अन्तरिक्ष भारत

भारतीय अन्तरिक्ष अनुसंधान संगठन

SPACE INDIA

Indian Space Research Organisation

जुलाई 2012 – आगस्त 2013 July 2012 – August 2013

The Indian Space Programme

Space activities in the country were initiated with the setting up of Indian National Committee for Space Research (INCOSPAR) in 1962. In the same year, work on Thumba Equatorial Rocket Launching Station (TERLS), near Thiruvananthapuram, was also started. The Indian space programme was institutionalised in November 1969 with the formation of Indian Space Research Organisation (ISRO). Government of India constituted the Space Commission and established the Department of Space (DOS) in June 1972 and brought ISRO under DOS in September 1972.

Department of Space (DOS) has the primary responsibility of promoting development of space science, technology and applications towards achieving self reliance and assisting in all round development of the nation. Towards this, DOS has evolved the following programmes:

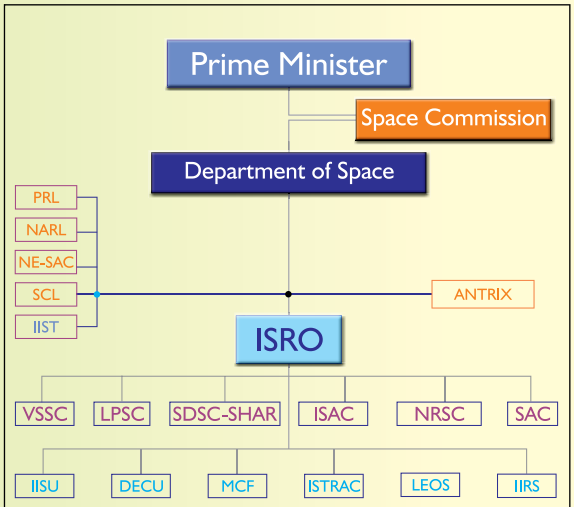
- Indian National Satellite (INSAT) programme for telecommunications, TV broadcasting, meteorology, developmental education, etc.
- Remote Sensing programme for the application of satellite imagery for various developmental purposes
- Indigenous capability for design and development of spacecraft and associated technologies for communications, resources survey and space sciences
- Design and development of launch vehicles with indigenous technology for access to space and orbiting INSAT, IRS spacecraft and space science missions
- Research and development in space sciences and technologies as well as application programme for national development

The 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, Indian Space Research Organisation (ISRO), Physical Research Laboratory (PRL), National Atmospheric Research Laboratory (NARL), North Eastern-Space Applications Centre (NE-SAC) and Semi-Conductor Laboratory (SCL).

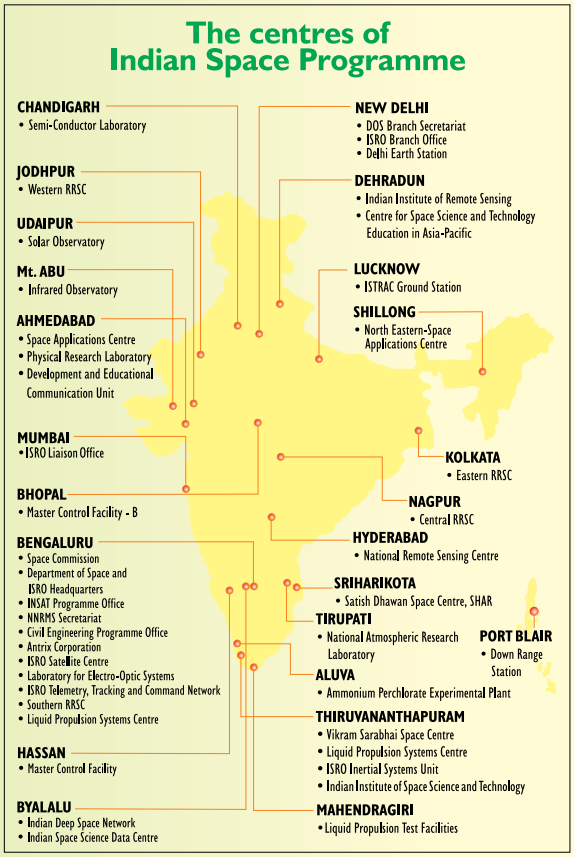
Antrix Corporation, established in 1992 as a government owned company, markets space products and services.

Both the DOS and ISRO Headquarters are located at Bengaluru. The developmental activities are carried out at the Centres and Units spread over the country.

So far, 71 Indian Satellite Missions and 39 Launches from Sriharikota have been conducted.



PRL: Physical Research Laboratory **NARL:** National Atmospheric Research Laboratory **NE-SAC:** North Eastern Space Applications Centre **SCL:** Semi-Conductor Laboratory **IIST:** Indian Institute of Space Science and Technology **ISRO:** Indian Space Research Organisation **Antrix:** Antrix Corporation Limited **VSSC:** Vikram Sarabhai Space Centre **LPSC:** Liquid Propulsion Systems Centre **SDSC:** Satish Dhawan Space Centre **ISAC:** ISRO Satellite Centre **NRSC:** National Remote Sensing Centre **SAC:** Space Applications Centre **IISU:** ISRO Inertial Systems Unit **DECU:** Development and Educational Communication Unit **MCF:** Master Control Facility **ISTRAC:** ISRO Telemetry, Tracking and Command Network **LEOS:** Laboratory for Electro-optic Systems **IIRS:** Indian Institute of Remote Sensing



अन्तरिक्ष भारत SPACE INDIA

भारतीय अन्तरिक्ष अनुसंधान संगठन
Indian Space Research Organisation

जुलाई 2012 – आगस्त 2013 July 2012 – August 2013

Contents

Editors

Deviprasad Karnik
A S Padmavathy
B R Guruprasad

Editorial / Circulation Office
Publications & Public Relations Unit, ISRO Headquarters, Antariksh Bhavan, New BEL Road, Bengaluru - 560 231, India.
www.isro.gov.in Designed by Imagic Creatives and Printed at Bengaluru.

ISRO hosts 39th Scientific Assembly of the Committee on Space Research (COSPAR-2012)

The Indian Space Research Organisation (ISRO) hosted the 39th Scientific Assembly of the Committee on Space Research (COSPAR-2012) with the theme "Space - for the benefit of Mankind" in the palace city of Mysore. COSPAR-2012 was organised at the N R Narayana Murthy Centre of Excellence, Infosys Campus, Mysore during July 14-22, 2012 to deliberate on the contemporary topics in the realm of space around the globe. The conference was co-hosted by Infosys Technologies Limited.

COSPAR:

Founded in 1958 by the International Council for Science, Committee on Space Research (COSPAR) is considered as one of the foremost space science research associations. It has both National Scientific Institutions and International Scientific Unions as members. The objectives of COSPAR are to promote scientific research in space at international level, with emphasis on the exchange of results, information and opinions, and to provide a forum, open to all scientists, for the discussion of problems that may affect scientific space research. These objectives are achieved through the organisation of scientific assemblies, publications and other means. The COSPAR Scientific Assembly provides the world's largest interdisciplinary forum for the exchange of recent results in the area of space research and, therefore, is a particularly important meeting for members participating in the scientific activities.

39th COSPAR Scientific Assembly (COSPAR-2012):

COSPAR Scientific Assembly is the largest conglomeration of Space Scientists in the world wherein the scientific results of the recent space missions and plans for future are presented and discussed through interactions. More than 2200 space scientists, from all over the world engaged in space science research activities, participated in the Scientific Assembly of COSPAR-2012. It was an international event of paramount importance and was a prestigious event for the country. COSPAR Scientific Assembly was held in India after 33 years. Prof. U R Rao, Chairman, Physical Research Laboratory (PRL) Council and former Chairman, ISRO was the Chair of the COSPAR Scientific Programme Committee. Dr. Giovanni F Bignami, Chairman of European Space Agency's Advisory Council, is the current President of COSPAR.

The main theme of 39th COSPAR-2012 assembly was **"Space for the Benefit of Mankind"**. The main areas of interest addressed in COSPAR-2012 include Earth Science, Meteorology, Climate, Atmospheric Science, Astrophysics, Life Science related to Space, Material Sciences in Space, Fundamental Physics in Space, Planetary Exploration, Space Weather etc.

