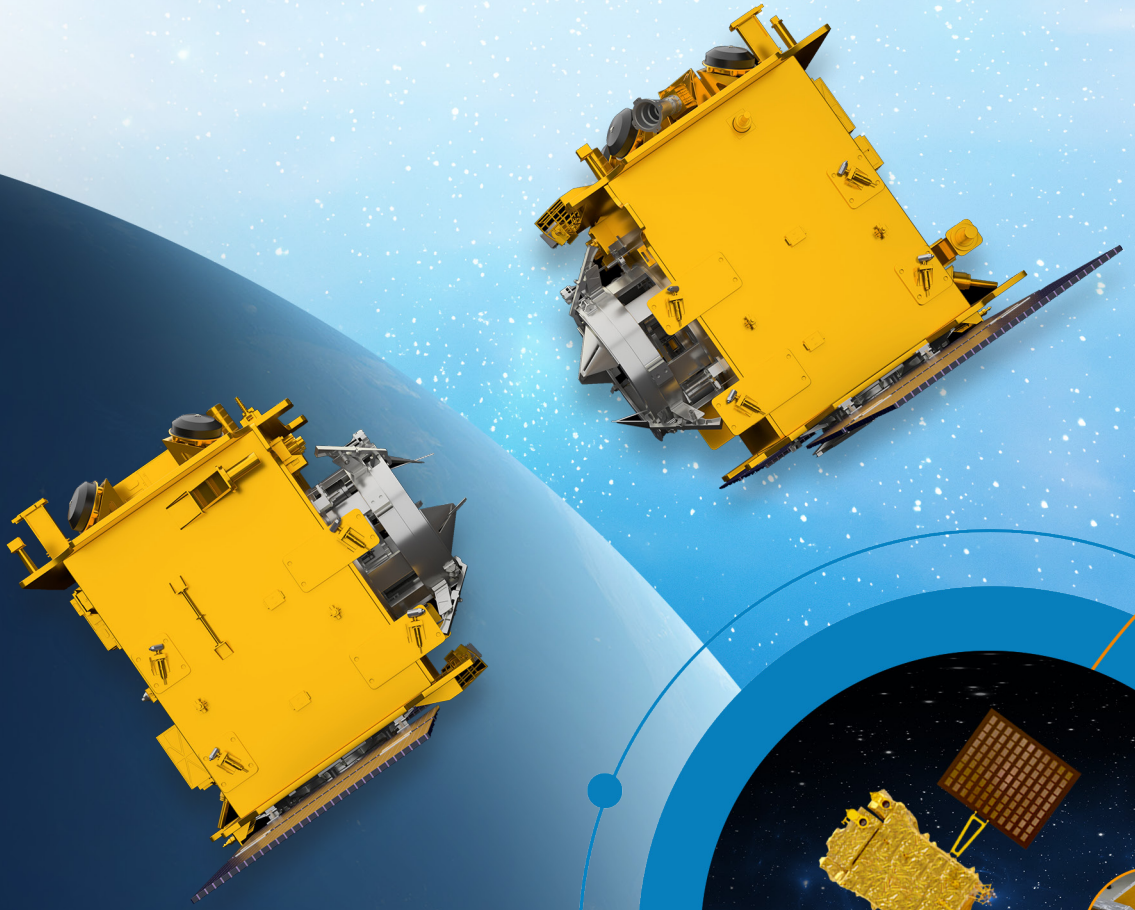
भारत सरकार
अंतरिक्ष विभाग

सत्यमेव जयते

GOVERNMENT OF INDIA
DEPARTMENT OF SPACE



वार्षिक रिपोर्ट
ANNUAL REPORT
2024-2025

भारत सरकार
अंतरिक्ष विभाग

GOVERNMENT OF INDIA
DEPARTMENT OF SPACE

वार्षिक रिपोर्ट
Annual Report

2024-2025

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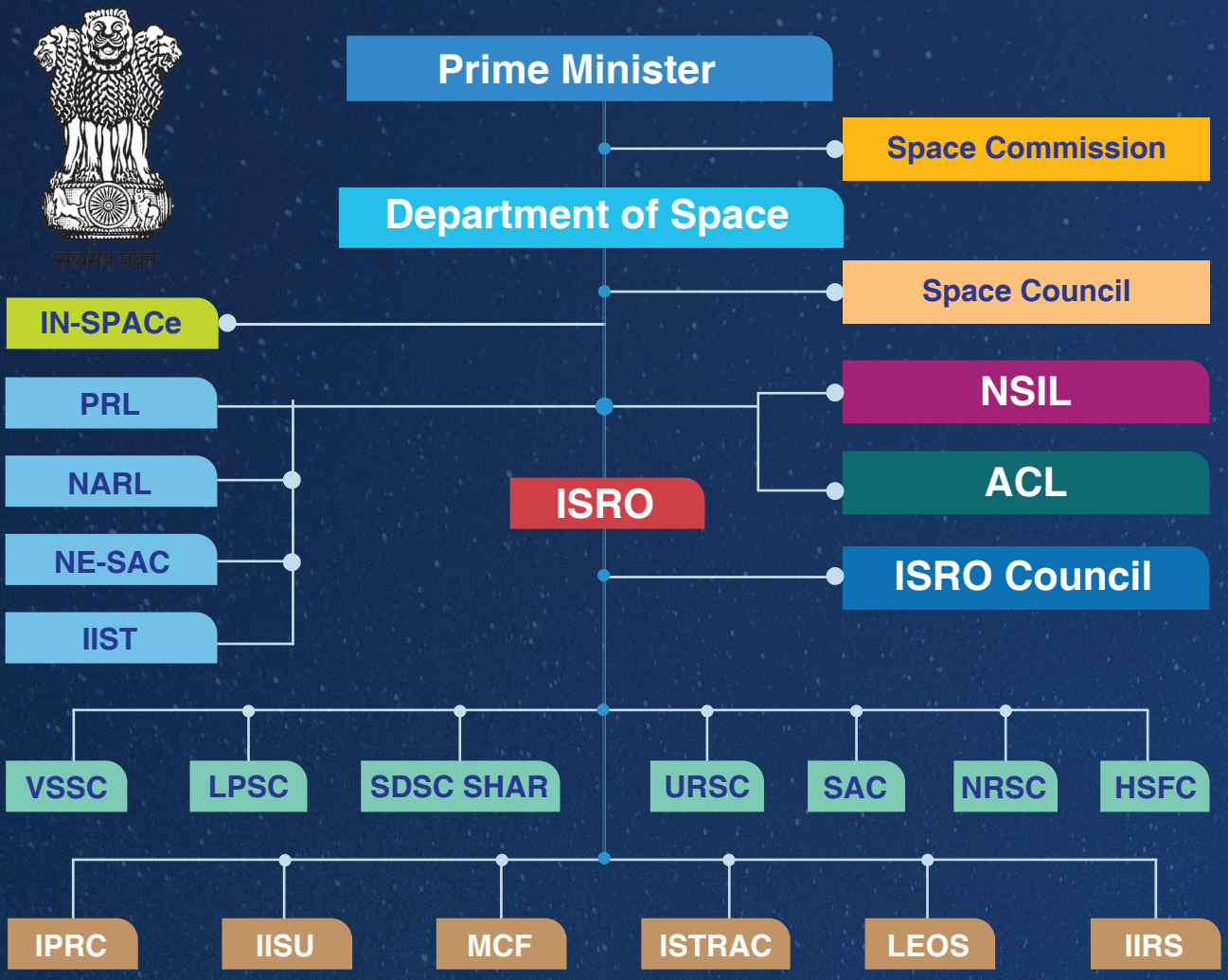
Space Missions

(As per Financial Year)

Mission	2023-24	2024-25	2025-26
Earth Observation Satellites	1	1	4
Communication Satellites	0	1	2
Navigation Satellites	1	1	0
Space Science Satellites	3	0	0
Technology Demonstrator	3	2	1
PSLV	4	2	4
GSLV MkII	2	1	3
LVM3	1	0	2
SSLV	0	1	2
Gaganyaan	0	0	3
TOTAL	15	9	21

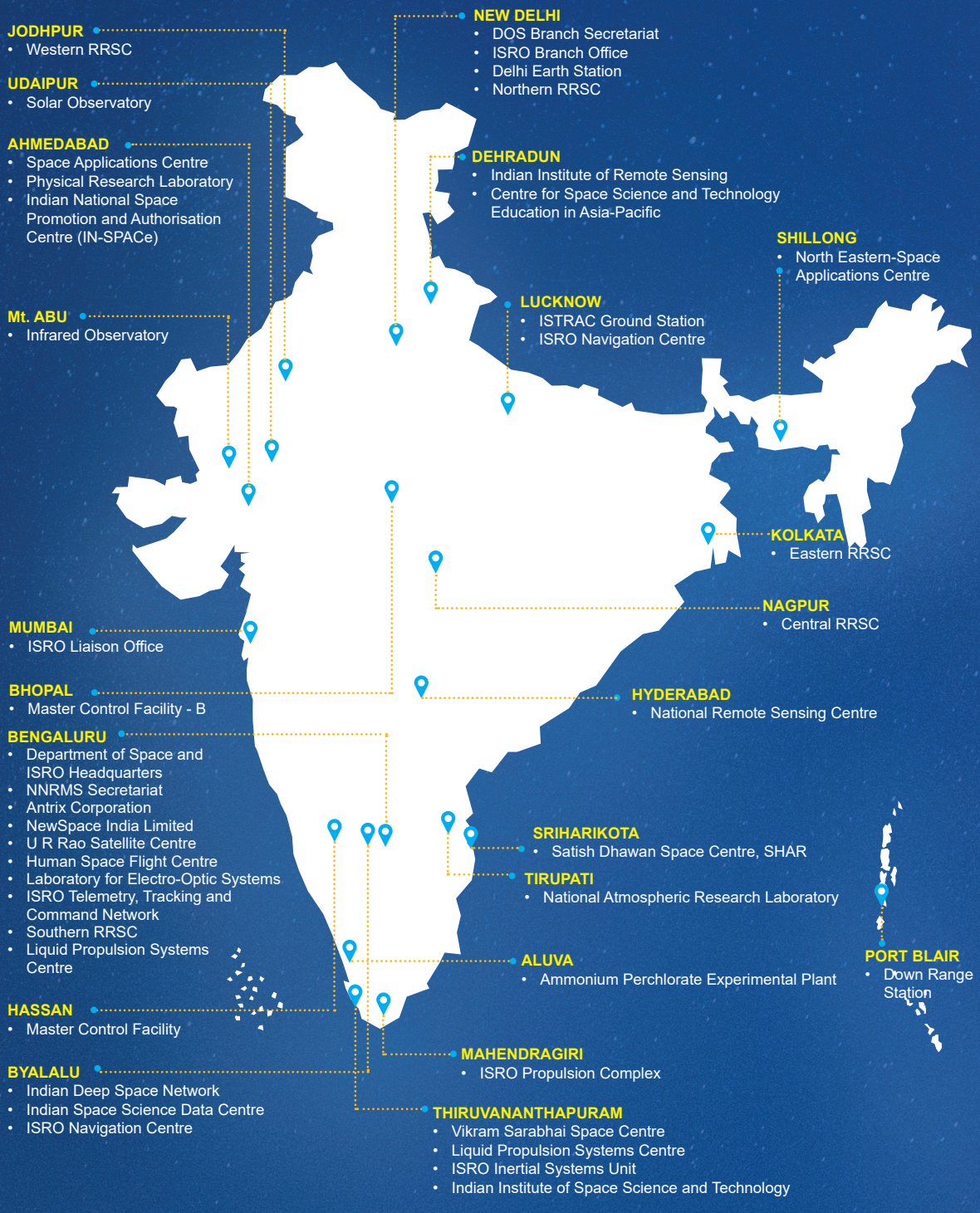
CHAPTER

01 Organisation Chart



ACL	Antrix Corporation Limited
HSFC	Human Space Flight Centre
IIRS	Indian Institute of Remote Sensing
IIST	Indian Institute of Space Science and Technology
IISU	ISRO Inertial Systems Unit
IN-SPACe	Indian National Space Promotion and Authorisation Centre
IPRC	ISRO Propulsion Complex
ISRO	Indian Space Research Organisation
ISTRAC	ISRO Telemetry, Tracking and Command Network
LEOS	Laboratory for Electro-Optics Systems
LPSC	Liquid Propulsion Systems Centre
MCF	Master Control Facility
NARL	National Atmospheric Research Laboratory
NE-SAC	North Eastern Space Applications Centre
NRSC	National Remote Sensing Centre
NSIL	NewSpace India Limited
PRL	Physical Research Laboratory
SAC	Space Applications Centre
SDSC SHAR	Satish Dhawan Space Centre Sriharikota High Altitude Range
URSC	U R Rao Satellite Centre
VSSC	Vikram Sarabhai Space Centre

DOS Establishments in India



Space activities in the country were launched with the setting up of the Indian National Committee for Space Research (INCOSPAR) in 1962. Work on the Thumba Equatorial Rocket Launching Station (TERLS) near Thiruvananthapuram was also started during the same year. In August 1969, the Indian Space Research Organisation (ISRO) was established. In June 1972, the Space Commission and the DOS were constituted by the Government of India (GoI) and brought ISRO under DOS in September 1972.

Space Commission formulates the policies and oversees the implementation of the Indian space programme to promote the development and application of space science and technology for the socio-economic benefit of the country. DOS implements these programmes through mainly ISRO, Physical Research Laboratory (PRL), National Atmospheric Research Laboratory (NARL), and North Eastern-Space Applications Centre (NE-SAC). Antrix Corporation Ltd. and NewSpace India Limited are the two Central Public Sector Enterprises set up for the commercialisation of R&D activities of DOS.

DOS Secretariat and ISRO Headquarters are located at Antariksh Bhavan in Bengaluru. Programme offices at ISRO Headquarters coordinate programmes like satellite communication, earth observation, navigation, launch vehicle, space science, disaster management support, sponsored research schemes, Technology Development, Human Spaceflight, international cooperation, systems reliability and quality, safety, budget and economic analysis, human resources and capacity building & public outreach. The major establishments of DOS and their area of activities are given in the following paragraphs.

VSSC

VSSC Main Building at Veli Range Complex

Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram

Vikram Sarabhai Space Centre (VSSC) at Thiruvananthapuram is the lead Centre of Indian Space Research Organisation (ISRO), mainly responsible for the design and development of space transportation systems and associated technologies. Major programmes at VSSC include Gaganyaan, Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV), Geosynchronous Satellite Launch Vehicle MkIII (LVM3), Small Satellite Launch Vehicle (SSLV), winged Reusable Launch Vehicle (RLV), Rohini Sounding Rockets as well as development of various technologies for future. PSLV, GSLV, LVM3 and SSLV are in operational phase. The Centre has been leading the development of ISRO's new generation launch vehicle (NGLV) as well as the development of critical activities related to Gaganyaan including Human rated HLVM3, design of Crew Module, parachute systems, Crew Escape System and mission design.

VSSC has core competence in multiple disciplines and pursues advanced research & development in cutting edge technologies for space transportation systems, its overall project management, technology transfer, academic interface and enabling space industry ecosystem.

URSC

U R Rao Satellite Centre (URSC), Bengaluru

URSC is the lead Centre for design, development, realization of communication, navigation, remote sensing, scientific and Interplanetary missions. Over the past five decades, specialized teams of scientists, engineers and technicians of URSC have built around 127 complex & advanced satellites for various applications in areas of telecommunications, television broadcasting, VSAT services, tele-medicine, tele-education, navigation, weather forecasting, disaster warning, search and rescue operations, earth observations, natural resource management, scientific and space science etc. with the support of administrative personnel.

URSC is also engaged in research and development activities involving cutting-edge satellite technologies, total management of all satellite missions, creation of a vibrant space industry for the realization of space systems, technology transfer, academia interface, etc. The Centre also houses ultra-modern design, development, fabrication and testing facilities for satellites. URSC is functioning in its sprawling 32 acres main campus, adjacent to NAL, HAL Airport Road and 110 acres ISRO Integration & Testing Establishment (ISITE) campus at Marathahalli, 8 km away from the main campus.

SDSC

Satish Dhawan Space Centre (SDSC) SHAR

Satish Dhawan Space Centre (SDSC)-SHAR, Sriharikota

Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota the Space Port of India is the backbone of Department of Space in providing the Launch Base Infrastructure for the Indian Space Programme. Envisaging the needs of the Launch vehicle & Satellite community and accordingly realizing the facilities have been the constant endeavor of this Centre.

SDSC SHAR has the State-of the art facilities for Solid Motor production, Testing & qualification of Systems, Stage Preparation Facilities, Vehicle Integration facilities, Satellite Preparation facilities, Propellant servicing systems, Mission Management systems etc., for simultaneous preparation and launch of two launch vehicles at any given point of time from the two operational launchpads and meet the ISRO's launch manifest.

LPSC

LPSC (Bengaluru)


LPSC (Valiamala)

Liquid Propulsion Systems Centre (LPSC), Thiruvananthapuram/Bengaluru

Liquid Propulsion Systems Centre (LPSC) is the lead Centre of ISRO for design, development and realization of earth-to-orbit advanced propulsion systems for launch vehicles and also space propulsion systems for spacecrafts. LPSC is vested with the responsibility of design, development and delivery of high performance space propulsion systems employing Earth Storable, Cryogenic, Semi Cryogenic and Electric Propulsion Systems for ISRO launch vehicles and Satellites.

LPSC activities and facilities are spread across its two campuses viz. LPSC, Valiamala/ Thiruvananthapuram and LPSC, Bangalore/Karnataka. The activities in its campus at Valiamala include design and development entities for earth storable, cryogenic, semicryogenic and electric propulsions systems. The end to end design, development and realisation of flow control components and modules, advance manufacturing and proto fabrication entities, project teams, management systems activities, as well as R&D activities in the area of propulsion and structure are carried out by expert entities. LPSC activities in its campus at Bangalore include design and realisation of propulsion systems for Earth Observation, Communication, Navigation satellites and other scientific missions. Also, development and production of transducers & sensors are undertaken here. A new campus at Tumkuru is also being established for Integrated Titanium alloy Tank production and Mono propellant thruster test facility.

SAC


SAC Main Campus


SAC New Bhopal Campus


SAC Bhopal Technical Campus


Delhi Earth Station

Space Applications Centre (SAC), Ahmedabad

Space Applications Centre (SAC), is a major research and development Centre of the Indian Space Research Organisation (ISRO). SAC today stands high in each of its endeavor with its strong space research & development capabilities and continues to deliver world-class technologies and applications for various national, strategic, societal and technology demonstration missions of ISRO. These applications are in diverse areas and primarily meet the communication, navigation and remote sensing needs of the country. Located at Ahmedabad, SAC is spread across three campuses having multi-disciplinary activities apart from Delhi Earth Station (DES), which is located in New Delhi. The genesis of the Centre dates back to 1966, with establishment of the Experimental Satellite Communication Earth Station (ESCES), by late Dr. Vikram A Sarabhai in Ahmedabad. In 1972, the different units of ISRO in Ahmedabad pursuing research in applications of space technology were merged to form Space Applications Centre (SAC). SAC has state-of-the-art electronic and mechanical fabrication facilities, highly sophisticated payload integration, climatic & environmental test facilities, systems reliability area, image processing and analysis facilities and project management support group.

HSFC

Human Space Flight Centre

Human Space Flight Centre (HSFC), Bengaluru

As the lead Centre for the Human space activities, HSFC is undertaking multi-disciplinary R&D activities in new domains of human science and technology, while conforming to high standards of reliability and human safety. HSFC is developing expertise, building necessary infrastructure and pursuing development of enabling technologies for the sustained human space flight missions in the country. HSFC is nurturing and streamlining new technologies related to life support systems, Bio Medical Research, Bioastronautics, Space Medicine, Crew Health Management, Simulators, virtual reality, space-based habitats, Human Centric Engineering Systems including advanced Crew Training Facilities. Crew recovery operations, procedures for crew mission operations, crew aids development and inter agency coordination are also essential activities of HSFC.

NRSC

National Remote Sensing Centre

National Remote Sensing Centre (NRSC), Hyderabad

National Remote Sensing Centre (NRSC) has the mandate for establishment of ground stations for receiving satellite data, generation of data products, aerial remote sensing data acquisition, dissemination to the users, development of techniques for remote sensing applications including disaster management support, geospatial services for good governance and capacity building for professionals, faculty and students.

NRSC operates through multiple campuses to meet national and regional geospatial needs. NRSC has three campuses at Balanagar, Shadnagar and Jeedimetla in Hyderabad and a hired facility at Old Airport, Begumpet and five Regional Remote Sensing Centres (RRSCs) in Bengaluru, Jodhpur, Kolkata, Nagpur and Delhi for promoting remote sensing applications for various states. Main Campus is at Balanagar, Hyderabad for Administration, Remote Sensing Applications and Aerial Services. The Campus at Shadnagar hosts the Integrated Multi Mission Ground Segment for Earth Observation Satellites (IMGEOS) facility. The aircraft operations are carried out from old airport, Begumpet.

The areas of Satellite Data Reception, Data Processing and Dissemination, Bhuvan Geoportal and Web Services, Earth and Climate Studies, and Disaster Management Support services operate from IMGEOS, Shadnagar. Bhuvan, Bhoonidhi and NDEM are the geoportals of NRSC for dissemination of satellite data and geo-spatial products and services in the country. Outreach facility at Jeedimetla in Hyderabad for providing training for professionals, faculty and students and for general outreach.

IPRC

ISRO Propulsion Complex

ISRO Propulsion Complex (IPRC), Mahendragiri

ISRO Propulsion Complex (IPRC), Mahendragiri is responsible for Assembly, Integration and Testing of liquid propulsion systems for operational and developmental launch vehicles. IPRC is also responsible for development, qualification and acceptance testing of Earth storable engines, Cryogenic engines, Semi cryogenic engines, spacecraft engines and thrusters and also provides platform for simulation trials for interplanetary missions. IPRC is equipped with state-of-art facilities necessary for realising the cutting edge technology products for ISRO's space programme.

ISTRAC


ISRO Telemetry Tracking and Command Network

ISRO Telemetry Tracking and Command Network (ISTRAC), Bengaluru

ISRO Telemetry Tracking and Command Network (ISTRAC), a unit of ISRO, is entrusted with the primary responsibility of providing TTC and mission control services to major Launch Vehicle and LEO and Interplanetary Spacecraft missions of ISRO. It has the additional responsibility of operating the complex Ground Segment of NavIC. ISTRAC is undertaking development of radar systems for launch vehicle tracking and meteorological applications, providing Search & Rescue and Disaster Management Services and supporting space based services like telemedicine, Village Resource Centres and tele-education. ISTRAC is also entrusted with Space Situational Awareness Activities (SSA), setting-up observational and data analysis facilities for space debris management.

In order to realize these objectives, ISTRAC has established a network of ground stations, 5 stations at Bangalore, 3 stations at Lucknow, 2 stations each at Mauritius, Sriharikota, Port Blair, Biak, 1 station each at Thiruvananthapuram, Brunei and the Indian Deep Space Network Stations IDSN-32 and two IDSN-18 (including new indigenous) terminals. The Mission Operations Complex located at Bangalore carries out round-the-clock mission operations for all remote sensing, science and planetary mission. All network stations of ISTRAC are connected to the Mission Operations Complex through dedicated high-performance satellite communication links and / or terrestrial communication links.

Under the NavIC Ground Segment, ISTRAC has established a network of stations consisting of 5 IRNSS CDMA Ranging stations (IRCDR) and 16 IRNSS Range and Integrity Monitoring stations (IRIMS). ISTRAC has also established the ISRO Navigation Centre-1 (INC-1), including an IRNSS Network Timing (IRNWT) facility at Bangalore and ISRO Navigation Centre-2 (INC-2), including an IRNWT facility at Lucknow.

MCF

Master Control Facility

Master Control Facility (MCF), Hassan

Master Control Facility (MCF) is only ISRO centre responsible for Launch & Early Orbit Phase (LEOP) or Transfer Orbit Satellite Service (TOSS), In-orbit payload testing and On-orbit operations of geosynchronous, navigational and meteorological spacecraft of ISRO. With the Geo-arch visibility of more than 140°, it is an ideal control centre in the South Asian region.

The facilities located at Hassan and Bhopal together now takes care operation of 31 Spacecraft (19 Communication, 9 Navigation and 3 Meteorology) with payloads classified into communication, meteorological & navigational category. These satellites are placed between 32.50°E & 129.50°E are in 12 orbital slots and most of them are collocated, scaling up payload capacity and optimum use of spectrum availability.

IISU

ISRO Inertial Systems Unit

ISRO Inertial Systems Unit (IISU), Thiruvananthapuram

IISU is responsible for the design and development of Inertial Systems for Launch Vehicles and Satellites. Major systems like Inertial Navigation Systems based on mechanical gyros and optical gyros, Attitude Reference Systems, Rate Gyro Packages, and Accelerometer Packages are developed indigenously and used in various missions of ISRO. IISU also designs and develops Actuators and Mechanisms, namely, Reaction Wheel, Momentum Wheel, Solar Array Drive, and Scan Mechanisms for spacecraft and allied applications. IISU is engaged in continuous Research and Development. IISU has initiated advanced technology development programmes in niche areas focusing on miniaturisation, low power & cost, and scalable sensors and systems.

LEOS

Laboratory for Electro-Optics Systems

Laboratory for Electro-Optics Systems (LEOS), Bengaluru

Laboratory for Electro-Optics Systems (LEOS) is a premier unit of ISRO responsible for the design, development and realization of state-of-the-art attitude and navigation sensors, high performance optics and special-purpose science instruments. These sensors and optical systems have been successfully flown in various missions of the Indian Space Programme. Demand-driven indigenous developments include star sensors, earth sensors, sun sensors, magnetometers, large-area high-precision telescope mirrors, multi-band matched opto-mechanical lens assemblies, thin-film and special purpose coatings, fiber optic gyroscopes, laser and fiber optics-based navigation sensors, MEMS devices, specialty detectors, ground and on-board software. LEOS houses a spectrum of in-house metrology instruments that are developed or procured and ground-calibrated for this purpose. The multitude of sensors, optics and photonic devices developed at LEOS are embedded into various aspects of satellite attitude determination, remote sensing, meteorological applications, scientific exploration, interplanetary missions, etc.

IIRS


Indian Institute of Remote Sensing

Indian Institute of Remote Sensing (IIRS), Dehradun

Indian Institute of Remote Sensing (IIRS) is a premier institute with a primary aim to build capacity in Remote Sensing and Geoinformatics and their applications through education and training programmes at postgraduate level. It is a constituent Unit of Indian Space Research Organisation (ISRO), Department of Space, Government of India. Formerly known as Indian Photo-Interpretation Institute (IPI), founded in 1966, the Institute is first of its kind in entire South-East Asia. While nurturing its primary endeavor to build capacity among the user community by training mid-career professionals since its founding in 1966, the Institute has enhanced its capability and evolved many training and education programmes that are tuned to meet the requirements of various stake-holders, ranging from fresh graduates to policy makers including academia, industry and NGOs.

The capacity building activities of the Institute are primarily grouped into the following three domains – (1) Training & Education (2) Research and (3) Outreach. The Institute also hosts and provides support to the Centre for Space Science and Technology Education in Asia and The Pacific (CSSTEAP), affiliated to the United Nations, to conduct the remote sensing and GIS training & education programmes at postgraduate level.

PRL

Physical Research Laboratory

Physical Research Laboratory (PRL), Ahmedabad

Physical Research Laboratory is mandated to conduct fundamental research in niche areas of sciences. Its research is organized in seven major science areas: Astronomy & Astrophysics, Solar Physics, Space and Atmospheric Sciences, Planetary Sciences, Geosciences, Atomic, Molecular and Optical Physics, and Theoretical Physics. From April to November 2024, the scientists of PRL have published 115 peer-reviewed scientific papers in reputed journals.

NARL

National Atmospheric Research Laboratory

National Atmospheric Research Laboratory (NARL), Gadanki

National Atmospheric Research Laboratory (NARL) is engaged in carrying out frontline research on atmospheric, ionospheric & space weather, and planetary ionospheric sciences through observations, technique/technology, instrument development, and simulation/modelling. NARL operates a large number of sophisticated instruments, including high power radars and lidars, measuring various atmospheric and ionospheric parameters from Gadanki, two comprehensive off-campus observatories, one at Kolkata and the other at Hyderabad, and networks of GNSS receivers and airglow imagers. NARL also has a High-Performance Computing (HPC) system for carrying out sophisticated computation, simulation and modelling for atmospheric and ionospheric research.

NARL provides weather forecasts and high-resolution upper air wind data for supporting the rocket launchings at SDSC-SHAR. NARL has a vibrant research and development programme, which includes Ph. D & PDF, capacity building, and public outreach programs.

NE-SAC

North Eastern Space Applications Centre

North Eastern Space Applications Centre (NESAC), Shillong

NESAC is an autonomous organisation under the Department of Space (DOS) that has dedicated more than 24 years of service to the eight states of the North Eastern Region (NER) of India through the application of space science and technology. The Centre's key objectives are: 1) to establish an operational remote sensing and geographic information system (GIS)-based natural resource information platform to support development, natural resource management, and infrastructure planning in the region; 2) to provide satellite communication services for education, healthcare, disaster management, and developmental communication; 3) to conduct research in space and atmospheric sciences and establish an instrumentation hub in collaboration with academic institutions in NER; 4) to provide integrated space-based support for disaster management; and 5) to develop regional infrastructure for capacity building in geospatial technology.

IIST


Indian Institute of Space Science and Technology

Indian Institute of Space Science and Technology (IIST), Thiruvananthapuram

Indian Institute of Space Science and Technology at Thiruvananthapuram, Kerala was established in 2007 to develop and discover possibilities of shaping manpower for Indian space programme. From its first steps in the alternate campus at VSSC, Veli in 2007, to the firm steps in Valiamala, IIST has evolved consistently, catalysing and adapting to changes. In the seventeen years of its functioning, the institute has dynamically evolved and expanded as a centre of multidisciplinary learning and research that spans themes across the fields of Aerospace, Avionics, Chemistry, Earth and Space Sciences, Humanities, Mathematics and Physics. IIST offers undergraduate, postgraduate, doctoral and post-doctoral programmes with a synergetic emphasis on Space Science & Technology applications.

ACL

Antrix Corporation Limited

Antrix Corporation Limited (ACL), Bengaluru

Antrix Corporation Limited (ACL) with its corporate office in Bengaluru is a wholly owned Government of India entity under the administrative control of Department of Space. ACL is engaged in providing space sector products and services worldwide ranging from supply of hardware and software, Earth observation and scientific missions, remote sensing data services, transponder lease services, mission support services and other allied services.

NSIL


NewSpace India Limited

NewSpace India Limited (NSIL), Bengaluru

NSIL got incorporated in 2019, as a wholly-owned Government of India Undertaking/Central Public Sector Enterprise (CPSE), under the administrative control of the DOS. NSIL has been categorized as Schedule 'A' CPSE by the Dept. of Public Enterprises (DPE) on February 06, 2020. The government of India enhanced the role and scope of NSIL to encompass more responsibilities in the primary business areas and widen the scope in June 2020. The revised mandate broadly covers (i) Owning satellites for Earth Observation and Communication applications; (ii) Providing space-based Earth Observation and Communication services; (iii) Building satellites and launching them as per demand; (iv) Building launch vehicles through Indian Industry and launch as per requirements; (v) Providing launch services and (vi) Technology Transfer to Indian Industry.

IN-SPACe

Indian National Space Promotion and Authorisation Centre (IN-SPACe), Ahmedabad

As the space sector was opened up to private enterprises and start-ups to undertake space activities to promote, handhold, regulate and authorise their activities, an autonomous nodal agency attached to DOS - the Indian National Space Promotion and Authorisation Centre (IN-SPACe) was formed. This will enhance the diffusion of space technology and boost the space economy within the country. IN-SPACe will permit and oversee the activities of private enterprises and start-ups. It regulates space activities, including the building of launch vehicles and satellites and providing space-based services as per the definition of space activities. It permits the sharing of space infrastructure of ISRO and the establishment of temporary facilities within the premises of ISRO. It promotes the establishment of new space infrastructure and facilities, by Non-Government Entities (NGE), in pursuance of space activities based on safety norms and other statutory guidelines and necessary clearances. IN-SPACe governs the usage of spacecraft data and the rolling out of space-based services and all the associated infrastructure for the same. IN-SPACe operates with its headquarters in Ahmedabad and a directorate in Bengaluru.

CHAPTER

02 Major Activities

2.1 Earth Observation, Data Processing, and Applications

1. Satellite Data Reception

The prime objective of Satellite Data Reception & Ingest Systems is to receive, ingest and pre-process the payload data from different Indian and foreign remote sensing satellites to meet the Indian systematic coverage and global data requirements of user community. Data from around 21109 passes is acquired from 17 Indian satellites and 10 foreign satellites during the year 2024, meeting >99.8 % station efficiency.

IMGEOS: Integrated Multi-Mission Ground Segment for Earth Observation Satellites - (IMGEOS) facility with eight (08) Antenna systems supports data reception from 27 satellites. (11 IRS Satellites, 6 User Satellites and 10 Foreign Satellites). The missions supported by IMGEOS are broadly divided into three categories.

- IRS Satellites: Passes are scheduled regularly from the Cartosat-3, Cartosat-2S (01), Hysis, Resourcesat-2, Resourcesat-2A, EOS-04, EOS-06, EOS-07, EOS-08, Scatsat-1 and SARAL
- User Satellites: Spare capacity of these satellites will be used by NRSC to meet the emergency/disaster user requirements. The list of satellites supported under this category is RISAT-2B, RISAT-2B-R1, EOS-01 and Cartosat-2S (3)
- Foreign Satellites: All visible passes are scheduled under this category. The list of satellites supported is AQUA, TERRA, Landsat-8, Landsat-9, S-NPP, JPSS-1, JPSS-2, NOVASAR, METOP-B and NOVA-19.

AS2 antenna with new feed system: Phase matching for single channel monopulse auto tracking is accomplished for S and X-band for this feed. The augmented terminal is currently operational and successfully supporting real time satellite data reception.

Anechoic Chamber Facility: Installation and commissioning of the Anechoic Chamber as new test facility, for precise Testing of antenna element parameters, is completed in RF&BSG Lab at IMGEOS, Shadnagar.

A software for generation of Antenna look angle using State Vectors is developed and operationalised on one of the 7.5M antenna system at IMGEOS facility Shadnagar.

Augmentation of AS2 terminal with new feed system

Anechoic Chamber Facility

AGEOS: Antarctica Ground Station for Earth Observation Satellites (AGEOS) facility at Bharati Station, Antarctica mainly targets global data coverage with nearly 10-11 orbits visibility from each satellite. The station has two Data reception antenna (DRS) systems and one Data Communication System (DCS). The station supports the TTC operations and payload data reception for all current IRS missions. The Station also supports Launch and Early Orbit Phase (LEOP) operations of PSLV. During year 2024 the station received data of around 6484 orbits from 8 IRS Satellites.

2. Antenna Systems: Technology Developments

X-band phased array antenna for satellite tracking: A dual circularly polarized microstrip patch antenna has been designed using a 90° hybrid coupler to support both right-hand and left-hand circular polarizations simultaneously.

32x32 High Speed Differential Data Switch Matrix: Designed and developed the High Speed Differential Data Switch Matrix that facilitates switching of base band data from 8 Antenna / Data Chains to 8 Data ingest systems.

Design of Travelling wave based multimode monopulse Coupler for Ka-band Auto Track (TWC) is completed. Improvement in performance of mode coupler in terms of insertion loss and mode purity is achieved. Fabrication model is prepared and fabrication initiated.

Development of Antenna Control Servo Systems for Compact full motion antenna: Servo loops are implemented on the drive system itself. The Development of programme tracking software completed. The testing of the system in the lab completed and its accuracy is within 100 milli degree.

3. Satellite Data Processing and Products Dissemination

Scheduling of satellite payloads for real time imaging, generating and disseminating data products to user community through Bhoonidhi portal is operationally done from 28 satellites (IRS and Non-IRS). Customized and value-added products are also generated as per the user requirements. New information products from AWiFS, LISS-III, and EOS-04(MRS), EOS-06 and EOS-8 are operationalized.

About 4,65,440 satellite data products from optical sensors of IRS satellites and 2,13,705 satellite data products from microwave sensors from various IRS and Non-IRS satellites were processed for Indian region during year 2024. Further, 7,43,614 global products acquired from IRS & Non-IRS missions were also processed.

Value Added Products

EOS-06 OCM-3 GAC NDVI time composite product at 1km spatial resolution for the entire globe with 8-day temporal resolution was developed and operationalized. A Full India NDVI time composite product from Resourcesat-2 (RS2) AWiFS at 100m spatial resolution for every 15 days was developed and operationalized.

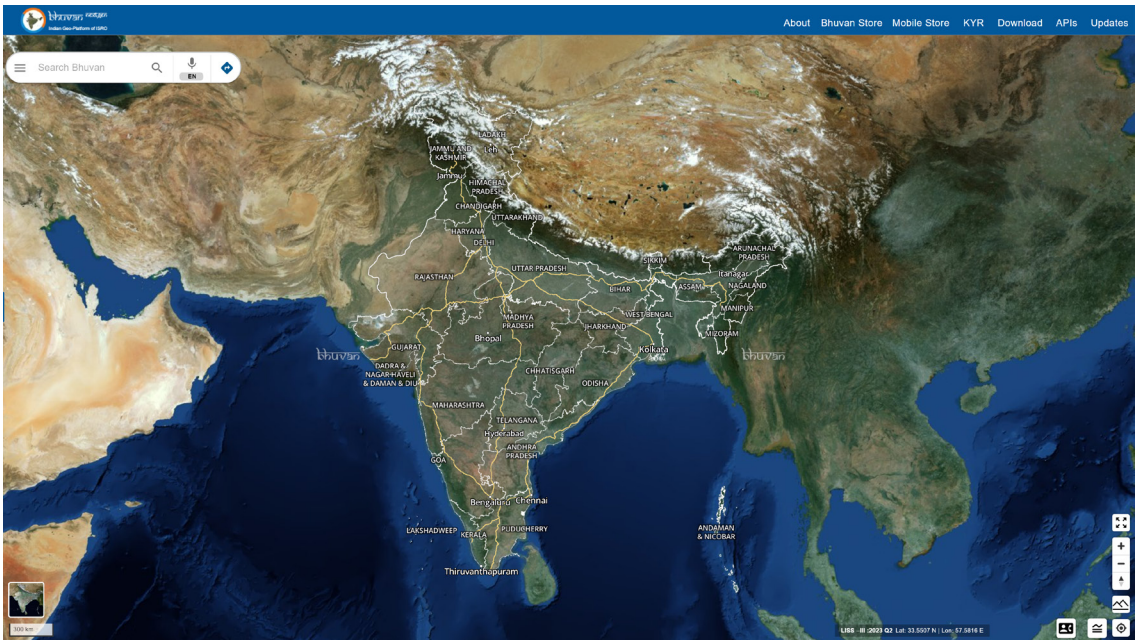
Indian Space Policy 2023 Implementation at Bhoonidhi: Priced Data dissemination through NSIL

In accordance with Indian Space Policy-2023, all the Indian remote sensing data coarser than 5 meters is disseminated as open & free data for all users and data finer than 5 meters is open & free for Government Entities (GE) and priced for Non-Government Entities (NGE). Software solutions were implemented to store the identified organisations as GEs at Bhoonidhi, segregate the Bhoonidhi user base as GE and NGE users and configure the data accessibility. NSIL is handling all commercial data dissemination.

4. Geo-Portals

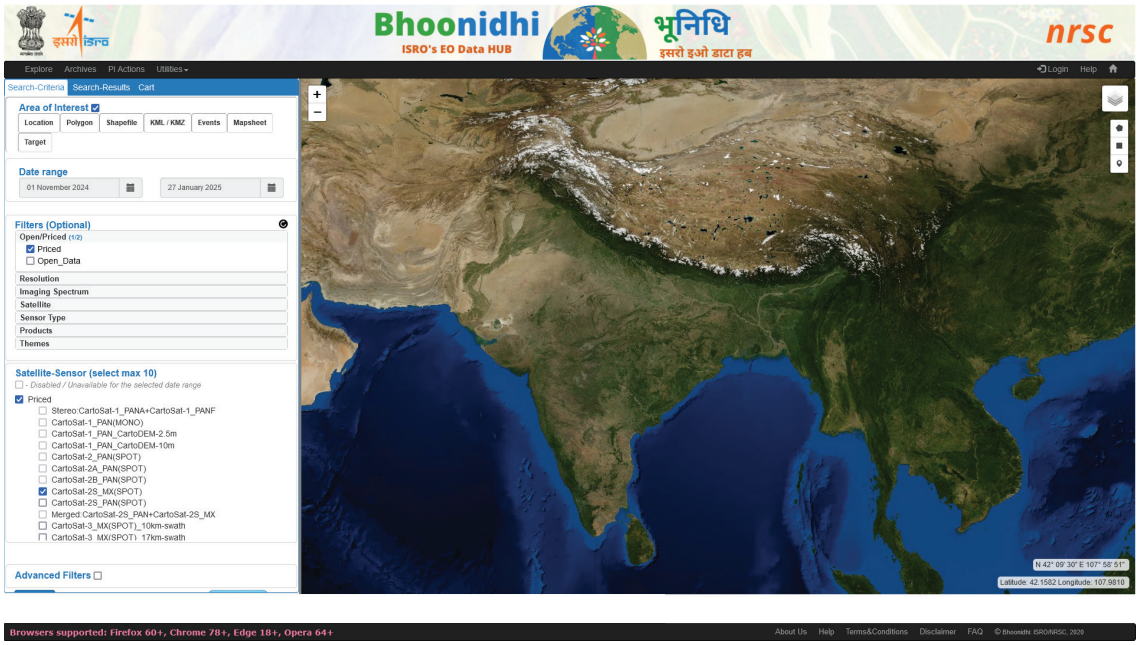
Earth observation data and thematic products of ISRO are facilitated through Web GIS portals disseminating Land, Cartography, Meteorology, Climate, Oceanographic information in various spatial and temporal scales. This mechanism ensures EO data availability to wide range of stakeholders seeking geospatial content to support their operational use, research, academics, planning or related uses.

Bhuvan NextGen: A newer version of Bhuvan (Bhuvan NextGen) has been developed and launched, using the latest frontend technologies. Solution is optimized for both web and mobile use, ensuring a seamless experience across devices offers comprehensive features. It caters to specific needs across five modes such as Standard, Thematic, Data Hub & Analytics, g-Governance and Disaster services. Bhuvan has expanded its services to Kenya through Bhuvan-Kenya geoportal in terms of basic geospatial services. Bhuvan PRAGATI (Pro-Active Governance and Timely Implementation) platform has been developed for the monitoring and assessment of PRAGATI projects. Apart from this, Bhuvan serves most of the remote sensing application datasets covering water, watersheds, rural development, groundwater, vegetation, agriculture as well as climate.



Bhoonidhi: Bhoonidhi portal is developed as ISRO's EO data hub for enabling access to the extensive EO data from 44 Indian and many foreign satellites. The Bhoonidhi portal is being upgraded with Spatio-Temporal Asset Catalogue (STAC) to increase the interoperability of searching for satellite data and seamless collaboration with other

international space agencies. Towards this, the STAC item structure was designed. Existing catalogue migration and live updates were enabled and Docker based deployment was done on Kubernetes cluster. This STAC is now operational for RS2, R2A, E0S-06, E0S-04 through Bhoonidhi-API Search end point. Bhoonidhi API, is designed as per the OpenAPI specification 3.0 to facilitate automated satellite data access by enabling users to search and download open data products programmatically. The API services have been enabled for the users on demand basis.

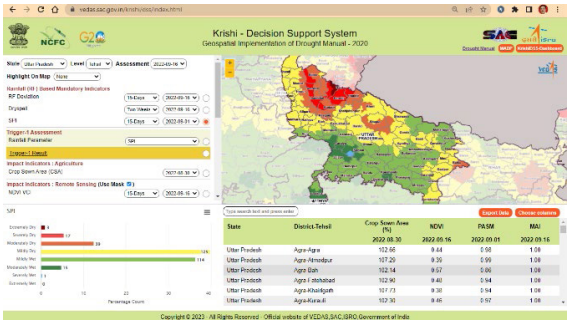


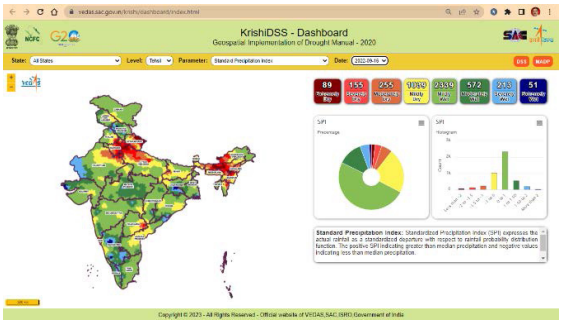
MOSDAC: Meteorological & Oceanographic Satellite Data Archival Centre (MOSDAC) is a portal dedicated for dissemination of data and derived products from Indian Meteorological and Oceanography satellites. INSAT3DS Imager and Sounder Data Products made operational through MOSDAC Geoportal. Design and development of software for data dissemination of GsMAP_ISRO Rainfall Product (Archived and NRT mode) as Open Data Science Products through MOSDAC Geoportal made operational. A web application with responsive design on a WebGIS platform for interactive visualization has also been made operational on MOSDAC Geoportal.

