddy River Delta, Bay of Bengal (image credit: ISRO/SAC, Prakash Chauhan)



Chlorophyll-a distribution by OCM-2 (LAC, Sept. 27, 2009) over the parts of the western Arabian Sea (image credit: ISRO)

Megha-Tropiques

- Megha tropiques is a unique satellite for climate research.

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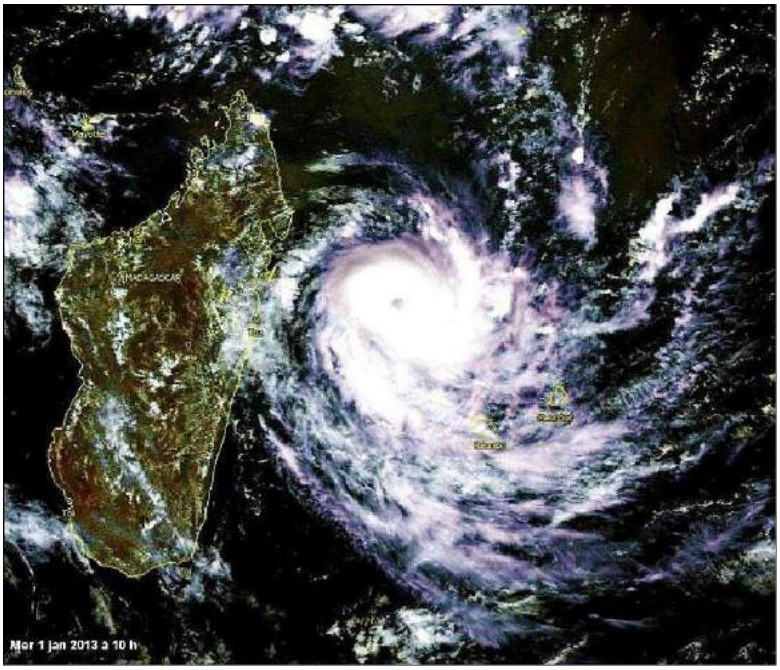
- It is a collaborative effort between Indian Space Research Organisation (ISRO) and French Centre National d'Etudes Spatiales (CNES).

- It is a satellite mission to study the water cycle in the tropical atmosphere in the context of climate change.

- It is also designed to understand tropical meteorological and climatic processes, by obtaining reliable statistics on the water and energy budget of the tropical atmosphere.

Mission Category	Climate & Environment Earth Observation
Launch Date	October 12, 2011
Launch Site	Satish Dhavan Space center, Sriharikota
Weight	1000kg
Orbit	Polar Sun Synchronous
Mission Status	In Service

Megha-Tropiques



Megha-Tropiques image of the Typhoon Bejisa acquired on January 01, 2014 (image credit: LATMOS)

SARAL

The Satellite is a joint Indo-French satellite mission for oceanographic studies.
SARAL performs altimetric measurements designed to study ocean circulation and sea surface elevation.

Mission Category	Climate & Environment Earth Observation
Launch Date	February 15, 2003
Launch Site	Satish Dhavan Space center, Sriharikota
Weight	407kg
Orbit	Polar Sun Synchronous
Mission Status	In Service

Illustration of SARAL spacecraft

KALPANA-1

- METSAT (renamed as Kalpana - 1 on February 5, 2003 after the Indian born American Astronaut Dr. Kalpana Chawla, who died on February 1, 2003 in the US Space Shuttle Columbia disaster) is the first in the series of exclusive meteorological satellites built by ISRO.

- Its mission is to collect data in layer of clouds, water vapor, and temperature of the atmosphere.

Mission Category	Climate & Environment Earth Observation
Launch Date	September 12, 2002
Launch Site	Satish Dhavan Space center, Sriharikota
Weight	1060kg
Orbit	Polar Sun Synchronous
Mission Status	In Service

Illustration of Kalpana-1

Sensors of Kalpana

VHRR/2 (Very High Resolution Radiometer):

Operating in 3 bands: visible, TIR,MWIR
Spatial Resolution: 2km in visible ans 8km in TIR and MWIR

DRT (Data Relay Transponder):
The objective is to collect data from unattended meteorological platforms in the ground segment. DRT receives receives signals from unattended weather data collection platforms and retransmits them to the central station. The data from these payloads are being used for comprehensive weather status and forecasting.

INSAT-3A

- **INSAT-3A**, a multipurpose satellite built by ISRO.It is located at 93.5 degree East longitude.
- It is third satellite in INSAT-3 series after INSAT-3B & INSAT-3C.
- It provides communication, weather, and search and rescue services..

Mission Category	Climate & Environment Earth Observation
Launch Date	April 10, 2003
Launch Site	Satish Dhavan Space center, Sriharikota
Weight	2950kg
Orbit	GEO stationary
Mission Status	In Service

Illustration of INSAT-3A

Very High Resolution Radiometer (VHRR)

A Very High Resolution Radiometer (VHRR) with imaging capacity in the visible (0.55-0.75 µm), thermal infrared (10.5-12.5 µm) and Water Vapour (5.7-7.1 µm) channels, provide 2x2 km, 8x8 km and 8x8 km ground resolutions respectively.

CCD camera:

•A CCD camera provides 1x1 km ground resolution, in the visible (0.63-0.69 µm), near infrared (0.77-0.86 µm) and shortwave infrared (1.55-1.70 µm) bands.

•**Data Relay Transponder (DRT)**

•A Data Relay Transponder (DRT) having global receive coverage with a 400 MHz uplink and 4500 MHz downlink for relay of meteorological, hydrological and oceanographic data from unattended land and ocean-based automatic data collection-cum-transmission platforms

APPLICATIONS OF IRS SATELLITES

- The Indian Remote sensing program is driven by the user needs. In fact, the first remote sensing based pilot project was carried out to identify coconut root-wilt disease in Kerala way back in 1970.