The COSPAR-2012 Scientific Assembly had thirty Parallel scientific sessions, Space Agency

Participants at the Space Agency Round table during COSPAR 2012

Round table, Inaugural and Awards ceremony, Opening Reception, Scientific Commission/ Panel Business meeting, interdisciplinary lectures, a Public lecture, Exhibition and Scientific poster sessions.

The Infosys campus at Mysore, which has all state of the art facilities to host such mega events, was primarily designed for the training of Infosys employees. The Global education centre at Infosys has the facility to conduct more than thirty parallel sessions. COSPAR delegates had a wonderful experience at Infosys Campus with the infrastructural facilities such as multiplex, cafeteria, accommodation area, Internet café, sports facilities, etc.

The Space Agency round table was chaired by Prof. U.R. Rao, Chairman Local Organising Committee (LOC) COSPAR-2012. Dr. K. Radhakrishnan, Chairman ISRO/Secretary DOS, Prof. R. Bonneville, Deputy Director for Program and Strategy, CNES, Dr. D. Kendall, Director General of Space Science and Technology, CSA,. Dr. H. Dittus, Executive Board Member DLR, Prof M. Nakamura, Research Director, Institute of Space and Astronautical Science, JAXA participated in the round table to discuss the topic "Space Vision-2020 and Beyond".

The invited lectures of eminent scientists from various parts of the globe were arranged on the latest developments in the field of space science. Some of the very interesting scientific topics covered were "The New Face of the Moon", "The Very Early Universe", "Dynamics of the Global Sun from Interior to Outer Atmosphere", "Origin and Signatures of Life", "The Gamma-ray Universe through Fermi", "Long-term Aerosol and Cloud Observations from Space for Climate Studies", "A Space Astronomy Global Road Map for the Next Decade". A public lecture was arranged on the topic "Exoplanets" by Prof Willey Benz at the senate hall of Mysore University.

New Directors Appointed for VSSC, LPSC and SDSC SHAR

Three centres of ISRO namely, Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram, Liquid Propulsion Systems Centre (LPSC), with campuses in Thiruvananthapuram, Bangalore and Mahendragiri and Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota, have new Directors (Mr. S. Ramakrishnan, Mr. M. Chandradathan and Dr. M.Y.S. Prasad respectively) from January 1, 2013.

Mr. S. Ramakrishnan, Distinguished Scientist of ISRO and who was Director, LPSC, assumed the office of the Director, VSSC. He took over the charge from Mr. P. S. Veeraraghavan, the retiring Director. VSSC is the lead centre for the design and development of launch vehicle technologies for the Indian Space Programme.

Mr.Ramakrishnan graduated in Mechanical Engineering in the year 1970 from Guindy Engineering College, Chennai and got his M.Tech in Aerospace from IIT, Madras in 1972 with first rank.

Mr. Ramakrishnan joined ISRO in August 1972 and worked as member in SLV-3 Project team responsible to develop India's first Satellite Launch Vehicle under the leadership of Dr. A.P.J. Abdul Kalam. Subsequently, he worked in the Polar Satellite Launch Vehicle (PSLV) programme and was Project Director for PSLV continuation programme during 1996-2002. Under his leadership, the PSLV was operationalised, enhancing its payload capacity from 900 kg to 1500 kg.

In 2003, Mr. Ramakrishnan took charge as Project Director, Geosynchronous Satellite Launch Vehicle Mk-III (GSLV Mk-III) and steered the Project during the crucial phase of design, engineering and first-off hardware.

He was also the Director (Projects) at VSSC. As Chairman, Flight Readiness Review, he played a key role in accomplishing the PSLV C-11/Chandrayaan-1 Mission.

Since June 2010, Mr.Ramakrishnan was heading the LPSC, one of the lead Centres of ISRO in the area of Liquid Propulsion Systems for Launch Vehicles and Spacecraft Programmes.

His fields of specialisation are Aerospace Propulsion, Launch Vehicle Systems and Project Management.

Mr. Ramakrishnan is the recipient of many prestigious awards including National Design Award (Institute of Engineers) in 2010, ISRO Performance Excellence Award during 2006 in recognition of his contribution to Indian Space Programme in the area of satellite launch vehicles, Astronautical Society of India award for contributions to Rockets and Related Technologies development and Dr. Biren Roy award from Aeronautical Society of India in recognition of his role in the operationalisation of PSLV launches and entering into commercial launch services. The Government of India conferred Mr.Ramakrishnan with Padmashree during 2003.

Mr. Ramakrishnan is a fellow of several Professional Bodies including Indian National Academy of Engineering, Aeronautical Society of India and Systems Society of India. He is also a member of International Academy of Astronautics (IAA).

Mr. M. Chandradathan, Distinguished Scientist who was Director, SDSC SHAR, Sriharikota, was appointed as Director, LPSC. He took over the charge from Mr. S. Ramakrishnan, who was appointed as Director, VSSC.

Mr. Chandradathan obtained his degree in Chemical Engineering from Government Engineering College, Trissur in 1971 and M.Tech from Birla Institute of Technology in 1985. He joined ISRO in 1972. Initially, he worked for the SLV-3 Project during its design phase and later was involved in the development of solid propellant formulations for SLV-3, and over three decades, made rich contribution to the realisation of solid motors for sounding rockets, SLV-3, ASLV and PSLV.

Subsequently, Mr. Chandradathan was assigned the responsibility of development and realisation of rocket nozzles mainly for solid motors. From 2000 to 2004 he was heading the group for ablative nozzle production where he was responsible for the development and realisation of 'flex nozzle' for the S200 motor which is the strap-on booster for GSLV Mk-III. During 2002 when the core team of GSLV Mk-III was formed, he was assigned the responsibility of Project Director, S200 booster for GSLV Mk-III.

Based on his vast experience in the field of solid motors, Mr. Chandradathan became Chief Executive of the existing solid propellant plant (SPROB) for making PSLV and GSLV boosters. In 2006, he was given the additional responsibility of realising the new Solid Propellant Plant (SPP), a world class solid booster production facility for making S200 solid booster, which was successfully commissioned and operationalised in 2008.

In the same year, Mr. Chandradathan became the Director of the Satish Dhawan Space Centre (SDSC) SHAR. His major contributions as Director, SDSC SHAR include the enhancement of solid booster production at SPROB for multiple launches of PSLV and GSLV, realisation of S200 segments for two ground tests as well as for the first experimental mission of GSLV Mk-III, two successful ground tests of S200 boosters with identical performance, augmentation of all SDSC facilities to meet the stage preparation and vehicle integration for GSLV Mk-III, realisation of a new world class Mission Control Centre and Launch Control Centre and a large number of other new facilities to meet the future launch vehicle requirements of ISRO.

Mr. Chandradathan has been the recipient of many awards including Performance Excellence Award of ISRO for the year 2009, Outstanding Chemical Engineer Award, 2009 from Indian Institute of Chemical Engineers and 'Individual Service Award' of ISRO for the year 2006.

Dr. M.Y.S. Prasad, Distinguished Scientist and Associate Director of SDSC SHAR, Sriharikota assumed the office of Director, SDSC SHAR. He took over the charge from Mr. M Chandradathan, who has been appointed as the Director of ISRO's Liquid Propulsion Systems Centre. SDSC SHAR with two launch pads is the spaceport of ISRO.

Dr. Prasad obtained his Bachelor of Engineering in Electronics and Communication from Government College of Engineering, Kakinada, Andhra Pradesh in 1974 and obtained his Doctoral Degree from Birla Institute of Technology and Science (BITS).

Dr. Prasad has a long and exceptional career in Indian Space Programme, steering various activities and Programmes of Indian Space Research Organisation (ISRO) in the past four decades. He worked for almost two decades in the Launch Vehicle development programmes of ISRO from 1975 to 1994 and was part of the Project Team of SLV-3, the first indigenously developed launch vehicle of India.

Dr. Prasad served as Counselor (Space) in Embassy of India, Paris from 1994 to 1997 during which he interfaced with all the Space Agencies and leading Aerospace Industries of European countries for ISRO's programmes.

He was the Director of Master Control Facility (MCF) of ISRO from 1998 to 2005, which manages all geostationary Satellites of India. During his tenure, the facilities in MCF were extensively augmented. Under his leadership, a new Master Control Facility was established at Bhopal, Madhya Pradesh.

Dr. Prasad was the Director of Development and Educational Communication Unit (DECU) and Deputy Director at Space Applications Centre (SAC) responsible for SATCOM and IT Applications Area from October 2005 to March 2008.

