Topic: Indian Remote Sensing Satellites (IRS)

Course: Remote Sensing and GIS (CC-11)

M.A. Geography (Sem.-3)

By

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Lecture-5

Concept:

India's remote sensing program was developed with the idea of applying space technologies for the benefit of human kind and the development of the country. The program involved the development of three principal capabilities. The first was to design, build and launch satellites to a sun synchronous orbit. The second was to establish and operate ground stations for spacecraft control, data transfer along with data processing and archival. The third was to use the data obtained for various applications on the ground. India demonstrated the ability of remote sensing for societal application by detecting coconut root-wilt disease from a helicopter mounted multispectral camera in 1970. This was followed by flying two experimental satellites, Bhaskara-1 in 1979 and Bhaskara-2 in 1981. These satellites carried optical and microwave payloads.

India's remote sensing programme under the Indian Space Research Organization (ISRO) started off in 1988 with the IRS-1A, the first of the series of indigenous state-of-art operating remote sensing satellites, which was successfully launched into a polar sun-synchronous orbit on March 17, 1988 from the Soviet Cosmodrome at Baikonur. It has sensors like LISS-I which had a spatial resolution of 72.5 meters with a swath of 148 km on ground. LISS-II had two separate imaging sensors, LISS-II A and LISS-II B, with spatial resolution of 36.25 meters each and mounted on the spacecraft in such a way to provide a composite swath of 146.98 km on ground. These tools quickly enabled India to map, monitor and manage its natural resources at various spatial resolutions. The operational availability of data products to the user organisations further strengthened the relevance of remote sensing applications and management in the country.

IRS System:

Following the successful demonstration flights of Bhaskara-1 and Bhaskara-2 satellites launched in 1979 and 1981, respectively, India began to develop the indigenous Indian Remote Sensing (IRS) satellite program to support the national economy in the areas of agriculture, water resources, forestry and ecology, geology, water sheds, marine fisheries and coastal management. Towards this end, India had established the National Natural Resources Management System (NNRMS) for which the Department of Space (DOS) is the nodal agency, providing operational remote sensing data services.Data from the IRS satellites is received *and disseminated by several countries all over the world. With the advent of high-*

resolution satellites new applications in the areas of urban sprawl, infrastructure planning and other large scale applications for mapping have been initiated. The IRS system is the largest constellation of remote sensing satellites for civilian use in operation today in the world, with 11 operational satellites. All these are placed in polar Sun-synchronous orbit and provide data in a variety of spatial, spectral and temporal resolutions. Indian Remote Sensing Programme completed its 25 years of successful operations on March 17, 2013.

The Saga of Indian Remote Sensing Satellite System:

IRS-1A, the first of the series of indigenous state-of-art operating remote sensing satellites, was successfully launched into a polar sun-synchronous orbit on March 17, 1988 from the Soviet Cosmodrome at Baikonur. The successful launch of IRS-1A was one of the proudest moments for the entire country, which depicted the maturity of satellite to address the various requirements for managing natural resources of the nation. Its LISS-I had a spatial resolution of 72.5 meters with a swath of 148 km on ground. LISS-II had two separate imaging sensors, LISS-II A and LISS-II B, with spatial resolution of 36.25 meters each and mounted on the spacecraft in such a way to provide a composite swath of 146.98 km on ground. The IRS-1A satellite, with its LISS-I and LISS-II sensors quickly enabled India to map, monitor and manage its natural resources at coarse and medium spatial resolutions. The operational availability of data products to the user organisations further strengthened the operationalisation of remote sensing applications and management in the country.

IRS-1A was followed by the launch of IRS-1B, an identical satellite, in 1991. IRS-1A and 1B in tandem provided 11-day repetivity. These two satellites in the IRS series have been the workhorses for generating natural resources information in a variety of application areas, such as agriculture, forestry, geology and hydrology etc. From then onwards, series of IRS spacecrafts were launched with enhanced capabilities in payloads and satellite platforms. The whole gamut of the activities from the evolution of IRS missions by identifying the user requirements to utilisation of data from these missions by user agencies is monitored by National Natural Resources Management System (NNRMS), which is the nodal agency for natural resources management and infrastructure development using remote sensing data in the country. Apart from meeting the general requirements, definition of IRS missions based on specific thematic applications like natural resources monitoring, ocean and atmospheric studies and cartographic applications resulted in the realisation of theme based satellite series, namely, (i) Land/water resources applications (RESOURCESAT series and RISAT series); (ii) Ocean/atmospheric studies (OCEANSAT series, INSAT-VHRR, INSAT-3D, Megha-Tropiques and SARAL); and (iii) Large scale mapping applications (CARTOSAT series). IRS-1A

development was a major milestone in the IRS programme. On this occasion of 30 years of IRS-1A and fruitful journey of Indian remote sensing programme, it is important to look back at the achievements of Indian Space Programme particularly in remote sensing applications, wherein India has become a role-model for the rest to follow. Significant progress continued in building and launching the state-of-the-art Indian Remote Sensing Satellite as well as in operational utilisation of the data in various applications to nation.