VEDAS: Visualisation of Earth Observation Data and Archival System (VEDAS) is web-based platform for accessing and analyzing EO data from Indian satellites to develop custom crafted applications for decision making. Wetland Information System on VEDAS portal provides geospatial map services, enabling temporal and spatial analysis of wetland dynamics. This initiative significantly supports environmental monitoring, policymaking,

and sustainable wetland management by leveraging satellite data and advanced geospatial tools.

Krishi-DSS: A Drought Monitoring Portal (Krishi-DSS) has been developed over VEDAS geo-portal specifically for the Ministry of Agriculture and Farmers' Welfare. It utilizes several satellite-based inputs and ancillary data for providing a robust, interactive and efficient system for near-real time monitoring of drought in India at district and taluka level. Krishi-DSS substantially improves the ease of drought assessment while reducing the possibility of human errors so as to ensure standardisation of procedures/processes.





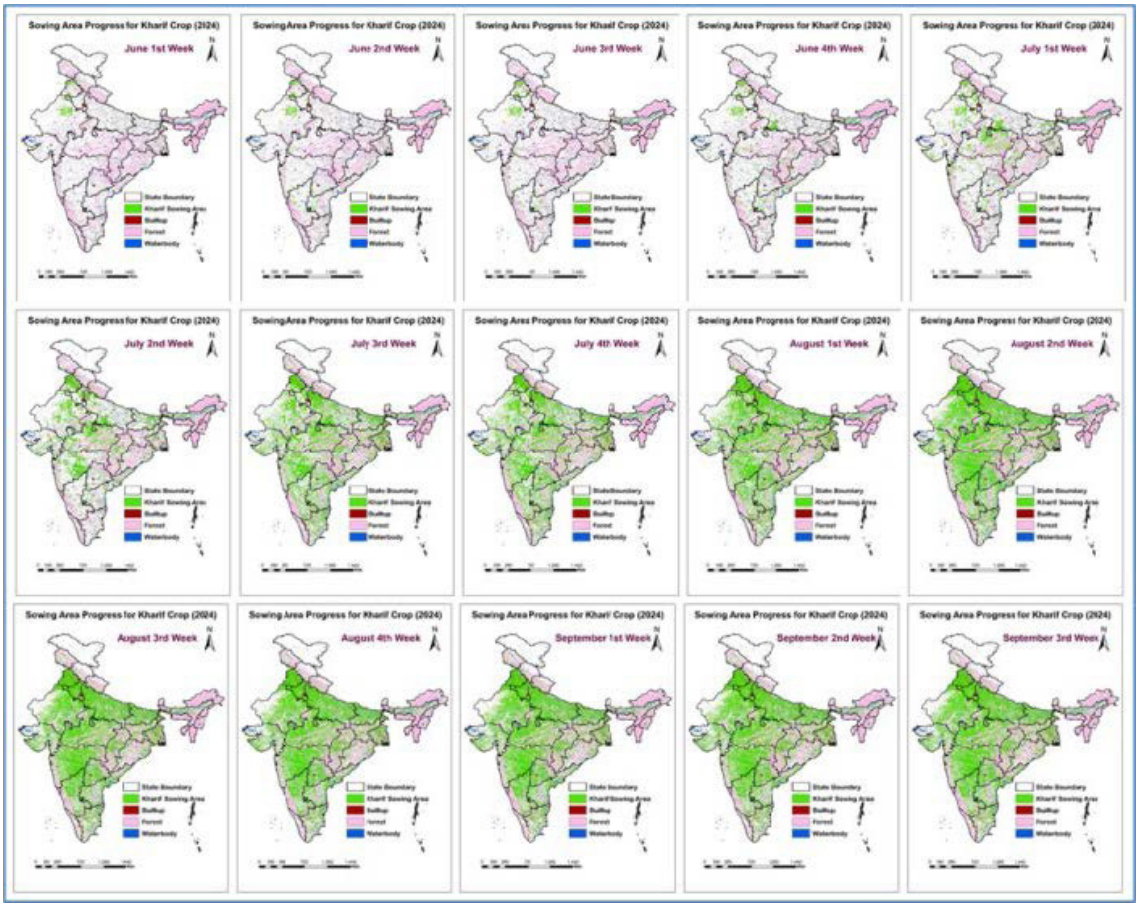
NICES: National Information System for Climate and Environment Studies (NICES) has developed and made accessible more than 70 geophysical variables pertaining to Terrestrial, Ocean and Atmosphere. Daily, 2-day, 7-day, 15-Day composite wind products and other wind derivatives such as wind stress, curl, divergence and wind energy potential generated using EOS-06 Level-2B data and disseminated through NICES portal. Additionally, Methane Emission Hotspots, Lightning Detection, Global ocean colour parameters are also disseminated. Number of NICES ECV downloads during Apr-Mid November, 2024 is about 18,300, whereas the product downloads are about 47,000. The total downloads are about 65,300.

North Eastern Spatial Data Repository (NeSDR): NeSDR is a e-Governance web applications cum single window data visualization and sharing platform, which is being used by various Govt. departments for their planning and developmental activities in North East Region and has catalogued more than 39 lakh site visits. Election e-atlases in the Lok Sabha elections-2024 in NER region has been promoted by this portal as an innovative approach towards better democratic process.

5. Remote Sensing Applications

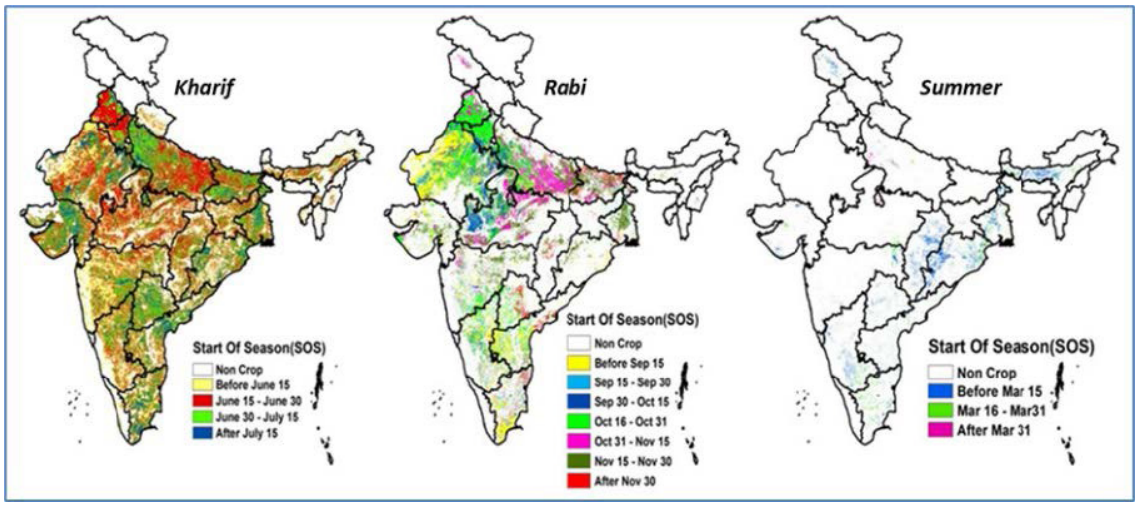
5.1 Agriculture

Operational crop progress monitoring at national scale using EOS-06 data: A semi-automated algorithm was developed for operational crop sowing and harvest progress monitoring in near real time during kharif and rabi seasons. Multi-temporal EOS-06 data was used synergistically with medium resolution satellite images for early and repetitive (weekly) detection of sown area to generate national scale agriculture outlook information.



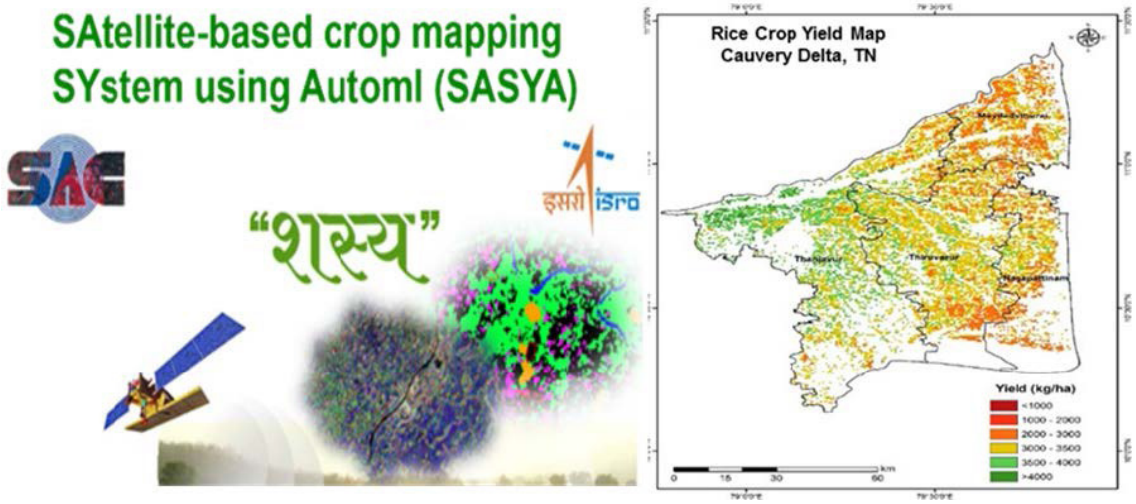
Harvest area progress during kharif 2024-25.

Generation of crop pheno-metrices from EOS-06 NDVI data: A spatial framework was established for extracting phenological attributes from EOS-06 NDVI product. Seasonal attributes such as Start of Season (SOS), Peak Season Time (PST), Peak of Season Vegetation Index (PSVI), End of Season (EOS), Length of Growing Season (LGS) etc. were extracted at country scale.



Start of Season (SOS) of agriculture area from EOS-06 at national scale (2023-24)

Satellite-based crop mapping System with Automl (SASYA): A processor (SASYA) has been developed for mapping crops using time series EOS-04 and other SAR data through automatic Machine Learning (ML) algorithms. The system was transferred and operationalized at MNCFC, MoA&FW.



Crop mapper using SASYA based on Auto-ML and GP-level rice yield estimation

Gram Panchayat level crop yield estimation: Under the YES-TECH programme of PMFBY the Gram Panchayat level crop yield was estimated using EO inputs and semi-physical model to support the crop insurance programme in eight states such. It was reported from Andhra Pradesh state agriculture department that 4865 additional farmers in two districts have been benefitted through claim settlements with the use of semi-physical yield model in YES-TECH in comparison to only CCE-based yield estimates.

2.1 Earth Observation, Data Processing, and Applications

Semi-Physical Model (SPM) for National System of Crop Yield Estimation: Under FASAL 2.0, automation of semi-physical yield model has been initiated through VEDAS WebGIS implementation with dashboard for user interface (https://vedas.sac.gov.in/vstatic/fasal2_dashboard/index.html).

Soil carbon estimation: A multi-scale framework, called 'Deep Carbon' model has been developed for soil carbon estimation using combination of imaging spectroscopy, multispectral observations and environmental covariates.

Applications of Space Techniques for Agricultural Assessment in NER (ASAAN): The acreage of important crops in the North Eastern Region (NER) was estimated using EO data. To ensure efficient field surveys, an Android-based mobile application 'ASAAN' has been developed which can be paired with a GAGAN dongle. Acreage estimated for winter rice in entire NER and summer rice, maize, & potato for selected districts in NER. Cropping intensity analysis of Assam has been carried out. Site suitability analysis has been carried out for rice, maize, mustard & millet in selected districts of Arunachal Pradesh and oil palm in Mizoram. The potential areas for organic agriculture have also been identified in the state of Sikkim.

Space based Support for Integrated Development of Horticulture in NER (SSIDH): The suitable sites for important horticultural crops were identifed and the locations for cluster based farming & establishment of post harvest infrastructure were identifed for selected districts of the NER. An Android-based mobile application named 'SSIDH' was developed for horticultural resources mapping. Site suitability analysis for priority horticultural crops was carried out for 47 selected districts of NER. The potential sites for clusterbased farming for cabbage & tomato have been identified in five districts of Mizoram. Moreover, suitable sites for allocation of cold storage facilities have been identified in 7 districts of Mizoram.

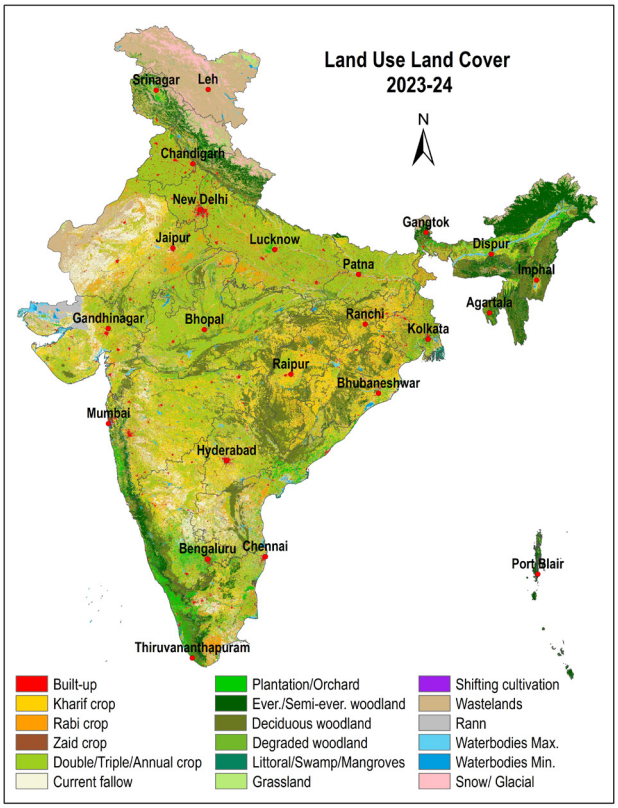
5.2 Environment, Energy & Bioresources

National Forest Biomass Estimation & Biomass change dynamics: Techniques for realistic assessment of forest biomass by integrating, ground; aerial and space-borne data is being developed. It will help assessment of carbon flux from forest landscape. Reference above ground biomass (AGB) maps, including uncertainty maps, at 100m and 40m spatial resolutions were generated. These maps serve as calibration/validation datasets to improve the accuracy and reliability of AGB mapping for current and upcoming EO missions (viz., GEDI, BIOMSS, and NISAR).

Environmental Quality Assessment of Forest Fire events in Nainital region: Analyzed the impact of forest fire events on air quality, focusing on carbon monoxide, formaldehyde and aerosols during April 2024 forest fire events in Nainital region. The comparative analysis of TROPOMI and OCM3 observations during April 2023 (no fire) and April 2024 (forest fire) periods highlighted high concentration and extended lifetime of trace gases, with implications for public health and long-term environmental effects.

Assessing response of alpine vegetation to climate warming using Open Top Chamber (OTC) based warming experiments: Response of alpine vegetation towards climate warming was evaluated using Open Top Chamber (OTC) experiment in the Gangotri National Park. Warming resulted in a 23% increase in the Growing Degree Days (GDD) inside the OTCs. Overall, an increase in the NPP in an order of 0.6 t/ha was observed for alpine vegetation with 1.3 °C rise in mean annual temperature.

National Land Use / Land Cover Mapping (2023-24): National Land Use / land Cover mapping for 18th cycle (2023-24), was accomplished using AWiFS data. Semi-automation approach was used to extract cropped area in Gross Cropped Area envelope for entire country. Crop Sown Areas in Kharif (Monsoon), Rabi (winter) and Zaid (summer) along with four sub-annual sown area products viz., August, September, December, and February were also prepared. Annual outputs are disseminated through Bhuvan. The analysis depicts that the distribution of LULC classes within India dominated by agricultural classes. The built-up area spans 112.27 Lakh ha, while cropland encompasses a total of 1793.24 Lakh ha.

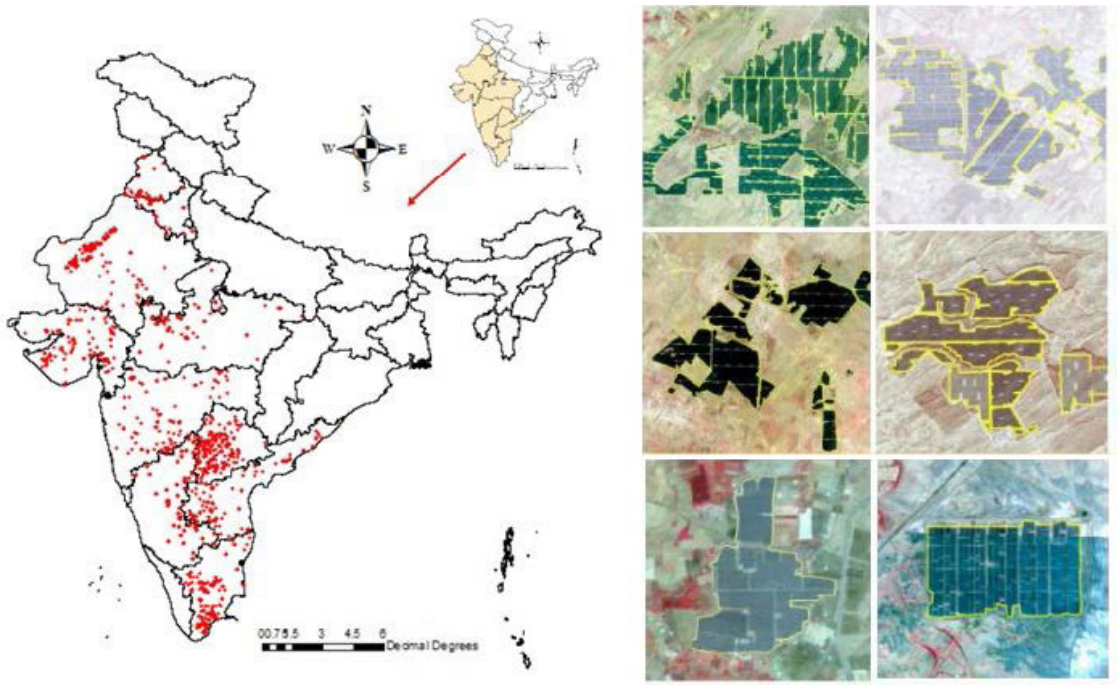


Land Use Land Cover map of India (2023-24)

Earth Observation, Data Processing, and Applications

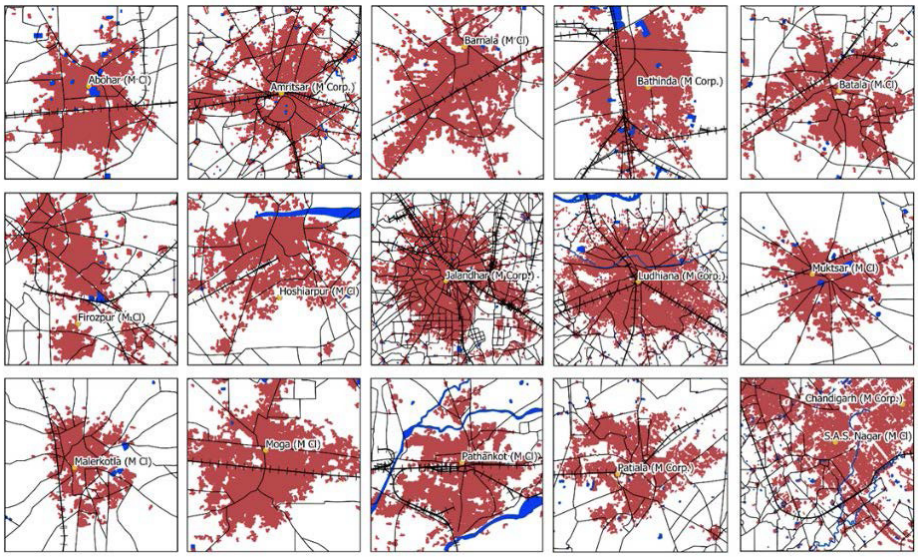
Paddy stubble burnt area progression in Punjab & Haryana – Kharif 2024 Near real time satellite-based monitoring and assessment of the actual paddy stubble burnt areas and its weekly/fortnightly progression has been carried out for Kharif 2024 for Punjab and Haryana states. An operational protocol document was prepared along with stakeholders for in-season paddy residue burnt area assessment and reporting at fortnight interval during September to November based on a request from the Commission for Air Quality Management (CAQM) in NCR and adjoining areas.

AI-based Solar Power Plants Extraction for Ten States from Resourcesat LISS IV data: The spatial extents of solar power plants were extracted from Resourcesat-2 LISS-4 data for ten states using artificial intelligence algorithm. Deep Learning Neural Network was used for automatic extraction of these solar power plants for the years 2018 and 2023. The temporal changes in the area covered by Solar Plants from year 2018 to year 2023 were quantified.



Location of auto-identified solar power plants in ten Indian states and their appearance on high resolution LISS-IV images

Built-up Area of Class-1 Cities: The built-up area of over 300 Class-1 cities of India is being extracted from Resourcesat-2/2A data for the year 2023-2024 using UNET Deep Learning Architecture.



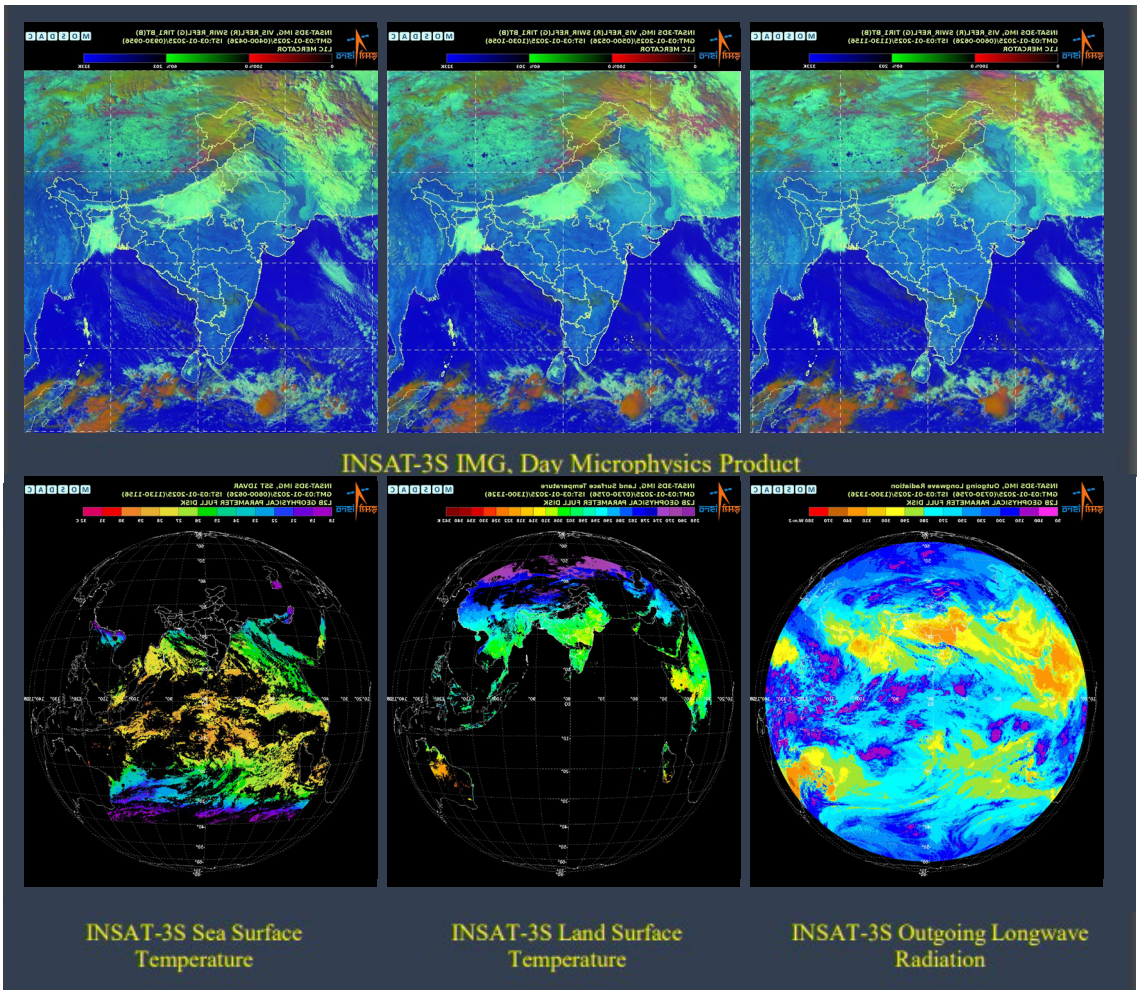
AI-extracted Built-up Area of Class-1 Cities of Punjab for Year 2023-2024

Desertification and Land Degradation Status Dashboard: Dedicated dashboard is developed, for dynamic visualization and analysis of desertification status, as a valuable resource for researchers and policy makers involved in monitoring and combating desertification complying to United Convention to Combat Desertification (UNCCD).

5.3 Satellite Meteorology

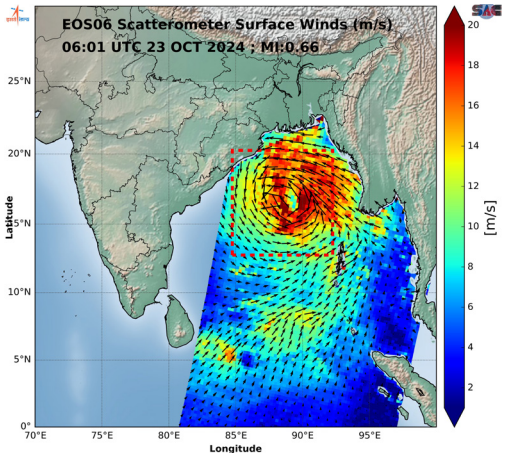
Operationalisation of Geophysical Parameters from INSAT-3DS: INSAT-3DS Satellite, a follow-on mission of Third Generation Meteorological Satellite, is fully funded by the Ministry of Earth Sciences (MoES). The data from INSAT-3DS is intended to boost India's weather, climate and ocean related observations, services and capability towards disaster mitigation & preparedness. Geophysical parameters from INSAT-3DS have been made operational at IMD's Multi Mission Meteorological Data Receiving & Processing System (MMDRPS) and ISRO's Meteorological & Oceanographic Satellite Data Archival Centre (MOSDAC). Near Real Time (NRT) visualization through image gallery, interactive web analytics and data dissemination was made operational through MOSDAC Geoportal. The concurrent operations of INSAT-3DR & 3DS satellites provide continuous weather observations every 15 minutes over the Indian region. The sounder payload of INSAT-3DR is operated in such a way that India land region sector data is covered up twenty times and the Indian Ocean region data is covered up four times (04, 11, 16 & 23 UTC) on an hourly basis. In the year 2024, tropical cyclones Remal, Asna, Dana and Fengal were monitored with INSAT 3DR & 3DS.

Earth Observation, Data Processing, and Applications



INSAT- 3DS Products

Operational generation of Wind Products using EOS-06 SCAT data: Various products pertaining to wind over Ocean are operationally generated using EOS-06 Scatterometer data. These products are disseminated to national users (IMD, NCMRWF) and international users (NOAA, EUMETSAT) for weather prediction and cyclone monitoring activities and hosted on Bhoonidhi and



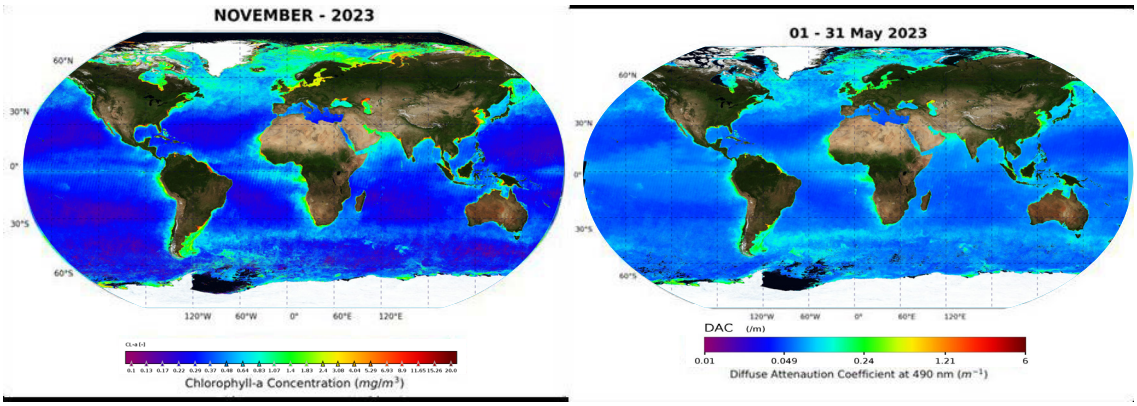
ISRO EOS-6 satellite Scatterometer image showing the wind direction and intensity of Cyclonic Storm 'DANA' in Bay of Bengal as on 23-Oct-2024

MOSDAC portals. The EOS-06 SCAT data enables the monitoring of cyclone genesis, its intensification, track and landfall, which are critical for the cyclone predictions and disaster mitigation & preparedness.

Nowcasting of TERLS Doppler Weather Radar: Developed WebGIS based application for interactive visualisation of near real time data for ISRO's TERLS (Thumba Equatorial Rocket Launching Station) Doppler Weather Radar (DWR) data and visualisation of Nowcast based on DWR data over TERLS and made operational.

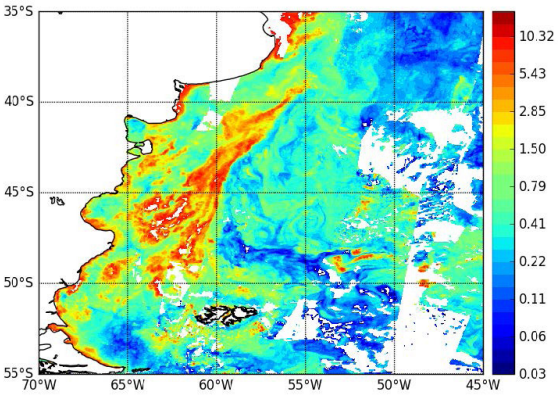
5.4 Satellite Oceanography

Operationalization of EOS-06 data Products: The algorithms are developed to derive various products from Ocean Colour Monitor (OCM) sensor of EOS-06 such as remote sensing reflectance (Rrs), chlorophyll-a (Chl-a) concentration and diffuse attenuation coefficient at 490 nm (Kd_490). A Globally 8-day as well as monthly composite Level-3 products are operationally generated and disseminated.



Global Level-3 binned product of Chl-a Concentration and Kd_490 from EOS06 OCM3 for November and May 2023

Phytoplankton Bloom: The phytoplankton bloom in Patagonian shelf waters in austral spring 2024 is captured by EOS-06 Ocean Colour Monitor. The rising water along the Patagonian shelf-break front carries nutrients to the surface, where phytoplankton thrive in spring and summer sunlight. This bloom is mostly dominated by diatoms and dinoflagellates.



EOS-06 OCM Chlorophyll-a concentration (8-15 Nov 2024) capturing the phytoplankton bloom in Patagonian shelf waters of Argentina

5.5 Water Resources

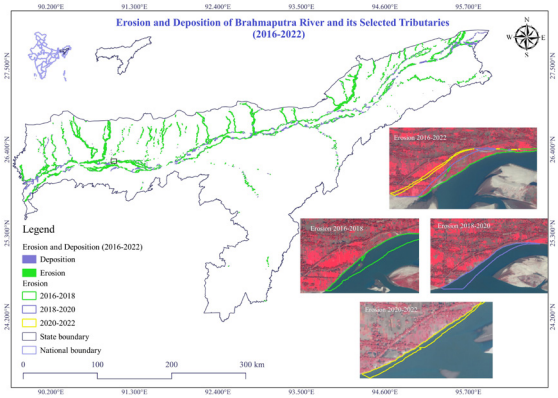
National Hydrology Project (NHP): Daily Water balance components @5.5 km grid (Soil Moisture, Evapotranspiration and Surface Runoff), Actual Evapotranspiration Products @750m & 5.5km resolutions, daily spatial snowmelt rate during April to June and hydrological drought indices were generated and disseminated. Developed a web based-DSS for Irrigation scheduling and performance assessment of Narayanpur irrigation command. GLOF modeling and risk assessment is carried out for 10 prioritized Glacial Lakes.

Aquifer Sustainability Management System (ASMS) using Space Technology based Geospatial Modelling for AMRUT cities: Pilot study conducted to create a city-wise GIS database on groundwater prospecting (GWP), groundwater quality (GWQ), and aquifer characterization covering urban and peri-urban areas for Atal Mission for Rejuvenation and Urban Transformation (AMRUT) cities. It involves development of sustainability plan for artificial recharge zonation/structures for aquifer sustainability including resource assessment at a scale of 1:10,000. It will help decision-makers to plan and implement suitable measures to achieve aquifer sustainability.

Urban Water - Information System (UWaIS): A geo-spatial database of urban water bodies under AMRUT programme was generated for 500 cities of the country. Urban Water Information System (UWaIS) consists of a geospatial dashboard with detailed information of urban water bodies along with long term land cover changes around the selected urban water bodies.

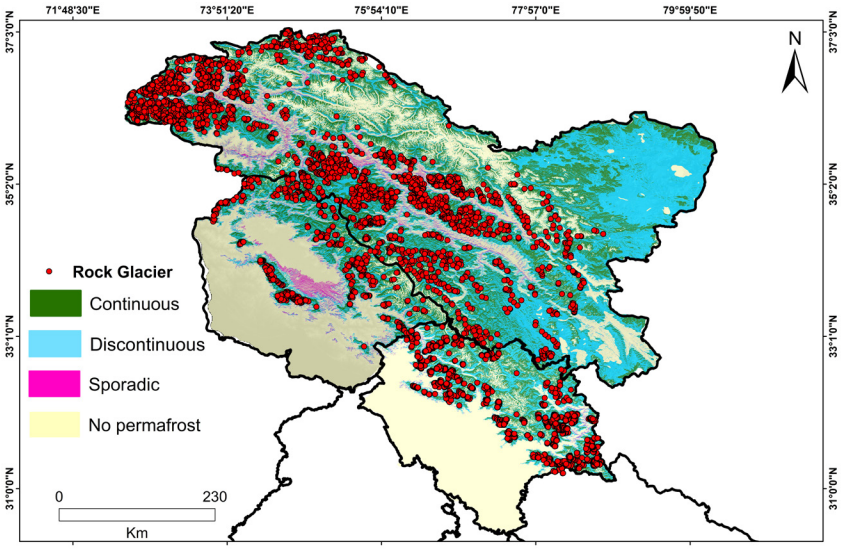
Soil Moisture Product: An indigenously developed Operational Algorithm was used for Soil Moisture Product generation at 500m spatial resolution with 17 day-repetivity using EOS-04 (RISAT-1A) C-band SAR data and is disseminated through Bhoonidhi portal.

Bank line Migration Studies and identification of vulnerable reaches of Brahmaputra, Barak and Selected Tributaries: The erosion and deposition along the banks of the Brahmaputra and its selected tributaries were estimated using satellite data based inputs, in addition to bank line migration rate and identifying possible locations for river



training. The possible vulnerable embankments along the Brahmaputra River, Barak River and major tributaries due to constant erosion and deposition processes were identified.

Rock glaciers of the semi-arid North Western Himalayas: Distribution and hydrological significance: Around 3082 rock glaciers, covering ~1466.6 km^2 area, that are still intact in the North Western Himalaya were identified and mapped using remote sensing data. Rock glaciers in North Western Himalaya are significant indicator of permafrost. The water volume equivalents (WVEQ) of these RGs was estimated.



The rock glaciers (RGs) shown on the permafrost map of North Western Himalaya.

Wetland Information System: Wetland Information System was developed over VEDAS portal to provide geospatial map services, enabling temporal and spatial analysis of wetland dynamics. Key indicators can be visualized and analysed using interactive features, such as raster and vector data layers. This system is built to support environmental monitoring, policymaking, and sustainable wetland management.

5.6 Disaster Management Support (DMS)

Near Real Time Flood Monitoring: In 2024, major floods observed in 16 states were monitored and mapped in near-real time using multi-mission satellite data. Nearly 300 flood inundation maps and value added products were disseminated to the concerned disaster management departments (SDMAs and NDMA) to support the relief and rehabilitation efforts.

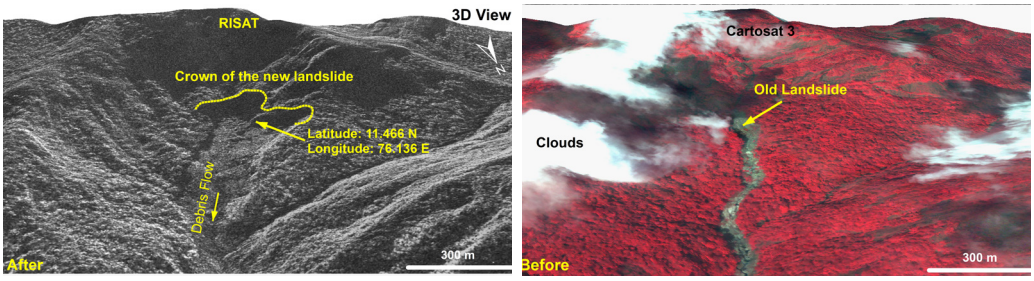
Earth Observation, Data Processing, and Applications

Operational Spatial Flood Early Warning System: ISRO has developed spatial flood early warning systems for Godavari and Tapi Rivers using space data under the National Hydrology Project (NHP), with high precision LiDAR DTM. Flood alerts are disseminated through Bhuvan-NHP and NDEM portals, and also issued to State Disaster Management Authorities with 2 days lead time and 85% accuracy.

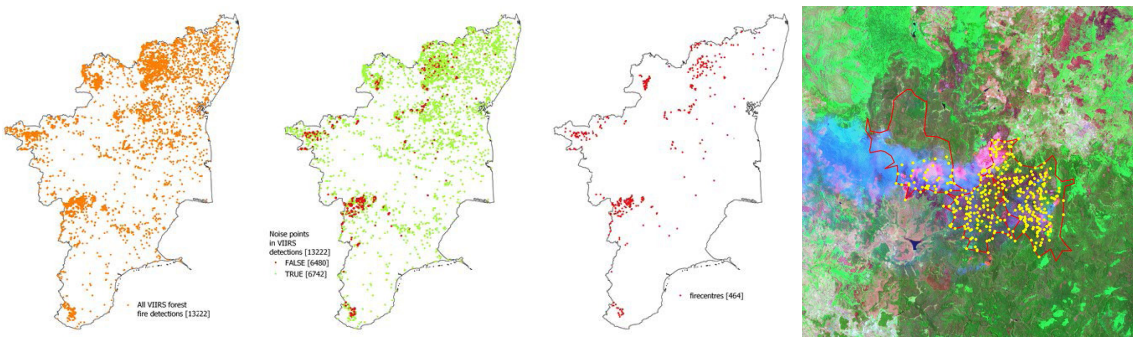
For Assam, the Flood Early Warning System (FLEWS) continued to operate, with an average year-to year alert success score of 80 to 85 % and an average lead time ranging from 12 to 36 hours. The project covers all flood prone districts of Assam providing actionable flood alerts at the revenue circle level.

FLEWS is being extended to the flood prone districts of North Eastern States with funding from the NEC. Physics based hydrological models for predicting flood hydrographs have been developed for Meghalaya, Nagaland, Mizoram, Arunachal Pradesh, Sikkim and Tripura. Calibration and validation of the hydrological models are at an advanced stage for river basins with available observed discharge data.

Satellite-based analysis of Wayanad landslide disaster on 30 July 2024, Kerala: A major debris flow was triggered by heavy rainfall in and around the Chooralmala town of Wayanad District in Kerala state of India. Very high resolution EOS-04 SAR images of 31 July, 2024 shows the entire extent of the debris flow from crown to end of run out zone.



Forest fire studies: Generation of high-resolution active fire detection from Landsat 8/9 has been operationalized with incorporation of information from Sentinel-3 and NOAA-21. Spatial and temporal clustering of active fire detections from VIIRS was carried out to describe fire patterns and fire behaviour.



Fire cluster and spread (08-04 to 03-05 2024) Spatial and temporal clustering of fires in Tamil Nadu

National Database for Emergency Management (NDEM): An updated version of NDEM (V5.0) is released in 2024. New services, such as Avalanche Alerts, Flood Risk Vulnerability, Forest Fire Vulnerability Districts, Lightning Hotspot Analysis, Flood Depth and Services of INCOIS (viz., Storm Surge, High Wave Alerts, Tsunami Warnings, Coastal Current and Swell Surge Alerts) are integrated in NDEM with enhanced geospatial visualization and feature information.

Integrated Control Room for Emergency Response (ICR-ER): ISRO provided technical support in establishing ICR-ER at the Ministry of Home Affairs (MHA), New Delhi, with a Disaster Recovery (DR) Centre at NRSC, Shadnagar campus.

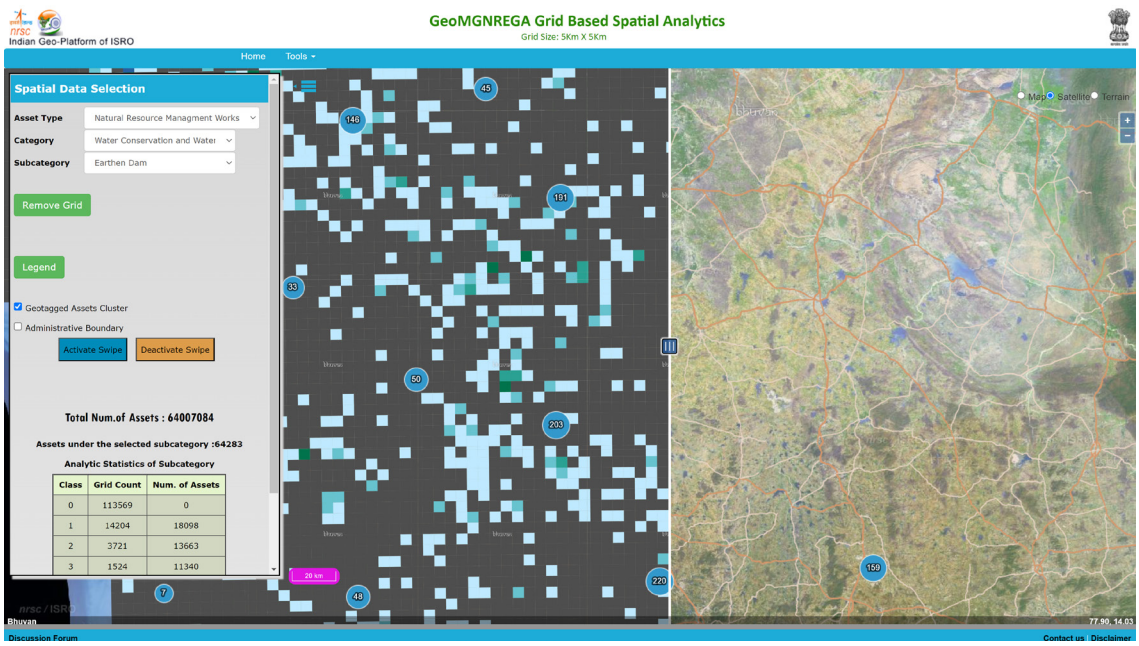
Lightning Detection & forecasting: Daily gridded Lightning observations for lightning ECV and hourly lightning point data are made operational. A thunderstorm tracking system using ground-based lightning data to nowcast severe weather and lightning is developed for the NER. The real time severe weather tracking system is operational at https://www.nerdrr.gov.in/storm/index.php and through "SMART Axom" mobile app.

Satellite data support for International Charter & Sentinel Asia: 41 Charter requests were serviced and 209 products were supplied towards Emergency & Disaster Management support for the disaster events during the year. Also, 46 requests were serviced under Sentinel Asia resulting in 113 products for emergencies. During the period, 100% requests were serviced for International Charter and Sentinel Asia.

NER-DRR Decision Support Systems for Disaster/Emergency Management in NER: The NER-DRR geoportal (https://www.nerdrr.gov.in) hosts updated geospatial database, coupled with advanced geospatial analytical tools, to assist disaster management officials in the NER states for disaster and emergency management.

5.7 Governance

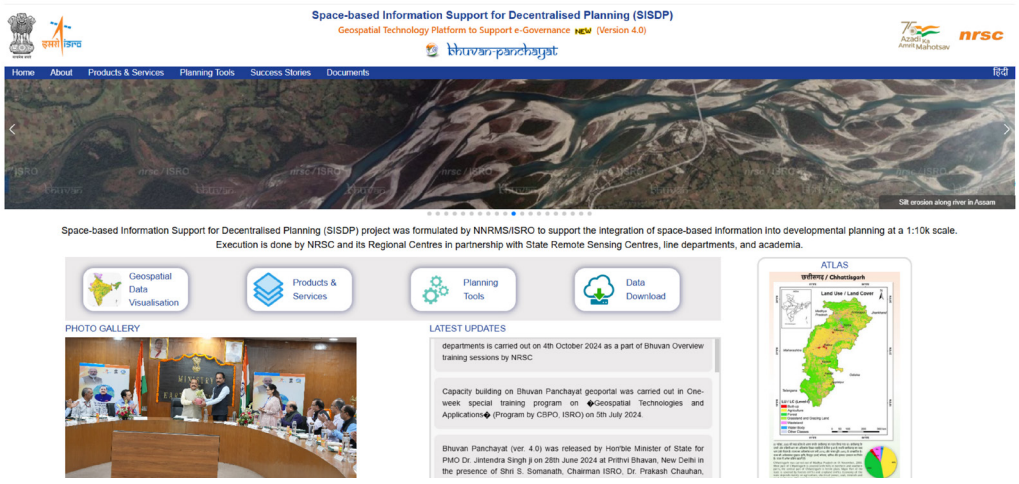
Geospatial technology for supporting MGNREGA Programme: The creation of assets and activities under the MGNREGA programme, are being monitored through Satellite data, Geoportal and mobile applications. More than 6 crore assets/ activities have been geotagged on the GeoMGNREGA geoportal. Subsequently, Yuktdhara geospatial planning portal is also developed, for decision support towards planning and implementation of new assets or activities. Monitoring of changes brought in, due to implementation of natural resource management activities in 23 Gram Panchayats (one GP for each state) of MGNREGA, over three years, was carried out.