He worked as Range Operations Director for all the launches during 2008-2010, including PSLV-C11 and Chandrayaan-1. During this period, he contributed to the realisation of a number of new facilities in SDSC SHAR.

Dr. Prasad represented India in the United Nations Committee on Peaceful Uses of Outer Space (UN-COPUOS) and its Science and Technology Sub-Committee for eleven years (1995-2006).

He is a member of the working group of COPUOS, which evolved "Space Debris Mitigation Guidelines".

Dr. Prasad has been active in the professional international organisations like IAF, IAA and SUIRG and worked as organising secretary of International Astronautical Congress 2007 held in Hyderabad, India. He was Vice President of International Astronautical Federation (IAF) from 2006 to 2010 and was elected as the Member of the prestigious International Academy of Astronautics (IAA) in 2008.

He has around 35 publications to his credit in various Indian and International Journals as well as International symposia.

Dr. Prasad is the recipient of many prestigious awards including ISRO Team Excellence award for the Development of Innovative Launch Facilities (2011), EDUSAT Utilisation Programme, Satellite based Disaster Warning and Communication Systems (2009), Operations of INSAT-2E (2007), ISRO Merit award for in-orbit management of geostationary satellites (2007) and Karnataka Rajyotsava award in the field of Science, 2001.

PSLV-C21, the 100th Mission of ISRO, successfully launches SPOT-6 and PROITERES satellites

India's Polar Satellite Launch Vehicle, in its twenty-second flight (PSLV-C21) launched the French earth observation satellite SPOT-6 along with a micro-satellite from Japan into a 655 km polar orbit inclined at an angle of 98.23 deg to the equator. PSLV-C21 was launched from the First Launch Pad (FLP) of Satish Dhawan Space Centre (SDSC SHAR), Sriharikota.

The successful launch of PSLV-C21 was witnessed by the Honourable Prime Minister of India.

With a lift-off mass of 712 kg, SPOT-6 is the heaviest satellite launched by PSLV for an international customer. The Japanese micro-satellite PROITERES, carried as an auxiliary payload, had a lift-off mass of 15 kg. PSLV-C21 was the eighth flight of PSLV in 'core-alone' configuration (without solid strap-on motors).

PSLV-C21 Lifts-off

Honourable Prime Minister at SDSC SHAR

PSLV-C21/SPOT-6 Mission

PSLV-C21/SPOT-6 mission, the 100th mission of ISRO, was successfully realised on September 9, 2012 at 09:53 hrs. SPOT-6 satellite was precisely injected into an orbit of 648.643 km x 655.488 km at an inclination of 98.289 deg. This was also the 21st successive successful mission of PSLV which used its Core Alone (PSLV-CA) variant. PSLV-C21 was a dedicated commercial mission with two foreign spacecrafts, namely, SPOT-6 (France) and PROITERES (Japan) on-board.

This mission also successfully flight-tested mini RESINS (Redundant Strap-down Inertial Navigation System), RGP (Rate Gyro package)-Digital and MEMS-RGP (Micro Electro Mechanical System-Rate Gyro Package) in piggyback mode.

Prime Minister's remarks after witnessing the launch of PSLV-C21 on September 9, 2012

"I am delighted at having witnessed today's launch of India's Polar Satellite Launch Vehicle-C21, carrying two foreign satellites. On behalf of all fellow Indians, I warmly congratulate the Department of Space and all members of the Indian Space Research Organisation fraternity for this spectacular success. As ISRO's 100th space mission, today's launch is a milestone in our nation's space capabilities.

I would also like to congratulate EADS Astrium of France and Osaka Institute of Technology of Japan for the successful launch of their satellites. The launch of these satellites on board an Indian launch vehicle is testimony to the commercial competitiveness of the Indian space industry and is a tribute to Indian innovation and ingenuity.

This year also marks the 50th anniversary of the commencement of our space programme. I am also happy to see here today many stalwarts of our space programme in its earlier years, including the Project Directors of our initial space missions. Given the string of successes since then, we often forget how challenging space technology is and what a relatively new field it continues to be. India is justly proud of its space scientists, who have overcome immense odds to set up world class facilities and develop advanced technologies. We owe a great deal to pioneers like Dr. Vikram Sarabhai and Prof. Satish Dhawan. I remember working closely with Prof. Dhawan when I was a Member of the Space Commission in the late 1970s, and I am privileged to have had this long association with our space endeavours. It is befitting that this new state-of-the-art mission control centre has been named after Prof. Satish Dhawan.

Questions are sometimes asked about whether a poor country like India can afford a space programme and whether the funds spent on space exploration, albeit modest, could be better utilized elsewhere. This misses the point that a nation's state of development is finally a product of its technological prowess. The founding fathers of our space programme faced a similar dilemma, but they persevered in pursuing their vision. When we look at the enormous societal and national benefits that have been generated in diverse fields, there can be no doubt that they were right. Equally, I have no doubt that ISRO will build on these glorious traditions and scale still greater heights.

The ISRO community has always been a source of inspiration to our country through its quest for the stars. I wish all of you the very best as you continue the journey to push the boundaries of science and technology, and reap its benefits for society and for accelerated social and economic development of our great country.

Jai Hind."

Prof. U. R. Rao inducted into the US Satellite Hall of Fame

Prof. U. R. Rao, former Chairman, ISRO and Secretary, Department of Space, was inducted into the highly coveted "Satellite Hall of Fame" by the "Society of Satellite Professionals International" at a gala function attended by over 1000 distinguished guests consisting of Space Scientists, Industry leaders, Administrators and Professionals on March 19, 2013 at Washington, D.C, USA. Prof. U. R. Rao, who is the first Indian Space Scientist to be inducted into the Satellite Hall of Fame, joins the select group of about 50 Hall of Fame Members including Dr. Arthur C. Clarke, Dr. James Van Allen, Dr. Harold Rosen, Olof Lundberg, Eddy Hartenstein, Frederic d'Allest, Sidney Topol, Takayushi Yoshida, Mary Ann Alliott, Mary Frost, Peter Jackson and Robert Berry.

Prof. Rao's citation read out at the time of induction is as follows: *"Prof. U.R. Rao, Chairman, the Governing Council of the Physical Research Laboratory at Ahmedabad. Prof. U.R. Rao is an internationally renowned space scientist who has contributed to the development of space technology in India and its extensive application to communications and remote sensing of natural resources since starting his career in 1960. More than any other single individual, Prof. Rao is responsible for the creation of India's space and satellite capabilities and their application to the nation's development. As head of the Indian Space Research Organisation, Prof. Rao undertook the responsibility for the establishment of satellite technology in India in 1972. Under his guidance, beginning with the first Indian satellite 'Aryabhata' in 1975, over 20 satellites were designed, fabricated and launched. Rao also accelerated the development of rocket technology in India, resulting in the successful launch of ASLV rocket in 1992 and the operational PSLV launch vehicle. He has tirelessly promoted the use of space technology for broadcasting, education, meteorology, remote sensing and disaster warning. Rao, who has published over 360 scientific and technical papers in various journals, has received many honours and awards, including the Padma Bhushan Award, a very high civilian award of the Government of India".*

"Space India takes this opportunity to congratulate Prof. U. R. Rao for this honour"

20th Meeting of Planning Committee – NNRMS Held

The 20th meeting of Planning Committee of National Natural Resources Management System (PC-NNRMS) was held on March 16, 2013 at ISRO Headquarters, Bangalore The meeting was held on the eve of the 25th year anniversary of the launch of India's first operational remote sensing satellite IRS-1A and the successful operational services rendered by a series of Earth Observation Missions in the country.

Dr. K. Kasturirangan, Member (Science), Planning Commission and Chairman, PC-NNRMS, chaired the meeting. The meeting was attended by PC-NNRMS members/ representatives of User Ministries and special invitees from ISRO/ DOS. The committee was briefed on the recent developments in Earth Observation, Space Segment, Ground Segment and the future plans and perspectives of ISRO/ DOS. Members of PC-NNRMS and representatives of various user ministries made a series of presentations to apprise the committee on the usage of earth observation data by the respective ministries. The Chairman of the Committee appreciated the efforts of User Ministries in institutionalising remote sensing data within their Ministries for planning and developmental activities. The committee reviewed the action items of the 19th PC-NNRMS held on June 26, 2012 and expressed satisfaction over the progress of various activities.