Today, the array of Indian Earth Observation (EO) Satellites with imaging capabilities in visible, infrared, thermal and microwave regions of the electromagnetic spectrum, including hyper-spectral sensors, have helped the country in realising major operational applications. The imaging sensors have been providing spatial resolution ranging from 1 km to better than 1m; repeat observation (temporal imaging) from 22 days to every 15 minutes and radiometric ranging from 7 bit to 12 bit, which has significantly helped in several applications at national level. In the coming years, the Indian EO satellites are heading towards further strengthened and improved technologies, taking cognizance of the learnings/ achievements made in the yester years, while addressing newer observational requirements and the technological advancements including high agility spacecrafts.

IRS data applications:

Data from Indian Remote Sensing satellites are used for various applications of resources survey and management under the National Natural Resources Management System (NNRMS). Following is the list of those applications:

- *Space Based Inputs for Decentralized Planning (SIS-DP)*
- *National Urban Information System (NUIS)*
- *ISRO Disaster Management Support Programme (ISRO-DMSP)*
- *Biodiversity Characterizations at landscape level- http://bis.iirs.gov.in*
- *Preharvest crop area and production estimation of major crops.*
- *Drought monitoring and assessment based on vegetation condition.*
- *Flood risk zone mapping and flood damage assessment.*
- *Hydro-geomorphological maps for locating underground water resources for drilling well.*
- *Irrigation command area status monitoring*
- *Snow-melt run-off estimates for planning water use in down stream projects*
- *Land use and land cover mapping*
- *Urban planning*
- *Forest survey*

- *Wetland mapping*
- *Environmental impact analysis*
- *Mineral Prospecting*
- *Coastal studies*
- *Integrated Mission for Sustainable Development (initiated in 1992) for generating locale-specific prescriptions for integrated land and water resources development in 174 districts.*
- *North Eastern District Resources Plan (NEDRP)- www.nedrp.gov.in*

IRS launch log:

The initial versions are composed of the 1 (A, B, C, D). The later versions are named based on their area of application including OceanSat, CartoSat, ResourceSat. Some of the satellites have alternate designations based on the launch number and vehicle (P series for PSLV).

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*
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	*RISAT-2*	*20 April 2009*	*PSLV-C12*	*In Service*
16	*Oceansat-2*	*23 September 2009*	*PSLV-C14*	*In Service*
17	*Cartosat-2B*	*12 July 2010*	*PSLV-C15*	*In Service*
18	*Resourcesat-2*	*20 April 2011*	*PSLV-C16*	*In Service*

19	*Megha-Tropiques*	*12 October 2011*	*PSLV-C18*	*In Service*
20	*RISAT-1*	*26 April 2012*	*PSLV-C19*	*In Service*
21	*SARAL*	*25 Feb 2013*	*PSLV-C20*	*In Service*
22	*Cartosat-2C*	*22 June 2016*	*PSLV-C34*	*In Service*
23	*ScatSat-1*	*26 September 2016*	*PSLV-C35*	*In Service*
24	*RESOURCESAT-2A*	*07 Dec 2016*	*PSLV-C36*	*In Service*
25	*Cartosat-2D*	*15 Feb 2017*	*PSLV-C37*	*In Service*
26	*Cartosat-2E*	*23 June 2017*	*PSLV-C38*	*In Service*
27	*Cartosat-2F*	*12 Jan 2018*	*PSLV-C40*	*In Service*
28	*RISAT-2B*	*22 May 2019*	*PSLV-C46*	*In Service*
29	*Cartosat-3*	*27 Nov 2019*	*PSLV-C47*	*In Service*
30	*RISAT-2BR1*	*11 Dec 2019*	*PSLV-C48*	*In Service*

IRS Data Availabilit ***Data from IRS is available to its users through NRSC Data Centre and also through Bhuvan Geoportal of ISRO.***

NRSC data center provides data through its purchase process while Bhuvan Geoportal provides data in free and open domain.