Geo-MGNREGA Analytics interface showing Earthen dam spread

Geospatial Technology for Integrated Watershed Monitoring: ISRO/ DoS has implemented Geospatial solution for monitoring >80,000 micro-watersheds under the Integrated Watershed Management Programme (PMKSY-WDC 1.0). Under this, more than 18 lakh interventions are geotagged. In WDC-PMKSY 2.0 around 1150 projects are assessed through Bhuvan tools employing high resolution satellite data (Cartosat 2S & 3). Capacity building programme for 17 states has been completed, wherein about 800 officials have been trained in the year 2024 for the use of the WDC 2.0 Mobile App and Bhuvan Portal. Under REWARD (Rejuvenating Watersheds for Agricultural Resilience through Innovative Development) initiative, standards for geospatial service for watershed monitoring are being standardised.

Decentralisation Support for Panchayat level Governance: "Bhuvan Panchayat 4.0" (https://bhuvanpanchayat.nrsc.gov.in) geoportal comprising of all India thematic database updated as part of Space-based Information Support for Decentralised Planning project is released. Portal enables access to detailed geospatial content at 1:10,000 scale for Gram Panchayat Development Planning.



Urban Plans for AMRUT Cities using Space Technology: Under AMRUT 1.0 National Mission, urban geospatial database for 238 Class-I cities was prepared using VHR data. NRSC has signed an MoU with MoHUA for AMRUT-2.0 towards preparation of 1:4,000 scale 2D urban geospatial database for the selected Class-II towns.

2.2 Space Applications

1. Satellite Communication Applications

A fleet of 19 communication satellites are operating over India with communication transponders in C-band, Extended C-band, Ku-band, Ka/Ku band and S-band. Out of these, 12 communication satellites are owned and operated by M/s NewSpace India Limited, a CPSE under Department of Space. GSAT-8 has completed its operational life. GSAT-20 (GSAT-N2) launched in November 2024 would commence operational services in Jan 2025. Further, as per the mandate of the Space Reform the transfer of three High Throughout Satellites viz GSAT-11, GSAT-19 and GSAT-29 to NSIL is under process.

All the 19 satellites together provide 317 operational bent-pipe transponders and 73 Gbps high throughput satellite (HTS) capacity. These satellites support the services like television broadcasting, DTH television, telecommunication, VSAT services, radio networking, strategic communications, In flight and maritime connectivity as well as societal applications like Tele-education, Tele-medicine and Disaster Management applications. The prominent users of the transponders are Government & Strategic users, Prasar Bharati, DTH and TV operators, Public sector units (BSNL, ONGC, AAI, ECIL etc.), private VSAT operators, banking and financial institutions, etc.

In order to meet additional transponder requirements from various user sectors, about 81 transponders in C & Ku-Band and HTS capacity of 1134 MHz leased from international satellite operators, on a back-to-back arrangement with users and satellite operators. In addition, about 40 transponders in C-band, are directly leased by the broadcasters for TV uplinking. Thus, satellite communication is playing a major role in the socio-economic development of the country.

2. Television

Communication Satellites have been a major catalyst for the expansion of television coverage over India through various broad caster including Doordarshan. DOS/ISRO has made available the required transponders capacity through Indian and foreign satellites to cater to the needs of television sector.

Doordarshan (DD) is presently operating 35 satellite channels and has a vast network of studios throughout length and breadth of the country and terrestrial transmitters of varying power at strategic areas. Doordarshan has 40 C-band Earth Stations for programme contribution & distribution of Doordarshan Channels and one C-Band DTH Earth Station for providing DTH service to Andaman and Nicobar Island where Ku-Band DTH footprints

are not available. The satellite communication has played a key role in capturing live news and events through DSNG services. Doordarshan is using a total of 20.36 Transponders (12.03 C Band & 8.33 Ku Band) of 36 MHz each on GSAT System.

3. Satellite Radio Networking

The satellite based connectivity for radio networking covers 90 Digital Channels (Through Captive Earth Station -80 Channels & DSNG - 10 Channels) for National, Regional & Vividh Bharati Networking through GSAT-10 (For Coverage Over Indian Geographic Main Land) & GSAT-18 (For Coverage Over Andaman & Nicobar and Lakshadweep Islands). The radio network is supported using 44 Captive Earth Station & DSNG and 501 Down Link Radio Network Terminals (RNTs). AIR is also Broadcasting 48 Radio Channels on DTH Platform of Doordarshan 'DD Free Dish'.

4. Telecommunications

Indian communication satellites have been supporting telecommunication applications for providing voice, data and broadband services. Satellite links are the primary means of connectivity to remote, far flung and difficult to access regions of the country and play the role of backup links for large number of services on terrestrial connectivity. Satcom links have a major role in banking sectors linking the ATMs with banks.

At present, the licensed SATCOM network in the country consist of more than 38 teleport operators with 72 Teleports, 32 VSAT operators with 60 VSAT Hubs and about 2.87 Lakh VSAT terminals, 5 DTH operators, 1 HITS operator and 47 DSNG operators of different sizes & capabilities and they are operating in satellite networks of BSNL, Government users, Captive CUG VSAT users, Commercial VSAT users and TV broadcasters and are being utilised for telecommunications and broadcasting applications. Satellite based captive networks are operationalized using VSAT systems for establishments like NTPC, ONGC, IOCL, ERNET, Indian Railway, Karnataka Power Transmission Corporation Ltd., etc. apart from private enterprises. In addition, GSAT satellites cater to captive government networks of various ministries and strategic agencies. In the year 2024, ISRO and SATCOM Monitoring Centre (SMC), DOT resolved 71 major interference issues observed / reported by the licensees/ satellite operators.

5. Telemedicine

Satellite Communication based Telemedicine is one of the unique application of space technology that is being utilised for the benefit of the society. Telemedicine technology utilises Information & Communications Technology (ICT) based system consisting of

customised Telemedicine software integrated with computer hardware and medical diagnostic instruments connected to the commercial Very Small Aperture Terminal (VSAT). Telemedicine enables patient to 'see & interact' with the doctor live through video links. ISRO's Telemedicine programme connects various remote & rural medical colleges & hospitals to major specialty hospitals in cities and towns using satellite communication.

Several nodes for Defence & Paramilitary forces have been established in remote, inaccessible and high-altitude areas such as Jammu & Kashmir, Leh, Ladakh, etc. as well as in glacier regions like Siachin. At present, around 179 Telemedicine nodes are operational. Out of these, around 80 Telemedicine nodes are located in high altitude regions. Continuing Medical Education (CME) programmes are conducted from SAC Studio or from remote user-ends in which medical experts/doctors share their knowledge & experiences and interact with connected remote hospitals. 12 CMEs have been conducted so far in in last one year. More than 8000 doctors/paramedical staff are benefitted.

Three (03) new nodes were established for Border Roads Organisation (BRO) in North East, Uttarakhand and Kashmir region. ISRO TM network was used by J&K Health Department

for providing Telemedicine services during Amarnath Yatra 2024. One node was installed at Baltal base camp and another node was installed at Panchtarani, enroute to Holy Cave Shri Amarnath Ji. SATCOM based telemedicine terminal (Centre) located in Arunachal Pradesh was inaugurated by Honorable Defence Minister Sri. Rajnath Singh, in North East Region.

6. Tele-education

Satellite communication plays an important role in providing Tele-Education (TE) programmes to students in the remote areas using live and recorded broadcast. It supplements curriculum based education for primary & secondary schools and under graduate as well as post graduate students. It also provides teacher's training as and when required. Satellite capacity and technical support was provided to BISAG-N for 200 educational channels under PM-eVidya Programme.

7. Satellite Aided Search and Rescue (SAS&R)

India is a member of the international COSPAS-SARSAT programme for providing distress alert and position location service under Search & Rescue (SAR) programme through the satellites in Geostationary Earth Orbit (GEO) and Low Earth Orbit (LEO). Under this programme, India has established two Local User Terminals (LUTs) for LEOs at Lucknow and Bangalore, whereas, the LUT for GEO is established at Bangalore. The Indian Mission Control Centre (INMCC) is located at ISTRAC, Bangalore.

The operations of INMCC/LUT are funded by the participating agencies namely, Indian Coast Guard, Airports Authority of India, Directorate General of Shipping and Defence Services and the system is operational for past 35 years.

INSAT-3DS (82Deg East), INSAT-3DR (74Deg East) and GSAT-17 (93.5 Deg East) carry Search and Rescue payloads operating in 406 MHz band. These satellites are in operation to pick up and relay the distress signals originating from the distress beacons of maritime, aviation and other users in the Indian subcontinent. INMCC also extends the SAR services to Bangladesh, Bhutan, Maldives, Nepal, Seychelles, Sri Lanka and Tanzania.

Presently INMCC is capable of receiving alerts from LEOLUT and GEOLUT (LG-MCC). Medium Earth Orbiting Local User Terminal (MEOLUT) is established during this year and its commissioning is under progress. MEOSAR ground segment commissioning tests were conducted and the results submitted for evaluation by COSPAS-SARSAT (C/S).

From January to December 2024, Indian Mission Control Centre (INMCC) provided search and rescue support to 11 distress incidents in Indian service area. Till date, there are 1139 registered users and total number of registered beacons are 20578 in our database.

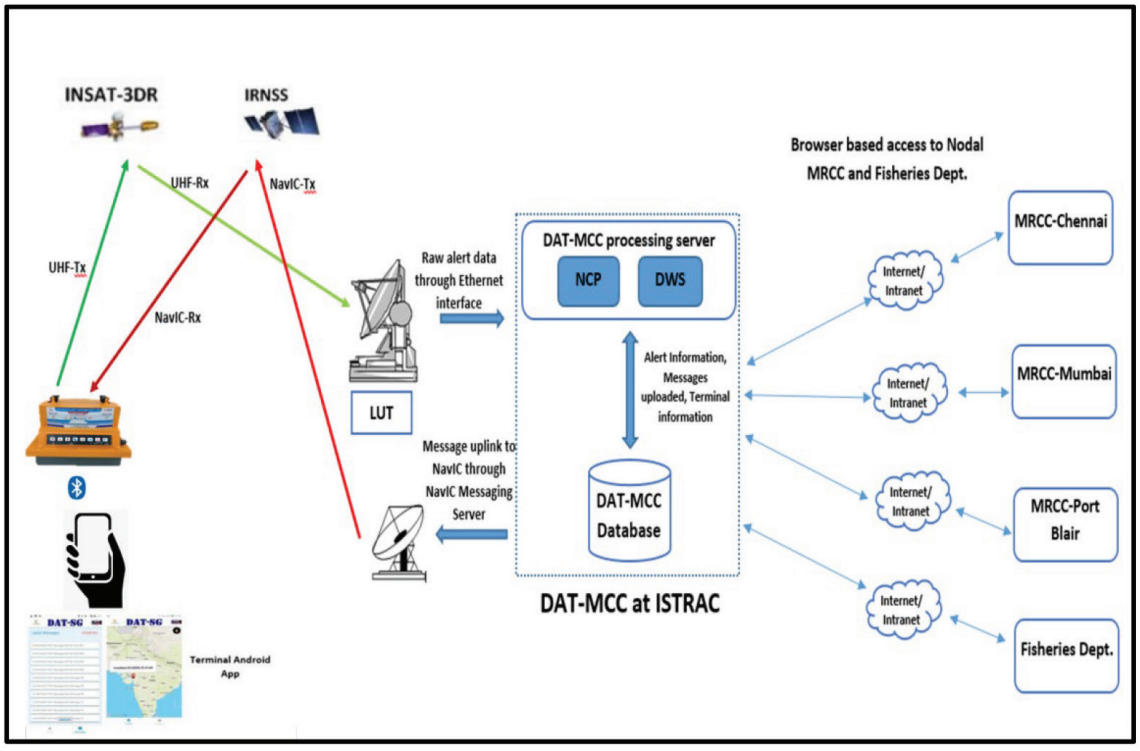
8. Data Relay Transponders (DRT)

Data Relay Transponders (UHF x C) are flown on INSAT-3DS, INSAT-3DR & GSAT-17 satellites. Data Relay Transponder (DRT) is used for collecting observational data such as weather data; ocean monitoring data, snow avalanches, and disaster alert signal etc. Field level terminals are one way transmitters which uplink the observational data to satellites in UHF band (402 MHz Band) at intervals. Such data is received by downlink station at user premises. More than 6,000 transponders have been deployed by different Government and institutional users for sensor data collection applications like AWS, Tsunami Early Warning etc.

9. Distress Alert Terminal- Second Generation (DAT-SG)

ISRO had developed Distress Alert Transmitter (DAT) for fishermen to support emergency message reporting for maritime search and rescue operations. ISRO has upgraded the heritage DAT by interfacing with the NavIC messaging receiver to provide acknowledgement of emergency messages together with information like potential fishing zones and emergency broadcast messages from control stations. This makes the SAR efforts more effective & user-friendly combining both satcom & satnav features. In coordination with SAC, INMCC established DAT-SG (Second Generation) hub at ISTRAC. The DAT- SG Mission Control Centre (MCC) was installed and operationalized at

INMCC-ISTRAC Bengaluru and the services were dedicated to the nation by Chairman-ISRO/Secretary-DOS in the presence of Director General, Indian Coast Guard in January, 2024.



DAT-2G Network

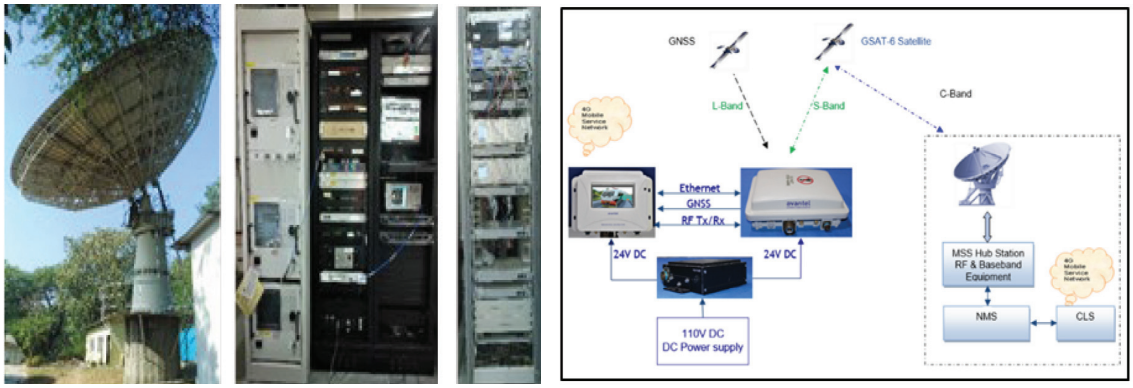
10. Mobile Satellite Services (MSS)

Mobile Satellite Services encompass a comprehensive SATCOM network for communication using handheld and portable devices. Through this network and infrastructure, ISRO supports various communication applications for different user groups namely Indian

Railways, Ministry of Home Affairs and other special user groups. 6.3m and 11.5m C-band Earth stations at Ahmedabad & Delhi with necessary baseband sub-systems have been established to provide uninterrupted services & demonstration.

11. Real-time Train Information System (RTIS)

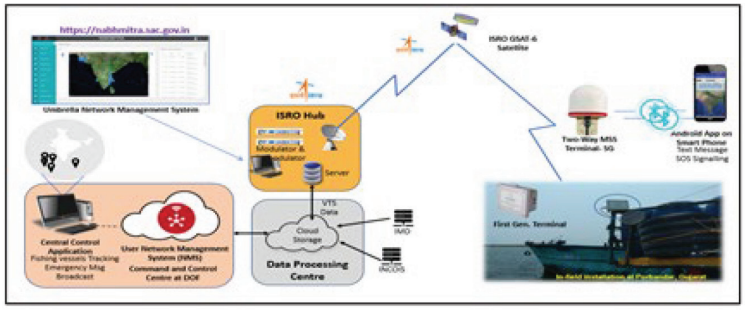
Using MSS service an indigenous solution has been developed and implemented for tracking the Trains on real-time namely "Real-time Train Information System (RTIS)". This enables enhancement of safety and operations of the Train services particularly in strategic segments. This helps in generation of events like station Approach/Arrival/Departure/ Run through/Unscheduled Stoppage. Centre for Railway Information System (CRIS) a unit of Indian Railways is the nodal agency for implementing the RTIS and 8000 trains were covered with RTIS with the capability to track the position of locomotives in real-time.



RTIS Network

12. Vessel Communication and Support System in Marine Fishing Vessels for Monitoring, Control and Surveillance (MCS)

ISRO has developed SATCOM terminals for tracking of sub-20m fishing vessels/ boats which go into deep sea for several days. The system provides for both the safety of the fishermen as well as monitoring their movements for security reasons. Proof of Concept was demonstrated by installing 500 Terminals in Tamilnadu, Puducherry and Gujarat. Further, Department of Fisheries has undertaken to rollout this solution for one lakh fishing vessels through M/s NSIL. By December 2024, more than 10000 terminals have been deployed across the Indian Costal States and Union Territories and registered in Nabhmitra. Recent cyclone "Dana" & "Fengal" reports were transmitted real time to all boat users, where transponders are installed.



Fishing Vessel Tracking Network

13. South Asia Satellite

South Asia Satellite (SAS) was launched on May 5, 2017 to provide satellite connectivity to Afghanistan, Bangladesh, Bhutan, India, The Maldives, Nepal and Sri Lanka. This satellite is carrying 12 Ku band transponders with coverage over the member nations.

A SatCom network has been established using two transponders in Bhutan for utilization of SAS and operational. The local team has been trained to handle operations and maintenance of the network. The network is being used for uplinking two TV channels and 4 Radio channels of Bhutan, Internet connectivity, connecting the Disaster Management Centres, and for critical telecom links. Bangladesh has established a dedicated network with hub in Dhaka to connect more than 100 schools, using two transponders on SAS. The Maldives is using one transponder on South Asia satellite for satcom based connectivity for islands with support from common Hub at DES, New Delhi. A project proposal for establishment of dedicated satcom network with a hub and 300 terminals, in Nepal is under consideration.

2.3 Navigation Systems

Navigation with Indian Constellation (NavIC) is India's independent regional navigation satellite system catering to a coverage area of India and 1500 km beyond the Indian mainland. ISRO has established the space and ground infrastructure. ISRO is making continuous efforts to enable civilian sectors like land transportation, aviation, maritime, mapping, surveying, geodesy, timing, telecommunications, etc., to utilize the services offered by NavIC. GPS Aided Geo Augmented Navigation (GAGAN) is a space-based augmentation system for civil aviation purposes in the Indian Flight Information Region (FIR). ISRO has established the space segment, while the ground segment is established by the Airports Authority of India (AAI).

Major developments in navigation systems during 2024 have been:

1. NavIC base layer constellation

NVS-01 satellite, carrying indigenous atomic clock, is characterized exhaustively for in-orbit performance against stringent functional and performance metrics. Detailed analysis has shown that the performance is comparable with the procured clocks. In addition, newly developed ionosphere model (NeQuick-N) is made operational for the new L1 signal. NavIC base layer currently consists of four satellites (IRNSS-1B, 1F, 1I, and NVS-01) providing PNT service. NVS-02 satellite, second in the NVS series of satellites, is in the final stages of launch.

NVS-02 satellite in cleanroom

2. NavIC ground segment

As a part of continuous operational readiness of all elements of NavIC ground segment, periodic switchover of navigation centres is taken up regularly. Under this endeavour, NavIC operation is switched between ISRO Navigation Centres INC-1 and INC-2 seamlessly, without impact on operational service.

3. Signal coordination

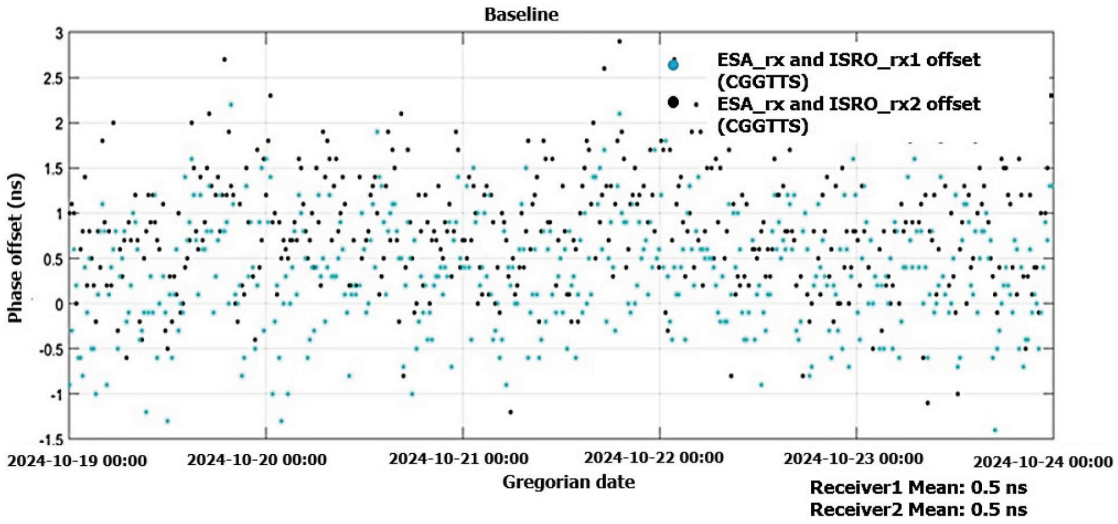
Coordination of new signals and services is being conducted with the other GNSS service providers. Resolution 609 aspects for NavIC L5 signals were addressed in ITU forum and successfully resolved.

4. Traceability of NavIC system time

ISRO has signed a contract with National Physical Laboratory (NPL), Delhi to ensure traceability of NavIC system time to UTC (NPLI).

5. NavIC-Galileo time offset

ISRO has signed an agreement with European Space Agency (ESA) for determination of time offset between NavIC and Galileo system times. The broadcast of NavIC-Galileo time offset (NGTO) will aid in improving the interoperability of respective systems. Under this agreement, two time transfer receivers were calibrated at NavIC and Galileo precise time facilities. Calibration of two more time transfer receivers will be carried out using the already calibrated receivers. Further, four more receivers will be deployed in operational chain of NavIC ground segment and NGTO will be broadcast through NavIC signals.



Time transfer calibration result

6. Precise product generation

The development of post processed NavIC products, essential for scientific applications involving NavIC, has been identified as a priority. Under this effort, clock and orbit products were successfully used in remote sensing application on a trial basis.

7. Marine fishing vessel and train tracking

National rollout for installation of Vessel Communication and Support System (VCS) in marine fishing vessels has been approved under Pradhan Mantri Matsya Sampada Yojana

(PMMSY). One lakh 'transponders' will be installed on-board marine fishing vessels (both mechanized and motorized) across 9 coastal states and 4 coastal Union Territories. These equipments use NavIC signals for location determination. More than 16K transponders have already been installed. Web application for network management system "Nabhmitra" is released and being used by Dept. of Fisheries.

ISRO has conceptualized and implemented Real-time Train Information System (RTIS) project for Indian Railways and a pilot project with Centre of Railways Information System (CRIS) was completed. NavIC is being used for location determination. Implementation on more than 8000 locomotives has been completed.

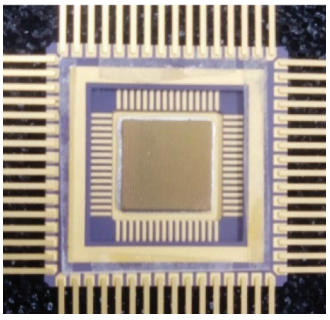
8. IST dissemination

Department of Legal Metrology, along with NPL and ISRO, is executing the project of dissemination of Indian Standard Time (IST) through five regional timescales and one disaster recovery centre. ISRO has carried out integration of the five regional timescales. These timescales are being installed in five Regional Reference Standards Laboratories (RRSLs) located at Ahmedabad, Bengaluru, Bhubaneshwar, Faridabad, and Guwahati. Site acceptance tests are in progress.

Shri Prahlad Joshi, Hon. Minister of Consumer Affairs, Food, and Public Distribution reviewing the timescale activity at RRSL, Bengaluru on 22nd August 2024

9. Mobile handsets

At present, more than 60 mobile handset models are available in market with NavIC capability. These include the handsets manufactured by reputed OEMs like Apple, Samsung, and Google. Many of the handsets are manufactured in India.



Low-node baseband ASIC realised by ISRO

10. Indigenous multi-GNSS chip

Three Indian industries are developing indigenous NavIC-based multi-GNSS chipsets under MeitY contract. ISRO has contributed in the technical evaluation process. One chipset has been cleared for production. The remaining two chipsets are in advanced stage of technical evaluation.

ISRO has designed low-node baseband ASIC with advanced features. The ASIC is currently in testing phase.

11. Pseudolite based navigation system

Pseudolite based navigation system, used for lateral guidance during landing phase, was successfully demonstrated in two RLV LEX missions. In both the missions, 100% availability and < 4 m accuracy was achieved.

12. GAGAN

GAGAN service is functional with three signals in space (PRN 127, PRN 128, PRN 132) from three GEO satellites viz. GSAT-8, GSAT-10 and GSAT-15 respectively. Renewal activity for continuation of PRN 127 and PRN 128 has been completed. GAGAN has been certified for navigation performance level of Approach with Vertical Guidance (APV-1) over India and for Required Navigation Performance (RNP 0.1) within Indian FIR. GAGAN system certification has been extended upto July 2026.

2.4 Space Science Exploration and Research

The Department of Space (DOS) conducts comprehensive Space Science Research through a three-pronged approach: observation, modeling, and simulation. Space-based missions explore celestial bodies and processes from various vantage points, while ground-based telescopes and observatories complement these observations. Additionally, laboratory analysis of meteoroids provides crucial insights. Physics-based and AI/ML-based modeling techniques are employed to understand and predict space phenomena. Computer simulations run these models to analyze and predict, while laboratory simulations replicate space environments for controlled experiments. These three components form an interconnected cycle, with observations constraining the models, models guiding simulations, and simulations refining our understanding of space. DOS actively contributes to all facets of this cycle, fostering collaboration between national institutes and academia.

The Department of Space (DOS) focuses on several key areas of space science research: atmospheric science and near-Earth space, solar system bodies, heliophysics and space weather, and astronomy, astrophysics, and exoplanets.

The year 2024 has been a significant one for Indian space exploration. The XPoSat mission was launched on January 1, 2024, and the Aditya-L1 spacecraft was successfully inserted into a halo orbit around the first Sun-Earth Lagrange point on January 6, 2024. Additionally, August 23, 2024, marked the first National Space Day, commemorating the historic soft landing of the Chandrayaan-3 lander in the Moon's South Polar Region. The International Astronomical Union has officially named the landing site "Station Shiv Shakti."

In addition to space-based experiments, ISRO/DOS conducts scientific experiments on the middle and upper atmosphere using the Rohini series of sounding rockets. Scientific experiments are also deployed on the PS-4 Orbital Experimental Module (POEM), which repurposes the fourth stage of the PSLV launch vehicle as an experimental platform.

The major activities carried out under space science exploration and research during 2024-25 are summarised in the subsequent sections.

1. Chandrayaan-3 Updates

Chandrayaan-3 has been successful in terms of mission accomplishments as well as scientific observations.

The scientific data acquired by the Chandrayaan-3 have been released to the scientific community through the ISSDC/PRADAN portal on August 23, 2024, on the maiden National Space Day, by the Honb'le Minister of State (Space) Dr. Jitendra Singh.

Chandrayaan-3, so far, yielded a few scientifically significant results. In a study published in peer-reviewed journal Icarus (https://doi.org/10.1016/j.icarus.2024.116329), scientists from PRL and ISRO have shown that Indian Lunar mission Chandrayaan-3 landed within a buried impact crater, which is around 160 km in size, ~4.4 km deep, and likely to be older than the South Pole Atkin (SPA) basin. This is revealed based on analysis of images obtained by Navigation Cameras on Chandrayaan-3 Pragyan rover and Chandrayaan-2 Orbiter's Optical High-Resolution Camera. The team has also reported the first in-situ elemental abundance of lunar soil near the Southern Polar region using measurements made by the Alpha Particle X-ray Spectrometer (APXS) on the Pragyan rover of the Chandrayaan-3 mission. This study published in the journal Nature (https://www.nature.com/articles/s41586-024-07870-7) has provided evidence that supports the Lunar Magma Ocean hypothesis, which predicts that the primordial lunar crust was formed as a result of the floatation of lighter anorthite plagioclase — but, APXS also detected higher abundance of magnesium-rich minerals, suggesting contributions from deeper layer material ejected from South Pole-Aitken basin during its formation. The analysis from 23 measurements at different locations within 50-metre of the Chandrayaan-3 landing site – Shiv Shakti point – showed that the lunar regolith is uniform in elemental composition, and hence can serve as an excellent ground truth for future remote sensing missions.

While these results have been from the Pragyan rover, the Vikram lander has brought out some insight about the lunar ground vibrations at the Shiv Shakti point. The ILSA payload onboard the Vikram lander has recorded over 250 distinct events, of which about 200 records are correlated to a few known activities involving physical movements by the rover or instruments for science experiments. The results have been published in the journal Icarus (https://doi.org/10.1016/j.icarus.2024.116285).

Chandrayaan-3 has received the following prestigious awards:

i. Rashtriya Vigyan (Team) Puraskar – Team
ii. International Astronautical Federation (IAF) Award for Excellence in Space Exploration
iii. John L. 'Jack' Swigert Jr. Award for Space Exploration
iv. Aviation Week Laureates Award (awarded to ISRO for the achievements of Chandrayaan-3 mission)

2. Ongoing Space Science Missions

2.1 XPoSat mission

The XPoSat mission was launched on January 01, 2024. It is globally the second space-borne experiment to study the X-Ray polarization from bright astronomical sources. The mission comprises two scientific instruments, viz. POLIX and XSPECT. The POLIX instrument was developed by the Raman Research Institute, Bengaluru, and XSPECT instrument by ISRO. The mission has, so far, conducted observations of some standard astronomical sources for calibration, while the payload verification phase is about to complete.

2.2 Aditya-L1 mission

Aditya-L1 is India's dedicated Solar science observatory situated in a halo orbit around the first Sun-Earth Lagrange point, which observes the Sun continuously. The scientific payloads of Aditya-L1 have completed their Payload Verification (PV) phase, in which the performance of the payloads were assessed. Science observations by the payloads have begun.

Meanwhile, the Active region AR13664 on the Sun, during its passage during the week of May 8 – 15, 2024, erupted several X-class and M-class flares, which were associated with Coronal Mass Ejections (CMEs) during May 8th & 9th. These produced a major geomagnetic storm on May 11, 2024. Two of the remote sensing payloads on board Aditya-L1 (SoLEXS and HEL1OS) captured these events during May 8-9, 2024 while the two in-situ payloads (ASPEX and MAG) captured this event during May 10-11, 2024 during its passage through L1. These observations were subsequently reported by ISRO, along with the observations made by the Chandrayaan-2 spacecraft, XPoSat as well as by USO-PRL ground-based facility.

The VELC instrument onboard Aditya-L1 captured the first spectroscopic observations of the onset phase of a CME in the 5303˚Angstrom emission line. VELC observed that the CME event caused coronal dimming (≈ 50%) for approximately 6 hours in the aftermath of the its onset, due to depletion of coronal material. It was further associated with a ~ 15% enhancement in the width of the emission line. The non-thermal velocity during the CME was found to be ≈24.87 km/s. A redshift of ≈ 10 km/s is indicated from the Doppler shift calculations. These observations from VELC/Aditya-L1 provide important clues to understand the source regions of the CMEs, and facilitate constraining the models of CMEs. The CME models, in turn, feed to the space weather models. These results are published in the Astrophysical Journal Letters.

The Aditya-L1 support cell, hosted by Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, has conducted three Aditya-L1 workshop events from February to September, 2024 at JECRC University (Jaipur), ARIES (Nainital) & IIT-Indore. The target participants were M.Sc. and PhD students studying Solar physics/Heliophysics/Space physics. Around 150 participants have benefited from these events. The workshops offered hands-on sessions on the data analysis from in-situ payloads of Aditya-L1, as well as imparted the knowledge of the Aditya-L1 mission, its payloads and their science objectives.

Aditya-L1 Support Cell workshop at IIT-Indore

In addition, there have been a few outreach activities on the Aditya-L1 mission, which were attended by school students.

Adiya-L1 outreach activity with school students at Indore

2.3 Chandrayaan-2 Mission

The Chandrayaan-2 orbiter has completed five years of observation and continues to study the Moon with eight science instruments. The orbiter has captured the signatures of solar eruptive events (May 11, 2024) from the lunar polar orbit. Solar X-ray Monitor (XSM) has observed many interesting phenomena associated with this geomagnetic storm. Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS) has also detected signs of high solar activity.

Chandrayaan-2, with its CLASS instrument, derived new elemental distribution maps, which are the first set of maps derived from three years of data at a spatial resolution of 150 km × 12.5 km, free of the topographic shadow effects and space weathering effects (https://doi.org/10.1016/j.icarus.2023.115898).

The CHACE-2 instrument onboard Chandrayaan-2 explored the spatial and diurnal variations of the number densities of lunar molecular water (H_2O), and hydroxyl (OH) over low (0° to 30°), middle (31° to 60°) and high (61° to 80°) latitudinal regions of the lunar exosphere during the local pre-sunrise, noon, sunset and midnight periods (https://doi.org/10.1016/j.icarus.2024.116365).

Under Chandrayaan-2 Announcement of Opportunity (AO) programme, second year funding support is provided to batch 1 projects (12 projects) and review of first year activities for batch 2 is also completed. The data from Chandrayaan-2 are being disseminated in the ISSDC/PRADAN portal regularly.

2.4 AstroSat Mission

The AstroSat is India's multi-wavelength astronomical observatory. Recently, AstroSat, in association with NASA's space observatories—Chandra, HST, NICER, Swift, discovered that a massive black hole has torn apart one star and is now using that stellar wreckage to pummel another star or smaller black hole. It provides astronomers with valuable insights, linking two mysteries where there had previously only been hints of a connection. The result is published in the journal Nature (https://www.nature.com/articles/s41586-024-08023-6).

The AstroSat and NASA's Space Observatories jointly captured dramatic eruptions from stellar wreckage around a massive Black Hole (https://doi.org/10.1038/s41586-024-08023-6). This tidal disruption event is termed as AT2019qiz. The AstroSat mission provides unique UV/X-ray capability for studying such events. AstroSat's Soft X-ray Telescope and the Ultra-Violet Imaging Telescope (UVIT) both detected the source AT2019qiz, the eruptions were captured in X-rays.

An announcement of opportunity soliciting proposals for AstroSat data under AO14 is released, reviewed and revised. AO14 approved proposals are being serviced from October 2024. Currently twenty-four funded projects are utilizing AstroSat data.

3. Newly Approved Space Science Missions

The Union Cabinet of the Government of India, on September 18, 2024, has accorded approval for two significant space science missions, viz. the Venus Orbiter Mission (VOM) to study different facets of Venus including its surface and atmosphere, and the Chandrayaan-4 mission, which is meant to collect lunar samples and bring back same to the Earth.

The Venus Orbiter Mission will explore the planet's atmosphere, surface, and its interaction with the Sun. Key scientific objectives include examining dust in the Venusian atmosphere, mapping its surface topography in high resolution, studying the solar X-ray spectrum near Venus, analyzing Venusian airglow, and investigating sub-surface characteristics. Additionally, the mission will serve as a technology demonstration for ISRO, testing aerobraking and thermal management techniques in the harsh Venusian environment.

The Chandrayaan-4 mission will demonstrate taking off from the lunar surface after collecting surface samples, and bringing back the same to the Earth with protection of the collected samples against damage and contamination. Much of the science in Chandrayaan-4 is concentrated on analysing the samples on ground, however, the cameras and sensors onboard the spacecraft modules will provide useful insights on the texture of lunar regolith around the landing site and geologic context for interpretation of analysed samples. Studying the returned samples, which are chemically and mineralogically diverse, involve steps ranging from classifying the samples, cataloguing, sample preparation all the way to sample characterisation.

4. Space Science Missions under Study Phase

A few space science missions are in study phase, which include DISHA Aeronomy mission, Mars Lander Mission and ExoWorlds mission. The Chandrayaan-5 / LuPEX mission, which is a collaborative venture between ISRO and the Japanese Space Agency JAXA, has received approval from the Space Commission, and is due for final approval. The department is also working on configuring future Astronomy missions.

5. National Collaboration in Space Science

ISRO has signed an MOU with the Indian Institute of Geomagnetism (IIG), an autonomous institute under the Department of Science and Technology, Government of India, for scientific collaboration in the domain of space science, technology and exploration, on September 4, 2024. The event took place in ISRO Headquarters, Bengaluru, and was

presided by Dr. Somanath S., Chairman, ISRO / Secretary, DOS. This collaboration will facilitate formulation of joint programme in the scientific understanding of the Sun-Earth connection, as well as exploration of space.

The event of MoU signing between ISRO and IIG, in ISRO HQ, Bengaluru, on September 4, 2024

6. International Collaboration and Meets on Space Science Exploration

Department of Space is engaged in International Cooperation activities in space science and exploration through ISRO – NASA Planetary Science Working Group, ISRO-ASI Heliophysics Working Group, ISRO-NOAA Heliophysics Co-operation, International Space Exploration Coordination Group (ISECG), International Mars Exploration Working group, to name a few. There have also been regular discussions with space agencies like NASA, ESA, JAXA, CNES, ASI, NASRDA on various aspects of cooperation in space research and exploration. ISRO is also a part of the COSPAR Task group for constellation of Small satellites. In 2024, ISRO/DOS has participated in several international meets with relevance to space science exploration, which include the 67th Session of the Committee on the Peaceful Uses of Outer Space during 19 - 28 June 2024, 45th Scientific Assembly of the Committee on Space Research (COSPAR) in Busan, South Korea from 13 - 21 July 2024, 75th International Astronautical Congress (IAC), in Milan, Italy, during 14-18 October 2024.

7. Space Science Promotion and Community Building

7.1 ISRO-START -2024 Event for Space Sciences

ISRO-Space science and Technology Awareness Training (ISRO-START) is an introductory level online awareness training programme in space science and technology, primarily

designed for the under-graduate and post-graduate students of science and technology. It is an annual event organised by ISRO with typically twenty-five hours of lecture, delivered by pan-India experts in the domain of space science and technology, spanning a duration of around three weeks. The main objective of ISRO-START is to attract the youngsters to the fields of space science and technology, impart systematic awareness of the topics with scientific authenticity, and thus, creating human resource to materialize India's long-term vision of space science exploration. The training modules comprise introductory level lectures on various aspects of space science and technology. Every year, around 300 academic institutes volunteer as nodal centres to facilitate simultaneous hosting of this online event across the country. The theme for the 2024 has been 'Exploration of the Solar System'. Every year, the ISRO-START event benefits around forty-thousand space enthusiasts. The online examination conducted after every ISRO-START event helps identifying young talents in space science, who are facilitated to attend a special student session in the National Space Science Symposium (NSSS).

7.2 Twenty-Second Edition of the National Space Science Symposium-2024 (NSSS-2024)

National Space Science Symposium (NSSS), sponsored by ISRO, is a biennial event, aimed to provide a scientific forum for researchers in the area of space sciences, planetary sciences, astronomy and astrophysics, Earth and atmospheric sciences, and allied areas to present new research findings, and hold specialized scientific discussions. The twenty-second NSSS (NSSS-2024) was held in Goa University, Goa from 26th February to 01st March, 2024. NSSS 2024 was jointly organized by ISRO, Goa University, National Institute of Oceanography (NIO), Goa and National Centre for Polar and Ocean Research (NCPOR). The number of registered participants was over 700 with 558 presentations in five technical parallel sessions and 48 presentations in students' session. The five technical parallel session themes were (i) Space based meteorology and oceanography, Geosphere-Biosphere interactions and Climate Change, (ii) Middle atmosphere, Ionosphere-Thermosphere-Magnetosphere, coupling processes and Space Weather Impact, (iii) Solar and Planetary Sciences, (iv) Astronomy and Astrophysics and (v) Enabling Technologies for Space Exploration. The sixth parallel session was conducted specially for the undergraduate students selected from all over the country. This session consisted of a workshop for the students conducted by ISRO scientists as well as oral presentations from the students. The students are encouraged to present their ideas on future space exploration and are guided by mentors. A few students for the students' session are selected based on the result of the ISRO-START programme online examination. A network is created among the students to promote peer-level scientific discussions.

Inaugural event of National Space Science Symposium 2024 (NSSS-2024) hosted by Goa University.

8. National-level Brainstorming Meeting for Space Science Roadmap Formulation (SSRF)

Space Science Roadmap Formulation (SSRF) meeting at the U R Rao Satellite Centre (URSC)/ ISRO in Bengaluru during April 22-23, 2024

The Space Science Roadmap Formulation (SSRF) meeting was held at the U R Rao Satellite Centre (URSC)/ISRO in Bengaluru during April 22-23, 2024. The meeting was organized by URSC and Science programme office of ISRO HQ. It drew over 200 scientists from various research centres and universities nationwide.

Six distinct space science themes were deliberated during the meeting:

- Astronomy & Astrophysics and Exoplanets
- Cosmology and Gravitation
- Astrobiology, Astrochemistry, and Space-biology
- Heliophysics and Space Weather
- Solar System Exploration
- Near-Earth Space Exploration

Experts from research institutes across the country delivered plenary talks on open scientific issues and global trends within the six themes. Subsequently, splinter groups engaged in focused discussions with domain experts to identify significant scientific problems for exploration in the near (2030), mid (2031-2035), and long (2035-2045) terms. Scientists from fifteen institutes and twenty-one universities participated in the meeting.

9. Meeting of the Apex Science Board (ASB), ISRO

Meeting of the Apex Science Board (ASB) in ISRO HQ

The Apex Science Board (ASB), ISRO, comprising a set of eminent scientists and academicians from institutes across the country, including ISRO/ DOS centres, met at ISRO Headquarters on November 29, 2024. The committee discussed about the Indian space science missions recently approved by the Government, possible ways of enhancing the national network in space science and exploration, as well as recommendations on a few programmes ideated by the scientists of the department.

2.5 Space Transportation Systems

India has achieved Atmanirbharta in space transportation systems through operationalization of the satellite launch vehicles viz. Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV), and Geosynchronous Satellite Launch Vehicle – Mark III (LVM3). Recently, the development of a Small Satellite Launch Vehicle (SSLV) has been completed, that is capable of launching small satellites of mass up to 500kg to Low-Earth Orbits. SSLV is envisaged to be handed over to Indian industry for the operational phase, towards which the process of technology transfer has already been initiated by the Department.

Self-reliance in space transportation system has been a key element in framing India's future space missions. Apart from launching satellites for earth observation, communication and navigation, which find societal benefits, India is now having the expanded vision with Human Space Programme and further space explorations. A human rated space transportation system based on LVM3 configuration (HLVM3) has been qualified under the ambit of the human spaceflight programme. In this year, the Government of India has approved the development of the Next Generation Launch Vehicle (NGLV) in order to meet the expanded vision of Indian Space programme which envisages establishing & operating the Bharatiya Antariksh Station by 2035 and a Crewed Indian Landing on the Moon by 2040. The development of NGLV is also expected to boost the Indian space ecosystem in terms of launch capability and capacity. The project envisages a higher degree of industry participation, compared to previous launch vehicle projects undertaken by ISRO. The development of advanced propulsion technologies including LOX-Methane propulsion, Semi-cryogenic propulsion, Electric propulsion & air-breathing propulsion have been taken up along with technologies for Vertical Take-off & Vertical Landing are being developed by ISRO with the support of industries and academia.

Major Events

- **Polar Satellite Launch Vehicle (PSLV):** Polar Satellite Launch Vehicle (PSLV) completed its 62nd launch during the period and continued to demonstrate its reliability and versatility through multi-satellite and multi-orbit missions.
  - PSLV-C59/PROBA-3: PSLV-C59 was a dedicated commercial launch service mission under a commercial agreement between NSIL and European Space Agency. In this mission, Proba-3, consisting of two satellites, was successfully injected into an elliptical orbit of 600 x 60530 km altitude

PSLV-C59 / PROBA-3 Mission

with an inclination of 59°on December 05, 2024, from Satish Dhawan Space Centre, Sriharikota. This was the 12th dedicated commercial mission of PSLV.

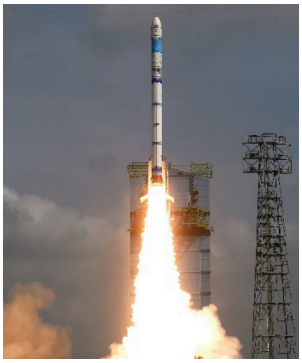
- PSLV-C60/SPADEX: PSLV-C60 successfully launched the Space Docking Experiment (Satellites) into an intended circular orbit of 474km on December 30, 2024, as a mission to demonstrate the Rendezvous & Docking between twoo satellites in orbit, from the First Launch Pad of Satish Dhawan Space Centre (SDSC), Sriharikota. After achieving the primary mission objective of deploying SPADEX satellites, the PSLV upper stage performed two orbit change maneuvers to bring down its orbit to 350km altitude and started functioning as an orbital experimental platform with autonomous control, communication, avionics and power systems to support 24 scientific/ technology demonstration payloads including 11 payloads from NGEs & Academia.