Chairmen/ Representatives of the Nine NNRMS Standing Committees highlighted the utilisation of space technology as well as the additional requirements in the respective sector viz., agriculture, bio-resources and environment, cartography, geology and mines, ocean and meteorology, rural development, urban development, water resources and capacity building. One of the important outcomes of the 20th PC-NNRMS meeting was the decision to form a New Standing Committee on Disaster Management Support (SC-DMS).

India's Communication Satellite GSAT-10 Launched Successfully

GSAT-10, India's advanced communication satellite, was successfully launched by Ariane-5 from Kourou, French Guiana on September 29, 2012. Weighing 3400 kg at lift-off, GSAT-10 is the heaviest Indian satellite that ISRO has built. GSAT-10 was ISRO's 101st space mission.

After a smooth countdown lasting 11 hours and 30 minutes, the Ariane-5 launch vehicle lifted off right on schedule at the opening of the launch window at 0248 hrs IST on September 29,2012. After a flight of 30 minutes and 45 seconds, GSAT-10 was injected into an elliptical Geosynchronous Transfer Orbit (GTO), very close to the intended one. The orbital parameters of GSAT-10, as recorded, were:

Parameter	Targeted	Achieved
Perigee (km)	250.85	250.92
Apogee (km)	35,885	35,853
Orbital Inclination with respect to Equatorial plane (deg)	6.001	5.998

ISRO's Master Control Facility (MCF) at Hassan took over the command and control of GSAT-10 immediately after the injection. Preliminary health checks on the various subsystems of the satellite, namely, Power, Thermal, Command, Sensors, Controls, etc., were performed and all the parameters were found satisfactory. Following this, the satellite was oriented towards the Earth and the Sun using the onboard propulsion system. The satellite was in good health.

The orbit raising manoeuvres of GSAT-10 satellite were successfully completed from MCF. The third and final orbit raising manoeuvre was performed on October 03, 2012 to place the GSAT-10 in an orbit with 35,734 km apogee (farthest point to earth), 35,585 km perigee (nearest point to earth) and an inclination of 0.172 degree with respect to the equator. With this, the orbital period of GSAT-10 became 23 hours 50 minutes.

The two solar panels and the two dual gridded reflector antennas were also deployed later. Subsequently, the satellite was moved towards its designated location of 83 degree East and in-orbit testing of its communication and navigations payloads was performed.

GSAT-10 carries 30 communication transponders (12 in Ku-band, 12 in C-band and 6 in Extended C-Band) as well as a GPS Aided GEO Augmented Navigation (GAGAN) payload operating in L1 and L5 bands. Navigation payload "GAGAN" would provide GPS signals of improved accuracy (of better than 7 meters) to be used by the Airports Authority of India for Civil Aviation requirements. GSAT-10 is the second satellite to carry GAGAN

Close-up view of GSAT-10 with one of the antennas partially deployed

payload after GSAT-8. GSAT-10 also carries a Ku-band beacon to help in accurately pointing ground antennas towards the satellite.

The 30 communication transponders onboard GSAT-10 will further augment the capacity in the INSAT system. The GAGAN payload provides Satellite Based Augmentation System (SBAS), through which the accuracy of the positioning information obtained from the GPS satellites is improved by a network of ground based receivers and made available to the users in the country through geostationary satellites.

Padma Bhushan Award for B. N. Suresh

Dr. B. N. Suresh has been selected for the prestigious Padma Bhushan Award of the year 2013 in the field of Science and Technology. Dr. B.N.Suresh known for Satellite Launch Vehicle design, joined Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram during 1969. He served as the Director of VSSC during the period 2003-2007. He also served as Founder Director for Indian Institute of Space Science and Technology (IIST) and was instrumental in establishing this world class Institution. He was Member, Space Commission and presently he is Vikram Sarabhai Distinguished Professor at ISRO HQ.

His field of specialisation are launch vehicle design, aerospace guidance and control systems, avionics, modeling and simulation and R&D management. He has made significant contributions for the development of India's launch vehicles like ASLV, PSLV and GSLV. He is a fellow of several professional bodies like Indian National Academy of Engineering (INAE), Astronautical Society of India (ASI), etc.

Dr. Suresh was the head of Indian delegation for the United Nations Committee on Peaceful Uses of Outer Space at Vienna, Austria between 2004-07. He was selected as Chairman of the prestigious United Nations Scientific and Technical Committee for the year 2006 by the Countries of the Asia Pacific. This has been a unique distinction for India, since in the last 42 years from its inception, a technical expert from a developing country was selected for this coveted post for the first time.

Dr. Suresh has won several awards and honours like "Dr. Biren Roy Space Science design Award" from Aeronautical Society of India (ASI), "Agni Award" from DRDO for achieving the self reliance, "ASI Award" for contribution to space technologies. "Distinguished Alumni Award" from IIT Madras and PES College of Engineering, Mandya ,"Ramanujam Award" by PSG Institute of Technology, "Technical Excellence Award" by Lions International, "Outstanding Achievement Award" by Dept of Space, GOI, "Lifetime Contribution Award" in engineering by Indian National Academy of Engineering, "National Systems Gold Medal" for lifetime contribution to large systems from Systems Society of India and "Aryabhata Award", the highest award by ASI for his invaluable contribution to aerospace developments. He was awarded "Padma Shri" in 2002.

Space India is delightfully proud to congratulate Dr. B. N. Suresh for this achievement

PSLV-C20 successfully launches Indo-French satellite SARAL and six commercial payloads

ISRO's Polar Satellite Launch Vehicle, PSLV-C20, successfully launched the joint Indo-French Satellite, SARAL, on February 25, 2013 in its twenty third flight from Satish Dhawan Space Centre (SDSC) SHAR, Sriharikota. Six other satellites, namely, UNIBRITE (NLS 8.1) and BRITE (NLS 8.2) from Austria, SAPPHIRE and NEOSSAT from Canada, AAUSAT-3 (NLS 8.3) from Denmark; and STRaND-1 from the United Kingdom, have also been launched into their planned orbits along with SARAL.

Honourable President of India, Shri Pranab Mukherjee along with the Governor of Andhra Pradesh, Shri E. S. L. Narasimhan, Chief Minister of Andhra Pradesh, Shri N Kiran Kumar Reddy, Minister of State (Prime Minister's Office), Shri V Narayanasamy and other dignitaries from the Government of Andhra Pradesh witnessed the launch from the state-of-the-art Mission Control Centre of SDSC. Honourable President, in his post launch remarks, congratulated the scientists and engineers of ISRO for the successful launch.

The President of India at SDSC SHAR

At the completion of the countdown, PSLV-C20 lifted off from the First Launch Pad at SDSC SHAR, at 1801 hrs (IST) with the ignition of the first stage of the launch vehicle. The important flight events, namely, stage ignitions, heat-shield separation, stage separations and satellite injections took place exactly as planned.

After a flight of 17 minutes 55 seconds, the main payload, SARAL, weighing 407 kg, was injected into a 785 km orbit inclined at an angle of 98.538 deg to the equator, very close to the intended one. Following this, the six auxiliary satellites together weighing 259.5 kg were also successfully injected.

This was the twenty second successive successful launch of ISRO's workhorse launch vehicle PSLV. Since its first successful launch in 1994, PSLV has launched 27 Indian satellites and 35 satellites for customers from abroad so far. It has also launched India's geosynchronous satellites, Kalpana-1 and GSAT-12, thereby proving its versatility. PSLV also launched India's first spacecraft mission to moon, Chandrayaan-1, in 2008. It is scheduled to launch India's first interplanetary mission, the Mars Orbiter Mission (MOM) spacecraft, by the end of this year.

PSLV-C20 on Launch Pad

ISRO Telemetry, Tracking and Command Network (ISTRAC) in Bangalore took over the SARAL's monitoring and control operations immediately after its injection. Following the automatic deployment of SARAL's solar panels, shortly after reaching orbit, all the subsequent operations proceeded normally.

SARAL was the 56th satellite launched by PSLV. PSLV-C20 was the ninth flight of PSLV in 'Core-Alone' configuration (without solid strap-on motors).