Capacity Building for IRS and Other Remote Sensing Data:

The capacity building programme of ISRO for IRS and other remote sensing applications is through Indian Institute of Remote Sensing (IIRS) Dehradun and UN affiliated Center of Space Science and Technology Education in Asia and the Pacific (CSSTEAP) Center located at Dehradun of Uttrakhand State in India.

Future IRS launches:

Following are the remote sensing satellites planned by ISRO to be launched next strengthening the fleet of IRS satellites and widening their applications:

- ***RESOURCESAT-3**: A follow on to Resourcesat-2, 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 slated to be launched during 2021.*

- ***OCEANSAT-3**: Oceansat-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 slated to the launched aboard PSLV in January 2020.*

- ***GISATs:** GISAT-1 is planned for launch in May 2020 and GISAT-2 is planned for launch in August 2020.They are expected to provide images from geostationary orbit during disasters.*
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- ***Past Satellites:***
- ***Aryabhata, 1975***
- ***Bhaskara I, 1979***
- ***Bhaskara II, 1981***
- ***Rohini Series, 1980-83***

- SROSS Series, 1985-92
- IRS-1A, 1988
- IRS-P1, 1993
- IRS-1B, 1991
- IRS-P2, 1994
- IRS-P3, 1996
- IRS-1D, 1997
- IRS-P4, 1999 (Oceansat)

Presently Working Satellites:

- IRS-P6, 2003 (Resourcesat-1)
- IRS-P5, 2005 (Cartosat-1)
- IRS-P7, 2007 (Cartosat-2)
- IRS-P6, 2011 (Resourcesat-2)
- RISAT-1, 2012 (RISAT-1)

Link:

- IPDPG of Space of Application Centre (SAC) Ahmedabad
- Indian Space Research Organisation (ISRO), Head Quarters
- National Remote Sensing Agency (NRSA), Hyderabad

List of Earth Observation Satellites

	Launch Date	Launch Mass	Launch Vehicle	Orbit Type	Application
RISAT-2BR1	Dec 11, 2019	628 Kg	PSLV-C48/RISAT-2BR1	LEO	Disaster Management System, Earth Observatio
Cartosat-3	Nov 27, 2019		PSLV-C47 / Cartosat-3 Mission	SSPO	Earth Observation
RISAT-2B	May 22, 2019	615 Kg	PSLV-C46 Mission	LEO	Disaster Management System, Earth Observatio

	Launch Date	Launch Mass	Launch Vehicle	Orbit Type	Application
HysIS	Nov 29, 2018		PSLV-C43 / HysIS Mission	SSPO	Earth Observation
Cartosat-2 Series Satellite	Jan 12, 2018	710 Kg	PSLV-C40/Cartosat-2 Series Satellite Mission	SSPO	Earth Observation
Cartosat-2 Series Satellite	Jun 23, 2017	712 kg	PSLV-C38 / Cartosat-2 Series Satellite	SSPO	Earth Observation
Cartosat -2 Series Satellite	Feb 15, 2017	714 kg	PSLV-C37 / Cartosat -2 Series Satellite	SSPO	Earth Observation
RESOURCESAT-2A	Dec 07, 2016	1235 kg	PSLV-C36 / RESOURCESAT-2A	SSPO	Earth Observation
SCATSAT-1	Sep 26, 2016	371 kg	PSLV-C35 / SCATSAT-1	SSPO	Climate & Environment
INSAT-3DR	Sep 08, 2016	2211 kg	GSLV-F05 / INSAT-3DR	GSO	Climate & Environment, Disaster Management Syst
CARTOSAT-2 Series Satellite	Jun 22, 2016	737.5 kg	PSLV-C34 / CARTOSAT-2 Series Satellite	SSPO	Earth Observation
INSAT-3D	Jul 26, 2013	2060 Kg	Ariane-5 VA-214	GSO	Climate & Environment, Disaster Management Syst