PSLV-C60 / SPADEX Mission

- **Geosynchronous Satellite Launch Vehicle (GSLV):** GSLV is a three-stage vehicle with solid, liquid, and cryogenic upper stage, designed to place a 2000 kg class of spacecraft into Geosynchronous Transfer Orbit (GTO).
  - GSLV-F15/ NVS-02 Mission will launch the second NVS satellite (NVS-02) in a series of 5 navigation satellites intended to replace/augment the aging in-orbit NavIC constellation and is tentatively scheduled in January 2025.
  - GSLV-F16/ NISAR Mission will launch the NISAR spacecraft i.e., NASA-ISRO Synthetic Aperture Radar Satellite, which is an advanced Earth Observation satellite jointly developed by NASA and ISRO. Realisation of vehicle stages systems are being carried and the satellite is planned to be launched from SDSC SHAR during first quarter of 2025-26.
- **Geosynchronous Satellite Launch Vehicle MKIII (LVM3):** LVM3 is a three-stage launch vehicle with two solid strap-on motors (S200), one liquid core stage (L110) and a cryogenic upper stage (C25).
  - The fifth operational mission i.e., LVM3-M5 will be the third dedicated commercial mission of NSIL through the LVM3 vehicle, wherein a satellite for a private international customer will be launched. Realisation of vehicle stage systems are being carried out and the mission is tentatively scheduled during Q1 2025-26.

2.5 Space Transportation Systems

- **Small Satellite Launch Vehicle (SSLV):** SSLV is an all-solid three-stage vehicle capable of launching 500kg class satellites into a 500km planar orbit.
  - SSLV-D3/ EOS-08: The third and final developmental flight of SSLV i.e. SSLV-D3 was successfully completed on August 16, 2024 from Satish Dhawan Space Centre, Sriharikota, with successful injection of the two spacecraft's i.e. EOS-08 as primary satellite, and SR-0 DEMOSAT as passenger satellite into a 475 km circular orbit with an inclination of 37.4°. With the successful completion of this flight, the scope of the SSLV Development Project has been completed thereby enabling operational missions to be undertaken by Indian industry and NSIL.



SSLV-D3 / EOS-08 Mission

- **Reusable Launch Vehicle (RLV):** The objective of the current RLV programme is to demonstrate critical technologies required for developing a winged body re-entry vehicle similar to that of an aircraft.
  - RLV LEX-03 Mission: The third consecutive and final autonomous runway landing experiment of the Reusable Launch Vehicle (RLV LEX-03) was conducted successfully on June 23, 2024 at the Aeronautical Test Range (ATR) of DRDO, located at Chitradurga, Karnataka. This mission demonstrated the autonomous landing capability of the RLV with more demanding off-nominal conditions including an intentional lateral shift of 500m from the runway, thereby validating the robustness of the onboard autonomous navigation, guidance & control system. The experimental data from this mission will further aid the developments towards the orbital re-entry mission of the winged Reusable Launch Vehicle.

RLV LEX-03

- **Test Vehicle (TV):** A new vehicle was developed as a low-cost test platform to carry out various experimental missions for in-flight functional testing of Crew Escape System (CES) for Gaganyaan, Vertical Take-off and Vertical Landing (VTVL) technology demonstration, space tourism, etc. The new vehicle called the Test Vehicle, is configured as a single-stage vehicle based on liquid propulsion system derived from the L40 strap-on stage of GSLV.

- The second developmental flight of Test Vehicle TV-D2 with Crew Escape System, carrying simulated Gaganyaan Crew Module is planned during Q4 2024-25. Realisation of vehicle stage systems for the 2nd developmental flight of Test Vehicle (TV-D2) has been completed and is available.

- **Development efforts towards realization of stages for the 1st un-manned Gaganyaan mission:**
  - Casting of all the solid motor segments for the first unmanned mission (Gaganyaan-GX mission) were completed in the previous year. Realisation of the L110 & C25 stages required for the first un-manned Gaganyaan mission have been completed and are available.
  - The launch campaign activities for the 1stun-manned Gaganyaan mission i.e., HLVM3/OM-1 mission commenced on December 18, 2024 at SDSC, Sriharikota with the stacking of the nozzle end segment over Strap-on Base Shroud for the first S200 motor at SVAB, SDSC.
- **Semi-Cryogenic Propulsion System:** The Semicryogenic engine project envisages the design and development of a 2000kN semi-cryogenic engine leading to the development of a Semicryogenic Stage (SC120) for LVM3, that enhance the payload capability of LVM3.
  - Based on the detailed analysis of the performance during the first integrated test on the Power Head Test Article (PHTA), which is an intermediate configuration of the Semicryogenic engine, further sub-scale tests were carried out at a lower level of engine configuration involving only minimal engine subsystems pre-burner. First short duration hot test on the lower level engine configuration was successfully carried out on May 02, 2024, and further five more confirmatory tests were carried out during the period May – July 2024, that provided sufficient confidence to proceed with the testing of the intermediate configuration (Power Head Test Article or PHTA) which are planned to be taken up during the fourth quarter of 2024-25.

PITA HOT TESTS

- **Uprated Cryogenic Stage (C32):** The uprated C32 stage project envisages the design, development and realisation of a cryogenic upper stage with an uprated engine thrust and higher propellant loading, which will enhance the payload capability of LVM3.

2.5 Space Transportation Systems

- Seven umbilical separation trials of the test article were completed successfully at the Second Launch Pad in SDSC, Sriharikota. The structural qualification tests for the Liquid Hydrogen (LH2) tank and the Inter-Tank Structure (ITSc) were completed successfully.

Structural Qualification test of LH2 tank with Closed ITSc and FSA

Umbilical Separation trials at SLP, SDSC

- The integration activities of the uprated cryogenic upper stage (C32 stage) powering the human rated LVM3 vehicle required for the first un-manned Gaganyaan i.e., LVM3-G1 mission, was successfully completed and dispatched to SDSC, Sriharikota on August 12, 2024.
- The fluid mockup test for uprated Cryogenic Upper Stage (C32) was successfully

C32 Stage for First un-manned Gaganyaan Flight

C32 Stage Fluid Mock-up at SDSC

completed on September 27, 2024. With this test, the various stage servicing operations including the pre-launch operations were satisfactorily simulated and the flight stage for the first unmanned flight of Gaganyaan mission (HLVM3-G1) is currently ready.

- **Development of Critical Technologies for Hypersonic Air-breathing Vehicle with Airframe integrated system (HAVA):** Air-breathing propulsion technology would enable improvement in payload mass fraction of space transportation systems. HAVA flight envisages to demonstrate the accelerated flight of the vehicle under hypersonic conditions using Scramjet.
  - The second experimental flight for the demonstration of Air Breathing Propulsion Technology was successfully conducted on July 22, 2024 from Satish Dhawan Space Centre, Sriharikota. The propulsion systems were symmetrically mounted on either side of a RH-560 Sounding rocket and launched. After flight duration of about 60 seconds from lift-off, when the vehicle achieved an altitude of approx. 18 km, the Scramjet engines were ignited with Gaseous Hydrogen(GH2) followed by successful initiation of combustion with space-grade Kerosene (isrosene) as planned. The flight test achieved satisfactory performance of the Sounding Rocket along with successful ignition of the Air Breathing propulsion systems. With this flight, critical technologies such as air intake mechanism, supersonic ignition of air breathing engines, and dual fuel injection systems have been successfully demonstrated.

Flight testing of Scramjet Engine with Dual Fuel

  - Being a highly complex technology, a series of similar experimental missions with Scramjet engines are planned to gather sufficient data towards fine tuning the performance of the engine. Experimental data from these missions will serve as a useful input for the development of Hypersonic Air Breathing Propulsion System.
- **Sounding Rockets:** Advanced Technology Vehicle Project conducts sounding rocket launches for the scientific exploration of the middle & upper atmosphere. It also provides a cost-effective platform for testing new technologies before introducing into launch vehicles.

- A two stage, un-guided, spinning, fin-stabilized RH560 vehicle was launched from SDSC, Sriharikota wherein the successful ignition of Air breathing propulsion systems was demonstrated.
- A total of 5 RH-200 rockets were successfully launched till during the start of the financial year till November 2024, from TERLS, SHAR, and Kulasekarapattinam. So far till November 2024,226 successive successful launches of RH200 rockets have been conducted.

- **Next Generation Launch Vehicle (NGLV):** The development of partially reusable, human rated & commercially viable Next Generation Launch Vehicle (NGLV) with enhanced launch capacity & capability has been initiated.
  - NGLV vehicle is a three-stage vehicle with a maximum payload capability of 30tonnes to LEO. Two variants of the vehicle i.e., with and without solid strap-ons are planned to be developed. The first and second stages are based on a common LOX-Methane Engine (LME-1100) having a nominal thrust of 1100kN and the third stage is based on an uprated version of the existing Cryogenic stage developed for LVM3 with a propellant loading of 32t. The core stage will be configured for recovery through vertical landing and reusability.
  - Overall vehicle configuration studies considering vehicle length, envelope of 9 clustered engines in the first stage, propellant loading, stage separation studies, launch pad interfaces and fabrication aspects have been completed. Overall drawings of the vehicle configuration, individual stage structures, interfaces and loads have been released for carrying out the preliminary design. The configuration of the LOX-Methane engine has been finalized and the design of subsystems completed.

LME-1100

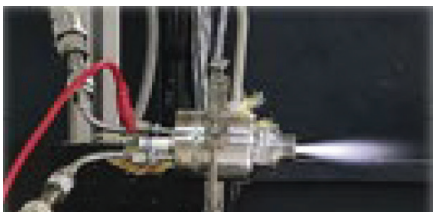
NGLV-CA

  - Overall mission design requirements defined and trajectory design completed. CFD simulations for ascent and booster stage descent completed for the core stage. Aerodynamic load distribution, overall aero coefficients generated and structural load estimation completed.
  - Several stage auxiliary systems which includes landing legs, steerable Grid-fins, and separation systems have been defined and detailed design is in progress.

Procurement planning activities for the realisation of various sub-systems are being finalized.

- **Development of key technologies for LOX-LCH4 Engine:** Envisages the development of key technologies involving realisation and testing of sub-systems which will provide the way forward for the development of the flight LME1100 engine for NGLV.
  - Realisation of sub-scale chamber and injector head for Gas Generator (GG) through Additive Manufacturing route completed. Development tests on the subscale GG completed and ignition of GOX-GCH4 propellant mixture at different sub-scale GG flow rates and igniter chamber pressure demonstrated.
  - Design of thrust chamber configuration and nozzle profile completed. Design of cooling system for thrust chamber finalized. Radiatively cooled C-C nozzle extension is proposed for vacuum version thrust chamber. Design of subscale thrust chamber and sub-scale injector head finalised.
  - Design and realisation of single element injector/ thrust chamber through 3D printing completed. Test article for single element test has been configured and fabrication drawings generated. Facility augmentation for the single element thrust chamber completed and tests to be commenced.
  - Design, development and qualification of spark torch igniter completed and 6 hots test demonstrating successful ignition conducted. Towards the realisation of full scale GG, Design for Additive Manufacturing (DfAM) studies carried out for full scale GG realization. 3D printing of spherical chamber & flanges completed. Further welding of GG chamber assembly is in progress. Realisation of GG injector head completed. Test plan generated for GG full scale development tests.

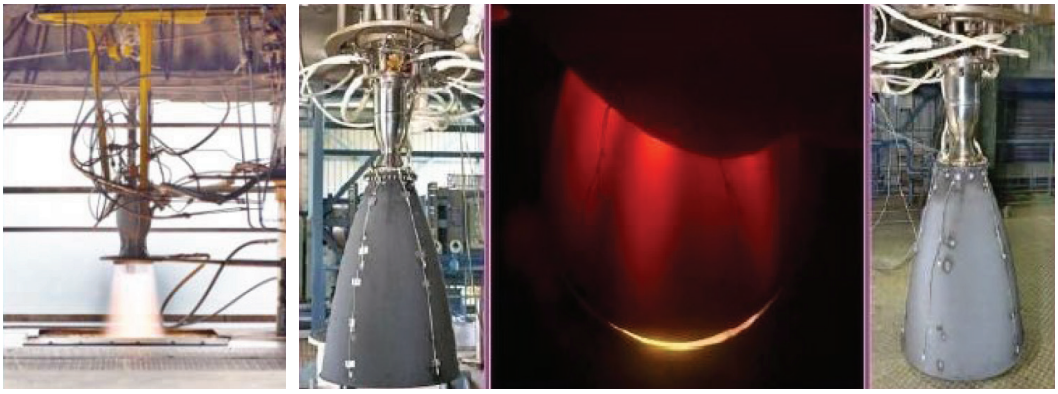
Ignition tests on the sub-scale GG



Igniter dev. Hot test

- **Development of New Technologies in Propulsion Systems:**
  - Multiple tests on different PS4 engines that power the 4th stage of PSLV, were carried out to demonstrate indigenous Stellite alloy & Carbon-Carbon for the nozzle divergent and validate the Additive Manufacturing route towards mass reduction & cost savings.

2.5 Space Transportation Systems



Hot test of PS4 Engine realised through AM

Hot test of PS4 Engine with Carb-Carbon Nozzle Divergent

- Short duration hot tests of the indigenous CE20 cryogenic engine demonstrating engine start capability without nozzle closure was successfully conducted for a duration of 2.5 & 2.8 seconds respectively in High altitude test condition. These tests were conducted in preparation for re-ignition of the cryogenic engine in space.

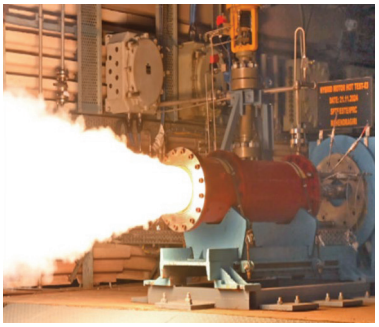
CE 20 Engine Restart Demonstration Test

- Full Nozzle Cryogenic Engine (CE20) undergoes hot test outside vacuum chamber in preparation for re-ignition in orbit: Successfully conducted hot tests of CE 20 E13 engine (AR100) using Nozzle Protection system (NPS) at Sea level conditions for a duration of 10 seconds & 200 seconds on November 29, 2024 & December 19, 2024 respectively at ISRO Propulsion Complex, Mahendragiri, Tamil Nadu. Performance of a multi-element igniter which aids the much essential engine restart capability was also demonstrated through this test.

CE 20 Engine Sea Level Test with Nozzle Protection System

- 30kN Hybrid motor: 30kN hybrid motor uses liquid oxygen (LO_x) and a metalized HTPB fuel. Development hot test of 30kN hybrid motor with HTPB+20%Al as fuel & Gaseous oxygen as oxidizer, was conducted for a duration of 10 seconds at Scramjet Propulsion test facility, IPRC on November 21, 2024. Successful ignition and sustained combustion achieved during the test for the intended duration.

The hybrid motor tested is scalable & stackable, including the advantages of throttling & restart. The 30kN hybrid motor being developed will be used for a sounding rocket flight demonstrator.



30kN Hybrid Motor Firing

- The first restart demonstration test of ISRO's workhorse Vikas Engine was successfully accomplished at the engine test facility at IPRC, Mahendragiri, on December 23, 2024. Restart of Vikas engine is a key technology demonstration for recovery of spent stages of launch vehicles and will aid in the development & demonstration of a booster stage recovery in Vertical Take-off & Vertical Landing (VTVL) mode. The total duration of the test was 56s, which included a first firing for 7s duration followed by an off-time of 42s and a second firing for 7s duration. All engine parameters in the test were normal and as expected.

Vikas Engine Restart Demonstration Test

2.6 Gaganyaan

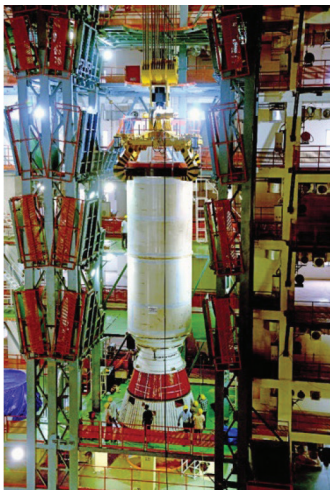
Gaganyaan is a national programme to demonstrate the capability to launch human beings to low earth orbit on an Indian launch vehicle and bring them back safely to earth. It comprises Uncrewed flights followed by a Crewed flight involving detailed qualification of several engineering subsystems, Crew selection & training, and development of human-centric products. The mission is broadly divided into three major phases, namely, ascent phase, orbital phase, and descent phase. In the ascent phase, the human rated launch vehicle carries the Orbital Module to a low earth orbit. The orbital phase starts with the injection of the Orbital Module by the launch vehicle into an elliptical orbit. This is further raised to a circular orbit using the engines present in the Orbital Module. The orbital phase ends with the beginning of the de-boost maneuvers carried out to initiate the return journey. The descent phase begins with the de-boost maneuvers which sets the course of the module towards the designated touch-down location. A series of activities will be carried out during the descent phase, which will finally end with a low-velocity splash down at a designated location in sea waters. The Gaganyaan programme involves complex and multi-disciplinary activities with an emphasis on human-centric approach in designing, realizing, and testing various subsystems.

The major activities carried out towards Gaganyaan missions include the following:

1. Human Rated Launch Vehicle (HLVM3)

Propellant Casting of all the segments of solid motors (HS200) is completed. Integrated test and actuator in loop simulation tests for one HS200 motor is completed. Fully integrated liquid core stage (L110-G) stage was prepared and positioned at SDSC. Fluid mock-up trials of C32-G are completed. Further, refurbishment of C32-G stage is completed for flight.

Vehicle Integration activities and launch campaign have commenced for Gaganyaan - G1 Mission.



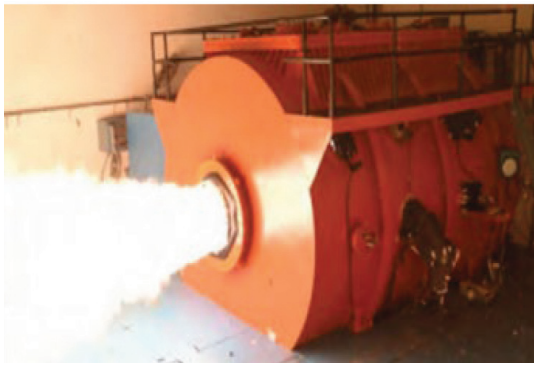
Stacking of HS200 PM Nozzle end Segment assembly

2. Crew Escape System

Crew Escape System (CES) comprising of 5 different types of quick-acting solid motors viz. High Altitude Pitch Motor (HPM), Low Altitude Pitch Motor (LPM), CES Jettisoning Motor (CJM), High Altitude Escape Motors (HEM) and Low Altitude Escape Motor (LEM) were realized. CES Nose Cone (CNC),

CJM-LEM Structure Upper (CLSU), CES Auxiliary systems & Grid fins were realised. Acoustic Protection System assembly was completed for HEM Thrust Transfer Structure (HTS). CES structures were delivered to SDSC for integration activities. Electrical checks for CES Avionic Deck Assembly (ADA) have commenced at VSSC. All solid motors for CES are ready after NDT. Nozzle assembly to CES motors is initiated. Static test of HEM in near vacuum condition (HAT test) was carried out to evaluate vacuum ignition characteristics of motor. Third static test of CES Jettisoning Motor (CJM) is completed. Static test for modified LPM is completed. Second and third static tests of Low-altitude Escape Motor (LEM) were successfully conducted.

Static test of LEM at SDSC



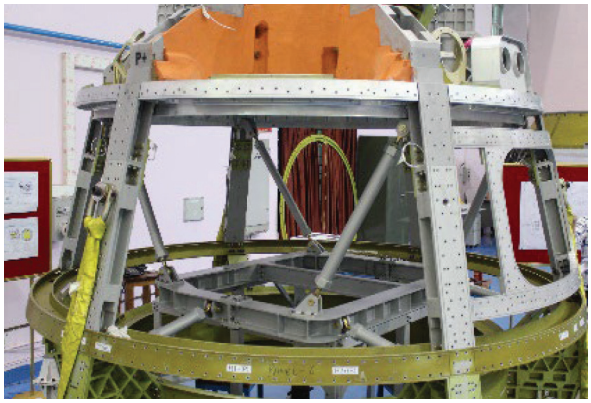
Static test of HEM at SDSC

Crew Escape System Hardware Subassemblies

3. Orbital Module

a. Crew Module: Integration of propulsion elements have commenced. Main, Apex Cover Separation (ACS) and Pilot parachutes realised. Aerial Drop tests for Main parachute using IL-76 aircraft were carried out successfully. Avionics packages are realised. Test & Evaluation for inertial sensor completed. Crew Module Fairing (CMF) structure is ready after Thermal Protection System (TPS) application. Trial assembly carried out for CMF with Crew Escape systems Ogive Shroud (CEOS). TPS application is completed

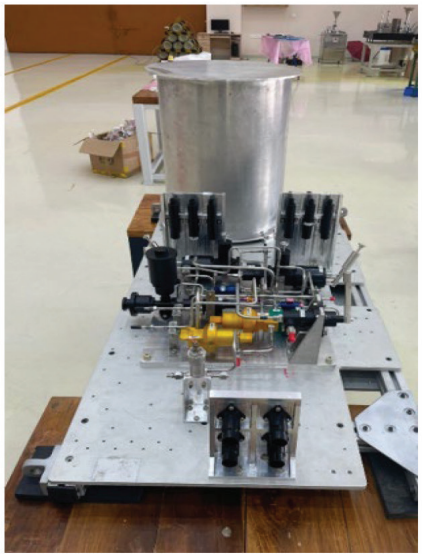
for CEOS ogive shroud and Crew Escape systems Conical Shroud (CECS). Pre-integration operations are completed. Interfaces of avionics, sensors and cameras are generated on Crew Module. For Crew Module Propulsion System (CMPS), interfaces are generated for tanks and valves. Electrical harnessing of CMPS at deck level are completed. Machining of Low-Density Ablative (LDA) tiles is completed. Trial suiting of Medium Density Ablative (MDA) tiles with metallic conical panels is completed. Final assembly of metallic dome hardware is completed for Low Density Carbon Phenolic (LDCP) application. TPS samples are realized for apex cover ring. TPS specimen realized for CM-SM separation system test and bonding has been completed.



Crew Module under Integration activities

b. Service Module: Service module integration activities have commenced for G1 mission. Power systems, simulation packages for onboard computer, various sensors, harnesses for electrical integration and ground check-out are realized. Integration of propulsion elements is completed. QFH antenna components with deployment mechanism are realized. Additional Service Module structure is realized and preparation has commenced for structural tests.

Service Module Integration Activity in Progress

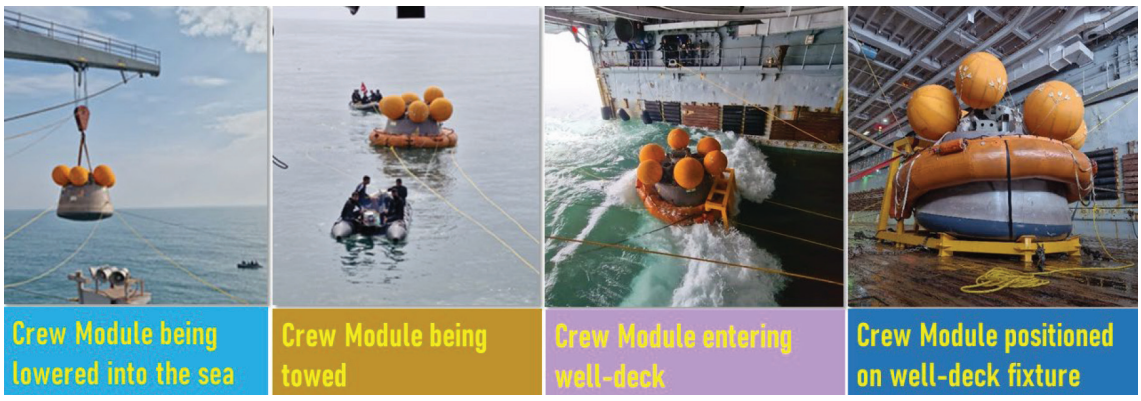


ECLSS Components Assembled on Deck

c. **Environment Control and Life Support System (ECLSS):** Qualification and functional tests for Thermal and Humidity Control Systems components are completed. Integration of ECLSS components to Service module have commenced. Crew Seat Assembly (CSA) hardware is realised and integrated with Crew Module for G1 mission.

4. Recovery Operations

Recovery and communication plans for G1 mission are finalized. Recovery Trials were carried out with a Ship having A-frame crane and Well deck.



CM Recovery using a Well Deck Ship in Collaboration with Indian Navy

5. Ground Network

Ground Network design for all phases of Gaganyaan mission incorporating internal and external agency stations have been completed. For the first unmanned G1 mission, configuration of network stations has been finalized. The communication links between Gaganyaan Mission Control Centre and ground stations have been upgraded to meet the technical requirements of the G1 mission. Flight dynamics software, data acquisition and transfer systems, interfaces, and communication protocols have been upgraded to meet the technical and security requirements.

Gaganyaan Mission Control Centre has undergone extensive upgrades, including enhancements to its network architecture, system capabilities, and connectivity, to meet the stringent requirements of the Gaganyaan mission.

6. Crew Training

Integrated training Repository Software was upgraded for management and archival of training resources. Revised academic training curriculum was evolved. Static Mock-up Simulator (SMS) was integrated and installed in Astronaut Training Facility (ATF) Bengaluru.

Quality Assurance (QA) process initiated for safety clearance of Static Mock-up Simulator (SMS) for crew training. SMS is being configured for carrying out Analog missions and Flight Procedure Document (FPD) based trials.

Gaganyaatris being familiarized with systems inside SMS at ATF

7. Progress of Gaganyaan Development Activities

Crew Module system: Full scale system level test of Crew Module Up-righting System (CMUS) was carried out, wherein inflation and 48-hour pressure holding of the floats were demonstrated.

Service Module: Qualification hardware for all avionics packages of SM have successfully undergone qualification tests for Gaganyaan ETLS. SM System Demonstration Module (SM-SDM) Phase-3 tests were successfully completed in IPRC-Mahendragiri.

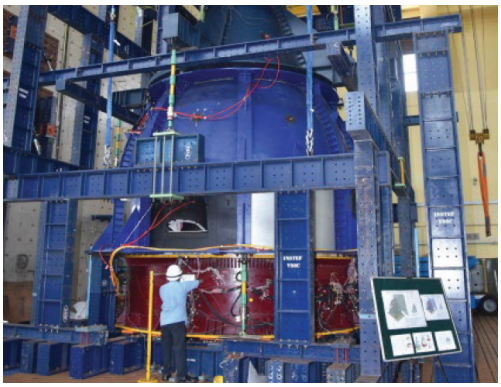
Environment control and Life support system: Demonstration of THCS integrated performance of both condensing and non-condensing network with radiators completed at Industry. Cabin temperature was achieved for the designed heat load for on-orbit pre-chilling condition. Humidity removal from condensing air-liquid heat exchanger are demonstrated. Qualification and acceptance tests were completed for space food & water containers, fire suppression system, Emergency Survival kit, medical kits and Radiation dosimeter. Integration of ECLSS hardware in Static Mock-up Simulator like ARS blower, heat exchangers, fire suppression system were carried out. Engineering/Developmental model of Personal Hygiene Management System to (PHMS) is developed. Development & qualification of Drive Actuator for motorized operating valve-1 is completed.

THCS Integrated Simulator

Structural testing: Structural qualification test for CECS and CEOS is completed. Apex cover structural load test (external pressure load case) is completed. SMF phase-1 test for

OMA+SMF structural qualification test is completed. Functional test of CMF separation system was carried out in Zero-G facility.

OMA+SMF structural qualification test



CECS & CEOS structural qualification test

Parachute & Separation Systems: The air drop test of main parachute and the phase-III Rail Track Rocket Sled (RTRS) tests for drogue parachute in two load conditions were carried out. Mortars (ACS/drogue/pilot), Reefing Line Cutter (RLC) - drogue and main chute, Compact Parachute Releaser Unit (CPRU) are ready and qualification tests are in progress.

Human Factors Engineering: Full-body Inertial Measurement Unit (IMU) sensors based Human Motion Capture (MoCap) system along with hand gloves and finger tracking system was commissioned. Re-configurable Crew Module (CM) skeletal habitable volume mock-up structure was realized to assess crew performance in terms of reachability, comfortability, visibility and other ergonomic aspects.

Micro-Meteoroid and Orbital Debris (MMOD): HVI tests were successfully completed. Based on the test results validation of the performance of Whipple shields and CM Conical region wall configuration in both Ballistic and Fragmentation velocity regimes of the Bumper Layer Envelope were successfully completed.

Crew Seat Assembly (CSA): Integrated design and analysis is completed for test fixture. Preliminary design and analysis for crew seat bucket is completed and Engineering prototype (polymer based) is realized using 3D printing route. An MoU is signed with IIT Madras for water impact studies with a scaled down CM model. Test plan, drop test setup and sensors, Data acquisition plan have been finalised.

8. Test Vehicle Project

Major activities for 2nd Test Vehicle mission like vibration test and leak checks of Propulsion Bay, autonomous and real time simulations, Phase-I electrical checks including proto flight vibration test, Phase II electrical & stage checks including powered envelope verification & cold Gimbal are completed. The integrated TV-D2 stage is ready at SDSC.

For TV-A1 Mission, all flight hardware, propulsion modules, engine and tanks are positioned at IPRC for stage integration. ICAS (Integrated Control Actuation System) with BLDC motor integrated in Test Vehicle Base Shroud Lower and checks are completed. Accommodation of pitch motor in CSIA (CES Interface adapter), retro motors in ITS, Onboard Flushing & Purging System (OFS) in base shroud and double wedge movable fin were studied. Avionics requirements are also finalized.

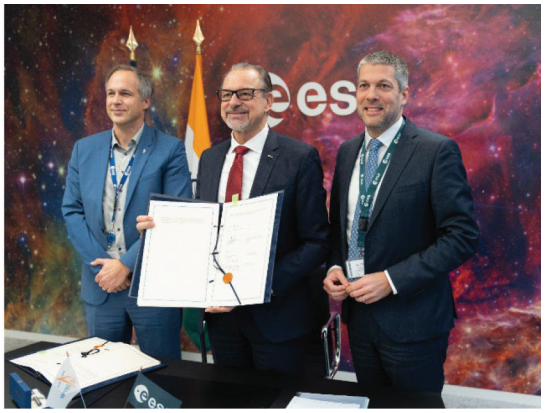
Integrated Parachute Test: To simulate parachute deployment during various descent phases of Gaganyaan Crew Module, a solid motor-based launch vehicle viz., Sub-Orbital Launch Vehicle for Experiments (SOLVE) is designed. The major activities carried out includes finalization of vehicle configuration with PSOM XL motor, Aerodynamic characterization, Structural load estimation and Integrated Avionics architecture configuration.

9. National & International Collaboration activities for Gaganyaan Programme

Agreement between ISRO-ESA for Astronaut Training, Mission Implementation and Research Experiments

An agreement was signed with European Space Agency (ESA) to collaborate on activities related to Astronaut Training, Mission Implementation and Research Experiments. The agreement was signed by Dr. S. Somanath, Chairman, ISRO/ Secretary, DoS and Dr. Josef Aschbacher, Director General, ESA. The agreement provides a framework for cooperative activities in human space exploration and research, especially in areas such as astronaut

training, support for experiment development and integration, including use of ESA facilities on International Space Station (ISS), human and biomedical research experiment implementation as well as joint education and outreach activities.



Agreement between ISRO and the National Aeronautics and Space Administration (NASA) for Hypervelocity Impact Testing

ISRO has signed an agreement with NASA to verify and validate the design of the Debris Shield to devise solutions for MMOD impacts during mission. ISRO will design and supply the test materials and NASA will carry out hypervelocity impact tests.

ISRO & Australian Space Agency (ASA) sign Implementation Arrangement for Gaganyaan

An Implementation Agreement (IA) was signed between Indian Space Research Organisation (ISRO) and Australian Space Agency (ASA) for cooperation in space activities between Australia and India. The IA enables cooperation between both space agencies on Crew as well as Crew Module recovery for Gaganyaan missions. The IA enables the Australian authorities to work with Indian authorities to ensure support for search and rescue of crew and recovery of Crew Module as part of contingency planning for ascent phase aborts near Australian sea waters.

MoU on Cooperation in Space Biotechnology with Department of Biotechnology (DBT), Ministry of Science and Technology and ISRO

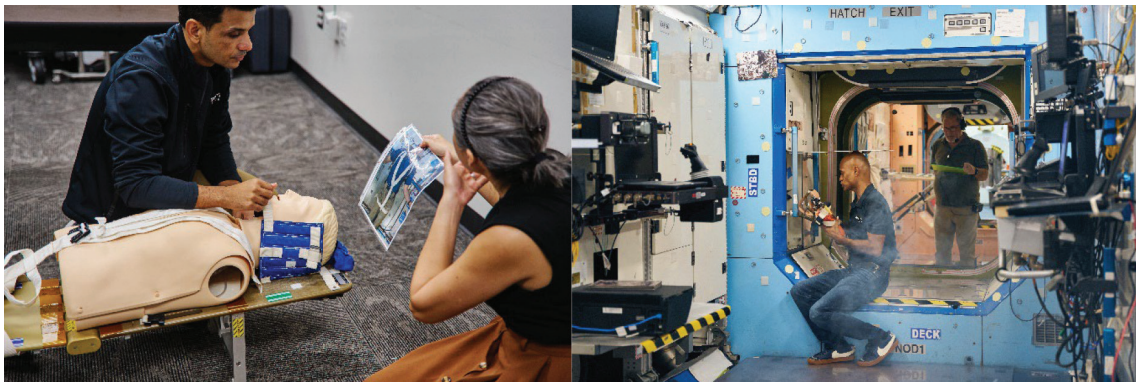
Department of Biotechnology (DBT), Ministry of Science and Technology and Indian Space Research Organisation (ISRO) signed Framework MoU on Cooperation in Space Biotechnology. This Collaboration would open up opportunities in Bio-astronautics and Biological research. A dedicated Biotechnology Experiment and Technology Demonstration Rack will be operationalised in the upcoming Bhartiya Antariksh Station in future.

10. Joint ISRO-NASA Mission to International Space Station (ISS)

Towards the goal of mounting a joint ISRO-NASA effort to International Space Station (ISS), Human Space Flight Centre (HSFC) of ISRO has entered into a Space Flight Agreement (SFA) with NASA identified service provider Axiom Space Inc.,USA for its upcoming Axiom-4 mission to the ISS. The mission is currently targeted for launch in Q2 2025 timeframe. For the present mission, National Mission Assignment Board has assigned Group Captain Shubhanshu Shukla as prime and Group Captain Prasanth Balakrishnan Nair as backup. Both prime and backup Gaganyatris commenced their training for the mission from first week of August, 2024. Preparatory activity such as Space Suit measurement has been completed. Other preparatory activities such as space food tasting sessions have also been completed at NASA's Johnson Space Centre and Axiom facility. Tours of Axiom, SpaceX and NASA facilities have been conducted for the Gaganyatris along with other mission Crew.

Training completed for familiarization with onboard ISS systems and their operating procedures, daily routine in space, management of onboard emergencies such as fire etc. Training sessions for handling medical emergencies in space have also been completed. Initial familiarization sessions with the ascent/descent vehicle (SpaceX Crew Dragon) has also been completed.

During the mission, the Gaganyatri will conduct scientific experiments in microgravity environment. Towards this, ISRO has finalized the scientific research complement comprising of selected experiments from various national research institutions. NASA's Research Integration Office is supporting the implementation of these experiments for the mission. ISRO is also actively engaging with international partners in this mission for finalizing the on-orbit scientific demonstrations as well as joint educational outreach programme, especially targeted towards the young student community.



Prime and backup crew undergoing training for ISS Mission

11. Unveiling of Gaganyaan Astronaut Corps and Astronaut wings

On a landmark event held at Dr Srinivasan Auditorium of VSSC on February 27th, 2024., Honorable Prime Minister, Shri Narendra Modi gave 'Astronaut wings' to the four astronaut designates for the prestigious Gaganyaan mission. Group Captains of Indian Airforce, Prasanth Balakrishnan Nair, Ajith Krishnan, Angad Pratap and Wing Commander Shubhanshu Shukla received the patches. He congratulated the four astronaut designates selected for the prestigious Gaganyaan mission and acknowledged the rigorous training they had undergone in the previous three years. He added that the Gaganyaan mission will take our country to new heights and is in concordance with our efforts to be the third largest economy in the world.

2.7 Technical Facility / Infrastructure

The significance of establishing new facilities and enhancing infrastructure at various ISRO centres aligns with programmatic needs, long-term goals, Atmanirbhar Bharat, and reforms in the space sector.

This section provides a detailed overview of the facilities and infrastructure set up at different centres.

Vikram Sarabhai Space Centre

High Pressure System in 1.2 m Trisonic Wind Tunnel

A state of the art 1.2 m Trisonic Wind Tunnel (TWT) has been established at TERLS to meet the demands of aerodynamic design and characterisation of ISRO's present and future launch vehicles. Dynamically and geometrically scaled models of the launch vehicle with appropriate measurement systems would be mounted in the test section for generating the data. In order to simulate the external air flow environments, the TWT has 10 major subsystems namely high-pressure system, quick shut off valve, pressure regulating system, settling chamber, flexible nozzle, transonic test section, diffuser, ejector, muffler and instrumentation and control system.

A Mach 2 blowdown was executed with closed loop control of the pressure relief valve and the run time of 20 s was achieved.

Additive Manufacturing Facility - ReDAMS

Considering the potential of Additive Manufacturing (AM) processes for the realization of aerospace quality launch vehicle components/assemblies and designing parts with improved performance, a 'Research & Development in Additive Manufacturing for Space (ReDAMS)' project is being established in MME / VSSC towards metal additive manufacturing activities.

Two facilities viz. Laser Powder Bed Fusion (L-PBF) and Laser Directed Energy Deposition (L-DED) machine under the ReDAMS project were commissioned.

2.8 PetaFlop (PF) Facility

The 2.8 PetaFlop (PF) supercomputing facility, one of the fastest supercomputers in India, will cater to the rapidly growing demands for high-performance computing (HPC) applications in Computational Fluid Dynamics (CFD), Multidisciplinary Design Optimization (MDO), structural and thermal analysis, weather prediction, machine learning, and other critical applications. The facility will be configured with high-performance compute nodes, each equipped with dual-socket motherboards and 256 GB of RAM. The facility will also feature

GPU-based nodes to accelerate tasks such as deep learning and complex simulations. For storage, the facility will incorporate robust PFS (Parallel File System) and NAS (Network-Attached Storage) servers, offering an impressive 2.5 PiB and 4 PiB capacities, respectively.

Augmented Satish Dhawan Supercomputing Facility (SDSF)

Satish Dhawan Supercomputing Facility, was established at VSSC in 2011. The SAGA-220 (Super computer for Aerospace with GPUArchitecture-220 Teraflops) has a peak performance of 220 Trillion Floating Point Operations Per Second (TFLOPS).

In House developed Computational Fluid Dynamics (CFD) software 'Parallel RANS Solver for Aerospace Vehicle Aero- thermo-dynamic Analysis' (PraVaHa) and PARAS are successfully deployed and demonstrated in High Performance Computing for aero-dynamic design and analysis.

Highlights of the augmented facility: The new HPC performance output (Rpeak) is 483.84 TFLOPS with 200 HDR Infini-Band network smart switches and 100 EDR InfiniBand network cards to form the Fat-Tree network topology. It includes 1G Ethernet for PXE booting of node OS and Intelligent power management interface (IPMI). It is designed with in-house developed new software stack for node Operating System (OS) and in-house configured new software for HPC cluster management and HPC monitoring tools.

Telemetry & Tracking Facilities

The C-Band Polarimetric Doppler Weather Radar (DWR) at TERLS provides round the clock weather observation for a range of 250 km in dual polarization mode and 400km in single polarization mode. This data is uploaded in near-real time to Meteorological & Oceanographic Satellite Data Archival Centre (MOSDAC), SAC and Indian Meteorological Department (IMD) servers.

The ISTRAC Trivandrum Ground Station, located within VSSC campus provides Telemetry, Tracking and Tele-command (TTC) support for Launch vehicles. The support is also extended for Phase-1 electrical checks (RF testing) of POEM and other sub-assemblies, as and when required.

PCM Production Activity Complex

Large-volume chemical and polymer products are outsourced, while production of small-volume remains in-house due to low demand and production disruption concerns. The PCM Production Activity Complex (ProAct) is established to address the production of small volume items in a cost-effective manner.

ProAct consists of the following,

- State-of-the-art process rooms (4 nos.) catering to all processing needs
- 26 major equipment, 9 analytical instruments and 37 types of utilities
- In-process analytical facility
- Raw material stores, Solvent store, raw material preparation facility and product packing storage rooms
- Zero-effluent facility for waste management.

AP Process Facility-II

AP Process Facility-II is established for AP Production augmentation to 3000 TPA. Commissioning and pre-qualification trials are completed.

AP Process Facility - II

Satish Dhawan Space Centre SHAR

PSLV Integration Facilities (PIF)

PIF is established to serve as Integration building for vehicle integration upto fourth stage, service building for MLP refurbishment works after launch, Mobile Launch Pedestals (MLP), bogie System with rail track & hauler for bogie (SPU) and check out systems & Pneumatic systems for electrical & leak checks. PIF facilities were dedicated to Nation on 27th February, 2024 by Hon'ble Prime Minister of India. PSLV-C60 Launch Vehicle Integration activities were carried out in PIF.

SSLV Launch Complex (SLC)

SDSC SHAR is responsible for realization of an exclusive SSLV Launch complex (SLC) at Madhavankurichi area, Tuticorin district, Tamil Nadu. Existing launch pads at SDSC SHAR Viz., First Launch Pad (FLP) and Second Launch Pad (SLP) are lined up for meeting launch demands of PSLV, GSLV & LVM-3 launches, thus realization of exclusive launch pad for SSLV is essential.

SSLV Launch Complex is proposed to be realized for serving the polar missions for SSLV and launch vehicles by non- government entities thereby reducing their occupancy period in SDSC SHAR facilities for ongoing launch manifest. The location of the site is selected in such a way that the azimuth corridor and permissible trajectory for SSLV is advantageous for polar missions as compared to SDSC SHAR. The launch complex consists of facilities for post-transport NDT, preparation of sub-assemblies & spacecraft, integration, launch, range systems for tracking, telemetry & telecommand and stage servicing, meteorology, material handling & safety systems.

Honourable Prime Minister, Shri. Narendra Modi laid Foundation Stone through virtual mode for Launch Complex at Kulasekarapattinam, Thoothukudi Dist. Tamil Nadu on 28.02.2024. First sounding rocket launched from the Launch Complex on 28.02.2024. Currently, Civil buildings configurations are finalized and detailed design is in progress. Procurement action initiated for major items viz. C Band Transmitter, Radar Antenna, Telecommand antenna, TR Limiter, Bogie and Rails. Fabrication of Mobile launch structure in progress at supplier site.

Gaganyaan Launch Complex & Recovery Systems (GLCRS)

Gaganyaan Launch Complex & Recovery Systems project is planned at SDSC SHAR towards enabling Human Space Missions from Second Launch Pad (SLP) and realization of associated Crew facilities. As part of qualification tests under Gaganyaan programme Ground Resonance Test (GRT) and Test Vehicle (TV-D1) launch completed successfully. All existing ground systems are being augmented to meet HLVM3-GX mission.

2.7 Technical Facility / Infrastructure

Gaganyaan Crew Module sub scale freefall drop test carried out successfully. Erection and commissioning trials are completed for Zip line system & Landing tower with CESB and procurement action initiated for new ergonomic basket.

Orbital Module Preparation Facility (OMPF) is realized to meet the integration requirements of CM, SM & CES motors & their integrated checks. Gaganyaan Control Facility (GCF) is being configured for monitoring, controlling & supervising the various activities of Gaganyaan mission.

Augmentation of SLP complex for Semi-cryo stage integration and servicing (ASLP)

To meet the immediate need of servicing the LVM3 variant with semi-cryo stage, augmentation of Second Launchpad is taken up. The configuration details are worked out for the augmentation. STS road map envisages the induction of Semi-Cryo stage in place of L110 and C32 as Cryogenic upper stage in place of C25. To meet the servicing requirements of the newly inducted stages, Augmentation of Second Launch Pad Project (ASLP) project is taken up. Major equipments viz., LOX tanks, cryogenic valves, Isrosene tanks, PLC based Automation system, Process flow components, remote valve enclosures are realised.