SARAL

The Satellite with ARGOS and ALTIKA (SARAL) is a joint Indo-French satellite mission for oceanographic studies. SARAL performs altimetric measurements designed to study ocean circulation and sea surface elevation. The payloads of SARAL are:

Ka band Altimeter, ALTIKA, built by the French National Space Agency CNES. The payload is intended for oceanographic applications and operates at 35.75 Giga Hertz.

A dual frequency total power type microwave radiometer operating at 23.8 and 37 GHz is embedded in the altimeter to correct tropospheric effects on the altimeter measurement. Doppler Orbitography and Radio-positioning Integrated by Satellite (DORIS) on board enables precise determination of SARAL orbit. A Laser Retro reflector Array helps to calibrate the precise orbit determination system and the altimeter system several times throughout the mission.

ARGOS Data Collection System built by the French National Space Agency CNES. ARGOS contributes to the development and operational implementation of the global ARGOS Data Collection System. It will collect a variety of data from ocean buoys to transmit the same to the ARGOS Ground Segment for subsequent processing and distribution.

In addition, ARGOS Payload allows the transmission of short messages directly to Data Collection Platforms, equipped with a receiver.

Solid State C-band Transponder (SCBT) is from ISRO and intended for ground RADAR calibration. It is a continuation of such support provided by C-Band Transponders flown in the earlier IRS-P3 and IRS-P5 missions.

The payloads of SARAL are accommodated in the Indian Mini Satellite-2 bus, which was built by ISRO.

SARAL Applications

SARAL data products will be useful for operational as well as research user communities in many fields like

- Marine meteorology and sea state forecasting
- Operational oceanography
- Seasonal forecasting
- Climate monitoring
- Ocean, earth system and climate research
- Continental ice studies
- Protection of biodiversity
- Management and protection of marine ecosystem
- Environmental monitoring
- Improvement of maritime security

MISSIONS

NO.	INDIAN LAUNCH VEHICLE/ SATELLITE MISSION	LAUNCH DATE
1.	ARYABHATA*	19.04.1975
2.	BHASKARA-1*	07.06.1979
3.	SLV-3 E1	10.08.1979
4.	ROHINI TECHNOLOGY PAYLOAD	
5.	SLV-3 E2	18.07.1980
6.	RS-1	
7.	SLV-3 D1	31.05.1981
8.	RS-D1	
9.	APPLE*	19.06.1981
10.	BHASKARA-2*	20.11.1981
11.	INSAT-1A*	10.04.1982
12.	SLV-3 D2	17.04.1983
13.	RS-D2	
14.	INSAT-1B*	30.08.1983
15.	ASLV-D1	24.03.1987
16.	SROSS-1	
17.	IRS-1A*	17.03.1988
18.	ASLV-D2	13.07.1988
19.	SROSS-2	
20.	INSAT-1C*	22.07.1988
21.	INSAT-1D*	12.06.1990
22.	IRS-1B*	29.08.1991
23.	ASLV-D3	20.05.1992
24.	SROSS-C	
25.	INSAT-2A*	10.07.1992
26.	INSAT-2B*	23.07.1993
27.	PSLV-D1	20.09.1993

NO.	INDIAN LAUNCH VEHICLE/ SATELLITE MISSION	LAUNCH DATE
28.	IRS-1E	20.09.1993
29.	ASLV-D4	04.05.1994
30.	SROSS-C2	
31.	PSLV-D2	15.10.1994
32.	IRS-P2	
33.	INSAT-2C*	07.12.1995
34.	IRS-1C*	28.12.1995
35.	PSLV-D3	21.03.1996
36.	IRS-P3	
37.	INSAT-2D*	04.06.1997
38.	PSLV-C1	29.09.1997
39.	IRS-1D	
40.	INSAT-2E*	03.04.1999
41.	PSLV-C2	26.05.1999
42.	OCEANSAT-1 (IRS-P4)	
43.	INSAT-3B*	22.03.2000
44.	GSLV-D1	18.04.2001
45.	GSAT-1	
46.	PSLV-C3	22.10.2001
47.	TES	
48.	INSAT-3C*	24.01.2002
49.	PSLV-C4	12.09.2002
50.	KALPANA-1	
51.	INSAT-3A*	10.04.2003
52.	GSLV-D2	08.05.2003
53.	GSAT-2	
54.	INSAT-3E*	28.09.2003

OF ISRO

NO.	INDIAN LAUNCH VEHICLE/ SATELLITE MISSION	LAUNCH DATE
55.	PSLV-C5	17.10. 2003
56.	RESOURCESAT-1	
57.	GSLV-F01	20.09.2004
58.	EDUSAT	
59.	PSLV-C6	05.05.2005
60.	CARTOSAT-1	
61.	HAMSAT	
62.	INSAT-4A*	22.12.2005
63.	GSLV-F02	10.07.2006
64.	INSAT-4C	
65.	PSLV-C7	10.01.2007
66.	CARTOSAT-2	
67.	SRE-1	
68.	INSAT-4B*	12.03.2007
69.	PSLV-C8	23.04.2007
70.	GSLV-F04	02.09.2007
71.	INSAT-4CR	
72.	PSLV-C10	21.01.2008
73.	PSLV-C9	28.04.2008
74.	CARTOSAT-2A	
75.	IMS-1	
76.	PSLV-C11	22.10.2008
77.	CHANDRAYAAN-1	
78.	W2M	21.12.2008
79.	PSLV-C12	20.04.2009
80.	RISAT-2	
81.	PSLV-C14	23.09.2009

NO.	INDIAN LAUNCH VEHICLE/ SATELLITE MISSION	LAUNCH DATE
82.	OCEANSAT-2	23.09.2009
83.	GSLV-D3	15.04.2010
84.	GSAT-4	
85.	PSLV-C15	12.07.2010
86.	CARTOSAT-2B	
87.	HYLAS	27.11.2010
88.	GSLV-F06	25.12.2010
89.	GSAT-5P	
90.	PSLV-C16	20.04.2011
91.	RESOURCESAT-2	
92.	YOUTHSAT	
93.	GSAT-8*	21.05.2011
94.	PSLV-C17	15.07.2011
95.	GSAT-12	
96.	PSLV-C18	12.10.2011
97.	MEGHA TROPIQUES	
98.	PSLV-C19	26.04.2012
99.	RISAT-1	
100.	PSLV-C21	09.09.2012
101.	GSAT-10	29.09.2012
102.	PSLV-C20	25.02.2013
103.	SARAL	
104.	PSLV-C22	01.07.2013
105.	IRNSS-1A	
106.	INSAT-3D*	26.07.2013
107.	GSAT-7*	30.08.2013

● Satellites in service ● Could not reach orbit ● In-orbit failure ● Launch not successful * Procured Launch

SARAL Satellite at Clean Room

Data from SARAL will be useful for researchers besides having many practical applications like marine meteorology and sea state forecasting, climate monitoring, continental ice studies, environmental monitoring, protection of biodiversity and improvement in maritime security.

Salient Features of SARAL	
Lift-off Mass	407 kg
Orbit	785 km polar Sun synchronous
Sensors	4 PI sun sensors, magnetometer, star sensors and miniaturised gyro based Inertial Reference Unit
Orbit Inclination	98.538°
Local Time of Equator crossing	18:00 hours
Power	Solar Array generating 906 W and 46.8 Ampere-hour Lithium-ion battery
Onboard data storage	32 Gb
Attitude and Orbit Control	3-axis stabilisation with reaction wheels, Hydrazine Control System based thrusters
Mission Life	5 years
Launch date	Feb 25, 2013
Launch site	SDSC SHAR Centre, Sriharikota, India
Launch vehicle	PSLV - C20

Auxiliary Payloads of PSLV-C20

Besides SARAL, PSLV-C20 carried six auxiliary payloads from Canada, Austria, Denmark and UK.