- This pilot project led the development of Indian Remote Sensing (IRS) satellites. Varieties of instruments have been flown onboard the IRS satellites to provide necessary data in a diversified spatial, spectral and temporal resolutions to cater to different user requirements in the country and for global usage.

- These IRS satellites observe the planet Earth from space and provide us periodically synoptic and systematic information pertaining to land, ocean and atmosphere and several aspects of environment.

- This information is a key ingredient in the program of the government at the Centre and State towards ensuring food and water security, sustaining our environment and eco-system, understanding weather and climate, monitoring and management of natural resources, planning and monitoring of developmental activities, support to management and mitigation during disaster events, and information for better governance.

Application Projects in Diversified Areas

AGRICULTURE AND SOIL

Geology & Mineral Resources

Bio Resources and Environment

Ocean and Meteorology

Cartography

Rural Development

Urban Development

Natural Resources Census

Water Resources

Disaster Management Support

FUTURE IRS LAUNCHES

RESOURCESAT-3:

•It will carry more advanced LISS-III-WS (Wide Swath) Sensor having similar swath and revisit capability as **Advanced Wide Field Sensor** (AWiFS), thus overcoming any spatial resolution limitation of AWiFS.
•Satellite would also carry **Atmospheric Correction Sensor** (ACS) for quantitative interpretation and geophysical parameter retrieval.
•It will be injected into **sun-synchronous orbit in year 2020**

CARTOSAT-3

- It will be an advanced version of Cartosat-2 series with improved spatial and spectral characteristics.
- It will have a panchromatic resolution of 0.25 meters and Max. of 1 meters which is a major improvement.
- Potential uses include weather mapping, cartography, and strategic applications.
- It will carry 3 payloads
- PAN Panchromatic camera
- HYSI Hyperspectral short wave infrared Radiometer
- Multispectral VNIR

OCEANSAT-3

- Oceasat-3 would carry Thermal IR Sensor, 12 channel Ocean Color Monitor, Scatterometer and Passive Microwave Radiometer.
- IR Sensor and Ocean Color Monitor would be used in the analysis for operational Potential Fishing Zones.
- Satellite is mainly for Ocean biology and sea state applications.
- It is expected to be launched in 2018.

IRS DATA AVAILABILITY

Data from IRS is available to its users through two resources:

- NRSC (National Remote Sensing Center)
- Bhuvan Geoportal of ISRO

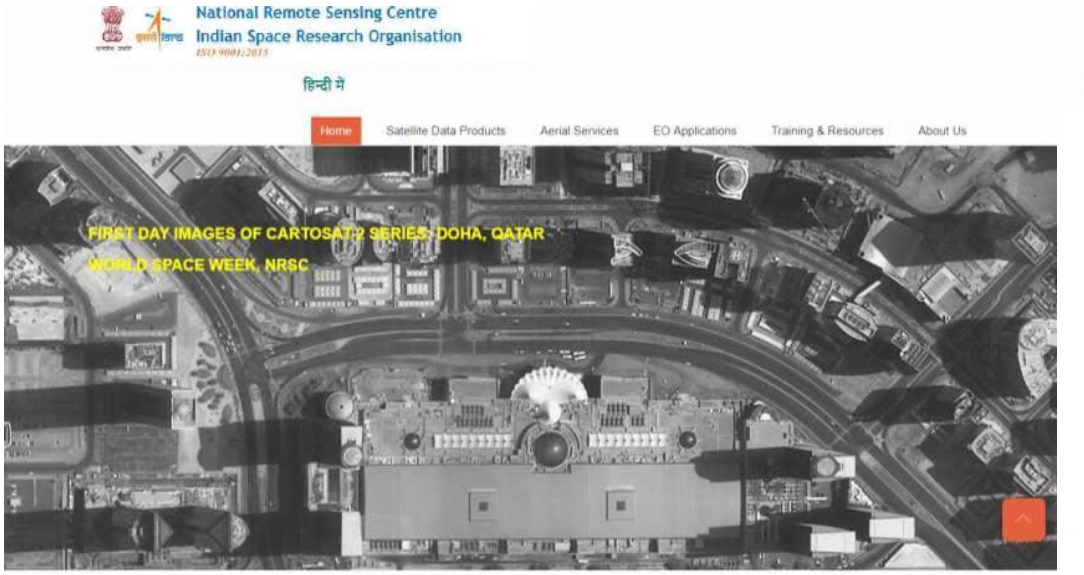
NRSC DATA CENTRE

- NRSC provides data for Natural resource management, geospatial applications and information services.

- It provides data through its purchase process.

- The major objective of this portal is the dissemination and sharing of geo-spatial information derived from IRS data on land use and land cover of India.

WEBPAGE OF NRSC



https://nrsc.gov.in

BHUVAN GEOPORTAL

• It allows users to explore 2D/3D representation of data.

•The browser is specifically tailored to view India, offering the highest resolution in this region and providing content in four local languages.

•Bhuvan made a modest beginning in 2009 with simple display of satellite data and basic GIS functionality with many thematic maps on display functions.

•Bhuvan provides strong foundation with 1m resolution satellite data for more than 350 cities which is being updated for large areas of the country.

•Some of the States using Bhuvan platform for specific applications are Punjab, Karnataka, Himachal Pradesh, Andhra Pradesh and North Eastern states.

• It provides data to its users free and in open domain.

WEBPAGE

http://bhuvan.nrsc.gov.in

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