SC120 Hardware Building

SC-LOFS Building

Space Theme Park

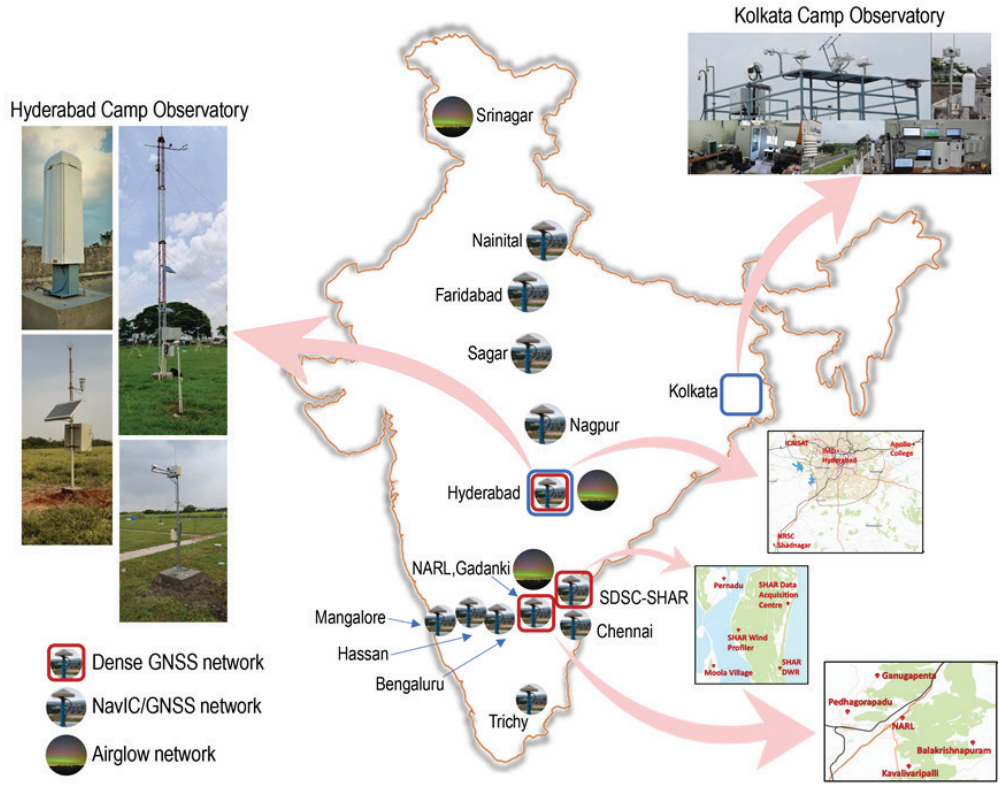
In tune with the Govt. of India policies and impetus on outreach programme, and to provide the opportunity to more public for witnessing the launch, Space Theme Park is planned at SDSC SHAR, Sriharikota. The major systems are 10000 seating

capacity Launch View Gallery, Space Museum, Space Theatre, Rocket garden and the Entrance plaza with necessary Security arrangements.

Currently, Launch View Gallery (LVG) Complex & Auxiliary Facilities such as Car Parking area, Water Treatment Plant, Sewage Treatment Plant, Cloak rooms, Electrical Substation are realized and operational. The realization of Space Museum, Learning & Knowledge Centre is now envisaged with in the Launch View Gallery Facility. Civil works are in progress for realization of Entrance Plaza, Rocket Garden & Toll Plaza.

National Atmospheric Research Laboratory

NARL has established two well-planned camp observatories and networks of GNSS receivers & airglow imagers to address various concerns of national importance and contemporary specific science questions. To understand the impact of rapid urbanization on land-atmospheric interactions, heat stress, changes in cloud and precipitation



patterns, a dense network of a variety of instruments has been established in and around Hyderabad. Another camp observatory established at Kolkata focuses on the vertical transport of aerosol and pollutants by deep convection and their effects on cloud systems and climate using a multisensor approach and modeling. A country-wide network of north-south and east-west chains of GNSS/IRNSS receivers aims to quantify the variations in ionosphere due to equatorial ionization anomaly and equatorial plasma bubble. In addition, 3 dedicated dense networks of GNSS receivers were established in rural (Gadanki), coastal (Sriharikota) and urban (Hyderabad) regions to demonstrate the potential of these receivers for meteorological applications, including improvement of nowcasting and forecasting of storms. A north-south chain of airglow imagers established at Srinagar, Hyderabad and Gadanki forms a formidable network for investigating equatorial and midlatitude ionosphere/thermosphere system and associated coupling processes.

National Clean Air Programme - Air quality monitoring

National Clean Air Programme (NCAP) was launched by Govt. of India for assessing and mitigating air quality. To realize the programme, NARL was recognised as an Institute of Repute (IoR) to provide scientific and technical inputs to achieve the NCAP objectives. NARL has conducted air quality monitoring campaigns at four strategic locations,

viz. traffic, residential, industrial and urban background in Chittoor, Kurnool, Anantapur and Kadapa during winter and summer seasons to identify the potential sources of air pollution through the chemical characterization of the collected air samples. Further, NARL has done extensive surveys including traffic, household, restaurants, street vendors, construction activities across the city to develop a GIS based emission inventory. This data form the basis for developing city level air quality management plan.

Human Space Flight Centre

Environment Control and Life Support System (ECLSS) Facility: Major works carried out include civil & PH works, Electrical Works, Air Conditioning Works, sliding gate, EOT Crane, 250kVA UPS installation were completed for ECLSS facility.

ISRO Propulsion Complex

Integrated Cryogenic Engine and stage Test facility (ICET)

The erection of Super structure, welding of deflector plates is completed. Erection of Lightning protection system is completed. Site acceptance tests (SAT) of Data acquisition system (DAS) and Digital measurement system (DMS) are completed. Completed Design review of Process & Instrumentation diagrams for augmentation of ICET towards LME 1100 engine tests.

Cryo Turbo Pump Test Facility

This new facility is being realized for performing tests of turbo-pumps with actual cryogenic propellants. Completed fabrication and installation of piping circuits pertaining to Gaseous Nitrogen (GN2) system, Gaseous Helium (GHe) system, Gaseous Hydrogen (GH2) system. Carried out functional test & tuning trials

for pressurisation control valve of LOX & LH2 run tanks. Completed Cold shock test of Flow meter skids (5 Nos.) with Liquid Nitrogen (LN2). Cryogenic Run tanks leak test completed.

LH_2 LOX & High Pressure run tank

Liquid Oxygen & Liquid Hydrogen low pressure system with Liquid Nitrogen (LN2) commissioning trials are completed. Chilling of the fill circuit with LN2 is completed. Performance validation trial runs are completed.

Liquid Propulsion Systems Centre

GO2 Test Facility

Oxygen test facility is established for testing of CPCS components of Gaganyaan in Gaseous Oxygen and Gaseous Helium up to 250 bar and testing of CPCS System in Gaseous Oxygen. The facility consists of three buildings viz. Gas storage building, Test Bay building & Instrumentation Lab.

GO2 Test Facility

Gaganyaan Components Assembly and Test facility (GCAT)

The facility is established for the assembly of Gaganyaan CPCS Control Components and testing of CPCS Components in GN2 (up to 100bar). The major features include 10,000 class and 100 class clean rooms for assembly of components, cleaning facilities for oxygen service and inspection facilities.

GCAT Clean Room

Integrated Titanium alloy Tank Production Facility (ITPF)

Integrated Titanium Alloy Tank Production Facility is a SPAC approved project envisaged to carryout end-to-end production of all variants of spacecraft propellant tanks and PS4 propellant tanks. The Cost of the facility is 329.60 Cr. All major equipments have been commissioned and put in use for functioning towards meeting the process requirement.

ITPF

Augmentation of LVM3 Tank Production Facility

Towards LVM3 facility augmentation, propellant tank production facility and CNC machining centre are established and is inaugurated by Chairman-ISRO and CMD, HAL on 5th June 2024. Civil infrastructure such as Welding shop, Dry-fit area & NDT, CNC shop, Annexure building including AHU rooms, CNC machining centre etc. were established as part of the facilities.

LVM3 Tank Production Facility

2.8 Technology Development

1. In-house R&D activities

Indian Space Research Organisation (ISRO) has been at the forefront of space technology and exploration since its inception. Over the years, leveraging its key resources, the organisation has made several strides in space technologies, making India a major player in the global space arena. Current areas of research and broad priority of Indian space programme includes Stage Recovery & Reuse, Reusable Launch Vehicle (landing Experiments & Orbital Re-entry Vehicle), Semi-cryo engine & stage, LOX-Methane Engine, Air breathing/ Hybrid Propulsion based Rockets, Advanced Materials & Manufacturing, Advanced Inertial systems, Low Cost Spacecrafts, Inter-linking of satellite networks, On-Orbit Servicing, Docking, Space Robotics, Lunar sample return, Quantum Communication, Electric Propulsion, Advanced Scientific Payloads, Space Based Surveillance, Atomic Clock, Travelling Wave Tube Amplifiers for communication payloads, Technologies for sustained Human space missions viz. Regenerative Life support systems, Rendezvous & Docking, Inflatable habitats, Human factor & Engineering studies, Space situational awareness, etc. Currently, ISRO has been pursuing around 1200 Nos. of Technology Development Programmes/ Advanced R&D activities.

The Government of India has outline India's Space Vision 2047, which targets establishing Bharatiya Antariksh Station (BAS) by 2035 and landing an Indian on Moon by 2040. In line to the Space Vision 2047, ISRO has initiated & pursuing technology developments for the approved projects

ISRO has already initiated futuristic and disruptive technologies such as Quantum Radar, In-Situ Resource Utilization (ISRU), Flexible satellite payloads, Magnetic & functional materials, Inter-planetary space exploration, Space Tourism, Low-temperature energy systems, Intelligent satellite, Self-destructing satellite, Space bio-mimetic AI powered applications for urban planning & agriculture, Cyber security etc.

2. Developmental activities through academia and industry

In order to utilize the technological potential of academia and industry for complimenting R&D activities of ISRO, which are more/ direct relevance to ongoing & immediate future missions, ISRO has initiated & pursuing following key collaborative developmental activities.

a. Mission Focussed Research Projects: Towards execution of 'Mission Focussed Research Projects of ISRO', a frame work MoU was signed between ISRO, IISc and FSID/

IISc on 24th October 2024. Currently, 20 project proposals were identified as part of this MoU. Signing of Joint Project Implementation Plan (JPIP) for individual projects is in progress.

b. **Centre of Excellence for R&D in Fluid & Thermal Sciences:** In order to enhance Research efforts in the area of Fluid & Thermal Sciences with involvement of academia, it is planned to establish a 'Centre of Excellence (CoE) – Research in Fluid & Thermal Sciences' at IIT Madras. Towards this, an MoU was signed between ISRO and IITM on 11th November 2024.

c. **Atmanirbharta in Development of Technologies/ Products/ Systems for Indian Space Programme:** ISRO is in the process of developing 100 nos. of technologies/ products/ systems through Indian industries. An Expression of Interest (EoI) was floated and industries are short-listed towards award of Request for Proposal (RfP) for selected items (50+Nos.).

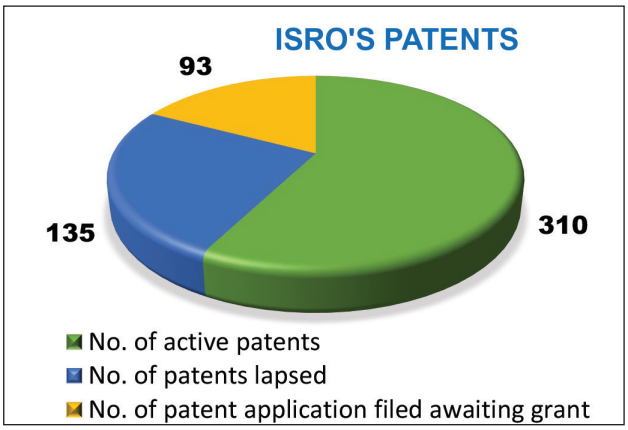
3. Spin-off technologies from ISRO to other sectors

In order to promote & expand the utilization of space technology for societal applications in various sectors as Spin-off applications, probable Space technologies that can be utilized for Automobile sector viz., Sensors, Coating, Adhesives, Noise & Vibration suppression system have been identified, as a beginning in this initiative. Towards this, a 'Workshop on Spin-off technologies for Automobile Sector' was jointly organized by ISRO & IN-SPACe with Automobiles Association on 11th December 2024.

2.9 Capacity Building

1. Intellectual Property Rights

ISRO has 310 active patents, 83 nos. of copyrights, and 13 nos. of trademarks. During the reporting period around 26 patent applications and 7 copyright applications are filled, 20 fresh patents were granted and active patents were renewed. Presently, 93 nos. of patent applications are under various stages of examination and 21 nos. are undergoing drafting by the patent attorneys before their eventual filing at the patent office. The IPR portal has been developed to process the IPR proposal from ISRO centres online and also create IPR processing online and the same is made operational.



2. Industry Interface

2.1 International Astronautical Congress (IAC-2024)

International Astronautical Congress (IAC-2024) was organized at Milan, Italy during October 14 - 18, 2024. ISRO along with NSIL & IN-SPACe participated in various technical sessions, and bilateral discussions with international space agencies & industries and also established an exhibition pavilion by showcasing achievements and future plans of Indian space programmes. DOS also facilitated for participation of Indian space start-ups in the event. The Secretary, DOS / Chairman, ISRO, and senior officials of DOS participated in the event.

2.2 Bengaluru Space Expo – 2024 (BSX-2024)

The Bengaluru Space Expo 2024 took place from September 18-20, 2024, at the BIEC in Bengaluru, organized by CII in collaboration with the ISRO, INSPACe & NSIL. This year's theme, "Accelerating Tomorrow: Harnessing the Potential of the Space Sector for Unified Expansion," attracted over 150 speakers and more than 800 delegates from 14 countries, including Australia, the UK, Russia, Sweden, and Italy.

ISRO established the Indian Space Pavilion with the participation of ISRO centres/Units. Conference had key sessions Viz., Indian Space Reforms & Policies: Influence on Indian Space Sector; Indian Space Reforms and Policies: Norms Guidelines and Procedures; Exploring Sectoral Business Opportunities via Indian Space Industries; Decisive Decade: Decadal Vision Roadmap for the Indian Space Economy; Socio-economic Impact of Space Technologies & Applications, and Futuristic & Emerging Technologies in Space: Commercial Prospects. In addition, the conference featured exclusive sessions for Australia, UK, Italy, Denmark, Singapore, World Economic Forum and European Space agency.

2.3 National Space Day Celebrations (NSpD-2024)

As part of the National Space Day (NSpD) 2024 celebrations, ISRO Centres across the country were divided into seven zones, each responsible for organizing and executing various outreach activities in their respective identified states. These activities aimed to engage the general public and students, fostering a deeper understanding of space science and technology. Throughout the NSpD celebrations, all DOS/ISRO Centres hosted multiple events in their designated zones, which included educational workshops, interactive sessions, exhibitions, and live demonstrations. The goal was to inspire curiosity and interest in space exploration among diverse audiences.

As a conclusion to the events conducted by ISRO Centres throughout the country, a grand event was held at Bharat Mandapam in New Delhi on August 23, 2024. This major event was graced by the Honourable President of India, who attended as the Chief Guest.

During the event, a summary report titled "The Socio-Economic Impact of the Indian Space Programme" was officially released by the Honourable Union Minister of State for Space, Dr. Jitendra Singh.

This document highlights the far-reaching contributions of India's space initiatives to various socio-economic sectors, showcasing the transformative impact of space technology on agriculture, communication, disaster management, education, healthcare, and rural development. It also underscores how the ISRO has enabled self-reliance in critical technologies while fostering innovation and entrepreneurship in the space sector.

2.4 Bengaluru Tech Summit – 2024 (BTS-2024)

BTS event was held at Bengaluru from 19th – 21st November 2024. During the event, Chairman, ISRO delivered a talk on the Indian Space Programme, highlighting ISRO's achievements and its upcoming space missions. Space exhibition was also established highlighting achievements of Indian Space Programme, which attracted a footfall of over 50,000+ visitors.

3. Student Outreach Programmes

3.1 Yuva Vigyani Karyakram (YUVIKA-2024)

The Yuva Vigyani Karyakram - 2024 (YUVIKA-2024) is a two-week' student's residential sponsored programme organized during May 13-24, 2024 at 7 Centres of ISRO / DoS viz. VSSC Thiruvananthapuram, SDSC Sriharikota, SAC Ahmedabad, URSC Bengaluru, NRSC Hyderabad, IIRS Dehradun, NE-SAC Shillong. Around 1 lakhs students applied for the

programme online, out of which 355 students representing 28 States and 8 Union Territories were selected & trained in 7 ISRO centres/units on Space Science and Technology. The programme includes teaching theory as well as practical demonstrations of scientific concepts, interaction with eminent scientists, lab/facility visits, sky gazing, robotic activities, and some co-curricular activities.

3.2 Bharatiya Antariksh Hackathon (BAH-2024)

The Bharatiya Antariksh Hackathon (BAH) was organized as part of the National Space Day-2024 Celebrations and was officially launched by the Secretary of DOS/ Chairman of ISRO on July 4, 2024. The hackathon featured 12 problem statements spanning the domains of Geospatial Technologies, Space Science, Image Processing, and AI/ML. These challenges were open to undergraduate, postgraduate, and Ph.D. students from across the country.

Out of an impressive 3,462 participating teams, each comprising 3 to 4 students, 100 teams were initially shortlisted based on their innovative ideas and problem-solving approaches. Subsequently, 30 teams were selected by an expert committee to participate in the Grand Finale.

The 30 hours Grand Finale was held at the National Remote Sensing Centre (NRSC), Hyderabad, on August 13-14, 2024. The competition witnessed an intense exchange of ideas and innovative solutions and ultimately,

three teams were selected as winners of BAH-2024 and awarded during National Space Day-2024 celebration at New Delhi.

3.3 IRoC-U 2024

In order to provide a greater opportunity for the students of the country to provide innovative solutions in the area of space robotics, URSC introduced the ISRO Robotics Challenge-URSC 2024 (IRoC-U 2024) to design and build a wheeled rover capable of performing tasks autonomously in a simulated environment. A total of 273 teams from various engineering colleges across India enrolled in the competition, out of which 10 teams qualified for Final field round after clearing Quals-1 and Quals-2 round. The winning teams of the final round were awarded during National Space Day-2024 celebration at New Delhi. The overwhelming response received for this challenge has catapulted into announcement of IRoC-U 2025 with the theme "Autonomous Navigation for an Aerial Vehicle (ANAV)".

3.4 JAYAKAR

JAYAKAR (Jan Jatiya Yuva Antariksha Karyakram) is a space education programme undertaken for selected EMRS students in collaboration with ISRO. The 7-day workshop took students on an interactive journey through various celestial phenomena, planting theoretical knowledge with hands on activities, simulations and real-world applications.

It is a residential programme, first phase of which was held w.e.f. 24th May, 2024, wherein students from six EMRSs from the States of Karnataka, Telangana & Rajasthan, have participated. This programme has been designed to provide space tutoring to young minds for inculcating interest in space exploration.

3.5 Space on Wheels

The "Space on Wheels" programme is a unique mobile science exhibition initiative by ISRO aimed at bringing space science and technology closer to students and the general public. ISRO signed an MoU with VIBHA organisation to facilitate the nationwide movement of six "Space on Wheels" units. In 2024, these mobile science units travelled across Maharashtra, Madhya Pradesh, Arunachal Pradesh, Kerala, Andhra Pradesh, and Assam, reaching diverse regions and communities. Over 10 lakh students from schools and colleges across the country benefited from the programme, gaining valuable insights into space science and its applications.

4. Human Resource Development

4.1 Implementation of Annual Capacity Building Plan (ACBP)

Implementation of Annual Capacity Building Plan in Department of Space is in progress as part of Mission Karmayogi. The ACBP of Department is also made online on i-GoT platform. Recommendations to obtain i-GoT courses for employees are made as per guidelines of Capacity Building Commission and Mission Karmayogi. Almost 15,000 employees (~ 95%) have been on boarded on i-GoT platform. Preparation of two i-GoT courses namely "Know about ISRO / Dept. of Space" and "Geo-spatial Technologies and Applications" are under progress. Other offline recommended courses of i-GoT are also under progress.

4.2 ISRO Technical Training Programme (ITTP)

ISRO is conducting ISRO Technical Training Programme in collaboration of Ministry of Skill Development & Entrepreneurship (MSDE), Government of India. The programme is intended to impart skill development training to the technical staff of ISRO at various technical facilities of National Skill Trainings Institutes (NSTIs) across the country under MSDE.

2.9 Capacity Building

Based on the MoU, ISRO has signed agreement with eight NSTIs viz. NSTI - Bengaluru, NSTI - Chennai, NSTI - Mumbai, NSTI - Trivandrum, NSTI - Ramanthapur, Hyderabad, NSTI - Jodhpur, NSTI - Calicut and NSTI - Dehradun.

A total of 30 ITTP programmes have been planned in FY 2024-25 in these NSTIs with aim of upskilling / re-skilling of 500 technical staff, out of which 19 programmes have already been completed with training of 290 staff. By the end of FY 2024-25, total nos of 99 ITTPs will be completed by achieving the goal to upskill / reskill of 50 % Technicians / Technical assistants and Technical Officers.

4.3 Drivers Training Programme (DTP)

ISRO and Institute of Driving Training and Research (IDTR), Pune has entered an MoU to reskill / upskill transport staff of ISRO. A total of eight programmers which included four programmes for Light Vehicles Drivers (LVDs) and four programmes for Heavy Vehicles Drivers (HVDs) by providing upskilling / reskilling training of 120 Drivers have been completed.

4.4 Capacity Building Programme on Geo-spatial Technologies and Applications (GSTA)

ISRO / Department of Space has been conducting a Capacity Building Programme on "Geospatial Technologies and Applications" in tandem with objectives of National Geospatial Policy - 2022.

In this lines, two programmes have been conducted at RRSC (W), Jodhpur and NRSC Hyderabad. Around 60 participants from 18 different user Ministries / Departments / Institutions have been benefitted from the programme.

4.5 Emerging Technologies Workshop

In series of Emerging Technologies workshop covering Data Driven Decision Making (DDCM), Artificial Intelligence, Machine Learning and Deep Learning has been conducted at VSSC, Thiruvananthapuram on April 08-09, 2024 in collaboration with Wadhwaani Institute of Technology and Policy (WITP), Capacity Building Commission and STI-CB Cell of office of PSA for all the launch vehicles Centres of ISRO.

A total of 43 Scientists / Engineers have been benefitted with these workshop.

4.6 Industry 4.0 Workshop

Two days Industry 4.0 Workshop has been conducted in collaboration with Siemens India Pvt. Ltd. at Tamil Nadu Advanced and Smart Manufacturing Centre (TANSAM), Chennai from June 20-21, 2024. A total of 31 Scientists / Engineers from 09 different ISRO Centres have been befitted from this workshop.

4.7 Organisational Learning Week

ISRO / Department of Space has conducted Learning Week at organisational level from June 24 to June 28, 2024 with following objectives.

- Orient everyone towards learning and capacity development at the same time.
- Reinforces each person's self-directed training needs in a coordinated social context

- To scale and embed a culture of learning, augmented by participatory discussions, and live master classes.
- Create a demonstration effect and a renewed commitment to learning and development as part of Mission Karma yogi.

The programme was inaugurated by Dr. S. Somanath, Secretary Department of Space / Chairman ISRO.

The programme conducted at three level viz. Three online master classes for 2 hours. 2.5 hours' classes at entity / centre level and 3 hours at individual level. The Learning week has a demonstrable effect of increasing activities at i-GoT platform by ISRO / DoS employee three times by increasing the course enrolments nos on i-GoT up to 6,323 at the end of Learning Week.

4.8 *Karmayogi Saptah* - National Learning Week

Karmayogi Saptah - National Learning Week was organised at ISRO / Department of Space from Oct. 19 to Oct. 25, 2024. A list of i-GoT courses and webinar as per suggestions on Capacity Building Commission and Mission Karmayogi have been suggested to ISRO / DoS staff. Total 15 nos of onsite programmes have been conducted as part of Karmayogi Saptah. The programme has received overwhelming response from ISRO staff.

5. RESPOND

5.1 Introduction

One of the key initiatives of the Capacity Building and Public Outreach (CBPO) office at ISRO Headquarters is fostering an Academic Interface. This initiative focuses on establishing knowledge, incubation and research centres across the nation while promoting collaborative research with academic institutions, laboratories, and other research entities. Recognizing the need to strengthen ties with institutions nationwide, ISRO has implemented various capacity-building measures to enhance academia's engagement in space-related activities.

These initiatives include R&D Projects under RESPOND, Space Technology Cells (STCs), Regional Academic Centres for Space (RAC-S), the Satish Dhawan Centre for Space Science (SDCSS) at the Central University of Jammu, a Centre of Excellence (CoE) at IISc, ISRO Chairs, and collaboration with the Centre for Nano Science and Engineering (CeNSE) at IISc.

5.2 Sponsored Research (RESPOND)

The RESPOND (Sponsored Research) programme, launched in the 1970s, encourages academic participation in space-related research. Through this programme, faculty from academic institutes and research centres undertake projects relevant to the Indian Space Programme, with ISRO providing both financial and technical support. RESPOND aims to strengthen academic research foundations, develop skilled human resources and enhance research facilities in institutions.

The programme focuses on fostering studies aligned with upcoming space activities, contributing directly to ISRO's various missions. RESPOND also supports national and international conferences on space science and related fields, organized by universities, institutions, and other organisations.

5.3 Space Technology Cells (STCs)

ISRO has established nine Space Technology Cells (STCs) at leading institutions to advance research in space technology and applications at IITs: Bombay, Kanpur, Kharagpur, Madras, Guwahati, Roorkee, and Delhi, IISc Bengaluru and Savitribai Phule Pune University (SPPU), Pune (Joint Research Programme).

5.4 Regional Academic Centres for Space (RAC-S)

Six Regional Academic Centres for Space (RAC-S) have been established nationwide by ISRO with the dual objectives of promoting space technology activities among students and conducting advanced research in areas relevant to the technological and programmatic needs of the Indian Space Programme in the future. Regional Academic Centres for Space have been established in the following six institutes representing six geographic regions of the country:

- Western Region: MNIT Jaipur
- North-Eastern Region: Gauhati University, Guwahati
- Northern Region: NIT Kurukshetra
- Southern Region: NITK Surathkal
- Central Region: IIT(BHU) Varanasi
- Eastern Region: NIT Patna

2.9 Capacity Building

RAC-S facilitates advanced research, capacity building, and awareness creation at the institutional level.

5.5 Collaboration with CeNSE, IISc

ISRO has partnered with the Centre for Nano Science and Engineering (CeNSE) at IISc to address its requirements in nanotechnology and nanoscience. This collaboration involves R&D, training, capacity building, and access to state-of-the-art nanofabrication and characterization facilities for R&D activities.

5.6 Centre of Excellence (CoE) at IISc

A Centre of Excellence on Advanced Mechanics of Materials has been established at IISc to pursue advanced research in materials science, focusing on non-classical continuum mechanics, geometric and data-driven models, and their applications in space technology.

5.7 Satish Dhawan Centre for Space Science (SDCSS)

The Satish Dhawan Centre for Space Science, a joint initiative by ISRO and the Central University of Jammu, addresses regional needs in geospatial applications, disaster management, and space-based technologies for regional development. Its primary focus is on R&D in space science and technology.

5.8 Activities

During the period, RESPOND supported 42 New Projects, 19 ongoing projects, R & D activities of nine Space Technology Cells and six Regional Academic Centre for Space. During the year, 24 sponsored projects have been successfully completed. Scientific publications have been emerged out of these projects apart from fulfilling the objectives.

During the year, 17 Universities/Colleges, 15 IITs /NITs and 4 Research Institutes/ Laboratories were involved in R & D projects (Figure-1). Further, during the year, large number of projects have been supported in the area of Space Technology (48) followed by Space Applications (8) and Space Science (5) (Figure-2).

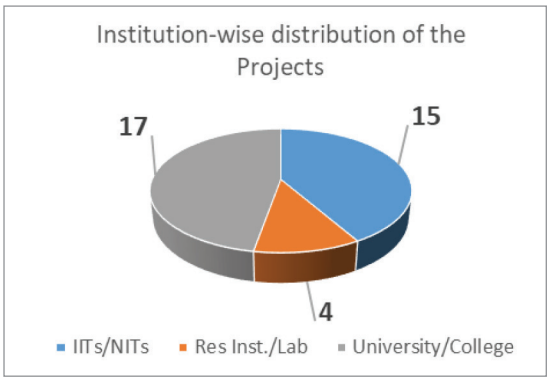


Fig (1)

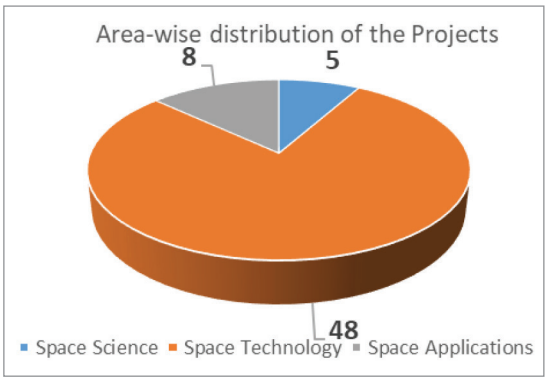


Fig (2)

5.9 Space Technology Cells

Having recognized the imperative need to generate basic knowledge through advanced academic research ISRO has set up nine Space Technology Cells (STC) at premier institutions like Indian Institute of Technology (IITs) - Bombay, Kanpur, Kharagpur, Madras, Guwahati, Roorkee and Delhi; Indian Institute of Science (IISc), Bengaluru and Joint Research Programme with Savitribai Phule Pune University (SPPU, Pune) to carry out research activities in the areas of space technology and applications.

During the period, 75 new projects and 116 ongoing projects pertaining to eight Space Technology Cells have been supported under STC Programme. Under STCs, 50 projects have been successfully completed during the year.

Details are given in the table below:

S.No	Name of the STC/JRP	No. of Projects		
		New	Ongoing	Completed
1.	IISc Bengaluru	13	25	9
2.	IIT Bombay	4	15	10
3.	IIT Kanpur	17	1	7
4.	IIT Kharagpur	4	24	9
5.	IIT Madras	9	18	3
6.	IIT Roorkee	11	17	4
7.	SPPU, Pune	9	5	8
8.	IIT Delhi	8	11	0
	Total	**75**	**116**	**50**

5.10 Projects at Regional Academic Centre for Space (RAC-S)

Under Regional Academic Centre for Space programme a total of 29 New projects, 34 ongoing, 6 student projects were supported. 2 completed projects during the year.

S.No.	Name of the RAC-S	No. of Projects			
		New	Ongoing	Student	Completed
1.	MNIT, Jaipur	9	10	0	2
2.	NIT Kurukshetra	2	2	6	0
3.	Gauhati University	0	3	0	0
4.	NITK Surathkal	5	6	0	0
5.	IIT (BHU)	8	10	0	0
6.	NIT Patna	5	3	0	0
	Total	**29**	**34**	**6**	**2**

The projects are reviewed by domain experts in ISRO and later by Joint Policy and Management Committees (JPMC) consisting of experts from ISRO and the academia.

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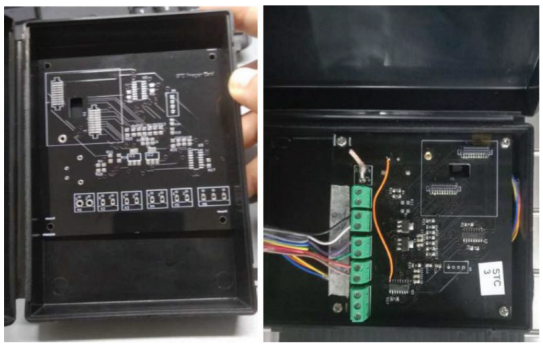
5.11 Highlights of some of the completed Projects under Sponsored Research

a) Compton Imaging in Hard X-rays

The project aimed to design, construct and test a set up to undertake compton imaging of sources in the hard x-ray energy range (>100 kev) and validate detector performance with software simulations. Under this project, new technology of Compton Imaging IN Hard X-rays has been demonstrated for the first time in India.

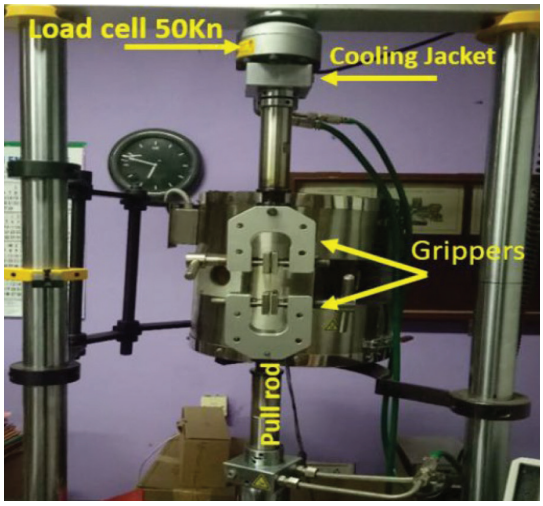


Final PCB Design

The experience and the knowledge gained under the project will be useful for many ISRO Space astrophysics projects with users in PRL and URSC.

b) Development of multi-stage deep drawing set-up and estimation of formability of Cu (0.5-0.8%,Cr -0.05%, Ti0.05% Zr alloy sheets for space applications

The project aimed at comprehensive understanding of the formability of Cu-Cr-Ti- Zr alloy used in the cryogenic and semi cryogenic engines. Under this project, a detailed polar effective plastic strain based FLD was developed, and further development of deep drawing and re-drawing set up was carried out to evaluate the multistage drawability. Also, detailed microstructural characterization, understanding of the failure mechanisms of CU-Cr-Ti-Zr sheets under different forming conditions was successfully completed. The deliverables are expected to be used as a guide for realizing the formed components and hence will improve the understanding of the materials behaviour under forming conditions.

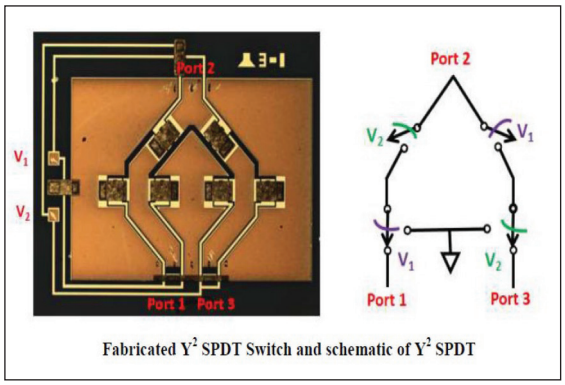


Tensile testing set up

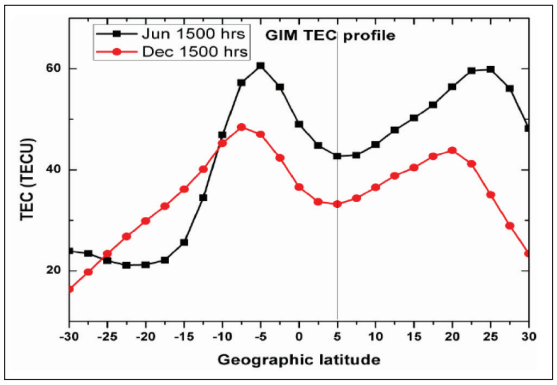
c) Design and Development of SPDT RF MEMS switches for Ku Band Applications

The project aimed to design and develop wafer –level SPDT RF MEMS switches for Ku band applications with a given specification. Under this project, the basic technology of fabrication of surface micro machined ohmic RF MEMS switches for operation at 12 GHz has been successfully completed.

d) Observational and modelling study of the Equatorial Ionization Anomaly (EIA) around 95E meridian



Fabricated Y^2 SPDT Switch and schematic of Y^2 SPDT



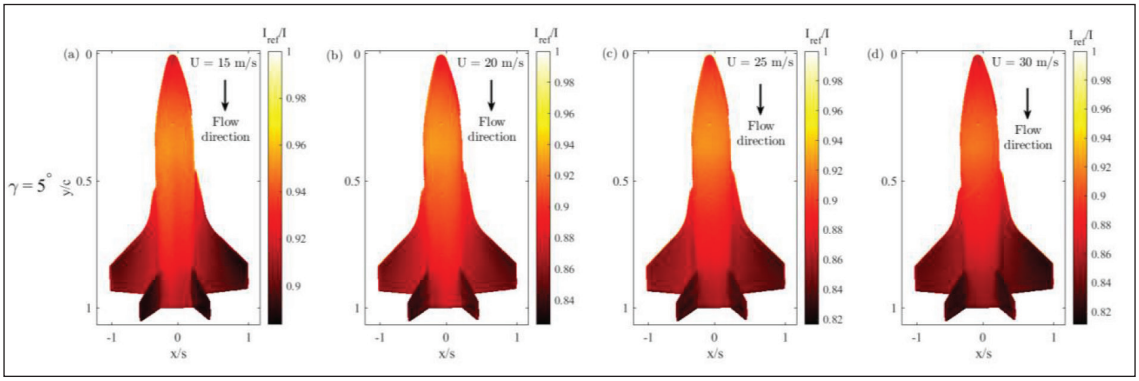
Mean EIA Profile

2.9 Capacity Building

Under this project, latitudinal and longitudinal variation of equatorial ionization anomaly using ground and satellite observation was studied. The research carried out under this project is useful in understanding and characterizing the low latitudes ionospheres in a better way. The deliverables of the project are useful for making IRNSS based navigation and applications more robust.

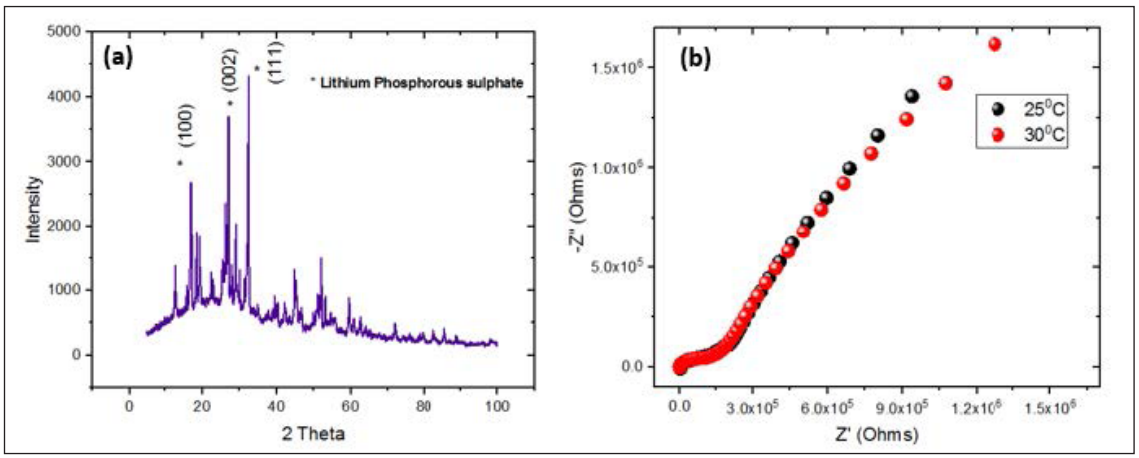
e) Experimental identification of laminar to turbulent transition and separation location using in house temperature sensitive Paint (TSP)

Under this project, the technique to provide the boundary layer transition from laminar to turbulent, which is a crucial input to design proper thermal protection system to re-entry vehicles such as RLV was developed. Experiments were completed on RLV model at IIT-K low speed wind tunnel tests to identify laminar to turbulent transitions.



Flow visualizations over internally heated RLV model

f) Sulfide based solid electrolytes for all solid Lithium ion batteries

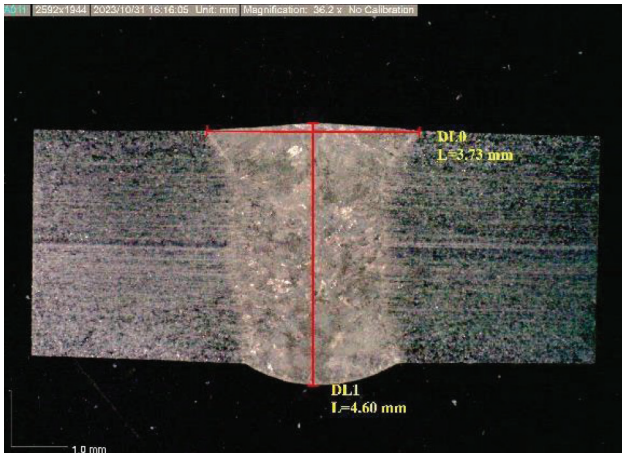


XRD pattern obtained for the prepared samples

The project aimed to prepare pure Li10Ge0.25P0.75S4 and Li2S:P2S5 glass ceramic thin films and exploring their growth behaviour and structural properties. The solid electrolyte prepared under this project is useful for the development of high energy density and safe for all solid state lithium ion cells which can be used for satellite and launch vehicle applications.

g) Optimization of flux activated gas tungsten arc welding parameters for stainless steel AISI 304L to achieve maximum weld depth to width ratio and improved mechanical properties

The project aimed to optimize the parameters for 3mm,4mm,5mm and 8mm thick AISI 304L plates using A -TIG, FB-TIG and FZ-TIG variants with different combinations of shielding gases such as Ar, Ar+2%H2 and Ar+23%He+2%N2. Under this project, depth to width ratio of weld were studied by varying the conditions. Final optimized set of parameters for each thickness 3mm,4mm,5mm and 8mm were provided as deliverable under the project.



Suggested welded parameters project wise

h) Design and simulation of Physical Layer and Medium access Control (MAC) layer functionalities of future Mobile satellite systems

The research under the project is focused on the design, simulation and performance comparison of physical layer transform (modulation and demodulation techniques and channel coding scheme). The algorithms proposed under the project have a potential for implementation into a computationally efficient burst structure in return link. The work has also provided a deep insight into use of polar codes and feasibility of realizing it on hardware.

i) Nanostructured carbon Electrodes for High-Voltage Hybrid Ion Super Capacitor

Under this project, MNIT Jaipur has developed working prototypes of high-voltage hybrid Lithium-ion supercapacitors with high surface area carbonaceous electrode materials. The biomass derived on activated carbon materials for high-voltage Supercapacitor applications like Na, K, and Zn-ion based supercapacitors with voltages over 3V was the deliverable in this project.

5.12 Workshops and Interaction meets:

a) RESONANCE

In order to boost up the quality and number of the proposals from North-eastern region, ISRO in collaboration with Gauhati University organized a "Space Technology Interest

Exploration Workshop", titled as "RESONANCE" on August 8, 2024 in Gauhati University Campus. This workshop was attended by faculty from Higher Educational Institutes in Northeast India, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura. The main aim of the workshop was to create awareness about Regional Academic Centre for Space (RACS) established at Gauhati University and also to highlight the advanced R & D requirements and opportunities available in ISRO.

Nearly 100 participants from various states of Northeast India, belonging to 13 different universities, 20 different postgraduate colleges, and 6 different autonomous research institutes have participated in the workshop.

ISRO Scientists with College Professors attended for this RESONANCE conference from the North-East region in Gauhati University.

b) A workshop on "Research Areas in Space" was organized for the faculty of IIT Guwahati at IIT Guwahati on August 09, 2024. The aim of the workshop was to create awareness about the various research opportunities available in

A workshop on Research Areas in Space at IIT Guwahati, Guwahati

ISRO. The meeting was attended by the faculty of IIT Guwahati. There were presentations from Senior Scientists of various ISRO/DOS Centres on various research areas of ISRO.

c) ISRO ACADEMIA Day-2024

ISRO has always looked for greater participation and contributions from academia in a focused manner, for timely accomplishment of its objectives. Considering the ongoing involvement of academia in ISRO activities and to enhance the collaboration to newer areas, ISRO Academia Day-2024 was organized at Indian Institute of Space Science and Technology (IIST), Valiamala on December 10, 2024. ISRO Academia Day-2024 aimed at providing a common platform to Academia as well as the scientific community of ISRO to share their knowledge, experience and create awareness about the opportunities available in ISRO for the promotion of Space Science & Technology, Education and Research.

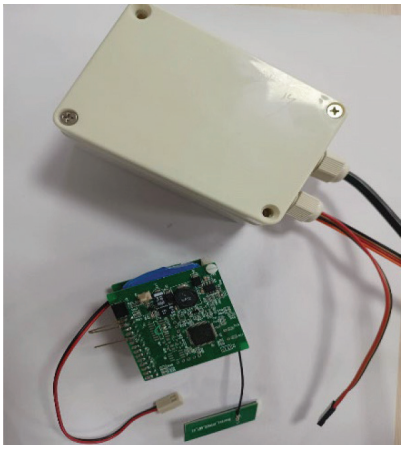
Around 150 participants mainly from IITs, NITs, selected Private and Scientific Institutes attended the programme. RESPOND Basket 2024 comprising of urgent and most important research areas for the faculty to select and prepare detailed proposals was also released during the event.

6. Space Technology Incubation Centres

Space Technology Incubation Centre (S-TIC) have been setup with aim to attract and nurture the young academia with innovative ideas / research aptitude for carrying out research, motivating and encouraging them to initiate the startups and business in the field of space technology & applications and developing the Academia–Industry ecosystem for Space Technology.

2.9 Capacity Building

At present, six S-TIC are functioning one each at six region of country viz. at NIT Agartala (North-Eastern zone), NIT Jalandhar (North zone), NIT Tiruchirappalli (South zone), MANIT, Bhopal (Central zone), VNIT, Nagpur (Western zone) and NIT Rourkela (Eastern zone). 5 Product / Prototype Development Projects varying from TRL-4 to TRL-8 have been completed at these S-TICs in FY 2024-25 and 25 projects are in progress.



NaVIC based Asset tracking system developed by STIC NIT Jalandhar in mentorship of SAC, Ahmedabad

FPGA based CCSDS band receiver developed by STIC NIT Jalandhar in mentorship of SAC, Ahmedabad

As in year 2024, S-TIC have created remarkable impact by providing on hand expertise to more than 350 students of various engineering / science disciplines for state of the art technical incubation and product development activities related to Space Science and Technology.

Project completion report and deliverables being handed over to ISRO by STIC.