Name	Weight	Country	Mission Objective
SAPPHIRE	148 kg	Canada	To obtain time-tagged images from space of the Resident Space Objects (RSO) and then extract the precise angular positions of the RSOs
NEOSSAT	74 kg	Canada	To acquire images of the regions of interest, in order to detect and track either near-Earth asteroids or satellites in Geostationary orbit
NLS 8.1 (UNIBRITE)	14 kg	Austria	To photometrically measure low-level oscillations and temperature variations in stars brighter than visual magnitude
NLS 8.2 (BRITE)	14 kg	Austria	To make photometric observations of some of the brightest stars in the sky
NLS 8.3 (AAUSAT-3)	3 kg	Denmark	To make a feasibility study of receiving Automatic Identification System signals from ships in arctic regions
STRaND-1	6.5 kg	UK	To evaluate the performance of Commercial Off-the-Shelf Mobile Phone Electronics in a space environment and to demonstrate the use of pulsed plasma thrusters on nano-satellites

SPEECH BY THE PRESIDENT OF INDIA, SHRI PRANAB MUKHERJEE AT THE LAUNCH OF POLAR SATELLITE LAUNCH VEHICLE (PSLV)-C20/SARAL MISSION

Sriharikota, February 25, 2013

1. *I was delighted to witness the remarkable launch of the Polar Satellite Launch Vehicle (PSLV) C20 SARAL Mission, along with six more satellites today. It is a pleasure to be in the midst of distinguished scientists and technologists who have gathered here to celebrate the culmination of the meticulously executed chain of events and rigourous pre-launch preparations for the Mission.*

2. *I congratulate the Indian Space Research Organization (ISRO) for successfully executing this Mission. I am confident that the SARAL spacecraft launched today would function as planned and perform as designed and serve the intended applications in Ocean Topography, Coastal Altimetry, Ocean currents monitoring and Animal migration studies worldwide. The PSLV has become a household name in our country and this mission would only reaffirm this position through its efficacy, accuracy and reliability of this launch vehicle.*

3. *An important manifestation of India's bilateral cooperation with foreign countries is in the field of Space technology. I congratulate the French space agency, Centre National d'etudes Spatiales (CNES), for whole-heartedly participating in this collaborative mission. This mission epitomizes the spirit of the Indo-French partnership, which the two nations have shared for decades.*

4. *Ladies and Gentlemen, curiosity is mankind's second nature and human beings have always sought to unearth the mysteries that lie beyond our Mother Earth. The desire to know the unknown has driven us to inculcate a scientific temper for inquiry.*

5. *India's space programme is about half a century old though our rich legacy of astronomy dates back to Aryabhatta and Bhaskara. Due to the genius of our space scientists led by stalwarts such as Dr. Vikram Sarabhai, Dr. Satish Dhawan, Prof. U.R. Rao, Prof. Kasturirangan and others, our space programme has over the years become successful in delivering to our country indigenous capability in design and development of satellites, launch vehicles and space applications.*

6. *It is heartening to note that in the road towards self-reliance, ISRO has played a vital role in the enhancement of technology levels and indigenization of strategic materials. The Indian National Satellite System is today a proud repository of the largest group of communication satellites in the Asia Pacific region. Our launch capabilities have been duly acknowledged the world over, with ISRO increasingly launching satellites of other countries.*

7. *Ladies and Gentlemen, challenges to our country's progress are many and they cannot be successfully countered without technology playing a pivotal role in the effort. This is true whether it is for ushering in a sustainable development paradigm, establish a strong agricultural sector, respond to climate change, building the rural sector amongst others. Our space programme has all along been an application-oriented initiative, and hence, been an able partner in our development process.*

8. *Our first Prime Minister, Late Pandit Jawahar Lal Nehru had once said and I quote: "It is science alone that can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources*

running to waste, of a rich country inhabited by starving people... Who indeed could afford to ignore science today? At every turn we have to seek its aid... the future belongs to science and those who make friends with science." (unquote).

9. *Our scientific progress has been built on this philosophy. We have used space applications to bring government closer to people, particularly those who are far removed from urban centers and reside in remote areas of the country. Space-based applications like tele-education and tele-medicine have enabled greater access to our rural population to these basic needs.*

10. *The telemedicine project has made it possible for health care centres in remote locations to connect with super specialty hospitals in towns and cities through INSAT satellites for provision of health care facility to the needy and under-served population. I am told that 1.5 lakh people are availing of the telemedicine facility annually.*

11. *The EDUSAT satellite has brought about a change in the way education is delivered in our schools, colleges and universities, including the non-formal education system. Interactive education has made it possible to bring education closer to our students, particularly those located in under-served areas.*

12. *The Village Resource Centre initiative, which connects resource centres like Agricultural Universities, Skill Development Institutes and Hospitals for training of people in diverse fields such as agriculture, horticulture, fisheries, livestock, water resources, computer literacy, micro finance and vocational training, is commendable. Over five lakh people have availed of this facility and I am sure many more will do so in the future.*

13. *Our farmers have hugely benefitted from weather forecasting as also tele-agriculture initiatives that educate them about different methods and techniques of farming. Management of our natural resources has greatly relied on our remote sensing capabilities.*

14. *Such socially relevant uses of technology that meet our country's development goals are imperative to address the demands of our population. Our endeavour must be to lower the cost of access to space through greater innovation and drive towards technology refinement.*

15. *Ladies and Gentlemen, ISRO enjoys tremendous trust amongst our countrymen. This faith and confidence puts the onus back on the organization to raise the bar of its performance, scale greater heights and explore newer frontiers.*

16. *Over the past three years, ISRO has successfully accomplished an impressive array of 15 missions including CARTOSAT-2B, MEGHATROPIQUES, RISAT-1 and a number of PSLV launches.*

17. *The entire nation is eagerly looking forward for the successful flight of the Geo-Synchronous Satellite Launch Vehicle (GSLV), with the Indigenous Cryogenic Stage. The planned experimental mission of GSLV Mark 3 is a huge step forward in the development of heavy-lift space transportation system in the country.*

18. *Our Chandrayaan-1 mission made the country proud. I am also confident of the first Indian inter-planetary venture, The Mars Orbiter Mission, targeted for this year, to be successful and to place India into the ranks of the few Nations that have attempted such a feat.*

19. *Ladies and Gentlemen, for India to occupy its rightful place in the comity of nation, we must promote innovation and technological advancement. ISRO should be in the forefront of such a movement.*

20. *I am certain that ISRO, with its team of able, energetic and committed professionals, will meet the future scientific and technological challenges and continue to be a nerve centre of innovation and creativity. I wish ISRO every success in the missions to come. Let me conclude by saying that India's tryst with space will continue to evoke awe amongst many.*

Thank you.

JAI HIND

Indian Remote Sensing Satellite Series – A Saga of 25 Years

The Indian Remote Sensing Programme attained an important milestone of completing 25 years of operational Earth Observation Services on March 17, 2013. It was on this red-letter day, in 1988, the first Indian Remote Sensing Satellite 'IRS-1A' was successfully launched. To mark the milestone of 25 years of operational remote sensing services a memorable event, a two day Symposium was organised by Indian Society of Remote Sensing (ISRS), in association with Astronautical Society of India (ASI), Indian Society of Geomatics (ISG), Indian Meteorological Society (IMS), Indian National Cartographic Association (INCA) and Space Society of Mechanical Engineers (SSME) at JN Tata Auditorium, National Science Seminar Complex, IISc., Bengaluru. The Symposium had a series of Technical Sessions on March 16 and March 17, 2013, in addition to the Commemorative Session on March 17, 2013.

The symposium was supported by Government Ministries and Industries. An 'IRS Expo', showcasing the potential of various industries in the Earth Observation related activities was also organised during both the days. About 600 participants from various parts of the country participated in this 2-day symposium including about 90 participants from Industries and 70 participants from various User Ministries and professional societies.

The symposium was inaugurated by Dr. K. Kasturirangan, Member (Science), Planning Commission and presided by Prof. U. R. Rao, Chairman, PRL Council. Dr. Saumitra Chaudhuri, Member, Planning Commission presided over the Commemorative Session on March 17, 2013. Eminent personalities from various Ministries as well as from Department Of Space addressed the participants on this august occasion. Pioneering contributors to the success of IRS-1A were honoured by the Presidents of all the organising Societies.

Participants had the opportunity to listen to the Directors of various ISRO Centres on the 'Retrospective and Prospective' aspects, on the Launch Services, Satellites, Payloads, Ground Segment and Remote Sensing Applications. Eminent speakers from the Remote Sensing User Community made presentations on the 'Utilisation of IRS data'. Professional Societies and Institutions in the country showcased the 'Outreach and Capacity Building' activities. Speakers from leading Space Industries made eloquent presentations in the 'Industry and Commercial Opportunities' session. The 'Reminiscence' on the evolution of IRS Programme by former Directors of ISRO Centres, gave a glimpse down the memory lane. Two popular talks by Professors of ISRO, on the 'National Natural Resources Management System' and 'Indian Remote Sensing Programme', took the participants from 'Back to Future'. There was also a panel discussion on "Setting long term goals for the future of Earth Observation", with eminent personalities from ISRO and User Ministries as panelists. Many new ideas were discussed as part of the session with active participation from all participants.