	Launch Date	Launch Mass	Launch Vehicle	Orbit Type	Application
SARAL	Feb 25, 2013	407 kg	PSLV-C20/SARAL	SSPO	Climate & Environment, Ea Observation
RISAT-1	Apr 26, 2012	1858 kg	PSLV-C19/RISAT-1	SSPO	Earth Observation
Megha-Tropiques	Oct 12, 2011	1000 kg	PSLV-C18/Megha-Tropiques	SSPO	Climate & Environment, Ea Observation
RESOURCESAT-2	Apr 20, 2011	1206 kg	PSLV-C16/RESOURCESAT-2	SSPO	Earth Observation
CARTOSAT-2B	Jul 12, 2010	694 kg	PSLV-C15/CARTOSAT-2B	SSPO	Earth Observation
Oceansat-2	Sep 23, 2009	960 kg	PSLV-C14 / OCEANSAT-2	SSPO	Climate & Environment, Ea Observation
RISAT-2	Apr 20, 2009	300 kg	PSLV-C12 / RISAT-2	SSPO	Earth Observation
IMS-1	Apr 28, 2008	83 kg	PSLV-C9 / CARTOSAT – 2A	SSPO	Earth Observation
CARTOSAT – 2A	Apr 28, 2008	690 Kg	PSLV-C9 / CARTOSAT – 2A	SSPO	Earth Observation

	Launch Date	Launch Mass	Launch Vehicle	Orbit Type	Application
CARTOSAT-2	Jan 10, 2007	650 kg	PSLV-C7 / CARTOSAT-2 / SRE-1	SSPO	Earth Observation
CARTOSAT-1	May 05, 2005	1560 kg	PSLV-C6/CARTOSAT-1/HAMSAT	SSPO	Earth Observation
IRS-P6 / RESOURCESAT-1	Oct 17, 2003	1360 kg	PSLV-C5 /RESOURCESAT-1	SSPO	Earth Observation
The Technology Experiment Satellite (TES)	Oct 22, 2001		PSLV-C3 / TES	SSPO	Earth Observation
Oceansat(IRS-P4)	May 26, 1999	1050 kg	PSLV-C2/IRS-P4	SSPO	Earth Observation
IRS-1D	Sep 29, 1997	1250kg	PSLV-C1 / IRS-1D	SSPO	Earth Observation
IRS-P3	Mar 21, 1996	920 kg	PSLV-D3 / IRS-P3	SSPO	Earth Observation
IRS-1C	Dec 28, 1995	1250 kg	Molniya	SSPO	Earth Observation
IRS-P2	Oct 15, 1994	804 kg	PSLV-D2	SSPO	Earth Observation

	Launch Date	Launch Mass	Launch Vehicle	Orbit Type	Application
IRS-1E	Sep 20, 1993	846 kg	PSLV-D1	LEO	Earth Observation
IRS-1B	Aug 29, 1991	975 kg	Vostok	SSPO	Earth Observation
SROSS-2	Jul 13, 1988	150 kg	ASLV-D2		Earth Observation, Experimental
IRS-1A	Mar 17, 1988	975 kg	Vostok	SSPO	Earth Observation
Rohini Satellite RS-D2	Apr 17, 1983	41.5 kg	SLV-3	LEO	Earth Observation
Bhaskara-II	Nov 20, 1981	444 kg	C-1 Intercosmos	LEO	Earth Observation, Experimental
Rohini Satellite RS-D1	May 31, 1981	38 kg	SLV-3D1	LEO	Earth Observation
Bhaskara-I	Jun 07, 1979	442 kg	C-1Intercosmos	LEO	Earth Observation, Experimental

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8) Note: At the time of project initiation, CCD arrays with maturity of production were limited to 2048 elements. Hence the swath of LISS-I was limited to about 150 km. Since LISS-II has a better resolution by a

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12) "India Calls IRS-1B Launch a Success," Space News, September 9-15, 1991, p. 12

13) "IRS-1B Completes 10 years of Remote Sensing Mission," Aug. 29, 2001,
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14) Note: The satellite designations P1, P2, P3, etc. stand for the launches carried out by the PSLV (Polar Satellite Launch Vehicle), the launch vehicle developed by ISRO

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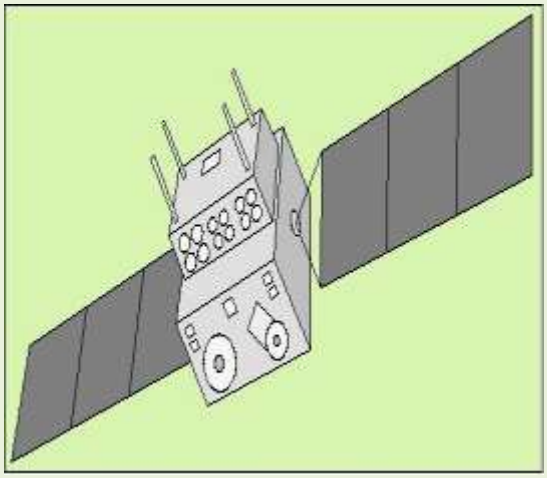

IRS-1B