2.10 Quality Management, Occupational Health & Safety

Assuring the Quality, Reliability and Safety of all the developmental and operational missions of ISRO is of paramount importance and the respective teams have taken up this challenge in the right earnest. Autonomous landing experiment of the Reusable Launch Vehicle, Air breathing propulsion experiment with Dual Fuel Scramjet engine on-board an Advanced Technology Vehicle and second successful developmental flight of SSLV-D3 stand out as the major achievements of the year. EOS-08, a novel Earth Observation Satellite was developed and launched with focus on miniaturisation and several novel technologies. Enormous efforts were also taken for the development of crucial technologies for the upcoming Gaganyaan mission. A first of its kind Space Docking experiment is scheduled by end December 2024. PSLV C59 launched European satellite Proba-3 into its intended and unique elliptical orbit.

Quality and Safety teams spread across the Centres/Units of ISRO kept a close vigil on every aspect of the missions and developmental activities. Exhaustive testing, analysis, qualification, acceptance, certification, audits, etc., along with compliance to quality/ safety manuals, plans and procedures, checklists, guidelines etc. continue to be the core responsibilities of the Quality and Safety teams. Rigorous reviews continue to be a strong pillar of ISRO's quality and safety systems. Experts critically brainstorm the various aspects at every stage leading up to the final go ahead for launch. The Directorate of Safety, Reliability and Quality (DSRQ) at ISRO headquarters continued to closely co-ordinate with various quality teams ensuring greater synergy of activities across internal and external work centres of ISRO.

Integrated approach to Quality and Safety

Over the last few decades, DOS/ISRO has come up with home grown management systems in the areas of quality and safety. These are the backbone of the success of ISRO missions. Risk management is the common goal of both Quality and Safety disciplines through risk identification, assessment and mitigation of potential hazards making the disciplines of quality and safety to be closely interconnected. Also, ISRO's recent efforts in the Human spaceflight Gaganyaan mission and pursuit of mega projects like the building of Bharatiya Antariksh Station demand a human centric approach in the design and development of space systems.

Recognizing the interdependence of Quality and Safety disciplines, it has been decided to bring the safety activities within the ambit of quality domain towards streamlining

the processes and optimising the resources towards achieving safe and reliable space systems. Also, in light of the importance of human rating certification activities for the ongoing/future human spaceflight missions, a dedicated Directorate for Human Rating Certification (DHRC) has been established. DHRC will function as a nodal agency for providing guidelines & directions for human rating certification activities and to ensure uniform implementation across ISRO Centres/Units including partnering organisations and institutes.

Quality Assurance of Developmental Missions

ISRO's foray into re-usable Launch Vehicle technology was demonstrated through the third successful Landing experiment of the Re-usable Launch Vehicle (RLV). The quality challenges with respect to this winged body named Pushpak were enormous. Re-validation of the several systems being re-used for this mission and qualification of a few hardware changes were the key focus areas for this mission.

Quality teams also contributed extensively towards the development of the scramjet engine working on hydrogen and a special grade kerosene, named ISROSENE, developed by ISRO. The certification/ acceptance of ISROSENE was taken up and several key tests were carried out for the scramjet engine on ground and at elevated altitude with the close involvement of the quality and safety teams.

Success of SSLV D3 represented the culmination of all the qualification, failure mode analysis and other reliability initiatives of the quality and development teams. EOS-08 satellite has several novel technology elements and fittingly called as a Technology Demonstration Satellite. This satellite is also a forerunner for several future operational satellites. The quality protocols and procedures have been meticulously followed for the spacecraft in spite of its fast-track development timeline.

Quality teams have contributed immensely towards the development of relative navigation, guidance and control systems / algorithms, sensors, mechanisms and various tests/simulations for SPADEX (Space Docking Experiment). Extensive verification and validation of the software area was also a key responsibility of the quality team.

Quality Assurance of Operational Missions

Ensuring the success of operational missions largely rests on the strength of the quality

systems in place. The operational missions of PSLV C59, PSLV C60 and GSLV F15 have gone through the rigour of testing and acceptance. Change management is one key focus area for operational missions. Configuration control boards set up for keeping track of all the changes in operational missions as well as various high level review fora thoroughly scrutinised the impact of all the changes and approved the changes based on a case by case basis. This is an important effort in the direction of ensuring reliability of operational mission. GSAT-20 and NVS-02 satellites have also undergone the established norms for ensuring the quality of spacecraft missions.

Integrated Product Assurance Board (IPAB)

An inter-centre Integrated Product Assurance Board (IPAB) takes up an independent and integrated review of all the ISRO Missions. The board functions as an ISRO-level nodal body towards formulating policies in the area of Quality and Reliability of Space systems. Its key focus area is identification of opportunities for systemic improvements in the area of quality and reliability and ensure implementation of uniform quality practices across all ISRO Centres / Units, as applicable. Strengthening of inter-Centre interfaces and sharing of best practices among various ISRO centres for continual improvement are its other objectives. The board is also authorised to carry out quality audits. IPAB continued the review of ISRO missions during 2024 and identified several key areas for standardisation and quality improvement.

ISRO Technical Standards

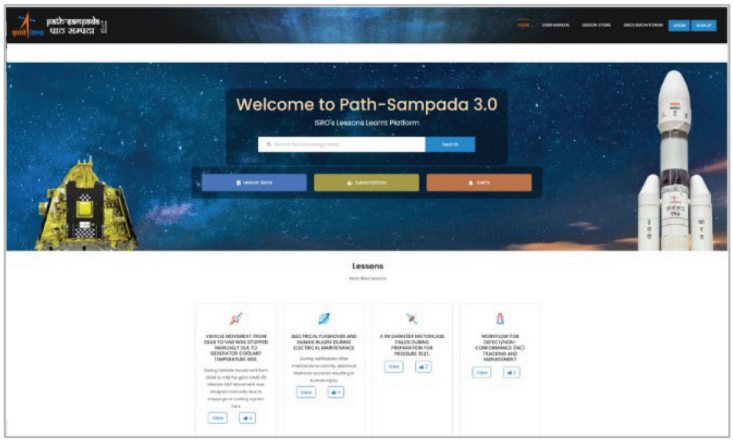
ISRO Technical Standards are a set of guidelines and specifications that ensure the quality and reliability of space missions and related technologies. These standards cover various aspects of space missions, including design, procurement, communication protocols, testing and storage conditions. They are essential for maintaining consistency and high performance in complex space projects. Development of these standards is an ongoing activity at ISRO for addressing

Release of ISRO Technical Standards by Chairman, ISRO

newer areas as well as up keeping of existing standards in-line with the international best practices. The efforts for generating the standards are further strengthened with the establishment of a new review system. The review system expanded the horizon of developing the standards into 10 different areas. With the continuous support of task teams and domain experts, three technical standards in the following areas could be realized during this year.

- Manufacturing, Procurement and Qualification of Printed Circuit Board
- Design, Fabrication and Qualification of On-Board Hybrid Micro Circuits
- Design, Fabrication and Qualification of On-Board Surface Acoustic Wave Device.

Path-Sampada 3.0



Path Sampada 3.0 - Lessons learnt platform of ISRO

Knowledge management (KM) is vital in the space industry due to the complexity, high risks, and long timelines of space missions. Effective KM ensures that critical knowledge, expertise, and data are systematically captured, stored, and shared across the organisation, enabling more efficient and informed decision-making. This process helps to prevent the loss of valuable insights when personnel change or Projects end, ensuring continuity and fostering innovation.

Space missions often involve unprecedented challenges, and documenting lessons learnt—whether from failures, successes, or unexpected events—helps avoid repeating mistakes in future projects. The integration of lessons learnt also enables quicker problem-solving, enhances collaboration, and promotes a culture of continuous improvement. Moreover, lessons learnt are crucial for training and mentoring new engineers and scientists, transferring knowledge to the next generation of experts. Ultimately, KM and lessons learnt contribute to mission success, improve safety, optimize resources, and drive innovation, while minimizing the inherent risks of space exploration.

Considering the importance of Lessons learnt, ISRO had built an online platform, Path-Sampada during 2016. Around 1170 lessons from various disciplines of ISRO activities were captured onto this platform. Considering the challenges involved in the existing platform for compatibility with latest operating systems, a new platform, Path-Sampada 3.0, has been designed and developed with the support of Indian Institute of Remote Sensing (IIRS), Dehradun. The new platform is developed with advanced features of hosting Quality Alerts, like and share options of lessons etc.

Space for Health

In order to leverage ISRO's specialized skills in the areas of space-related design, applications, project management, quality etc., to build solutions for various problems in the healthcare sector, ISRO entered into a Memorandum of Understanding (MoU) with Association of Healthcare Providers (India) [AHPI], New Delhi on 05th July 2024. Various teams across the organisations are working on the following problems along with AHPI and its associate institutes.

- Geotagging of healthcare services in India
- Health risk assessment of air pollution in rural and urban neighbourhoods of South India
- Heat related morbidity and evaluation of adaptation methods to heat in the most heat-stressed district of Telangana
- Role of Artificial Intelligence in Healthcare: Empowering Healthcare Professionals
- Open Clino-Building 3D printable Desktop Clinostats for making microgravity research accessible
- Epidemiology of scrub typhus in Meghalaya

Progress monitoring is being carried out through the Programme Review and Advisory Committee (PRAC) for the successful completion of these projects in a time bound manner.

World Quality Day

World Quality Day is celebrated annually in ISRO to promote a culture of excellence, fostering continuous improvement, and emphasize the importance of maintaining high standards in every aspect of space exploration, from engineering to operations. This year too, ISRO centres organized the event with talks from eminent personalities. ISRO Headquarters organized the event on 14th November with the participation of senior

Safety, Reliability & Quality experts from across the organisation. Dr. Pavuluri Subbarao, M/s Ananth Technologies; Shri Krishan Kumar Agarwal, M/s BEL; Shri Shashi Kumar, M/s LDRA and Shri Adisesha C S, M/s Collins Aerospace delivered talks and enlightened the audience.

Occupational Health and Safety Highlights

The Indian space programme continued to be free from any major incidents during this year as well. The saga of launches started with the launch campaign of **PSLV-C58/ XPoSat Mission**, followed by **GSLV-F14/INSAT-3DS** mission. The other missions were also accomplished without any safety related non-conformance or anomalies. Similar to previous launches, well established safety procedures, safety standards and emergency preparedness plan were implemented to prevent any unforeseen incidents. Safety surveillances were available round the clock during the launch campaign activities. Activities involving production and transportation of solid propellants, earth storable propellants, cryogenic propellants, rocket motors & pyrotechnic materials etc; and assembly & integration of rocket stages and satellites and high pressure gas servicing at launch pad were carried out under the full time participation of safety team.

The most significant achievement from safety perspective was the vacuum ignition testing of Cryogenic Engine CE20 Engines at TCT facility of IPRC. Another major accomplishment was the successful and safe disposal of hazardous waste in a safe and environmentally friendly manner. Safety surveillance was ensured during fabrication, integration, thermovac test, vibration tests and pressure hold test of satellites. Safety review of radiation sources for various spacecraft was also completed without any waivers.

Safety Mechanism

Board of Occupational Health & Safety (BOHS) is the nodal body to oversee implementation of ISRO/DOS Occupational Health, Safety & Environmental Policy in ISRO Centres/Units. Centre Safety Committee (CSC) at various ISRO/DOS Centres/Units reviews and clears locations for construction and commissioning of new facilities and new processes. The Safety teams provide surveillance and necessary clearances for potentially hazardous operations. In order to authorise the explosives-related activities and to ensure safety during manufacture, storage, transport & disposal of solid propellants and explosives a multi-tier mechanism has been evolved. As part of this mechanism, an Apex Committee oversees the activities and implementation of safety protocols and guidelines during the

above operations. Inter-Centre Audit Committees have been constituted by the Apex Committee for verification of implementation of safety guidelines and protocols. Timely Audits were completed by the respective teams during the year.

Security of space assets and capabilities

Security of all the space assets in-orbit and the ground assets and capabilities is given utmost importance by DOS and is regarded as an element of National security. A high-level committee is working towards identification of the various threats to space assets and their various mitigation strategies. Key technologies and critical infrastructure to be developed for further enhancing the security of space assets and capabilities are being taken up in a fast-track mode. This activity is carried out in close coordination with various domain experts of ISRO, and auditing of the activities has been initiated for continual improvement.

DSRQ, ISRO HQ acts as the nodal office for the implementation of Crisis Management Plan of DOS. The systems and processes in place at DOS for the management of all possible crisis scenarios are found to be in order, and key steps for further enhancement have been identified.

Promotion of Safety culture and practices

Safety promotional activities have been continued through the celebration of National safety day, Fire service day, World environment day and other events by issuing posters and conducting safety seminars. Glimpses of some of the safety events at ISRO Centres are provided below.

2.11 International Cooperation

Indian Space Research Organisation (ISRO) continues to pursue its successful cooperation with space agencies of other nations and multilateral organisations through joint activities of mutual interest; sharing expertise in the applications of space technology, organising/ participating in international events. The scope of international cooperation is becoming wider and diverse, in tune with ISRO's enhanced capabilities, recent achievements and approvals given by Government of India for flagship programmes. Emerging space ecosystem in India with the ongoing reforms in the Indian space sector is also providing opportunity for expanding international space cooperation.

Till date, ISRO/DOS and India have signed space cooperative documents with space agencies of 61 countries (Afghanistan, Algeria, Argentina, Armenia, Australia, Bahrain, Bangladesh, Bhutan, Bolivia, Brazil, Brunei Darussalam, Bulgaria, Canada, Chile, China, Colombia, Egypt, Finland, France, Germany, Hungary, Indonesia, Israel, Italy, Japan, Kazakhstan, Kuwait, Luxembourg, Maldives, Mauritius, Mexico, Mongolia, Morocco, Myanmar, Nepal, Nigeria, Norway, Peru, Portugal, Republic of Korea, Russia, Sao-Tome & Principe, Saudi Arabia, Singapore, South Africa, Spain, Sri Lanka, Sultanate of Oman, Sweden, Syria, Tajikistan, Thailand, The Netherlands, Tunisia, Ukraine, United Arab Emirates, United Kingdom, United States of America, Uzbekistan, Venezuela, and Viet Nam) and 5 multinational bodies (European Centre for Medium Range Weather Forecasts – ECMWF; European Commission – EC, European Organisation for the Exploitation of Meteorological Satellites - EUMETSAT, European Space Agency – ESA; and South Asian Association for Regional Cooperation – SAARC).

During this period, many cooperative documents are signed including: (i) ISRO - European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) agreement for meteorological satellite data exchange, (ii) India - Brunei Darussalam MoU for the operation of ground station, (iii) ISRO – National Institute for Metrological Research of Italy agreement for installing NavIC receiver, (iv) IIRS - University of Twente (The Netherlands) MoU on the implementation of Master's Degree and Postgraduate Diploma programme, (v) ISRO – Australian Space Agency Implementing Arrangement for cooperation on crew and crew module recovery for the Gaganyaan human space flight mission, (vi) ISRO – ESA technical implementation plan for Gaganyaan support, (vii) ISRO – NASA agreement for hypervelocity impact testing, and (viii) ISRO – ESA agreement for cooperation on activities related to astronaut training, mission implementation and research experiments.

Subsequent paragraphs highlight other major international cooperation activities during this period.

The ISRO-NASA joint satellite (NISAR) is at the final stages of assembly, integration and testing for a proposed launch in 2025. India's Gaganyaatris are currently undergoing the training at USA for an ISRO-NASA joint mission to International Space Station. Both sides are also discussing on joint experiments in ISS; development of docking system for interoperability, planetary protection guidelines, and advanced astronaut training, including ground support team. Under the professional exchange programme three ISRO officials visited NASA facilities/ Labs and five NASA officials visited ISRO Centres.

As part of ISRO-CNES cooperation, technical teams from both sides successfully completed two reviews of System Interface Performance Validation for the joint satellite mission, named TRISHNA (Thermal infra-Red Imaging Satellite for High-resolution Natural resource Assessment). Both sides have also organised an International Science Workshop at Ahmedabad in November 2024 to promote utilization of TRISHNA data and science products.

The discussions with Australia to get support for Gaganyaan mission (for crew recovery operations and setting up of temporary ground station in Cocos (Keelings) Island) made significant progress.

The discussions are continuing well on: earth observation, satellite navigation and human space flight (with ESA); proposed joint lunar polar exploration mission (with JAXA); launch vehicle engine production by Indian Industry in India and delivering additional equipment and spares for Gaganyaan program (with Russia); Heliophysics, and earth observation (with Italy); implementation of joint plan of action (with Bhutan); and demonstration of sounding rocket launch (with Saudi Arabia). In addition, JWG meetings were organized with space entities of Uzbekistan, Argentina, Colombia, and UAE to explore potential collaboration opportunities.

As part of the India – Mauritius Joint Satellite Project, MRIC engineers were trained at ISRO Centres on satellite data processing and utilisation. An exclusive 4-week training on "Remote Sensing and GIS for agriculture information" for 21 Kenyan officials was conducted at IIRS in August 2024. A 4-day in-person 'ISRO-AEM (Mexico) workshop on forest fire management was conducted at Mexico, benefitting about 30 Mexican officials.

ISRO is working towards realising G20 Satellite for Environment and Climate Studies as an international cooperative project. Instrument proposals are received from space agencies of interested G20 nations for further evaluation. The activities towards establishing

2.11 International Cooperation

ground station in Vietnam under India - ASEAN space cooperation is progressing well with completion of basic design. Under the QUAD space cooperation ISRO organised an online Space Situational Awareness (SSA) workshop with participation of entities dealing with SSA from all the QUAD countries. ISRO is also working on a proposal to create monitoring system for extreme weather events for one of the countries in Indo Pacific region under the QUAD framework.

ISRO hosted many international events, including the 42nd Annual Meeting of Inter Agency Space Debris Coordination Committee (IADC); and the 43rd annual meeting of Space Frequency Coordination Group (SFCG). ISRO will be hosting IAF's Global Space Exploration Conference (GLEX-205) in India during May 7-9, 2025.

ISRO delegation has participated in the prominent international space events that include: 75th International Astronautical Congress; 5th Space Economy Leaders Meeting of G20; 30th meeting of International Committee on GNSS; 30th Session of Asia Pacific Regional Space Agency Forum (APRSAF); International Space Life Sciences Working Group (ISLSWG) meeting; CALCON Technical meeting; 28th session of the Intergovernmental Consultative Committee (ICC) of the Regional Space Application Programme for Sustainable Development (RESAP) of UNESCAP; and 45th Asian Conference on Remote Sensing (ACRS); Heads of Space Agency meeting of BRICS countries, 52nd CGMS Plenary; Sessions of COPUOS and its Sub Committees; 45th session of Committee on Space Research (COSPAR) and Experts Group meeting of the Wassenaar Arrangement.

Many prominent officials including Ambassadors of Mexico, Slovenia, Thailand & USA; British High Commissioner; Swedish State Secretary for Foreign Trade; Member of German Parliament; and Head Australian Space Agency visited ISRO Centres.

During this period ISRO have been recognised internationally with various awards, including: induction of Dr. Somanath S, Chairman, ISRO/ Secretary, DOS into the prestigious IAF's Hall of Fame, COSPAR's Vikram Sarabhai Medal (to Dr. Anil Bhardwaj, Director PRL); and "IAA 2024 Laurels for Team Achievement" and "2024 IAF World Space Award' for Chandrayaan-3 team.

2.12 Space Commerce

1. Background

NewSpace India Limited (NSIL) got incorporated during March 2019, as a Central Public Sector Enterprise (CPSE) under Department of Space. It was created with the vision to spur the growth of the Indian Industry to undertake space related activities and to commercially exploit products and services emanating from Indian Space Programme for global customers.

During June 2020, as a part of Space Reforms under "Unlocking India's potential in space sector", an initiative by Government of India, NSIL got mandated to undertake End to End Commercial Space Activities related to Satellites and Launch Vehicles on a Demand Driven model.

As on 31st March 2024, NSIL has successfully completed five years of its commercial space business operations. Company has substantially grown in terms of businesses and revenues.

2. Business Verticals

To cater to the business needs and the enhanced mandate of NSIL as approved by the Cabinet, it has created six business verticals as indicated below:

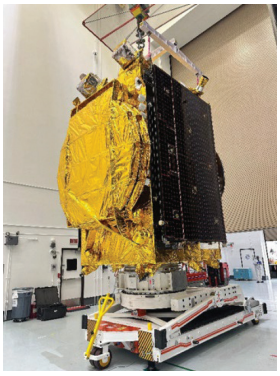
3. Business Operations

NSIL made good stride in all its major business operations as per the enhanced mandate. Major highlights of business accomplishments from 1st April, 2024 to 31st December 2024 are as indicated below:

2.12 Space Commerce

3.1. Owning and Operating Satellites on Demand Driven Model

3.1.1 2nd Demand Driven Mission of NSIL: "GSAT-N2" HTS Communication Satellite



- GSAT-N2, weighing 4,700 kg is a Ka-Ka band High Throughput Satellite with 48 Gbps capacity, for meeting the Broadband connectivity needs of Indian mainland and neighbouring islands.
- GSAT-N2 satellite was successfully launched on-board Falcon-9 of M/s SpaceX, USA on 18th Nov 2024.
- GSAT-N2 satellite had reached its final GeoStationary Orbit and has been located at its designated orbital slot of 68 deg E longitude.

- Satellite after successfully completing its In-orbit testing would commence its commercial services from Jan 2025. Bulk of the GSAT-N2 satellite capacity has been contracted to Indian Customers.
- Entire funding for the GSAT-N2 mission has been borne by NSIL

3.1.2 3rd Demand Driven Mission of NSIL: "GSAT-N3" S-Band communication satellite

- GSAT-N3 is a 4,500 kg S-band communication satellite meant primarily for meeting the service needs of Tri forces. GSAT-N3 would be the follow-on satellite to the existing GSAT-6 satellite that is nearing its end-of-life.
- NSIL has secured the commitment from Tri Forces for utilising the capacity onboard GSAT-N3. In addition, GSAT-N3 satellite capacity would also cater to other Govt user requirements viz. Indian Railways, Department of Fisheries, MHA.
- GSAT-N3 is presently under realisation at ISRO facilities. Launch is envisaged during Q1 of 2026.
- Entire funding for the mission will be borne by NSIL.

3.2. End-to-End Launch Vehicle building through Indian Industry

3.2.1. ISRO's - Polar Satellite Launch Vehicle (PSLV)

- NSIL contracted with M/s HAL [Lead Partner of M/s HAL and L&T consortia] for End-to-End manufacturing of five nos of PSLV. As part of this, the 1st fully Indian Industry manufactured PSLV would be realised and launched during Q1 of 2025.

3.2.2. ISRO's - Small Satellite Launch Vehicle (SSLV)

- To cater to the launch on demand requirement of Govt users, NSIL is realising 15 nos of SSLV through Indian Industry.
- NSIL plan is to realise 15 SSLV's in the coming 2-3 years' time frame.

3.2.3. ISRO's - Launch Vehicle Mark-3 (LVM-3) through PPP model

- NSIL has floated a Request for Qualification (RFQ) for End-to-End production of LVM-3 through Indian Industry under a PPP mode of partnership.
- Three Indian Industry partners have been technically qualified. NSIL would be shortly releasing the RFP to these technically qualified bidders.
- As part of this initiative, NSIL through PPP partnership with Indian Industry envisages to realise 60 plus LVM3 in the coming 12-14 Yrs to cater to the emerging Global launch service needs.

3.3. Launch Services for customer satellites on-board ISRO's Launch Vehicle

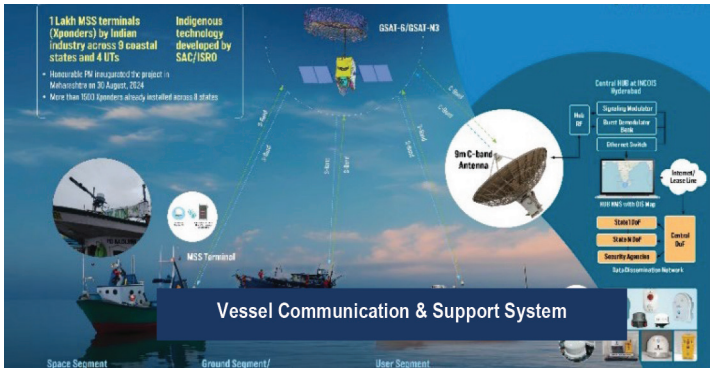
- As on date, NSIL has successfully launched 61 International and 3 Indian customer satellites on-board PSLV. This includes successful completion of Four (4) Dedicated Customer satellite missions on-board PSLV.
- A Dedicated PSLV Launch for launching Proba-3 satellite of European Space Agency is planned during Dec 2024.
- Another Dedicated PSLV mission for launching Indian Govt customer satellite is planned during Q1 of 2025. This PSLV mission would also carry several other customer satellites as co-passengers on commercial basis.
- NSIL has signed one Dedicated LVM3 Launch service contract with an International customer for launching their communication satellite during Q1 of 2025. This would be the third commercial launch of LVM3, first two being towards launch of 72 OneWeb Satellites of M/s OneWeb, UK on-board two LVM3 missions during 2022-23.
- During 2024, NSIL has signed Dedicated Launch Service Agreement (LSA) with M/s Space Machines Company, Australia for launching their satellite onboard SSLV during 2026. This would be the 1st Dedicated commercial launch of SSLV

3.4. Satellite Building

- NSIL has submitted Techno-Commercial Proposals to domestic and international customers towards viz. (a) building Communication satellites; (b) building Earth Observation Satellites; (c) providing Satellite Bus Platforms; and (d) establishment of Ground Segment.

2.12 Space Commerce

3.5. Satcom Services



- NSIL has been leasing space segment capacity in various bands for different applications namely DTH, VSAT, TV, DSNG, IFMC etc. on bent pipe and HTS satellites. In addition, NSIL has been leasing capacity on foreign satellites on a back to back basis to meet the demands of the Indian users for DTH and VSAT applications.
- NSIL presently owns and operates 12 Communication Satellites (latest being GSAT-N2) and about 300 transponder capacities on-board satellites are being leased through 150+ agreements (including foreign satellite transponders).
- NSIL has been identified as the implementing agency by Department of Fisheries for "National Rollout plan for Installation of Vessel communication and support system in Marine fishing vessels for Monitoring, control and surveillance (MCS)" under "Pradhan Mantri Matsya Sampada Yojana (PMMSY) Scheme". As part of this, NSIL has identified three Indian Industry partners for Supply, Installation, Operation and management of ~100,000 indigenous MSS terminals ("Xponders") on-board the fishing vessels including creation/development of ground infrastructure. As of 02 Dec 2024, 25378 Terminals have been delivered and 9602 Terminals have been successfully installed in the fisherman Boats.

3.6. Mission Support

- Till date, NSIL has provided Fourteen Launch Vehicle Tracking Supports and five (5) Launch and Early Orbit Phase (LEOP) support (including one Deep Space Mission Support) to Indian and International Customers as part of Mission support services.
- NSIL is in discussion for providing TTC (Telemetry, Tracking and Command) support for three Indian customers and two International customers including Deep Space Mission Support.

3.7. Technology Transfer & Spin-off

- Till date, NSIL has signed 75 Technology Transfer Agreements for transferring ISRO developed Technologies to Industry.

4. Corporate Social Responsibility & Sustainable Development (CSR & SD)

- NSIL has taken up CSR&SD activities in the areas of Healthcare, Education, Sanitation, Social Justice and Empowerment, Skill Development, Sustainable Development and Disaster Management Support.
- For FY 2023-24, an amount of ₹ 8,77,81,000 was identified for CSR&SD activities . Company has successfully undertaken 24 Projects in association with various NGOs/ Agencies as per the company's CSR&SD policy.
- For FY 2024-25, an amount of ₹ 12,72,23,012 has been identified for CSR&SD activities.

5. NSIL Financials

- As on Date, NSIL Authorised capital is ₹ 7500 Cr and Paid-up capital is ₹ 5607.60 Cr
- NSIL's total revenue during FY 2023-24: ₹ 2395.21 Cr and the Profit Before Tax: ₹ 803.59 Cr.
- NSIL's estimated revenue for FY 2024-25: ₹ 2600 Cr.

2.13 IN-SPACe

Authorisation, Promotion, and Enablement are three major areas of operation for IN-SPACe. Under each area, a brief update on the major activities undertaken by IN-SPACe is provided below.

1. Programme Management and Authorisation (PMA) Activities

a. IN-SPACe has issued 56 authorisations till date, out of which 36 authorisations are for space activities by Non-Government Entities. During the period April 2024 to December 06, 2024, 23 authorisations have been issued.

b. Some of the major authorisations issued recently to the NGEs are:

- Establishment and operations of Firefly satellites (3 satellites) by M/s. PixxelSpace India Pvt Ltd., Bengaluru, GSAT-N2 by M/s. New Space India Pvt Ltd., Bengaluru, SR-0 Demosat by Space Kidz India, Chennai,
- Establishment and operations of Ground Stations by M/s. Dhruva Space Private Limited, Hyderabad, M/s. Avantel Limited, Hyderabad, M/s. Azista BST Aerospace Pvt Ltd, Hyderabad and M/s. HEX20 Labs India Pvt Ltd., Thiruvananthapuram
- Authorisation to few communications satellites to enable provisioning of their capacity in India for communication services.

c. PMA has received 480 applications as on December 01, 2024 from more than 382 Indian Entities. The nature of requests includes authorisation, handholding, facility support and consultancy, Technology Transfer and facility usage. PMA has signed 11 MoUs during the period April – December 2024. The total MoUs signed by PMA till date is 58.

d. IN-SPACe has issued 40 registration certificates to 31 data disseminators for dissemination of primary data of 58 satellites and 11 constellations.

e. IN-SPACe has issued 26 Advisory notes/NOC to NGEs to enable submission of ITU filings to ITU-R through WPC Wing of DoT and seeking SCOMET license from DGFT, out of which 12 were issued during the reporting period.

f. IN-SPACe was responsible for selection of payloads realized by NGEs to be flown onboard PSLV Orbital Experiment Module (POEM), in coordination with ISRO. 10 payloads from NGEs have been selected to be flown on POEM-4 onboard PSLV-C60.

g. IN-SPACe formulated and released the Norms, Guidelines and Procedures for Implementation of Indian Space Policy – 2023 in respect of Authorisation of Space Activities (NGP) in May 2024. The authorisation applications are being processed as

per the NGP. The NGP includes the list of Space Activities which need Authorisation from IN-SPACe, criteria for granting the Authorisation and necessary conditions/ guidelines to be adhered-to by an Applicant.

h. IN-SPACe had released an Announcement of Opportunity for making available an Indian ITU Filing to NGEs to enable establishment and operation of an Indian communication satellite. The beneficiary of the AO enabling access to this Indian Orbital Resource has been announced.

i. A Brainstorming Session on Ground Station as a Service (GSaaS) was conducted by IN-SPACe with the objective to discuss on the GSaaS opportunities in India. The session was attended by officials from DoT and WPC wing of DoT, ISRO, IN-SPACe and industry associations along with participants from more than 15 industries exploring GSaaS. As a sequel to this, IN-SPACe has brought out a paper on GSaaS describing the opportunities, scope of activities, regulatory guidelines & procedures, and way forward for Ground Station Operators looking to provide GSaaS in India.

2. Technical Directorate (TD) Activities

a. IN-SPACe is facilitating the process of Transfer of Technology (ToT) from ISRO to private industries, as mandated by the Indian Space Policy.

b. IN-SPACe, ISRO and NSIL has initiated the process for transfer of Small Satellite Launch Vehicle (SSLV) technology. Space commission has cleared the base price of the Technology Transfer. RFP has been updated and sent to six shortlisted industries shortlisted by duly following an EOI process. Bids submission is up to 15th Jan., 2025.

c. Summary of Technology Transfers to NGEs is given below:

Summary (As on 01 November 2024)	Number
Applications received	114
ToT agreement approved and signed (since 2020)	75
Number of NGEs acquired the Technology Transfer (since 2020)	51

d. IN-SPACe has initiated activities towards establishing Space-based Earth Observation system through NGEs under Public Private Partnership (PPP):

- A pre-EOI conference was held on 08 August 2024 participated by 32 NGEs.
- An Expression of Interest (EOI) has been released on 14 September 2024, 42 participants responded.
- Consulted user ministries, viz., Ministry of Agriculture & Farmer Welfare, NDMA, Ministry of Panchayati Raj, Ministry of Environment, Forest & Climate Change,

Ministry of mines (Geological Survey of India), Ministry of Ports, Shipping and Waterways, to discuss on the applicability of the proposed Earth Observation (EO) Satellite constellations to be built by NGEs through PPP.

e. IN-SPACe Technical Centre exclusively established for NGEs, was inaugurated by Union Minister of State Dr. Jitendra Singh on 5th of March, 2024. Till Date, a total of 105 tasks have been accomplished by 24 NGEs using the various technical facilities.

f. As on 01 November 2024, 44 NGEs have been provided technical support for more than 180 tasks to access various ISRO facilities for testing their hardware.

g. IN-SPACe in coordination with Bureau of Indian Standards (BIS) has deliberated and recommended 56 standards, related to Project Management, Safety and Quality Management; Spacecraft Systems and Operations; Space Debris and Contamination Control, for adoption in BIS as Indian Standards.

h. Venture Capital Fund: RfP for selection of Fund Managers to manage ₹ 1,000 Crore Venture Capital Fund for the Indian Space Sector issued in November-2024. Four (4) bids are received and are under evaluation.

3. Promotion Directorate (PD) Activities

a. To accelerate promising start-ups, IN-SPACe had launched Seed Fund scheme to provide initial financial assistance to Indian early-stage space start-ups through a grant of up to INR 1 cr. Under this scheme IN-SPACe had announced four sector specific announcements till date viz. Use of space technology in Agriculture sector, Disaster Management, Urban Development and Marine sector. Out of four announcements, in three sectors seed fund is already released to the grantee(s) and in Marine sector proposal are under evaluation.

b. In a move to foster skill development of industry and academia in the space sector, IN-SPACe conducted Short Term Skill Development Courses as detailed below as on Dec 2024. In Total 434 candidates participated in the below mentioned Short-Term Skill Development programme: -

Course No.	Short Term Skill Development courses	Duration	Place of Course Conduction
1st	Use of Space Technology in Agriculture Sector	19 to 24 Nov, 2023	IIT Roorkee, Greater Noida Campus
2nd	Orbital Mechanics, Attitude Dynamics and control, Space based navigation and Mission planning	17 to 22 Dec, 2023	ISRO Guest House, Devanahalli, Bengaluru

3rd	A2Z of satellite technology	03 to 08 March, 2024	IN-SPACe HQ, Ahmedabad
4th	Mission design and development of Avionics for launch vehicle	19 to 24 May, 2024	IIST, Trivandrum
5th	Essentials of Space Data Products and Services	07 to12 July, 2024	IN-SPACe HQ, Ahmedabad
6th	Introduction to Advances in Propulsion System for Launch Vehicles, Satellites and Landing Missions	25 to 31 Aug, 2024	ISRO Guest House, Devanahalli, Bengaluru
7th	Essentials of Space based Communication and Navigation Systems	29 Sep to 05 Oct, 2024	IN-SPACe HQ, Ahmedabad

- Under the IN-SPACe Skill Development Initiatives, IN-SPACe has been recognized as awarding and assessing body status by National Council for Vocational Education and Training (NCVET). Till date Six skill development courses/ qualifications have been submitted to NCVET for National Skill Qualifications Framework (NSQF) and is approved.
- A total of sixty one teams qualified for the PDR round of IN-SPACe CANSAT India student competition 2024-25(2nd Edition).

c. IN-SPACe- Industry meet 2024 was held on June 06, 2024 at Ahmedabad. Around 200 delegates from industries, start-ups, academia, Government and investors participated in the meet.

d. IN-SPACe Pre-Incubation Entrepreneurship (PIE) programme was launched on June 06, 2024. A total 105 applications received are being evaluated.

e. A National Committee for Adoption of Space Tech Education in India is formed by Chairman IN-SPACe, with participation of over 14 universities/Institutions. A total of nine Institutions and Universities has adopted space tech education in their curriculum.

An MOU with Indian Institute of Technology, Roorkee is signed, for collaborating on curriculum development and programmes that provide benefits to students.

Developed one-week Student Immersion programme at IN-SPACe Technical Centre, for the students taking space technology courses.

f. IN-SPACe with Research and Information System for Developing Countries (RIS) has conducted study on "Expanding India's Commercial Space Sector Footprint Internationally".

g. Inputs for around 45 parliamentary questions raised were provided to DOS by IN-SPACe up to 15th December 2024 for the F.Y. 2024-25.

2.14 India's Space Vision 2047

Government of India has announced the Space Vision 2047, which targets establishing Bharatiya Antariksh Station (BAS) by 2035 and landing of an Indian on Moon by 2040. Towards this, Government has approved five important projects: Gaganyaan follow-on missions and establishment of BAS 1st module by 2028, Development of Next Generation Satellite Launch Vehicle (NGLV) by 2032, Chandrayaan-4 by 2027, to develop and demonstrate the technologies to come back to Earth after successfully landing on the Moon and also collect moon samples, Venus Orbiter Mission (VOM) by 2028, to study the Venusian surface and subsurface, atmospheric processes and influence of Sun on Venusian Atmosphere and establishment of Third Launch Pad (TLP) at spaceport of India, Sriharikota.

ISRO has formulated a roadmap for space science exploration missions, integrating multiple domains of developments, towards achieving the goal of Space Vision 2047. These efforts focus on technological advancements, international partnerships, increasing the participation of private players and advancing space exploration missions.

The major milestones of the achieving Space Vision 2047 are Launch of 1st module of Bharatiya Antariksh Station (BAS) by 2028, Establishment of full BAS by 2035 and Indian Moon landing by 2040.

CHAPTER

03 Resource Management

3.1 Budget at a Glance

(₹ in Crore)

S.No.	Particular	BE 2024-25	RE 2024-25	BE2025-26
1	Establishment Expenditure	478.56	416.08	398.85
2	Space Technology	10087.52	8985.59	10230.21
3	Space Applications	1611.71	1527.98	1706.79
4	Space Sciences	133.57	127.24	371.00
5	INSAT Satellite Systems	276.00	218.44	207.00
6	Other Central Sector Expenditure	455.39	450.42	502.35
	Total	**13042.75**	**11725.75**	**13416.20**

Progress of Expenditure on Ongoing Projects

(₹ in Crores)

S. No.	Projects	Sanctioned Cost	Cum. Exp. upto 31.03.2024	BE 2024-25	RE 2024-25	BE 2025-26	Balance at the end of March 2026
1	2	3	4	5	6	7	8 = {3-4-6-7}
1	PSLV Continuation Programme (Phase - 5)	3090.00	2850.56	100.00	30.00	20.00	189.44
2	PSLV Continuation (Phase-6)	6131.00	2014.43	400.00	477.00	300.00	3339.57
3	GSLV MK III Continuation Programme (Phase-1)	4338.20	1527.38	375.00	350.00	350.00	2110.82
4	GSLV Operational (F11-F16)	1710.58	930.00	150.00	139.30	150.00	491.28
5	GSLV MK II Continuation Programme (Phase-4)	1914.48	307.37	200.00	109.82	200.00	1297.29
6	Gaganyaan Follow-on Missions leading to precursor for Bharatiya Antariksh Station	20193.00	4603.58	1200.00	847.35	1200.00	13542.07

7	Joint ISRO-NASA Mission to ISS	715.00	0.00	715.00	412.00	135.00	168.00
8	Semi-cryogenic Engine Development Project	1798.00	1483.78	90.00	35.00	50.00	229.22
9	Semi-cryogenic Stage Development Project	969.00	402.10	100.00	80.00	100.00	386.90
10	Development of Small Satellite Launch Vehicle	237.84	201.92	25.00	25.00	9.82	1.10
11	Development of Next Generation Launch Vehicle (NGLV)	8239.64	0.00	0.00	3.00	158.00	8078.64
12	RLV Orbital re-entry experiment	416.35	93.85	76.75	47.00	75.00	200.50
13	RISAT-1B	605.29	466.27	75.00	73.00	46.00	20.02
14	Oceansat-3/3A	673.17	529.33	30.00	27.67	40.00	76.17
15	NASA-ISRO Synthetic Aperture Radar (NISAR) Mission	513.00	487.41	18.00	12.50	10.00	3.09
16	Resourcesat-3S & 3SA	697.22	337.83	50.00	56.00	50.00	253.39
17	Resourcesat-3 & 3A	728.39	254.08	30.00	34.00	50.00	390.31
18	High Resolution Satellite (HRSAT) Constellation	556.92	305.22	40.00	18.00	40.00	193.70
19	G20 Satellite Mission	879.98	0.00	3.75	33.75	34.00	812.23
20	IDRSS	843.75	454.13	93.75	78.25	80.00	231.37
21	GSAT-22/23/24 Satellites	865.75	551.83	5.00	5.11	1.00	307.81
22	GSAT-30/31/32 Spacecraft	959.50	625.32	5.00	5.00	1.00	328.18
23	INSAT-3DR	140.00	138.63	1.00	1.00	0.00	0.37
24	GSAT-20 Satellite	755.00	658.60	40.00	40.63	40.00	15.77
25	Technology Demonstration Spacecraft (TDS-01)	224.25	115.68	50.00	48.45	40.00	20.12

3.1 Budget at a Glance

26	Technology Demonstration Spacecraft (TDS-02)	780.73	0.00	1.00	0.75	40.00	739.98
27	Chandrayaan-III	250.00	219.13	10.00	18.50	0.00	12.37
28	Venus Orbiter Mission	824.00	0.00	1.00	2.10	50.00	771.90
29	Chandrayaan-4 Mission	2104.06	0.00	0.00	0.00	150.00	1954.06
30	Chandrayaan-5 Mission	981.99	0.00	0.00	0.00	2.00	979.99
31	X-Ray Polarimeter Satellite (XPoSat)	60.00	57.47	1.00	0.85	0.00	1.68
32	TRISHNA	530.38	1.28	16.50	8.21	40.00	480.89
33	Space Docking Experiment Mission	124.47	86.75	10.00	16.00	10.00	11.72
34	Aditya-L1	378.53	362.94	13.00	13.00	0.00	2.59
35	IRNSS 1J/1K/1L/1M/1N	964.68	568.20	75.00	73.00	120.00	203.48
36	TWT Facility	493.79	427.75	50.00	62.79	1.00	2.25
37	PSLV Integration Facility (PIF)	471.62	309.29	22.80	17.00	1.00	144.33
38	SSLV Launch Pad	985.96	223.73	108.83	162.70	300.00	299.53
39	NETRA	509.01	55.27	26.50	10.11	18.00	425.63
40	Augmentation of Solid Motor Production Facilities (ASMP) / SPROB	628.84	520.86	5.50	7.00	1.00	99.98
41	Third Launch Pad	3984.86	0.00	0.00	0.00	1.00	3983.86
	TOTAL	**72268.23**	**22171.97**	**4214.38**	**3380.84**	**3913.82**	**85128.76**

Budget Allocation towards advanced R&D activities and Infrastructure establishment

(₹ in Crores)

Item	BE 2024-25	RE 2024-25	BE 2025-26
Advanced R&D	180.60	134.70	218.81
Infrastructure	1526.79	1410.67	1702.99
Total	**1707.39**	**1545.37**	**1921.80**

3.2 Human Resources

The total approved sanctioned strength of the Department as on 01.01.2025 is 20295 out of which 19248 is sanctioned strength of ISRO, IN-SPACe & DoS. The sanctioned strength of Autonomous units & PSE/PSUs is 1047. The Scientific & technical manpower of ISRO is about 75% of the overall manpower and administrative manpower is 25%.

The existing welfare measures such as housing, medical, canteen, schooling for children, etc. are extended to the employees of ISRO under various approved institutional schemes. Life insurance coverage from accidents in the work place is provided to the employees by schemes such as VISWAS and SAFE, a special scheme for assistance to families in exigency, at a relatively low premium through internal trusts.

Key importance is laid to the competency requirements of the individuals, required for contributing effectively and efficiently towards realisation of the organisational goals and resulting achievements. Hence stringent recruitment process is adopted to ensure quality personnel are inducted into the system and greater importance is attached towards continuous development of the human resources, periodically in tune with the programmatic requirements. Accordingly, the recruitment norms fine-tuned from time to time.

The Centralized recruitments & Centre Specific recruitments are continued with revised recruitment norms in place. ISRO/DOS has been absorbing bright graduates from the Indian Institute of Space Science and Technology (IIST) on successful completion of the B. Tech/Dual degree programme, meeting the benchmark set. The fourteenth batch of students, who were admitted to B. Tech/Dual degree during September 2020 at IIST have graduated during June 2024 and a total of 101 eligible students are inducted in DOS/ISRO.

ISRO has established the 'Live Register' scheme, wherein a PhD holder in specialized areas of studies in engineering/technology/science relevant to the Indian Space programme can submit their dossiers to ISRO. The candidature is reviewed depending up on the requirement and suitability Centres.

During the year 2024-2025 centralized recruitment actions for filling up of about 870 posts in both S&T and Admin categories are completed. Further, plan of action for filling up the vacancies arising during 2025 is also generated.

Training:

Training & Development activities are envisaged through both, Centralised and Decentralised systems. The scheme of Centralised Induction Training Programme for

3.2 Human Resources

newly joined scientist/engineers, introduced during 2002, is being continued. The training programme is aimed at introducing the newly recruited scientists/engineers to ISRO systems by providing necessary exposure to the programmes, achievements, rules, regulations, systems, processes, etc. During 2024, a total of 300 newly joined scientists/ engineer were given induction training.

Customised, exclusive management and leadership development training programmes were organised for 80 Scientists/ Engineers in executive and middle level respectively through reputed management institute. ISRO has been participating in academic programmes conducted by the International Space University through nominations and a total of 10 candidates have availed the opportunity.