ISRO Navigation Centre Inaugurated

The ISRO Navigation Centre (INC), established at Indian Deep Space Network (IDSN) complex at Byalalu, about 40 km from Bangalore, was inaugurated on May 28, 2013 by Mr. V. Narayanasamy, Minister of State in the Prime Minister's Office, Ministry of Personnel, Public Grievances and Pensions. INC is an important element of the Indian Regional Navigation Satellite System (IRNSS), an independent navigation satellite system being developed by India.

Speaking on the occasion, Mr Narayanasamy appreciated the commitment and dedication of Indian space scientists in realising the objectives of the country's space programme. The Minister also gave away various awards instituted by Astronautical Society of India (ASI) and ISRO.

IRNSS will have a constellation of seven satellites and enables its users to determine their location and time accurately. These satellites will be positioned in geostationary and inclined geosynchronous orbits at 36,000 km. IRNSS coverage will extend over India and its neighborhood and the satellites are equipped with high precision atomic clocks and continuously transmit navigation signals to users.

As the focal point of many critical operations of IRNSS, INC is responsible for providing the time reference, generation of navigation messages and monitoring and control of ground facilities including ranging stations of IRNSS. It hosts several key technical facilities for supporting various navigation functions.

Key to the navigation support is the time reference to which all ground systems and the satellite clocks are synchronised. This time reference is generated by the high precision timing facility located at INC. This timing facility is equipped with high stability, high precision atomic clocks to provide stable and continuous time reference to the navigation system.

IRNSS will have a network of twenty one ranging stations geographically distributed primarily across India. They provide data for the orbit determination of IRNSS satellites and monitoring of the navigation signals. The data from the ranging/monitoring stations is sent to the data processing facility at INC where it is processed to generate the navigation messages. The navigation messages are then transmitted from INC to IRNSS satellites through the spacecraft control facility at Hassan/Bhopal. The state of the art data processing and storage facilities at INC enable swift processing of data and support its systematic storage.

INC is connected to the ranging stations and to the satellite control facilities through two highly reliable dedicated communication networks consisting of satellite and terrestrial links. The hub for the satellite communication links is hosted at INC.

Panoramic view of ISRO Navigation Centre at Byalalu

NASA Chief visits ISRO Centre at Ahmedabad

Charles F. Bolden Jr., Administrator of National Aeronautics and Space Administration (NASA) of United States, visited Space Applications Centre (SAC) of Indian Space Research Organisation (ISRO) at Ahmedabad on June 25, 2013.

The NASA Administrator had a meeting with Dr. K. Radhakrishnan, Chairman, ISRO/ Secretary, Department of Space along with senior officials of ISRO to discuss the on-going cooperative activities between ISRO and NASA and also the potential areas of future cooperation.

NASA-Chief with Chairman-ISRO and Director-SAC

Mr. Charles Bolden delivered a talk on 'NASA's Space Programme' highlighting the current work at NASA as well as future plans to advance space exploration and reach new destinations such as an asteroid and Mars. In his talk, he made a special mention of NASA's new asteroid initiative, which includes work

NASA-Chief delivering talk:
'Space Technology for the Benefit of Humankind'

to identify and characterise asteroids of all types and a mission to capture and redirect an asteroid into an orbit closer to Earth so that astronauts can visit it. The talk was delivered in SAC Auditorium and transmitted to all ISRO Centres and Units. Mr. Bolden also visited some of the technical facilities of SAC pertaining to the development of satellite sensors and antennas.

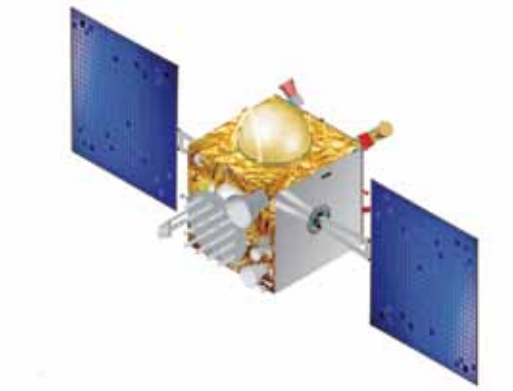
India and United States pursue active civil space cooperation mainly in the areas of earth sciences, space exploration, satellite navigation and professional exchange.

This is the first visit by Charles F. Bolden Jr. to any ISRO Centre after he took over as NASA Administrator in July 2009. Mr. Bolden is the third NASA chief to visit ISRO in the past 4 decades.

PSLV-C22 Successfully Launches IRNSS-1A, India's First Navigation Satellite

ISRO's Polar Satellite Launch Vehicle, PSLV-C22, successfully launched IRNSS-1A, the first satellite in the Indian Regional Navigation Satellite System (IRNSS), in the early morning hours of July 2, 2013 from Satish Dhawan Space Centre, Sriharikota. This is the twenty third consecutively successful mission of PSLV. The 'XL' configuration of PSLV was used for the mission. Previously, the same configuration of the vehicle was used thrice to launch Chandrayaan-1, GSAT-12 and RISAT-1 satellites.

At the completion of the countdown, PSLV-C22 lifted off from the First Launch Pad at 23:41 hrs IST on July 1, 2013 with the ignition of the first stage and four



strap-on motors of the launch vehicle. The important flight events, namely, stage and strap-on ignitions, heat-shield separation, stage and strap-on separations and satellite injection took place exactly as planned. After a flight of 20 minutes 17 seconds, the IRNSS-1A Satellite, weighing 1425 kg, was injected to the intended elliptical orbit of 282.46 km X 20,625.37 km. It may be recalled, earlier, IRNSS-1A was scheduled for launch onboard PSLV-C22 on June 12, 2013 at 01:01 hrs. However, the launch was postponed, as an anomaly was observed in one of the electro-hydraulic control actuators in the second stage of PSLV-C22. Later, control actuator was replaced and vehicle was made ready for launch within a month.

After injection, the solar panels of IRNSS-1A were deployed automatically. ISRO's Master Control Facility (MCF) at Hassan, Karnataka assumed the control of the satellite. Subsequently,the satellite was positioned in its Geosynchronous Circular Orbit at 55 deg East longitude after conducting five orbit maneuvers from MCF, Hassan.

IRNSS-1A is the first of the seven satellites constituting the space segment of the Indian Regional Navigation Satellite System. IRNSS is an independent regional navigation satellite system designed to provide

position information in the Indian region and 1500 km around the Indian mainland. IRNSS would provide two types of services, namely, Standard Positioning Services (SPS) - provided to all users - and Restricted Services (RS) provided only to authorised users.

A number of ground stations responsible for the generation and transmission of navigation parameters, satellite control, satellite ranging and monitoring, etc., have been established in as many as 15 locations across the country.

The entire IRNSS constellation of seven satellites is planned to be completed by 2015-16.

President of India congratulates ISRO on the Launch of India's First Navigation Satellite, IRNSS

Rashtrapati Bhavan : 02-07-2013

The President of India, Shri Pranab Mukherjee has congratulated the Indian Space Research Organisation (ISRO) on the successful launch of the Indian Regional Navigation Satellite System (IRNSS), India's first Navigation Satellite.

In a message to Dr. K. Radhakrishnan, Chairman of ISRO, the President has said "I congratulate you and your team on the successful launch of the Indian Regional Navigation Satellite System (IRNSS). This launch of India's first dedicated navigation satellite is a significant milestone in the progress of our space programme and space applications".

Prof. Satish Dhawan Endowed Fellowship Established at California Institute of Technology

The Department of Space/Indian Space Research Organisation has established an endowed fellowship at the Graduate Aerospace Laboratories of the California Institute of Technology, California, USA. This fellowship is established in honor of Prof. Satish Dhawan, who was the former Chairman of Indian Space Research Organisation during its formative period 1972-1984.

Prof. Satish Dhawan was an alumnus of the Graduate Aerospace Laboratories at California Institute of Technology (Caltech) and obtained his PhD in aerospace in 1951. He was serving as Distinguished Visiting Professor during 1971-72 at Caltech, immediately preceding his assumption of the Chairmanship of ISRO in 1972. Prof. Dhawan was not only a visionary leader of ISRO but also an internationally recognised researcher and a legendary teacher. He was bestowed with the Distinguished Alumni Award by Caltech in 1969, the highest alumnus honor. The Government of India honoured Prof. Satish Dhawan by awarding him Padma Vibhushan in the year 1981.