In addition, an average of 600 personnel was provided training through different programmes such as Structured Training Programmes of ISRO, centralised trainings on specialised themes, AJNIFM training on public procurement programme, Executive Development Programme by IISTD and other major external executive training programmes through NIAS, i2P2M, ASCI, CII, etc.

Other programmes such as;(i) Refresher courses for knowledge enhancement for technicians, technical assistants and technical support staff; (ii) Special training programmes for Administrative staff covering rules, procedures, systems and covering latest changes in the system; (iii) Training programmes for scientific/technical staff on specific technical topics of relevance in specific centres/units; and (iv) Programmes on other relevant topics for other personnel, depending upon their specialization; (v) General training programme to improve soft skills, computer skills, management & leadership aptitude, etc. are conducted as part of cadre training requirement. These training programmes are implemented both through centralised and de-centralised training programmes.

As part of avenue for upskilling, ISRO has put in place sponsored education scheme, where aspiring meritorious Scientists/Engineers can pursue higher studies, viz. ME/ M.Tech & PhD through IISc, select IITs and IIST. Further, to scale up the upskilling requirements as well as in compliance with New Education Programme, ISRO has opened the scheme for acquiring masters through online programmes offered by institutes of national importance like IISc, IITs, etc. and IIST.

Capacity Building: Internship Scheme in DoS/ISRO for external participants in line with New Education Policy is implemented in DoS to encourage and instill scientific temperament in the young minds.

Information as on October 31, 2024

Sl. No.	Details	Group-A		Group-B		Group-C	
A.	**GENERAL:** Total Number of Employees	Sci/ Tech Staff	Admn Staff	Sci/ Tech Staff	Admn Staff	Sci/ Tech Staff	Admn Staff
	(i) Male Employees	6964	275	2015	848	916	726
	(ii) Female Employees	1642	174	128	703	54	111
B.	**SCHEDULED CASTES/SCHEDULED TRIBES :**						
	(i) Number of Scheduled Caste Employees	614	67	386	231	178	183
	(ii) Number of Scheduled Tribe Employees	164	28	125	86	73	38
C.	**PERSONS WITH BENCHMARK DISABILITIES (PWBD):**						
	(i) Number of persons with Benchmark Disabilities existing						
	1. Blindness and low vision	9	1	4	10	2	8
	2. Deaf and hard of hearing	20	0	22	8	11	3
	3. Locomotor Disability including cerebral palsy, Leprosy Cured, Dwarfism, Acid Attack Victims and Muscular Dystrophy	131	18	82	32	17	4
	4. Autism, intellectual disability, Specific Learning Disability and Mental Illness	0	0	0	0	0	0
	5. Multiple Disability from amongst persons under clauses (a) to (d) including deaf-blindness in the posts identified for each disabilities	0	0	0	0	0	0
	(ii) Number of Persons with Benchmark Disabilities appointed during the year						
	1. Blindness and low vision	0	0	0	0	0	1
	2. Deaf and hard of hearing	1	0	0	0	1	0

Sl. No.	Details	Group-A		Group-B		Group-C	
	3. Locomotor Disability including cerebral palsy, Leprosy Cured, Dwarfism, Acid Attack Victims and Muscular Dystrophy	0	0	4	0	2	0
	4. Autism, intellectual disability, Specific Learning Disability and Mental Illness	0	0	0	0	0	0
	5. Multiple Disability from amongst persons under clauses (a) to (d) including deaf-blindness in the posts identified for each disabilities	0	0	0	0	0	0
D.	**EX-SERVICEMEN:**						
	(i) Number of Ex-servicemen existing	19	7	29	65	22	162
	(ii) Number of Ex-servicemen appointed during the year	0	0	0	0	4	10
E.	**OTHER BACKWARD CLASSES:**						
	(i) Number of OBCs existing	2322	93	1205	564	581	355
	(ii) Number of OBCs appointed during the year	19	2	52	6	56	9
F.	**ECONOMICALLY WEAKER SECTION (EWSs)**						
	(i) Number of EWSs existing	4	0	20	2	35	4
	(ii) Number of EWSs appointed during the period 01.11.2023 to 31.10.2024	1	1	7	2	16	3
G.	**MINORITIES**	985	42	1027	213	107	320
H.	**APPRENTICES TRAINING:**						
	(i) Number of Apprentices trained during the year	1994					
	(ii) Number of successful apprentices out of (i) above	1397					
	(iii) Number of apprentices appointed as regular employees during the year against apprentice quota, if any.	0					
I.	Number of personnel staff attached to Hon'ble Minister of State (Space)	3					

STATUS OF SCHEDULED CASTE/SCHEDULED TRIBE PERSONNEL IN DOS/ISRO

Sl No	Centre/Unit	Total Strength of Employees 2024-25	Strength of SC Employees 2024-25	Strength of ST Employees 2024-25
1	VSSC	4518	351	30
2	SAC	1814	136	117
3	URSC	1329	267	103
4	SDSC-SHAR	2109	345	116
5	LPSC	1239	129	21
6	NRSC	748	94	38
7	MCF	291	36	13
8	ISTRAC	395	49	14
9	DOS/ ISRO HQ	378	46	23
10	ADRIN	147	11	5
11	IIRS	75	9	4
12	PRL	280	13	6
13	NARL	73	9	0
14	NESAC	54	1	7
15	IIST	96	3	0
16	HSFC	278	22	8
17	IPRC	645	132	8
18	NSIL	27	2	0
19	ANTRIX	14	0	0
20	IN-Space	46	4	1
	TOTAL	**14556**	**1659**	**514**

STATUS OF PERSONS WITH DISABILITIES IN DOS/ISRO

Sl No	Centre/ Unit	Total Strength of Employees 2024-25	Strength of Persons with Disabilities	Classification of Employees with Disabilities				
				Blindness & Low vision	Deaf and hard of hearing	Locomotor Disability including cerebral palsy, Leprosy Cured, Dwarfism, Acid Attack Victims and Muscular Dystrophy	Autism, Intellectual disability, Specific Learning Disability and Mental Illness	Multiple Disability from amongst persons under clauses (a) to (d) including deaf-blindness in the posts identified for each disabilities
1	VSSC	4518	111	15	23	73	0	0
2	SAC	1814	38	2	6	30	0	0
3	URSC	1329	63	9	14	40	0	0
4	SDSC-SHAR	2109	57	2	6	49	0	0
5	LPSC	1239	28	1	7	20	0	0
6	NRSC	748	22	2	4	16	0	0
7	MCF	291	4	0	0	4	0	0
8	ISTRAC	395	12	0	0	12	0	0
9	DOS/ ISRO HQ	378	7	1	0	6	0	0
10	ADRIN	147	5	0	0	5	0	0
11	IIRS	75	4	0	0	4	0	0
12	PRL	280	6	1	0	5	0	0
13	NARL	73	1	0	0	1	0	0
14	NESAC	54	1	0	0	1	0	0
15	IIST	96	2	0	0	2	0	0
16	HSFC	278	5	1	2	2	0	0
17	IPRC	645	14	0	2	12	0	0
18	NSIL	27	1	0	0	1	0	0
19	ANTRIX	14	1	0	0	1	0	0
20	IN-Space	46	0	0	0	0	0	0
	TOTAL	**14556**	**382**	**34**	**64**	**284**	**0**	**0**

STATUS OF REPRESENTATION OF EX-SERVICEMEN IN DOS/ISRO

Sl No	Centre/Unit	Total Number of Employees in Group - C 2024-2025	Total Number of Ex-Servicemen in Group - C 2024-2025
1	VSSC	554	102
2	SAC	223	6
3	URSC	80	6
4	SDSC-SHAR	378	14
5	LPSC	185	29
6	NRSC	82	5
7	MCF	49	1
8	ISTRAC	32	2
9	DOS/ ISRO HQ	43	4
10	ADRIN	16	2
11	IIRS	3	1
12	PRL	11	0
13	NARL	8	0
14	NESAC	3	0
15	IIST	0	0
16	HSFC	42	0
17	IPRC	97	12
18	NSIL	0	0
19	ANTRIX	1	0
20	IN-Space	0	0
	TOTAL	**1807**	**184**

WOMEN EMPLOYEES IN DOS/ISRO

Sl No	Centre/Unit	Total Number of Employees 2024-2025	Number of Women Employees 2024 - 2025	
			Scientific & Technical Staff	Administrative Staff
1	VSSC	4518	555	394
2	SAC	1814	224	66
3	URSC	1329	371	62
4	SDSC-SHAR	2109	132	107
5	LPSC	1239	95	89
6	NRSC	748	145	46
7	MCF	291	26	11
8	ISTRAC	395	73	28
9	DOS/ ISRO HQ	378	21	84
10	ADRIN	147	30	9
11	IIRS	75	17	4
12	PRL	280	31	18
13	NARL	73	7	5
14	NESAC	54	8	4
15	IIST	96	19	6
16	HSFC	278	20	11
17	IPRC	645	44	34
18	NSIL	27	1	5
19	ANTRIX	14	2	3
20	IN-Space	46	3	2
	TOTAL	**14556**	**1824**	**988**

3.3 Grant-in-Aid

S. No.	Programme Office	Sanction No. & Date	Name of the Grantee Institute	Purpose of the Grant	Sanctioned Amount (Rs.)
1	RESPOND	DS_2B-13012(2)35/2023-Sec.2 dt.28.04.2023	S V National Institute of Technology	Combustion Dynamics of Rocket Engine and its active control using high Energy Plasma Discharge for phrase desynchronization	15,90,000.00
2	RESPOND	DS_2B-13012(2)34/2023-Sec.2 dt.27.04.2023	NITTE Meenakshi Institute of Technology	Development of Controlled Radiation Pattern Antenna for interference mitigation and anti-jamming of NaviC Satellite system receivers	11,04,940.00
3	RESPOND	DS_2B-13012(2)53/2023-Sec.2 dt. 03.08.2023 & 12.02.2024	Symbiosis Institute of Geoinformatics	Groundwater dynamics in India: Investigation using radiocarbon, stable isotope ratios and satellite data	24,87,500.00
4	RESPOND	DS_2B-13012(2)50/2023-Sec.2 dt.14.08.2023 & 13.03.2024	Dayananda Sagar University	Polarisation Imaging Camera for Characterisation of planetary atmosphere and surface	24,97,880.00

3.3 Grant-in-Aid

5	RESPOND	DS_2B-13012(2)58/2023-Sec.2 dt.13.01.2024	Sri Ramdeobaba College of Engineering and Management	Fabrication and Performance Optimisation of Thin Film bulk Acoustic Wave (BAW) resonators and filters	23,93,138.00
6	RESPOND	DS_2B-13012(2)88/2023-Sec.2 dt. 08.03.2024	PSG College of Technology	Development of wide bandgap semiconductor based solar blind photodetectors	10,73,920.00
7	RESPOND	B.19012/106/2015 dt. 18.03.2024	National Institute of Advanced Studies, Bengaluru	ISRO Grants for NIAS Ph. D Programme during 2023-24	40,00,000.00
8	SPO	DS_2B-13012(2)/13/2019-Sec.2 dt. 15.05.2023	Dayananda Sagar University	Telltale of Galactic Black hole X-ray binaries from Astrosat archival observations	6,43,424.00
9	RESPOND	DS_2B-13013(1)/1/2019-Sec.2 dt.04.07.2023	Homi Bhabha Centre for Science Education	16th International Olympiads on Astronomy and Astrophysics	38,76,379.00
10	RESPOND	DS_2B-13012(1)/24/2023-Sec.2 dt.04.12.2023	Synergia Foundation	9th Synergia Conclave 2023	10,00,000.00
11	RESPOND	DS_2B-13012(1)/20/2023-Sec.2 dt. 08.10.2023	Aeronautical Society of India	International Conference cum Exhibition on aerospace and aviation in 2047	25,00,000.00

12	RESPOND	DS_2B-13012(2)/79/2023-Sec.2 dt.13.09.2023	Veer Surendra Sai University of Technology	Setting up of Veer Surendra Sai Space Innovation Centre	16,12,213.00
13	RESPOND	DS_2B-19012/119/2016-Sec.2 dt.01.03.2024	Current Science Association	Publication of current Science Journal	10,00,000.00
	TOTAL	**Rupees Two Crores Fifty-Seven Lakhs Seventy-Nine Thousand Three Hundred and Ninety-Four Only**			**2,57,79,394.00**

CHAPTER

04 Others

4.1 Space in Parliament

Indian Space Programme continued to attract the attention of both the Houses of Parliament. Questions answered in Parliament during January, 2024 – December, 2024 are as below:

Questions	Budget Session 2024		Monsoon Session 2024		Winter Session 2024		Total	
	15th Session of 17th Lok Sabha	263rd Session of Rajya Sabha	2nd Session of 18th Lok Sabha	265th Session of Rajya Sabha	3rd Session 18th Lok Sabha	266th Session of Rajya Sabha	LS	RS
Starred Questions	00	00	00	01	00	03	00	04
Unstarred Questions	04	02	12	08	16	11	32	21
Total	**04**	**02**	**12**	**09**	**16**	**14**	**32**	**25**

The Questions were with respect to Distress Alert Transmitter, Sending Humans to Space, Space Station of ISRO, Aditya-L1 Satellite, International Collaborations in the Field of Space Research, Encouraging Startups to Boost India's Space Programme, Guidelines to Private Players by IN-SPACe, Private Players in Space Sector, Progress of Gaganyaan, Pushpak Viman Launch Vehicle, Initiative to study the Asteroids, Space Programmes and Missions, Space Exploration and Technology Development, Space Technology and Space Cooperation, Support to Space Technology Startups, Successful ISRO Missions, Indianisation of Technique in Space Sector, Indian NAVIC System, Feasibility Study for Space Tourism, Achievements related to Space Programmes and Missions, Space Debris Management, Space Industrial and Propellants Park Project in Tamil Nadu, ISRO's contribution to Capacity building and Education, Coastal Erosion in Sriharikota, Andhra Pradesh, Launching of Foreign Satellites by ISRO, Services offered by Antrix Corporation Limited, Shukrayaan Mission, Space Sector Startups Fund, ISRO's Space Missions, Analogue Mission in Tibet Region By ISRO, Space Debris Management, NASA-ISRO Synthetic Aperture Radar Mission, Space Technology Programme in Andhra Pradesh, Startups in Space Sector, Challenges in development and timely execution of India's space exploration Missions, Chandrayaan, Gaganyaan Mission, Status of Gaganyaan Mission, Collaborations in the Field of Space Research, Private Companies Working with ISRO, Bhartiya Antariksh Space Station, Homegrown Space Products, Benefits of Moon Mission, Aditya-L1 Mission, Efforts to Make India a Developed Nation By 2047 in Space Sector, Shukrayaan Mission, Promotion of Private

Sector in Space Sector, Operationalisation of the Bharatiya Antariksh Station, Regulating Ground Station As a Service Industry, Outcomes of Aditya-L1 Mission, Opportunities for Space Sector Startups in Foreign Countries, Utility of Small Satellites, Space Missions, Bharatiya Antariksh Station, India's Space Vision 2047, Public-Private Partnerships of ISRO, Space Research and Development in Odisha.

During the year 2024, Committee on Government Assurances (Lok Sabha) held discussion with the representatives of the Department of Space/ISRO on 05.01.2024 at Ahmedabad and Committee on Public Accounts, held discussion with the representatives of the Department of Space/ ISRO on 16.10.2024 at Bengaluru.

4.2 Vigilance

Annexure-1

Category of employees	Type of cases	Cases pending as on 01.10.2023	Cases received during the period 01.10.2023 to 30.09.2024	Total (Col. 3+4)	Disposed during 01.10.2023 to 30.09.2024	Pending (Col. 5-6)
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Group-A & Group-B (Gazetted) & Group-A (Non-Gazetted)	Disciplinary (Non-Vigilance)	20	4	24	3	21
	Disciplinary (Vigilance)	1	-	1	1	-
Group-B (Non- Gazetted) & Group C	Disciplinary (Non-Vigilance)	32	22	54	26	28
	Disciplinary (Vigilance)	-	-	-	-	-
	TOTAL	**53**	**26**	**79**	**30**	**49**

Annexure-2

Sl. No.	Particulars	
1.	Number of complaints of sexual harassment received during the period 01.10.2023 to 30.09.2024	**5**
2.	Number of complaints disposed of during the period 01.10.2023 to 30.09.2024	**4**
3.	Number of workshops on awareness programmes against sexual harassment conducted during the period 01.10.2023 to 30.09.2024	**15**

4.3 Progressive use of Hindi

- This year also, implementation of Official Language Hindi and all other related programmes in the Department of Space (DOS) continued with vigor. Official Language Implementation Committee held its quarterly meetings to review the progress in the use of Official Language Hindi. DOS/ISRO and its Centres and Units have also participated in the meetings of Town Official Language Implementation Committee (TOLIC) constituted in their respective towns.
- Meeting of DOS-DAE Joint Hindi Salahkar Samiti (JHSS) was held on 20.03.2023 at Vigyan Bhavan, New Delhi. Action Taken Report on the minutes of meeting has been prepared on the points pertaining to Department of Space. Necessary action is being initiated pertaining to reconstitution of Joint Hindi Salahkar Samiti of Department of Space and Department of Atomic Energy.
- Department took part in the first phase of 46th meeting of Central Official Language Implementation Committee on 22.10.2024. Officer on Special Duty (OSD) and Joint Director (OL), DOS Branch Secretariat, New Delhi participated in the meeting held under the Chairmanship of Secretary, Department of Official Language.
- URSC, Bengaluru and MCF, Hassan of the Department are also shouldering the additional responsibilities of TOLIC Secretariat at Bengaluru & Hassan respectively.
- All the Centres/Units of the Department located in 'A', 'B' and 'C' regions have achieved the target prescribed for Hindi/Bilingual correspondence by the Department of Official Language.
- Department and its Centres/Units purchased Hindi books for Library in accordance with the target set up by DOL.
- All advertisements issued by the Department are either in Bilingual (Hindi & English) or in Trilingual (Regional Language, Hindi & English).
- In order to implement Official Language Hindi in a more meaningful and effective manner and to evaluate the progressive use of Official Language Hindi in DOS/ISRO Units/Centres, an Annual Inspection Programme for the period 2023-24 was drawn up by Department. The inspection of concerned Centres/Units has been carried out by all Inspecting Officers.
- Training Programmes in Hindi under Hindi Teaching Scheme were continued in the Department. The percentage of employees having working knowledge of Hindi in most of the Centres/Units of DOS/ISRO is more than 80%. An action plan has been prepared for imparting training at the earliest to the remaining employees of Units/ Centres within the time limit prescribed by DOL.
- During every quarter of the year Hindi Workshops were regularly conducted in all the Units/Centres of DOS/ISRO, in which hands-on sessions were organized in order to make the employees more efficient to work in Hindi.
- Five Days Special Technical Translation Training Programme was conducted by DOS, Branch Secretariat, New Delhi under the auspices of Central Translation Bureau, New Delhi during 10-14 June, 2024 for Junior and Senior Translation Officers of all the Centres/Units of DOS/ISRO to enhance their translation skills.
- Hindi Day and Fourth All India Official Language Conference was organised at Bharat Mandapam, New Delhi during 14-15 September, 2024 by Department of Official

4.3 Progessive use of Hindi

Language wherein, large number of officers/employees from Units/Centres of DOS/ISRO participated in this conference. During the function Department of Official Language released (Diamond Jubilee Souvenir) Hirak Jayanti Smarika, in which an article named "Atmanirbharta Ke Pariprekshya me Rajbhasha ka Mahatva" penned by Dr. S. Somanath, Secretary, DOS/Chairman, ISRO has been published mentioning activities regarding "OL Hindi implementation in the Department".

- Hindi Day, Hindi Week, Hindi Fortnight and Hindi Month were organised in all the Units/Centres of DOS/ISRO, during which competitions like; Essay Writing, Noting and Drafting, Crossword, Simple Translation, Dictation, Calligraphy, Hindi Typing, General Knowledge Quiz, Solo Singing, Antakshari, Vividha etc., have been conducted. These competitions have been organised for Hindi speaking and other than Hindi speaking employees separately. In this connection, various Hindi competitions were conducted for family members/children of the employees. Cash prizes were awarded to all the winners.
- Department always plays an active role in the activities of TOLIC. It conducts various programmes under the auspices of TOLIC. This year, on 24.10.2024, a 'Hindi Noting & Drafting' competition was conducted for the member offices of TOLIC (O-2), Bengaluru in Antariksh Bhavan. Also, many employees of DOS/ISRO HQ participated in the competitions conducted by the other member offices and won prizes.
- 'Incentive Scheme' under which the officers/employees doing maximum work in Hindi during the Hindi month are awarded, continued during the year. Incentive scheme of the Department 'SOLIS' also continued during the year and officers/employees of DOS/ISRO HQ and its Centres/Units were awarded Cash Prizes and Certificates for doing routine work in Hindi.
- Department has received proposals for publishing 07 (Seven) books in Hindi from SAC, Ahmedabad and 01 (One) book from PRL, Ahmedabad during the year 2023-24. After the review process and obtaining approval, further action for publication of 05 (Five) books from SAC, Ahmedabad and 01 (One) book from PRL, Ahmedabad is under process.
- During the year 18th edition of 'Disha', the In-house magazine of DOS/ISRO HQ was published. Along with this, In-house Hindi magazines were brought out by various Centres/Units of the Department.
- Several banners, pamphlets, panels/posters/standees, brochures etc. pertaining to ISRO's launches and other outreach programmes were brought out in Hindi.
- Website of the Department is fully in bilingual and it is regularly updated in English as well as in Hindi. The website meticulously follows the GIGW guidelines.
- 'Action Taken Reports' pertaining to assurances given to Hon'ble Second Sub-Committee of the Committee of Parliament on Official Language during the inspections of RRSC (East), Kolkata (held on 29.12.2023) and ILC, Mumbai (held on 18.01.2024) were submitted to Committee Secretariat, New Delhi on 03.06.2024 & 16.07.2024 respectively. At present, the inspections of IIST, Thiruvananthapuram and IISU, Thiruvananthapuram is scheduled to be held on 09.01.2025 by Hon'ble Committee. Further, Questionnaire pertaining to NE-SAC, Umiam has been submitted to Committee Secretariat, New Delhi in November, 2024 and inspection date is yet to be declared.

- In order to celebrate 'World Hindi Day' on 10 January, 2025, various competitions are planned in all the Centres/Units of Department. On this occasion, competitions are conducted for Hindi speaking and other than Hindi speaking employees separately. Talk in Official Language Hindi on various topics are also planned along with this.
- An Official Language Orientation Programme for the OL staff across the Department was organized by NE-SAC, Umiam on 03.10.2024.

Hindi Technical Seminar

Every year, various Centres/Units of the Department conduct Pool level Technical Seminars in Hindi on various subjects. During Inter Centre Technical Seminar, a session on Official Language is also included. Souvenir is also brought out in electronic/book form. During the year, following Centres/Units of the Department organized Hindi Technical Seminars:

Sl. No.	Centre/Unit	Date	Topic
1.	NE-SAC, Umiam	03 October, 2024	Space Technology Applications in sustainable development
2.	LPSC, Valiamala	18 October, 2024	Advanced Technology for Interplanetary Missions & Challenges
3.	SAC, Ahmedabad (Inter Centre Technical Hindi Seminar)	07-08 November, 2024	**Technical Session** ISRO's indigenous initiative for developed India by 2047 **OL Session** Contribution of Official Language in propagation of Indian Space Programme.
4.	URSC, Bengaluru	06 December, 2024	Technical Challenges in establishing Indian Space Station and solutions for the same
5.	MCF, Hassan	10 December, 2024	Role of Ground Segment towards success of Near and Deep Space Missions

Awards for OL Implementation

National Level

- For the Best implementation of the Official Language, Department of Space was awarded the "Rajbhasha Kirti Puraskar" (Second Prize) for the year 2023-24 by Hon'ble Minister of State, Ministry of Home Affairs. The award was given during the Hindi Day and Fourth All India OL Conference organised at Bharat Mandapam, New Delhi during 14-15 September, 2024 by Department of OL.
- For the Best In-house magazine, 'Abhivyakti', the In-house magazine of SAC, Ahmedabad was awarded First Prize by the Hon'ble Minister of Home & Co-operation of India. The award was given during the Hindi Day and Fourth All India OL Conference organised at Bharat Mandapam, New Delhi during 14-15 September, 2024 by Department of OL.

4.3 Progessive use of Hindi

Regional Level

- The following Centres/Units of DOS were awarded for best implementation of OL Hindi at regional level during the year:

Sl. No.	Centres/Units	Region	Award	Year
1.	RRSC (South), Bengaluru	(Region 'C')	Second	2023-24
2.	APEP, Aluva	South-West Region (Region 'C')	Third	2023-24
3.	NE-SAC, Umiam	North-East Region (Region'C')	Third	2023-24

TOLIC Level

- The following Centres/Units of DOS were awarded for the best implementation of OL Hindi `by its respective Town Official Language Implementation Committee during the year:

Sl. No.	Centres/Units	Region	Award	Year
1.	IIST, Thiruvananthapuram	'C'	• Third Prize for Best OL Hindi Implementation. • Third Prize for In-house Magazine 'Antariksha Dharayein'.	2022-23
2.	LPSC, Valiamala	'C'	• First Prize for Best OL Hindi Implementation. • Second Prize for In-House Magazine 'Nodan Mukur'. • Overall Championship award for scoring highest marks in competitions held during Joint OL Utsav.	2022-23
3.	NE-SAC, Umiam	'C'	Second	2023-24
4.	RRSC (West), Jodhpur	'A'	Second	2023-24
5.	VSSC, Thiruvananthapuram	'C'	• First Prize for In-House Magazine 'Gagan.' • Second Prize for Best OL Hindi Implementation. • Championship Prize for scoring highest marks in competitions held during OL Parva.	2024-25

4.4 Right to Information

Right to Information (RTI) Act 2005 is implemented in this Department as per the mandate of RTI Act. With the increased RTI applications and in order to disseminate the information in time, Department of Space/ISRO had decentralized the adjudication of RTI applications/ appeals at Centres/Units/Autonomous Bodies/PSU level with effect from 01/11/2018. In terms of Section 5 & 19 of the Right to Information Act, 2005, all the DOS/ISRO Centres/ Units/ Autonomous Bodies/ PSU (Antrix)/ CPSE (NSIL)/ INSPACe have identified and designated the Transparency Officer, Nodal Officer, Appellate Authority and Central Public Information Officer for implementation of RTI Act.

As per Section 4 (1) (b) of RTI Act, Department of Space has published the following information on the web page: https://www.isro.gov.in/RTI.html

1. RTI Act
2. Guidelines for RTI Logo
3. Handbook on RTI Act
4. Guidelines for obtaining information under RTI Act
5. Suo moto disclosure under Section 4 (1) (b)
   - **i. The particulars of organisation, functions and duties**
     - Organisation Chart
     - Work Allocation in Dept. of Space
     - Functions and duties
   - **ii. The powers and duties of officers and employees**
   - **iii. The procedure followed in the decision making process including channels of supervision and accountability**
   - **iv. The norms set for discharge of functions**
   - **v. The rules, regulations, instructions, manuals and records, held or under control or used by employees for discharging functions**

The rules and regulations formulated by the Government of India in the form of fundamental Rules, Supplementary Rules, General Financial Rules, Delegation of Financial Powers Rules, etc., are followed with suitable modifications, wherever required. The Following are the rules, manuals, etc., held by the Department of Space used by employees for discharging functions:

1. DOS Employees (CCA Rules)
   a. DOS Employees – CCA Rules – 1976
   b. DOS Employees – CCA Rules – Amendment October 2017

c. DOS Employees – CCA Rules – Amendment January 2019
d. DOS Employees – CCA Rules – Amendment October 2019
e. DOS Employees – CCA Rules – Amendment April 2022

2. DOS Study Leave Rules
a. Study Leave Rules (Upto 1997)
b. Study Leave Rules – Amendment – 2006
c. Study Leave Rules – Amendment – 2015
d. Study Leave Rules – Amendment – 2021
3. DOS Allotment of Residence Rules
4. DOS Book of Financial Powers
5. DOS Purchase Manual
6. DOS Stores Procedure
7. Transfer Policy – Transfer and posting of Officers in Administrative areas – guidelines
   a. Transfer policy - Transfer and posting of Officers in Administrative areas - guidelines
   b. Guidelines for Inter Centre Transfers in DOS/ISRO - for officials other than officers in Administrative

vi. A statement of the categories of documents that are held or under control

vii. The particulars of any arrangement that exists for consultation with or representation by the members of the public in relation to the formulation of policy or implementation thereof.

viii. A statement of the boards, councils, committees and other bodies consisting of two or more persons constituted as its part or for the purpose of its advice and as to whether meetings of those boards, councils, committees and other bodies are open to the public or the minutes of such meetings are accessible for public

ix. A directory of officers and employees

x. The monthly remuneration received by each of officers and employees including the system of compensation as provided in regulations

xi. The budget allocated to each of its agency indicating the particulars of all plans, proposed expenditures and reports on disbursements made

xii. The manner of execution of subsidy programmes including the amounts allocated and the details of beneficiaries of such programmes

xiii. Particulars of recipients of concessions, permits or authorisations granted.

a. The Department of Space does not give any concession or issue any permit/ authorisation.

xiv. Details in respect of the information available to or held by it reduced in an electronic form

The relevant documents relating to procurement management, personnel management and management of services are held by the Department. The following documents are held by the Department:

1. Demands for Grants
2. Annual Report
3. DOS Purchase Manual
4. DOS Stores Procedure
5. DOS Book of Financial Powers
6. DOS Employees (CCA Rules)
    a. DOS Employees – CCA Rules – 1976
    b. DOS Employees – CCA Rules – Amendment October 2017
    c. DOS Employees – CCA Rules – Amendment January 2019
    d. DOS Employees – CCA Rules – Amendment October 2019
    e. DOS Employees – CCA Rules – Amendment April 2022
7. DOS Study Leave Rules
    a. Study Leave Rules (Upto 1997)
    b. Study Leave Rules – Amendment – 2006
    c. Study Leave Rules – Amendment – 2015
    d. Study Leave Rules – Amendment – 2021
8. DOS Allotment of Residence Rules
9. Norms for Recruitment and Career Prospects
10. Transfer policy - Transfer and posting of Officers in Administrative areas – guidelines

a. Transfer policy - Transfer and posting of Officers in Administrative areas – guidelines

b. Guidelines for Inter Centre Transfers in DOS/ISRO - for officials other than officers in Administrative

The above documents are available in electronic form only and no copies are available for sale.

xv. The particulars of facilities available to citizens for obtaining information including the working hours of a library or reading room, if maintained for public use.

xvi. The names, designations and other particulars of the Public Information Officers

a. List of Transparency Officer, Nodal Officers, Appellate Authority, Central Public Information Officers in DOS

b. List of Earlier CPIOs & FAAs from 1.1.2015

xvii. Other Information

1. Official tours of Officers at the level of Joint Secretary (JS) & above.
   a. July 2024 to September 2024
   b. April 2024 to June 2024
   c. January 2024 to March 2024
   d. April 2023 to June 2023
   e. January 2023 to March 2023
   f. October 2022 to December 2022
   g. July 2022 to September 2022
   h. April 2022 to June 2022
   i. January 2022 to March 2022
2. Telephone numbers and addresses of Secretary and other Officers Officials of Department of Space dealing with Parliament work
3. Transfer and Posting of Officers in Administrative Areas
4. Audit Report of the DOS/ISRO on proactive disclosure under RTI Act, 2005 (2022-2023)
5. Details of tender bids awarded, names of suppliers, rates and total amount
6. Information regarding CAG and PAC paras as well as action taken reports (ATR) on those paras which have been laid on the table of both houses of parliament
7. Frequently asked Questions (FAQs)
8. Application Fee

6. List of PIOs and APIOs of DOS and ISRO Centres
7. Information under section 25(3) of right to information Act, 2005
8. Annual Report
9. Human Resources
10. Citizen's Charter
11. Public Grievances
12. ISRO's Timeline from 1960s to Today

During the period December 2023 to November 2024, **3036** applications were received and information was disseminated under the provisions of the RTI Act. **358** Appeals were received by the First Appellate Authority and **22** appellants approached the Second Appellate Authority, i.e., Central Information Commission.

4.5 Audit Observations

1. Status of the Action Taken Note (ATN)

			Details of the Paras/PA reports on which ATNs are pending			
Sl. No	Year	No. of Paras/ PAC reports on which ATNs have been submitted to PAC after vetting by Audit	No. of ATNs not sent by the Ministry even for the 1st time	No. of ATNs sent by the Ministry and awaiting vetting by Audit	No. of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	No. of ATNs which have been finally vetted by audit but have not been submitted by the Ministry to PAC
1	**2**	**3**	**4**	**5**	**6**	**7**
1	Report No.6 of 2020 (Para No.5.1) Grant of additional increments	One	Nil	Nil	Nil	Nil
2	Report No.6 of 2020 (Para No.5.2) Silicon carbide mirror development facility	One	Nil	Nil	Nil	Nil
3	Report No.6 of 2020 (Para No.5.3) Creation of posts without approval of competent authority	One	Nil	Nil	Nil	Nil
4	Report No.6 of 2020 (Para No.5.4) Residency period for promotion fixed at lower than prescribed level	One	Nil	Nil	Nil	Nil
5	Report No.6 of 2020 (Para No.5.5) Management of civil works	One	Nil	Nil	Nil	Nil

			Details of the Paras/PA reports on which ATNs are pending			
Sl. No	Year	No. of Paras/ PAC reports on which ATNs have been submitted to PAC after vetting by Audit	No. of ATNs not sent by the Ministry even for the 1st time	No. of ATNs sent by the Ministry and awaiting vetting by Audit	No. of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	No. of ATNs which have been finally vetted by audit but have not been submitted by the Ministry to PAC
1	**2**	**3**	**4**	**5**	**6**	**7**
6	Report No.21 of 2022 (Para No.2.1) Management of fabrication activities at Vikram Sarabhai Space Centre	One	Nil	Nil	Nil	Nil
7	Report No.21 of 2022 (Para No.2.2) Avoidable investment of ₹28.09 crore	One	Nil	Nil	Nil	Nil
8	Report No.21 of 2022 (Para No.2.3) Avoidable payment of Taxes and Duties of ₹69.02 lakhs	One	Nil	Nil	Nil	Nil
9	Report No.21 of 2022 (Para No.2.4) Non-utilisation of GSAT-6 Satellite	One	Nil	Nil	Nil	Nil
10	Report No.21 of 2022 (Para No.2.5) Irregular expenditure of ₹7.57 crore towards development of Sullurupeta	One	Nil	Nil	Nil	Nil

4.5 Audit Observations

			Details of the Paras/PA reports on which ATNs are pending			
Sl. No	Year	No. of Paras/ PAC reports on which ATNs have been submitted to PAC after vetting by Audit	No. of ATNs not sent by the Ministry even for the 1st time	No. of ATNs sent by the Ministry and awaiting vetting by Audit	No. of ATNs sent but returned with observations and Audit is awaiting their resubmission by the Ministry	No. of ATNs which have been finally vetted by audit but have not been submitted by the Ministry to PAC
1	**2**	**3**	**4**	**5**	**6**	**7**
11	Report No.24 of 2023 (Para No.2.1) Avoidable payment of ₹1.14 crore on electricity charges	Nil	Nil	One	Nil	Nil
12	Report No.24 of 2023 (Para No.2.2) Sub optimum utilisation of the capacities of GSAT-18 satellite	Nil	One	Nil	Nil	Nil
13	Report No.24 of 2023 (Para No.2.3) Short Closure of project for the development of Special Grade Carbon Fibre	Nil	Nil	One	Nil	Nil

2. Summary of audit observations during 2024

a. C&AG Report Union Government, Scientific Departments Report No. 24 of 2023 Para 2.1 titled "Avoidable payment of ₹1.14 crore on electricity charge":

Inability to realistically assess contract demand with the actual consumption of electricity by a unit a Department of Space viz., Liquid Propulsion System Centre (LPSC-B), Bengaluru had resulted in avoidable expenditure of ₹1.14 crore.

b. C&AG Report Union Government, Scientific Departments Report No. 24 of 2023 titled Para 2.2 titled "Sub optimum utilisation of the capacities of GSAT - 18 satellites"

Department of Space launched GSAT-18 satellite in October 2016. The satellite could not be utilized fully and DOS incurred avoidable expenditure of ₹17.27 crore on hardware and launch services of GSAT-18 satellite.

c. C&AG Report Union Government, Scientific Departments Report No. 24 of 2023 titled Para 2.3 titled "Short closure of project for the development of Special Grade Carbon Fibre"

VSSC undertook a project to develop Special Grade (T800 grade) Carbon Fibre to indigenise and ensure continuous supply for its programmes. The MoU was however, short closed due to improper planning and lack of clarity on availability of resources (facility, financial and manpower), required for the project resulting in infructuous expenditure of ₹4 crore.

CHAPTER

05 Milestones & Acronyms

5.1 Milestones

1962

- Indian National Committee for Space Research formed and the works on establishing Thumba Equatorial Rocket Launching Station (TERLS), started

1963

- First sounding rocket launch from TERLS (November 21, 1963)

1965

- Space Science and Technology Centre (SSTC) established in Thumba

1967

- Experimental Satellite Communication Earth Station (ESCES) set up at Ahmedabad

1968

- TERLS dedicated to the United Nations (February 2, 1968)

1969

- ISRO formed (August 15, 1969)

1972

- Space Commission and DOS set up. ISRO was brought under DOS (June 1, 1972)

1972-76

- Air-borne remote sensing experiments

1975

- ISRO becomes Government Organisation (April 1, 1975)
- First Indian Satellite, Aryabhata, launched (April 19, 1975)

1975-76

- Satellite Instructional Television Experiment (SITE) conducted

1977-79

- Satellite Telecommunication Experimental Project (STEP) carried out

1979

- Bhaskara-1, an experimental satellite for earth observations, launched (June 7, 1979)
- First Experimental launch of SLV-3 with Rohini Technology Payload onboard (August 10, 1979). The satellite could not be placed in orbit

1980

- Second Experimental launch of SLV-3. Rohini satellite successfully placed in orbit (July 18, 1980)

1981

- First developmental launch of SLV-3. RS-D1 placed in orbit (May 31, 1981)
- APPLE, an experimental geostationary communication satellite successfully launched (June 19, 1981)
- Bhaskara-II launched (November 20, 1981)

1982

- INSAT-1A launched (April 10, 1982). Deactivated on September 6, 1982

1983

- Second developmental launch of SLV-3. RS-D2 placed in orbit (April 17, 1983)
- INSAT-1B launched (August 30, 1983)

1984

- Indo-Soviet manned space mission (April 1984)

1987

- First developmental launch of ASLV with SROSS-1 satellite onboard (March 24, 1987). The satellite could not be placed in orbit

1988

- Launch of the first operational Indian Remote Sensing satellite, IRS-1A (March 17, 1988)
- Second developmental launch of ASLV with SROSS-2 onboard (July 13, 1988). The satellite could not be placed in orbit
- INSAT-1C launched (July 22, 1988). Abandoned in November 1989

1990

- INSAT-1D launched (June 12, 1990)
- Launch of second operational Remote Sensing satellite, IRS-1B (August 29, 1991)

1992

- Third developmental launch of ASLV with SROSS-C on board (May 20, 1992). Satellite placed in orbit
- INSAT-2A, the first satellite of the indigenously-built second-generation INSAT series, launched (July 10, 1992)

1993

- INSAT-2B, the second satellite in INSAT-2 series, launched (July 23, 1993)
- PSLV-D1, the first developmental launch of PSLV with IRS-1E onboard (September 20, 1993). The satellite could not be placed in orbit

5.1 Milestones

1994

- Fourth developmental launch of ASLV with SROSS-C2 onboard (May 4, 1994). Satellite placed in orbit
- PSLV-D2, the second developmental launch of PSLV with IRS-P2 onboard (October 15, 1994). The satellite was successfully placed in Polar Sun Synchronous Orbit

1995

- INSAT-2C, the third satellite in the INSAT-2 series, launched (December 7, 1995)
- Launch of the third operational Indian Remote Sensing Satellite, IRS-1C (December 28, 1995)

1996

- PSLV-D3, the third developmental launch of PSLV with IRS-P3 onboard (March 21, 1996). Satellite placed in Polar Sun Synchronous Orbit

1997

- INSAT-2D, the fourth satellite in INSAT-2 series, was launched (June 4, 1997). Becomes inoperable on October 4, 1997. (An in-orbit satellite, ARABSAT-1C, later renamed INSAT-2DT, was acquired in November 1997 to partly augment the INSAT system)
- PSLV-C1, the first operational launch of PSLV with IRS-1D onboard (September 29, 1997). Satellite placed in orbit

1998

- INSAT system capacity augmented with the readiness of INSAT-2DT acquired from ARABSAT (January 1998)

1999

- INSAT-2E, the last satellite in the multipurpose INSAT-2 series, launched by Ariane from Kourou, French Guiana (April 3, 1999)
- Indian Remote Sensing Satellite, IRS-P4 (Oceansat-1), launched by Polar Satellite Launch Vehicle (PSLV-C2) along with Korean KITSAT-3 and German DLR-TUBSAT from SDSC SHAR, Sriharikota (May 26, 1999)

2000

- INSAT-3B, the first satellite in the third generation INSAT-3 series, launched by Ariane from Kourou, French Guiana (March 22, 2000)

2001

- Successful flight test of Geosynchronous Satellite Launch Vehicle (GSLV-D1) on April 18, 2001, with an experimental satellite GSAT-1 onboard
- Successful launch of PSLV-C3 on October 22, 2001, placing three satellites – India's TES, Belgian PROBA, and German BIRD into Polar Sun Synchronous Orbit

2002

- Successful launch of INSAT-3C by Ariane from Kourou, French Guiana (January 24, 2002)
- Successful launch of KALPANA-1 by ISRO's PSLV-C4 from SDSC SHAR (September 12, 2002)

2003

- Successful launch of INSAT-3A by Ariane from Kourou, French Guiana (April 10, 2003)
- Successful launch of GSLV-D2, the second developmental test flight of GSLV with GSAT-2 onboard from SDSC SHAR (May 8, 2003)
- Successful launch of INSAT-3E by Ariane from Kourou, French Guiana (September 28, 2003)
- Successful launch of Resourcesat-1 by ISRO's PSLV-C5 from SDSC SHAR (October 17, 2003)

2004

- GSLV-F01, the first operational flight of GSLV from SDSC SHAR. EDUSAT successfully placed in GTO (September 20, 2004)

2005

- Successful launch of Cartosat-1 and HAMSAT by PSLV-C6 from the newly established Second Launch Pad at SDSC SHAR (May 5, 2005)
- Successful launch of INSAT-4A by Ariane from Kourou, French Guiana (December 22, 2005)

2006

- GSLV-F02, the second operational flight of GSLV from SDSC SHAR with INSAT-4C onboard (July 10, 2006). The satellite could not be placed in orbit

2007

- PSLV-C7 successfully launches four satellites – India's Cartosat-2 and Space Capsule Recovery Experiment (SRE-1) as well as Indonesia's LAPAN-TUBSAT and Argentina's PEHUENSAT-1 (January 10, 2007)
- Successful recovery of SRE-1 after manoeuvring it to re-enter the earth's atmosphere and descend over the Bay of Bengal about 140 km East of Sriharikota (January 22, 2007)
- Successful launch of INSAT-4B by Ariane launch vehicle from Korou, French Guiana, on March 12, 2007
- PSLV-C8 successfully launched an Italian satellite AGILE on April 23, 2007, under a commercial contract with Antrix Corporation
- Launch of GSLV-F04 with INSAT-4CR onboard from SDSC SHAR on September 2, 2007

5.1 Milestones

2008

- PSLV-C10 successfully launched TECSAR satellite on January 21, 2008, under a commercial contract with Antrix Corporation
- PSLV-C9 successfully launched ten satellites on April 28, 2008: India's Cartosat-2A, Indian Mini Satellite-1 (IMS-1), and eight Nanosatellites for International Customers under a commercial contract with Antrix Corporation
- PSLV-C11 successfully launched the Chandrayaan-1 spacecraft on October 22, 2008
- European Ariane-5 launch vehicle successfully launched W2M satellite on December 21, 2008, jointly built by Antrix / ISRO and EADS Astrium on a commercial basis

2009

- PSLV-C12 successfully launched RISAT-2 and ANUSAT on April 20, 2009
- PSLV-C14 successfully launches Oceansat-2 and six nanosatellites for international customers under a commercial contract with Antrix Corporation (September 23, 2009)

2010

- Successful static testing of GSLV Mk-III Launch Vehicle's S200 Solid Propellant Booster Rocket Stage (January 24, 2010)
- GSLV-D3, the first launch of GSLV with indigenous Cryogenic Upper Stage and GSAT-4 satellite onboard. GSAT-4 could not be placed in orbit (April 15, 2010)
- PSLV-C15, the seventeenth flight of PSLV, successfully launches India's Cartosat-2B and STUDSAT, Algeria's ALSAT-2A, Canada's NLS-1 and NLS-2 on (July 12, 2010)
- Successful Static Testing of GSLV Mk-III Launch Vehicle's L110 Liquid Core Stage (September 8, 2010)
- European Ariane-5 launch vehicle successfully launched HYLAS satellite on November 27, 2010, jointly built by Antrix / ISRO and EADS Astrium on a commercial basis
- GSLV-F06, the seventh launch of GSLV with GSAT-5P satellite onboard, could not place the satellite in orbit (December 25, 2010)

2011

- PSLV-C16 successfully launched India's Resourcesat-2, YOUTHSAT and X-SAT from Singapore on April 20, 2011
- GSAT-8 Communication Satellite launched by Ariane launcher from Kourou, French Guiana, on May 21, 2011
- PSLV-C17 successfully launched GSAT-12 Communication Satellite on July 15, 2011
- Second successful static testing of S-200 booster to be used in GSLV Mk-III on September 4, 2011
- PSLV-C18 successfully launched the Indo-French satellite Megha-Tropiques and three co-passenger satellites – Jugnu from IIT, Kanpur, SRMSat from SRM University, Chennai and VesselSat–1 from Luxembourg – on October 12, 2011

2012

- PSLV, in its twenty-first flight (PSLV-C19), launched India's first Radar Imaging Satellite (RISAT-1) from Sriharikota on April 26, 2012
- In its twenty-second flight (PSLV-C21), PSLV successfully launched French earth observation satellite SPOT-6 along with Japanese microsatellite PROITERES from Sriharikota on September 09, 2012
- India's heaviest communication satellite, GSAT-10, was successfully launched by Ariane-5 VA 209 from Kourou, French Guiana, on September 29, 2012

2013

- PSLV, in its twenty-third flight (PSLV-C20), successfully launched Indo-French Satellite SARAL along with six smaller satellites from abroad from Sriharikota on February 25, 2013
- PSLV, in its twenty-fourth flight (PSLV-C22), successfully launched India's first dedicated navigation satellite IRNSS-1A from Sriharikota on July 01, 2013
- India's advanced weather satellite INSAT-3D was successfully launched by Ariane-5 VA-214 from Kourou, French Guiana, on July 26, 2013
- India's advanced communication satellite GSAT-7 was successfully launched by Ariane-5 VA-215 from Kourou, French Guiana, on August 30, 2013
- Mars Orbiter Mission, India's first interplanetary mission to planet Mars, was successfully launched by PSLV-C25 from Sriharikota on November 05, 2013
- Trans Mars Injection Manoeuvre performed on Mars Orbiter Spacecraft on December 01, 2013, to place it in Mars Transfer Trajectory

2014

- In its first successful flight with indigenous Cryogenic Upper Stage, GSLV-D5 successfully placed GSAT-14 into GTO on January 05, 2014
- PSLV, in its twenty-sixth flight (PSLV-C24), successfully launched IRNSS-1B, the second satellite of the Indian Regional Navigation Satellite System (IRNSS) from SDSC SHAR, Sriharikota, on April 04, 2014
- PSLV-C23 Successfully launched French Earth Observation Satellite-SPOT 7 and four other co-passenger satellites from SDSC SHAR, Sriharikota, on June 30, 2014
- India's Mars Orbiter Spacecraft successfully entered into an orbit around planet Mars on September 24, 2014
- PSLV, in its twenty-eighth flight (PSLV-C26), successfully launched IRNSS-1C, the third satellite of the Indian Regional Navigation Satellite System (IRNSS) from SDSC SHAR, Sriharikota, on October 16, 2014
- India's communication satellite, GSAT-16 successfully launched by the Ariane-5 VA221 from Kourou, French Guiana, on December 07, 2014

5.1 Milestones

- The first experimental suborbital flight (LVM3-X / CARE) of India's next-generation launch vehicle LVM3 (GSLV Mk-III) was successfully conducted from Satish Dhawan Space Centre SHAR, Sriharikota on December 18, 2014. The CARE module carried onboard to a height of 126 km successfully recovered

2015

- PSLV-C27 Successfully Launches India's Fourth Navigation Satellite IRNSS-1D on March 28, 2015 from SHAR, Sriharikota
- PSLV-C28 successfully launched three identical DMC3 commercial Earth Observation Satellites, along with two smaller satellites from the United Kingdom, into a polar Sun Synchronous Orbit on July 10, 2015, from SHAR, Sriharikota
- Geosynchronous Satellite Launch Vehicle (GSLV-D6), equipped with the indigenous Cryogenic Upper Stage (CUS), successfully launched 2117 kg GSAT-6 into a GTO on August 27, 2015, from SHAR, Sriharikota
- AstroSat, India's first dedicated astronomy satellite successfully launched by PSLV-C30 on September 28, 2015, from SHAR. Along with AstroSat, six satellites from international customers - LAPAN-A2 of Indonesia, NLS-14 (Ev9) of Canada, and four identical LEMUR satellites of the USA – were also launched by this PSLV flight
- The 3164 kg GSAT-15 carrying Ku-band transponders and GAGAN payload was launched successfully by the European Ariane-5 VA-227 from Kourou, French Guiana, on November 11, 2015
- In its thirty-second flight conducted from SDSC SHAR, Sriharikota on December 16, 2015, PSLV-C29 successfully launched six satellites from Singapore (400 kg TeLEOS-1 as primary satellite and five other co-passenger payloads)

2016

- The Polar Satellite Launch Vehicle, in its 33rd flight (PSLV-C31), launches IRNSS-1E, the fifth satellite of the Indian Regional Navigation Satellite System (IRNSS), on January 20, 2016, from SDSC SHAR, Sriharikota
- The Polar Satellite Launch Vehicle, in its 34th flight (PSLV-C32), launches IRNSS-1F, the sixth satellite of the Indian Regional Navigational Satellite System (IRNSS) on March 10, 2016, from SDSC SHAR, Sriharikota
- The Polar Satellite Launch Vehicle, in its 35th flight (PSLV-C33), launches IRNSS-1G, the seventh satellite of the Indian Regional Navigation Satellite System (IRNSS), into a Sub-Geosynchronous Transfer Orbit (Sub-GTO) on April 28, 2016, from SDSC SHAR, Sriharikota
- India's Reusable Launch Vehicle-Technology Demonstrator (RLV-TD), successfully flight tested on May 23, 2016, from SDSC SHAR, Sriharikota. RLV-TD is one of the most technologically challenging endeavors of ISRO towards developing essential technologies for a fully reusable launch vehicle to enable low-cost access to space

- India's Polar Satellite Launch Vehicle, in its 36th flight (PSLV-C34), launches the 727.5 kg Cartosat-2 Series Satellite for earth observation and 19 co-passenger satellites together weighing about 560 kg at lift-off into a 505 km polar Sun Synchronous Orbit (SSO) on June 22, 2016, from Sriharikota. The co-passenger satellites are from the USA, Canada, Germany, and Indonesia, as well as two satellites (SATHYABAMASAT and SWAYAM) from the Indian University / Academic Institute
- The first experimental mission of ISRO's Scramjet Engine towards the realisation of an Air Breathing Propulsion System was successfully conducted on August 28, 2016, from SHAR
- India's Geosynchronous Satellite Launch Vehicle (GSLV), in its tenth flight (GSLV-F05), launches INSAT-3DR, an advanced weather satellite weighing 2,211 kg into a Geostationary Transfer Orbit (GTO) on September 08, 2016, from SDSC SHAR, Sriharikota
- India's Polar Satellite Launch Vehicle, in its 37th flight (PSLV-C35), launches the 371 kg SCATSAT-1 for weather-related studies and seven co-passenger satellites into polar Sun Synchronous Orbit (SSO) on September 26, 2016, from SDSC SHAR Sriharikota. Co-passenger satellites are ALSAT-1B, ALSAT-2B, ALSAT-1N from Algeria, NLS-19 from Canada, and Pathfinder-1 from USA, as well as two satellites PRATHAM from IIT Bombay and PISAT from PES University, Bengaluru
- India's latest communication satellite, GSAT-18, was inducted into the INSAT / GSAT system on October 06, 2016, from Kourou, French Guiana, by Ariane-5 VA-231. Weighing 3,404 kg at lift-off, GSAT-18 carries 48 communication transponders to provide services in Normal C-band, Upper Extended C-band, and Ku-bands of the frequency spectrum along with a Ku-band beacon for accurately pointing ground antennas towards the satellite
- In its 38th flight (PSLV-C36), ISRO's Polar Satellite Launch Vehicle successfully launched a 1,235 kg Resourcesat-2A Satellite on December 07, 2016, from Satish Dhawan Space Centre SHAR, Sriharikota. This is the 37th consecutively successful mission of PSLV

2017

- In its thirty-ninth flight (PSLV-C37), ISRO's Polar Satellite Launch Vehicle successfully launched the 714 kg Cartosat-2 Series Satellite along with 103 co-passenger satellites on February 15, 2017, from SHAR, Sriharikota. This is the thirty-eighth consecutively successful mission of PSLV. The total weight of all the 104 satellites carried onboard PSLV-C37 was 1378 kg. This is the highest number of satellites launched in a Single Flight
- India's Geosynchronous Satellite Launch Vehicle, in its eleventh flight (GSLV-F09), successfully launched the 2230 kg South Asia Satellite (GSAT-9) from SDSC SHAR, Sriharikota, into its planned Geosynchronous Transfer Orbit (GTO) on May 05, 2017. This is the fourth consecutive success achieved by GSLV carrying indigenously developed Cryogenic Upper Stage

5.1 Milestones

- The first developmental flight (GSLVMk-III D1) of India's heavy-lift launch vehicle GSLV Mk-III was successfully conducted on June 05, 2017, from SHAR, Sriharikota, with the launch of the GSAT-19 satellite. This was the first orbital mission of GSLVMk-III, which was mainly intended to evaluate the vehicle's performance, including that of its fully indigenous cryogenic upper stage during the flight. Weighing 3136 kg at lift-off, GSAT-19 is the heaviest satellite launched from Indian soil
- ISRO's Polar Satellite Launch Vehicle PSLV-C38 successfully launched the 712 kg Cartosat-2 Series Satellite along with 30 co-passenger satellites on June 23, 2017, from SHAR, Sriharikota. This is the thirty-ninth consecutively successful mission of PSLV
- India's communication satellite, GSAT-17, was inducted into the INSAT/GSAT system on June 29, 2017, from Kourou, French Guiana by Ariane-5 VA-238. The 3477 kg GSAT-17 carries communication payloads in C-band, Extended C-band, and S-band for providing various services to the country. The satellite also carries equipment for meteorological data relay and satellite-based search and rescue services
- The forty-first flight of India's Polar Satellite Launch Vehicle (PSLV-C39), carrying IRNSS-1H Navigation Satellite, conducted on August 31, 2017, from Satish Dhawan Space Centre SHAR, Sriharikota, was unsuccessful

2018

- In its 42nd flight, PSLV-C40 successfully launched the 710 kg Cartosat-2 Series Remote Sensing Satellite along with 30 co-passenger satellites on January 12, 2018, from SHAR, Sriharikota. The co-passenger satellites comprise one microsatellite and one nanosatellite from India as well as 3 microsatellites and 25 Nanosatellites from six countries, namely, Canada, Finland, France, the Republic of Korea, the UK and the USA
- GSLV-F08, in its 12th flight as a Geosynchronous Satellite Launch Vehicle (GSLV) launched GSAT-6A from the Second Launch Pad (SLP) in SHAR, Sriharikota, on March 29, 2018. However, the satellite lost communication with the ground station
- India's Polar Satellite Launch Vehicle, in its forty-third flight (PSLV-C41) in, launched IRNSS-1I Satellite from First Launch Pad (FLP) of SDSC SHAR, Sriharikota, on April 12, 2018. The IRNSS-1I is the eighth satellite to join the NavIC navigation satellite constellation
- A major technology demonstrator called as Pad Abort Test was successfully carried out at SHAR, Sriharikota, on July 05, 2018. This was one of the tests to qualify for a Crew Escape System, a critical human spaceflight technology. The first Pad Abort Test demonstrated the safe recovery of the crew module in case of any exigency at the launch pad
- PSLV-C42 Successfully Launched two foreign satellites from SDSC, SHAR, Sriharikota on September 16, 2018. This mission launched two earth observation satellites, NovaSAR and S1-4 (together weighing nearly 889 kg) of M/s Surrey Satellite Technologies Limited (SSTL), the United Kingdom, under commercial arrangement with Antrix Corporation Limited

- On November 14, 2018, GSLV Mk-III D2 successfully launched a communication satellite, GSAT-29, into orbit weighing about 3423 kg from SDSC SHAR, Sriharikota
- PSLV-C43, on November 29, 2018, successfully launched India's Hyperspectral Imaging Satellite (HysIS) and 30 international co-passenger satellites. HysIS, the primary satellite of the PSLV-C43 mission, weighing about 380 kg, is an earth observation satellite configured around ISRO's Mini Satellite-2 (IMS-2) bus. The co-passengers of HysIS include 1 Microsatellite and 29 nanosatellites from 8 different countries. These satellites have been commercially contracted for launch through Antrix Corporation Limited, the commercial arm of ISRO
- ISRO's next-generation high throughput communication satellite, GSAT-11, was successfully launched on December 05, 2018, from the Kourou launch base, French Guiana, by Ariane-5 VA-246. Weighing about 5854 kg, GSAT-11 is the heaviest satellite built by ISRO. GSAT-11 is the forerunner in the series of advanced communication satellites with multi-spot beam antenna coverage over the Indian mainland and Islands. GSAT-11 will play a vital role in providing broadband services across the country. It will also provide a platform to demonstrate new-generation applications
- GSLV-F11 successfully launched GSAT-7A, ISRO's 39th communication satellite, on December 19, 2018, from the Second Launch Pad (SLP) of SHAR, Sriharikota. GSAT-7A, with a lift-off mass of 2250 kg, is a geostationary satellite carrying communication transponders in Ku-band. The Satellite is built to provide communication capability to users over the Indian region

2019

- PSLV-C44 successfully launched Microsat-R and Kalamsat-V2 on January 24, 2019, from Sriharikota
- On February 06, 2019, GSAT 31 was successfully launched from Kourou, French Guiana, on board the Arianespace rocket
- EMISAT and 28 customer satellites were successfully launched onboard PSLV-C45 on April 01, 2019, from Sriharikota. The launch viewing gallery was inaugurated and opened to the public for viewing launches live from Sriharikota
- On May 22, 2019, RISAT-2B satellite was successfully launched onboard PSLV-C46 from Sriharikota
- Chandrayaan-2 satellite was successfully launched into an earth orbit by GSLV Mk-III M1 on July 22, 2019
- On November 27, 2019, Cartosat-3 and 13 customer satellites were successfully launched by PSLV-C47 from Sriharikota
- On December 11, 2019, PSLV-C48 successfully launched RISAT-2BR1satellite and 9 customer satellites from Sriharikota

5.1 Milestones

2020

- On January 17, 2020, GSAT-30 was successfully launched from Kourou, French Guiana, on board the Arianespace Ariane-5 VA-251 rocket
- EOS-01 and nine customer satellites were successfully launched by PSLV-C49 on November 07, 2020, from Sriharikota
- PSLV-C50 successfully launched CMS-01 on December 17, 2020, from Sriharikota

2021

- On February 28, 2021, PSLV-C51 successfully launched Amazonia-1 and 18 co-passenger satellites from Sriharikota. It marked the first dedicated launch for NSIL. Out of 18 co-passengers, four were from IN-SPACe and the remaining from NSIL
- GSLV-F10 carrying EOS-03 was launched from Sriharikota on August 12, 2021. The mission could not be accomplished as intended due to a technical anomaly

2022

- On February 14, 2022, PSLV-C52 injected Earth Observation Satellite EOS-04, a Radar Imaging Satellite designed to provide high-quality images under all weather conditions, into an intended sun-synchronous polar orbit. It also placed a student satellite, INSPIREsat-1 and a technology demonstrator satellite, INS-2TD, which is a precursor to India-Bhutan Joint Satellite (INS-2B)
- On June 22, 2022, GSAT-24, a communication satellite weighing 4180 kg with Pan India coverage for meeting DTH applications, was launched successfully through Arianespace. It was the first Demand Driven mission by NSIL, post space reforms
- On June 30, 2022, PSLV-C53 launched three satellites DS-EO satellite, NeuSAR satellite, and SCOOB-I satellite. All satellites belonged to Singapore. This was the second dedicated commercial mission of NewSpace India Limited (NSIL). This mission performed PSLV Orbital Experimental Module (POEM) activity to conduct scientific experiments using the spent PS4 stage as an orbital platform. It was first time that the PS4 stage would orbit the earth as a stabilized platform
- On August 7, 2022, the first developmental flight of a small satellite launch vehicle (SSLV) was conducted. The vehicle could not place the satellites into 356 km circular orbits but placed in 356 km x 76 km elliptical orbit and thus fell short of its target
- On October 23, 2022, LVM3 placed 36 satellites of OneWeb in their intended orbits. This was a dedicated commercial mission for a foreign customer through NSIL. This was one of the biggest commercial orders executed by ISRO. With this launch, the LVM3 enters into the global market in a grand manner
- On November 18, 2022, the first launch of a launch vehicle built by a private company in India was accomplished. Vikram-S, a suborbital launch vehicle from M/s Skyroot Aerospace Pvt. Ltd., Hyderabad, was launched successfully from SDSC, Sriharikota
- A private launchpad and mission control centre was established within the ISRO campus at SDSC SHAR, Sriharikota, for the first time. The launchpad is designed and operated

by a private company, an Indian space-tech start-up, Agnikul. It was inaugurated by Chairman ISRO, on November 25, 2022

- On November 26, 2022, PSLV-C54 successfully launched the EOS-06 satellite along with eight nanosatellites into two different SSPOs. The mission used two Orbit Change Thrusters (OCTs) introduced in the Propulsion Bay Ring of the Vehicle to achieve two different orbits. Nanosatellites included the India-Bhutan Satellite

2023

- On February 10, 2023, SSLV-D2 injected Earth Observation Satellite EOS-07, having experiments including mm-Wave Humidity Sounder and Spectrum Monitoring Payloads. It also placed Janus-1 of ANTARIS, USA and AzaadiSAT-2 realised by 750 girl students across India guided by Space Kidz India, Chennai
- On March 26, 2023, the LVM3 M3 vehicle launched 36 numbers of OneWeb India-2 satellites into their intended 450 km circular orbit with an inclination of 87.4 degrees. This contract was executed through NSIL
- On April 2, 2023, the Reusable Launch Vehicle Autonomous Landing Mission (RLV LEX) was conducted. The test was performed at the Aeronautical Test Range (ATR), Chitradurga, Karnataka. The autonomous landing was carried out under the exact conditions of a Space Re-entry vehicle's landing "high speed, unmanned, precise landing from the same return path" as if the vehicle arrives from space
- On April 22, 2023, PSLV-C55 vehicle successfully launched TeLEOS-2 satellite. This is a dedicated commercial mission through NSIL with TeLEOS-2 as primary satellite and Lumelite-4 as a co-passenger satellite. The satellites weigh about 741 kg and 16 kg, respectively. The mission had the PSLV Orbital Experimental Module (POEM), where the spent PS4 stage of the launch vehicle would be utilized as an orbital platform to carryout scientific experiments through non-separating payloads. The payloads belong to ISRO/Department of Space, Bellatrix, Dhruva Space, and the Indian Institute of Astrophysics
- On May 29, 2023, GSLV-F12 vehicle deployed the NVS-01 navigation satellite, weighing about 2232 kg, into a Geosynchronous Transfer Orbit. NVS-01 is the first of the second-generation satellites envisaged for the Navigation with Indian Constellation (NavIC) services. NVS series of satellites will sustain and augment the NavIC with enhanced features and incorporate L1 band signals additionally to widen the services
- On July 14, 2023, the LVM-3 M4 vehicle, in its fourth operational flight, launched Chandrayaan-3 to a precise Geo Transfer Orbit (GTO)
- On July 30, 2023, PSLV-C56 launched DS-SAR satellite, along with 6 co-passengers. Configured in its core-alone mode, C56 launched a 360 kg satellite into a Near-equatorial Orbit (NEO) at 5 degrees inclination and 535 km altitude
- On August 5, 2023, following a series of maneuvers, Chandrayaan-3 was inserted into the lunar orbit. The lander module was successfully separated from the propulsion module on August 17, 2023. The lander module was brought to a 25 km x 134 km orbit around the moon on August 20, 2023

5.1 Milestones

- On August 23, 2023, Chandrayaan-3 soft-landed on the moon
- On August 24, 2023, the rover descended on the lunar surface. For over 14 Earth days, in-situ scientific experiments were conducted on the moon, near its south pole
- On September 03, 2023, a hop test was conducted on Chandrayaan-3 lander. On October 13, 2023, the propulsion module was brought to an Earth-bound orbit, demonstrating the capability of Earth-return maneuvers
- On September 2, 2023, PSLV-C57 launched Aditya L1, the first Indian solar observatory, into precise orbit. Four maneuvers and a planned trajectory correction maneuver ensured Aditya-L1's Trans-Lagrangean Point 1 Insertion (TL1I) on October 8, 2023.
- On October 18, 2023, the Gaganyaan TV D1 Test Flight was accomplished. The Crew Escape System performed as intended. Performance of various separation systems incorporated into the Crew Escape System, the characteristics and deceleration systems demonstration at higher altitude & its recovery was demonstrated

2024

- The Aditya-L1 observatory was successfully injected into Halo orbit L1 on January 6, 2024
- PSLV-C58 successfully launched XPoSat, (X-ray Polarimeter Satellite) India's first dedicated polarimetry mission to study various dynamics of bright astronomical X-ray sources in extreme conditions on January 1, 2024, into the intended orbit. Both the XSPECT and POLIX payloads began astronomical observations during January and February respectively
- PSLV-C58 had the PSLV Orbital Experimental Module-3 (POEM-3) that successfully conducted 10 experiments through payloads identified and supplied by ISRO and IN-SPACe
- On February 17, 2024, GSLV-F14 successfully deployed INSAT-3DS, a meteorological satellite into the Geosynchronous Transfer Orbit (GTO). GSLV-F14/INSAT-3DS mission is fully funded by the Ministry of Earth Sciences (MoES). The satellite initiated Earth imaging operations with the first set of images captured on March 7, 2024
- On March 22, 2024, the Reusable Launch Vehicle Autonomous Landing Mission (RLV LEX-02) landing experiment, the second of the series, was conducted at Aeronautical Test Range (ATR), Chitradurga in Karnataka. After accomplishment of RLV-LEX-01 mission in last year, RLV-LEX-02 demonstrated the autonomous landing capability of RLV from off-nominal initial conditions at release from Helicopter. The RLV was made to undertake more difficult manoeuvres with dispersions, correct both cross-range and downrange and land on the runway in a fully autonomous mode.
- On June 23, 2024, Reusable Launch Vehicle Autonomous Landing Mission (RLV LEX - 03) was conducted at the Aeronautical Test Range (ATR) in Chitradurga, Karnataka. RLV LEX-03 re-demonstrated the autonomous landing capability of the RLV under more challenging release conditions (cross range of 500 m against 150 m for LEX-02) and more severe wind conditions.
- On July 22, 2024, the second experimental flight for the demonstration of Air Breathing

Propulsion Technology was carried out. The Propulsion systems were symmetrically mounted on either side of a RH-560 Sounding rocket and launched from SDSC, Sriharikota. The flight test achieved satisfactory performance of the Sounding Rocket along with successful ignition of the Air Breathing propulsion systems.

- On August 16, 2024, the third developmental flight of SSLV was successfully launched. The SSLV-D3, in its third and final development flight, launched EOS-08 satellite.
- On Nov 19, 2024, GSAT-N2 satellite was successfully launched on-board Falcon-9 of M/s SpaceX, USA.
- On Dec 05, 2024, PSLV-C59 vehicle launched Proba-3 satellite. This is a dedicated commercial mission conducted through NSIL, featuring the launch of the Proba-3 satellite for an In-Orbit Demonstration (IOD) mission aimed at showcasing precise formation flying. The mission comprised of two spacecrafts viz., the Coronagraph Spacecraft (CSC) and the Occulter Spacecraft (OSC), both launched together in a stacked configuration.
- On December 30, 2024, PSLV-C60 vehicle successfully launched SpaDeX satellites. SpaDeX mission is a cost-effective technology demonstrator mission for the demonstration of in-space docking. The SpaDeX mission consists of two small spacecraft (about 220 kg each) which are launched independently and simultaneously, into a 470 km circular orbit at 55° inclination.
- PSLV-C60 had the PSLV Orbital Experimental Module-4 (POEM-4) that carried a total of 24 payloads, of which 14 payloads are from ISRO/DOS Centres and 10 payloads are from various Non-Government Entities (NGEs) comprising Academia and Start-ups that have been received through IN-SPACe.

2025

- On January 16, 2025, ISRO successfully completed docking of two SPADEX satellites (SDX-01 & SDX-02).
- On January 29, 2025, GSLV-F15 vehicle launched NVS-02 satellite weighing about 2250 kg, into a Geosynchronous Transfer Orbit. This launch marked the 100th Launch from the India's Spaceport Sriharikota.

5.2 Acronyms

AA	Aluminium Alloy
AAI	Airport Authority of India
ABPP	Air Breathing Propulsion Project
ACL	Antrix Corporation Limited
ADCOS	Advisory Committee for Space Sciences
ADRDE	Ariel Delivery Research and Development Establishment
ADT	Advanced Dvorak Technique
AFC	Autonomous Film Cooling
AFTN	Aeronautical Fixed Telecommunication Network
AGB	Above Ground Biomass
AGEOS	Antarctica Ground Station for Earth Observation Satellites
AICTE	All India Council for Technical Education
AIT	Assembly, Integration and Testing
AMD	Atomic Minerals Directorate
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
AoI	Area of Interest
APEP	Ammonium Perchlorate Experimental Plant
APRSAF	Asia Pacific Regional Space Agency Forum
APV	Approach with Vertical Guidance
AQUA	Aqua Earth-Observing Satellite Mission
ARG	Automatic Rain Gauge
ARIES	Aryabhatta Research Institute of Observational Sciences
ASA	Australian Space Agency
ASAAN	Applications of Space Techniques for Agricultural Assessment in NER
ASCI	Administrative Staff College of India
ASDM	Aerial Services and Digital Mapping
ASEAN	Association of Southeast Asian Nations
ASIC	Application Specific Integrated Circuit
ASICs	Application Specific Integrated Circuits
ASLP	Augmentation of Second Launch Pad Project
ASMS	Aquifer Sustainability Management System
ASPEX	Aditya Solar wind Particle Experiment
ASTDC	Advanced Space Technology Development Cell

ATF	Astronaut Training Facility
AVIRIS-NG	Airborne Visible Infrared Imaging Spectrometer-Next Generation
AWiFS	Advanced Wide Field Sensor
AWS	Automatic Weather Stations
BAH	Bharatiya Antariksh Hackathon
BIS	Bureau of Indian Standards
BISAG-N	Bhaskaracharya National Institute for Space Applications and Geo-informatics
BPOFM	Bunched Passage Orifice Flow Meter
BRO	Border Roads Organisation
BSNL	Bharat Sanchar Nigam Limited
BSX	Bengaluru Space Expo
CANSAT	Can Satellite
CAQM	Commission for Air Quality Management
CATVAC	Comprehensive Assembly and Test Vacuum Chamber
CCoE	Chief Controller of Explosives
CDMA	Code Division Multiple Access
CECS	Crew Escape systems Conical Shroud
CeNSE	Centre for Nano Science and Engineering
CEOS	Committee on Earth Observation Satellites
CEOS	Crew Escape systems Ogive Shroud
CES	Crew Escape System
CFD	Computational Fluid Dynamics
CFRP	Composite Fiber Reinforced Plastic
CGMS	Coordination Group for Meteorological Satellites
CHACE	CHandra's Atmospheric Composition Explorer
CHAMAN	Coordinated programme on Horticulture Assessment & Management using Geoinformatics
CII	Confederation of Indian Industry
CJM	CES Jettisoning Motor
CLASS	Chandrayaan-2 Large Area Soft X-ray Spectrometer
CME	Continuing Medical Education
CME	Coronal Mass Ejections
CMOS	Complementary Metal Oxide Semiconductor

5.2 Acronyms

CMPS	Crew Module Propulsion System
CMS	Communication & Data Relay Satellite
CMUS	Crew Module Up-righting System
CNES	Centre National d'Etudes Spatiales
COB	Chip-On-Board
CoE	Centre of Excellence
CORS	Continuously Operating Reference Stations
COSPAR	Committee on Space Research
COSPAS	Cosmicheskaya Sistema Poiska Avariynich Sudov
CPCB	Central Pollution Control Board
CRIS	Centre for Railway Information System
CSA	Charge Sensitive AmplifierCrew Seat Assembly
CSR&SD	Corporate Social Responsibility and Sustainable Development
CSSTE-AP	Centre for Space Science and Technology Education in Asia and the Pacific
CUG	Closed User Group
CUS	Cryogenic Upper Stage
DAC&FW	Department of Agriculture, Cooperation & Farmers' Welfare
DAT	Distress Alert Transmitter
DCS	Data Communication System
DECU	Development and Educational Communication Unit
DEM	Digital Elevation Model
DfAM	Design for Additive Manufacturing
DGCA	Directorate General of Civil Aviation
DHRC	Directorate for Human Rating Certification
DISHA	Disturbed and quiet-time Ionosphere-thermosphere System at High Altitudes
DMS	Disaster Management Support
DOHS	Directorate of Occupational Health and Safety
DoLR	Department of Land Resources
DOORS	Dynamic Object Oriented Requirements System
DOS	Department Of Space
DOT	Department of Telecommunications
DRT	Data Relay Transponder

DSN	Deep Space Network
DSNG	Digital Satellite News Gathering
DSRQ	Directorate of Safety, Reliability and Quality
DTH	Direct-to-home
DWR	Doppler Weather Radars
ECIL	Electronics Corporation of India Limited
ECLSS	Environment Control and Life Support System
ECMWF	European Centre for Medium Range Weather Forecasts ECVs Essential Climate Variables
EGC	Engine Gimbal Control
EIA	Equatorial Ionization Anomaly
EIRP	Effective Isotropic Radiated Power
EMA	Electromechanical actuators
ENWi	Electron density and Neutral Wind
EO	Earth Observation
EOC	Early Operations Capability
EOS	Earth Observation Satellite
ERNET	Education and Research Network
ESA	European Space Agency
ESCES	Experimental Satellite Communication Earth Station
ESIC	Employees State Insurance Corporation
EUMETSAT	European Organisation for Exploitation of Meteorological Satellites
FCC	False Colour Composite
FIR	Flight Information Region
FLEWS	Flood Early Warning System
FLP	First Launch Pad
FM	Flight Model
FPD	Flight Procedure Document
FSI	Forest Survey of India
FSS	Fixed Satellite Services
FTP	File Transfer Protocol
GAC	Global Area Coverage
GAGAN	GPS Aided Geo Augmented Navigation
GDD	Growing Degree Days

5.2 Acronyms

GEDI	Global Ecosystem Dynamics Investigation
Geo MGNREGA	GIS Implementation of MGNREGA
GEO	Geostationary Earth Orbit
GHRC	Geo High Resolution Camera
GHz	Giga Hertz
GIGW	Guidelines for Indian Government Websites
GIS	Geographical Information System
GISAT	Geo Imaging Satellites
GLEX	Global Space Exploration Conference
GLOF	Glacial Lake Outburst Flood
GNSS	Global Navigation Satellite System
GOCO	Government Owned and Company Operate
GPP	Gross Primary Production
GPS	Global Positioning System
GRT	Ground Resonance Test
GSaaS	Ground Station as a Service
GSAT	Geosynchronous Satellite
GSI	Geological Survey of India
GSLV Mk-III	Geosynchronous Satellite Launch Vehicle Mark III
GSLV	Geosynchronous Satellite Launch Vehicle
GSTA	Geo-spatial Technologies and Applications
GTO	Geosynchronous Transfer Orbit
GWP	Ground Water Prospecting
HAVA	Hypersonic Air Breathing Vehicle with Air frame integrated system
HEM	High-altitude Escape Motor
HLVM3	Human - Rated Launch Vehicle Mark-3
HMC	Hybrid Micro Circuit
HPM	High Altitude Pitch Motor
HSP	Human Spaceflight Programme
HTPB	Hydroxyl-Terminated PolyButadiene
HTS	High Throughput Satellite
HTVE	High Thrust Vikas Engine
HySIS	Hyper Spectral Image Sensor
i2P2M	International Institute of Projects and Programme Management

IA	Implementation Arrangement
IAA	International Academy of Astronautics
IAC	International Astronautical Congress
IADC	Inter-Agency Space Debris Coordination Committee
IAF	International Astronautical Federation
ICC	INSAT Coordination Committee
ICC	Intergovernmental Consultative Committee
ICD	Interface Control Document
ICET	Integrated Cryogenic Engine and stage Test facility
ICG	International Committee for Global Navigation Satellite Systems
ICR-ER	Integrated Control Room for Emergency Response
ICT	Information & Communication Technology
IDSN	Indian Deep Space Network
IDTR	Institute of Driving Training and Research
IFMC	In Flight and Maritime Connectivity
i-GOT	Integrated Government Online Training
IGS	International Ground Stations
IIG	Indian Institute of Geomagnetism
IIRS	Indian Institute of Remote Sensing
IISc	Indian Institute of Science
IISL	International Institute of Space Law
IIST	Indian Institute of Space Science and Technology
IISU	ISRO Inertial Systems Unit
IIT	Indian Institute of Technology
IITs	Indian Institute of Technologies
IMD	India Meteorological Department
IMDPS	INSAT Meteorological Data Processing System
IMGEOS	Integrated Multi-Mission Ground Segment for Earth Observation Satellites
IMPRINT	IMPacting Research Innovation and Technology
IMS	Indian Mini Satellite
INC	IRNSS Navigation Centre
INCOIS	Indian National Centre for Ocean Information Services
INCOSPAR	Indian National Committee for Space Research

5.2 Acronyms

INMCC	Indian Mission Control Centre
INSAT	Indian National Satellite
IN-SPACe	Indian National Space Promotion and Authorisation Centre
IOCL	Indian Oil Corporation Limited
IPMI	Intelligent Power Management Interface
IPRC	ISRO Propulsion Complex
IRCDR	IRNSS CDMA Ranging Stations
IRDCN	IRNSS Data Communication Network
IRIMS	IRNSS Range & Integrity Monitoring Stations
IRNSS	Indian Regional Navigation Satellite System
IRNWT	IRNSS Network Timing Facility
IRoC-U	ISRO Robotics Challenge-URSC
IRS	Indian Remote Sensing
IRSCF	IRNSS Spacecraft Control Facility
ISECG	International Space Exploration Coordination Group
ISITE	ISRO Satellite Integration and Test Establishment
ISLSWG	International Space Life Sciences Working Group
ISPRS	International Society for Photogrammetry and Remote Sensing
ISRO	Indian Space Research Organisation
ISS	International Space Station
ISSDC	Indian Space Science Data Centre
IST	Indian Standard Time
ISTRAC	ISRO Telemetry, Tracking and Command Network
ITBP	Indo Tibetan Border Police
ITTP	ISRO Technical Training Programme
IWMP	Integrated Watershed Management Programme
JAXA	Japan Aerospace Exploration Agency
JAYAKAR	Jan Jatiya Yuva Antariksha Karyakram
JPSS	Joint Polar Satellite System
KSDMA	Kerala State Disaster Management Authority
LAC	Local Area Coverage
LCS	Lagrangian Coherent Structures
LDCP	Low Density Carbon Phenolic
LEM	Low-altitude Escape Motor

LEO	Low Earth Orbit
LEOLUT	Low Earth Orbiting Local User Terminal
LEOP	Launch and Early Orbit Phase
LEOS	Laboratory for Electro-Optics Systems
LGS	Length of Growing Season
LiDAR	Light Detection and Ranging
LIN	Liquid Nitrogen
LIS	Land Information System
LISS	Linear Imaging Self-Scanning
IIST	Indian Institute of Space Science and Technology
LME	LOX-Methane Engine
LPM	Low Altitude Pitch Motor
LPSC	Liquid Propulsion Systems Centre
LSA	Launch Service Agreement
LST	Land Surface Temperature
LULC	Land Use / Land Cover
LULC	Land Use Land Cover
LuPEX	Lunar Polar Exploration
LUTs	Local User Terminals
LWIR	Long Wave Infrared
M&C	Monitor & Control
MADRAS	Microwave Analysis and Detection of Rain and Atmospheric Structures
MCC	Mission Control Centre
MCF	Master Control Facility
MDA	Medium Density Ablative
MEMS	Micro-Electro-Mechanical Systems
MEOLUT	Medium Earth Orbiting Local User Terminal
MEOSAR	Medium Earth Orbit Search and Rescue
MHA	Ministry of Home Affairs
MHRD	Ministry of Human Resource Development
MIDH	Mission for Integrated Development of Horticulture
MMDRPS	Multi Mission Meteorological Data Receiving & Processing System
MMOD	Micro-Meteoroid and Orbital Debris

5.2 Acronyms

MNCFC	Mahalanobis National Crop Forecast Centre
MoA&FW	Ministry of Agriculture & Farmers Welfare
MoD	Ministry of Defence
MODIS	Moderate Resolution Imaging Spectroradiometer
MoES	Ministry of Earth Sciences
MOSDAC	Meteorological and Oceanographic Satellite Data Archival Centre
MoU	Memorandum of Understanding
MRCCs	Maritime Rescue Coordination Centres
MRD	Ministry of Rural Development
MSA	Mechanical Systems Area
MSDE	Ministry of Skill Development & Entrepreneurship
MSS	Mobile Satellite Services
NARL	National Atmospheric Research Laboratory
NASA	National Aeronautics and Space Administration
NASRDA	National Space Research and Development Agency
NavIC	Navigation with Indian Constellation
NCAP	National Clean Air Programme
NCMRWF	National Centre for Medium Range Weather Forecasting
NCPOR	National Centre for Polar and Ocean Research
NCVET	National Council for Vocational Education and Training
NDEM	National Database for Emergency Management
NDMA	National Disaster Management Authority
NDVI	Normalised Difference Vegetation Index
NDVI	Normalized Difference Vegetation Index
NEC	North Eastern Council
NEE	Net Ecosystem Carbon Exchange
NER	North Eastern Region
NE-SAC	North Eastern-Space Applications Centre
NeSDR	North Eastern Spatial Data Repository
NGEs	Non-Governmental Entities
NGLV	Next Generation Launch Vehicle
NGOs	Non-Government Organisations
NGPE	Non-Government Private Entity
NHP	National Hydrology Project

NIAS	National Institute of Advanced Studies
NICES	National Information System for Climate and Environment Studies
NIO	National Institute of Oceanography
NISAR	NASA-ISRO Synthetic Aperture Radar
NOAA	National Oceanic and Atmospheric Administration
NPLI	National Physical Laboratory India
NPS	Nozzle Protection System
NRSC	National Remote Sensing Centre
NSIL	NewSpace India Limited
NSpD	National Space Day
NSQF	National Skill Qualifications Framework
NSSO	National Sample Survey Office
NSSS	National Space Science Symposium
NSTIs	National Skill Trainings Institutes
NTPC	National Thermal Power Corporation
NTU	Nanyang Technical University
NVS	Navigational Satellite
NWH	North West Himalaya
OBC	On-Board computer
OCM	Ocean Colour Monitor
OEMs	Original Equipment Manufacturers
ONGC	Oil and Natural Gas Corporation
ORV	Orbital Re-entry Vehicle
OTC	Open Top Chamber
PAT	Pad Abort Test flight
PC-NNRMS	Planning Committee on National Natural Resources Management System
PHMS	Personal Hygiene Management System
PHTA	Power Head Test Article
PIE	Pre-Incubation Entrepreneurship
PIF	PSLV Integration Facilities
PMFBY	Pradhan Mantri Fasal Bima Yojana
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PMMSY	Pradhan Mantri Matsya Sampada Yojana

5.2 Acronyms

POEM	PSLV Orbital Experimental Module
POLIX	Polarimeter Instrument in X-rays
PPP	Public-Private Partnership
PRADAN	Professional Assistance for Development Action
PRAGATI	Pro-Active Governance and Timely Implementation
PraVaHa	Parallel RANS Solver for Aerospace Vehicle Aero- thermo-dynamic Analysis
PRL	Physical Research Laboratory
PSLV	Polar Satellite Launch Vehicle
PSVI	Peak of Season Vegetation Index
QUAD	Quadrilateral Security Dialogue
R&D	Research & Development
RAC-S	Regional Academic Centres for Space
RAPID	Real Time Analysis Product & Information Dissemination
RCCs	Rescue Coordination Centres
RCS	Reaction Control System
RCT	Reaction Control Thrusters
RDAS	Reconfigurable Data Acquisition System
ReDAMS	Research & Development in Additive Manufacturing for Space
RESAP	Regional Space Application Programme for Sustainable Development
RESPOND	Research Sponsored
RESPOND	Sponsored Research
REWARD	Rejuvenating Watersheds for Agricultural Resilience through Innovative Development
RFP	Request For Proposal
RIS	RLV Interface System
RISAT	Radar Imaging Satellite
RLV-TD	Reusable Launch Vehicle
RN	Radio Networking
RNP	Required Navigation Performance
RNT	Radio Network Terminal
ROSA	Radio Occultation Sounder for Atmospheric studies
ROSCOSMOS	Russian Federal Space Agency

ROTs	Receive Only Terminals
RRSCs	Regional Remote Sensing Centres
RRSLs	Regional Reference Standards Laboratories
RS	Restricted Service
RTI	Right to Information
RTIS	Real-time Train Information System
RTRS	Rail Track Rocket Sled
SAARC	South Asian Association for Regional Cooperation SAC Space Applications Centre
SANSA	South African National Space Agency
SAPHIR	Sounder for Probing Vertical Profiles of Humidity SAR Synthetic Aperture Radar
SARAL	Satellite with ARGOS and ALTIKA
SARSAT	Search and Rescue Satellite Aided Tracking
SAS & R	Satellite Aided Search and Rescue
SAS&R	Satellite Aided Search and Rescue
SATCOM	Satellite Communications
SATNAV	Satellite Navigation
SBAS	Satellite Based Augmentation System
SCATSAT	Scatterometer Satellite
SCENC	Semi Cryo Engine Nozzle Closure
SCORPIO	Satellite Based Cyclone Observation for Real-time Prediction over Indian Ocean
SDCSS	Satish Dhawan Centre for Space Science
SDMA	Space Division Multiple Access
SDSC SHAR	Satish Dhawan Space Centre Sriharikota High Altitude Range
SFCG	Space Frequency Coordination Group
SIS	Signal-In-Space
SITE	Satellite Instructional Television Experiment
SITs	Satellite Interactive Terminals
SLC	SSLV Launch Complex
SLP	Second Launch Pad
SMC	SATCOM Monitoring Centre
SMS	Static Mock-up Simulator

5.2 Acronyms

SoLEXS	Solar Low Energy X-ray Spectrometer
SOLVE	Sub-Orbital Launch Vehicle for Experiments
SPADEX	Space Docking Experiment
SPPU	Savitribai Phule Pune University
SPROB	Solid Propellant Space Booster Plant
SPS	Standard Positioning Service
SSA	Space Situational Awareness
SSC	Swedish Space Centre
SSIDH	Space based Support for Integrated Development of Horticulture in NER
SSLV	Small Satellite Launch Vehicle
SSPA	Solid State Power Amplifier
SSPO	Sun-synchronous Polar Orbit
SSRF	Space Science Roadmap Formulation
SST	Sea Surface Temperature
SSTL	Surrey Satellite Technology Limited
SSTM	Sea Surface Temperature Monitor
SSV	Space Service Volume
STAC	Spatio-Temporal Asset Catalogue
START	Space science and Technology Awareness Training
STC	Space Technology Cells
STCs	Space Technology Cells
STEP	Satellite Telecommunication Experimental Project
SVAB	Second Vehicle Assembly Building
SWIR	Short Wave Infrared
TDP	Technology Development Programmes
TDV	Technology Demonstrator Vehicle
TERLS	Thumba Equatorial Rocket Launching Station
TG	Temperature-Greenness
TMA	Trimethyl Aluminum Experiment
TOLIC	Town Official Language Implementation Committee
ToT	Transfer of Technology
TPS	Thermal Protection System

TRISHNA	Thermal Infra-Red Imaging Satellite for High-resolution Natural Resource Assessment
TROPOMI	TROPOspheric Monitoring Instrument
TSTO	Two-Stage-to-Orbit
TT&C	Telemetry, Tracking & Commanding
TTC	Telemetry, Tracking and Telecommand
TV	Television
TWRIS	Telangana Water Resources Information System
TWT	Trisonic Wind Tunnel
UAE	Ukraine, United Arab Emirates
UAY	Uchchatar Avishkar Yojana
UFA	Unfurlable Antenna
UFS	Urban Frame Survey
UK	United Kingdom
ULBs	Urban Local Bodies
UN	United Nations
UNCCD	United Convention to Combat Desertification
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNISPACE	United Nations Conference on the Exploration and Peaceful Uses of Outer Space
UNNATI	Unispace Nanosatellite Assembly & Training
URSC	U R Rao Satellite Centre
USA	United States of America
USGS	United States Geological Survey
UWaIS	Urban Water - Information System
VCS	Vessel Communication and Support System
VEDAS	Visualization of Earth observation Data and Archival System
VELC	Visible Emission Line Coronagraph
VHRS	Very High Resolution Satellite
VIBHA	Vijnana Bharati
VLSIs	Very Large Scale Integrated Circuits
VNIR	Very Near Infra Red
VOM	Venus Orbiter Mission

5.2 Acronyms

VSAT	Very Small Aperture Terminal
VSSC	Vikram Sarabhai Space Centre
VTM	Velocity Trimming Module
VTVL	Vertical Take-off and Vertical Landing
WDC	Watershed Development Component
WVEQ	Water Volume Equivalents
XPoSat	X-ray Polarimeter Satellite
XSPECT	X-ray Spectroscopy and Timing
YES-TECH	Yield Estimation System using Technology
YUVIKA	Yuva Vigyani Karyakram

ISRO'S NEXT FRONTIER