The fellowship provides an excellent opportunity every year starting from the winter session of the academic year 2013-14 to one meritorious graduating student from the Aerospace Department of the Indian Institute of Space Science and Technology, Thiruvananthapuram to be sponsored by the Department of Space, to pursue Masters in Aerospace Engineering at Caltech.

India's Advanced Weather Satellite INSAT-3D Successfully Launched

India's Weather Satellite INSAT-3D, carrying advanced weather monitoring payloads, was launched successfully in the early hours of July 26, 2013 by Ariane-5 (VA214) launch vehicle from Kourou, French Guiana. After a smooth countdown of 11 hours and 30 minutes, the Ariane-5 lifted off right on schedule at the opening of the launch window at 01:24 hours IST, July 26, 2013. After a flight of 32 minutes and 48 seconds, INSAT-3D was placed in an elliptical Geosynchronous Transfer Orbit (GTO), very close to the intended orbit.

Soon after the separation of INSAT-3D from the Ariane-5's upper cryogenic stage, the satellite's solar panel automatically got deployed. ISRO's Master Control Facility (MCF) at Hassan in Karnataka took over the control of INSAT-3D immediately.

Subsequently, INSAT-3D was successfully placed in Geosynchronous orbit after three orbit raising manoeuvres commanded from ISRO's Master Control Facility at Hassan.

Though there was an anomalous behaviour of the satellite after the deployment of its solar panel, the Mission Operations Team of ISRO could immediately bring the Satellite into normalcy using the prescribed contingency procedures and then resume the orbit-raising operations.

With a lift-off mass of 2060 kg, INSAT-3D carries four payloads - Imager, Sounder, Data Relay Transponder and Satellite Aided Search & Rescue payload. Among them, the six channel imager can take weather pictures of the Earth and has improved features compared to the payloads in KALPANA-1 and INSAT-3A, the two Indian Geostationary Satellites providing weather services for the past one decade.

The 19 channel sounder payload of INSAT-3D adds a new dimension to weather monitoring through its atmospheric sounding system, and provides vertical profiles of temperature, humidity and integrated ozone.

Data relay transponder, the third payload carried by INSAT-3D, receives the meteorological, hydrological, oceanographic parameters sent by Automatic Data Collection platforms located at remote uninhabited locations and relays them to a processing centre for generating accurate weather forecasts.

INSAT-3D is also equipped with a search and rescue payload that picks up and relays alert signals originating from the distress beacons of maritime, aviation and land based users and relays them to the mission control centre to facilitate speedy search and rescue operations.

ISRO has taken up the responsibility of end-to-end reception and processing of INSAT-3D data and the derivation of meteorological parameters with India Meteorological Department (IMD), New Delhi. An indigenously designed and developed INSAT-3D

Meteorological Data Processing System (IMDPS) is installed and commissioned at IMD, New Delhi with a mirror site at Space Applications Centre, Bopal, Ahmedabad.

INSAT-3D Payloads Turned on

Two meteorological payloads (Imaging System, Atmospheric Sounder) were activated on August 7-8, 2013. Performance of payloads are satisfactory and the preliminary images received are of good quality. The cameras are undergoing testing and commissioning phase.

Imaging System

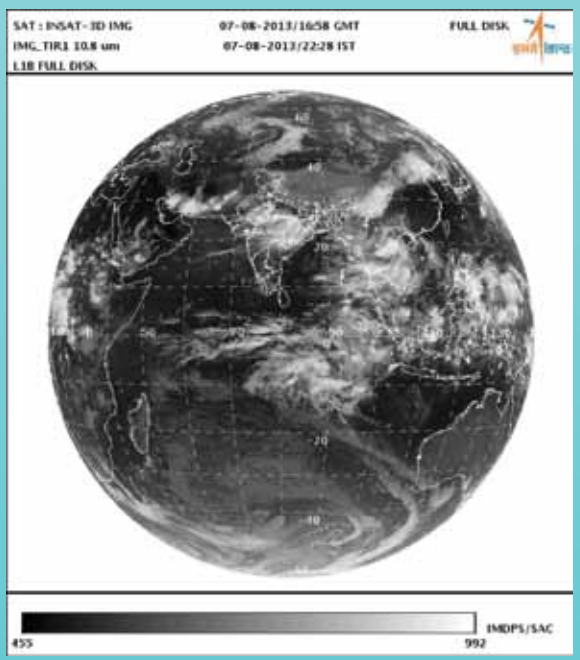
For meteorological observations, INSAT-3D carries a multi-spectral Imager (optical radiometer) capable of generating the images of the earth in six wavelength bands significant for meteorological observations, namely, visible (VIS), short-wave infrared (SWIR), middle infrared (MIR), water vapor (WV) and two bands in thermal infrared (TIR1 and TIR2) regions. The Imager will generate images of the earth disk from geostationary altitude of 36,000 km every 26 minutes and provide information on various parameters, namely, outgoing long-wave radiation, quantitative precipitation estimation, sea surface temperature, snow cover, cloud motion winds, etc. Imager payload is an improved version of VHRR flown on INSAT-3A and Kalpana-1 satellites with significant improvements in spatial resolution, number of spectral channels and functionality.

Atmospheric Sounder

INSAT-3D also carries a newly developed 19 channel sounder, which is the first such payload to be flown on an ISRO satellite mission. The Sounder has eighteen

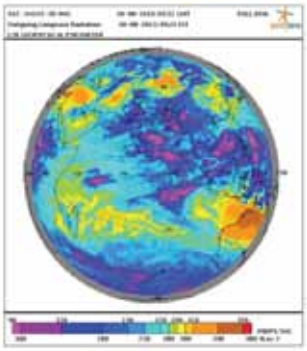
INSAT-3D in clean room with its solar panel deployed

narrow spectral channels in short-wave infrared, middle infrared and long wave infrared regions and one channel in the visible region. It will provide information on the vertical profiles of temperature, humidity and integrated ozone. These profiles will be available for a selected region over Indian landmass every one hour and for the entire Indian Ocean Region every six hours.

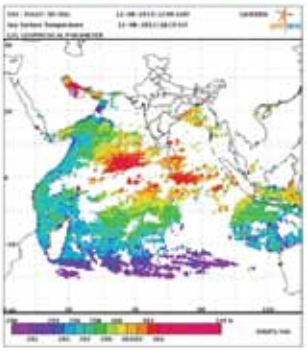


First image from INSAT-3D Imager

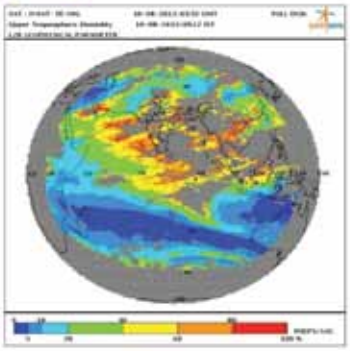
INSAT-3D Imager
Geo-Physical Parameters (L2)



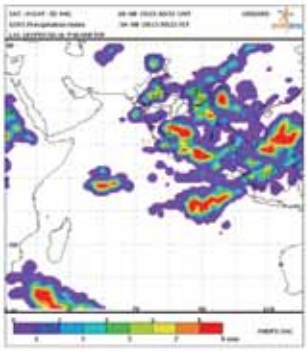
OLR



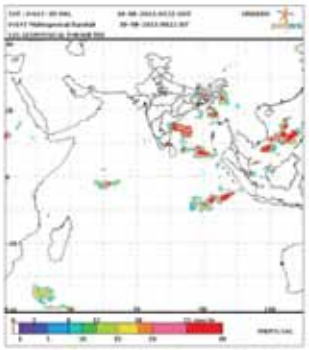
SST



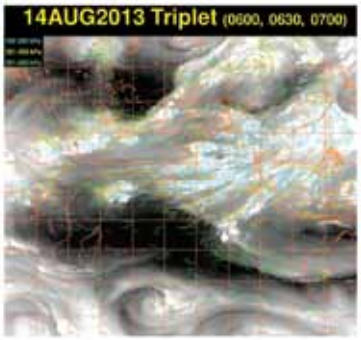
UTH



Precipitation Index

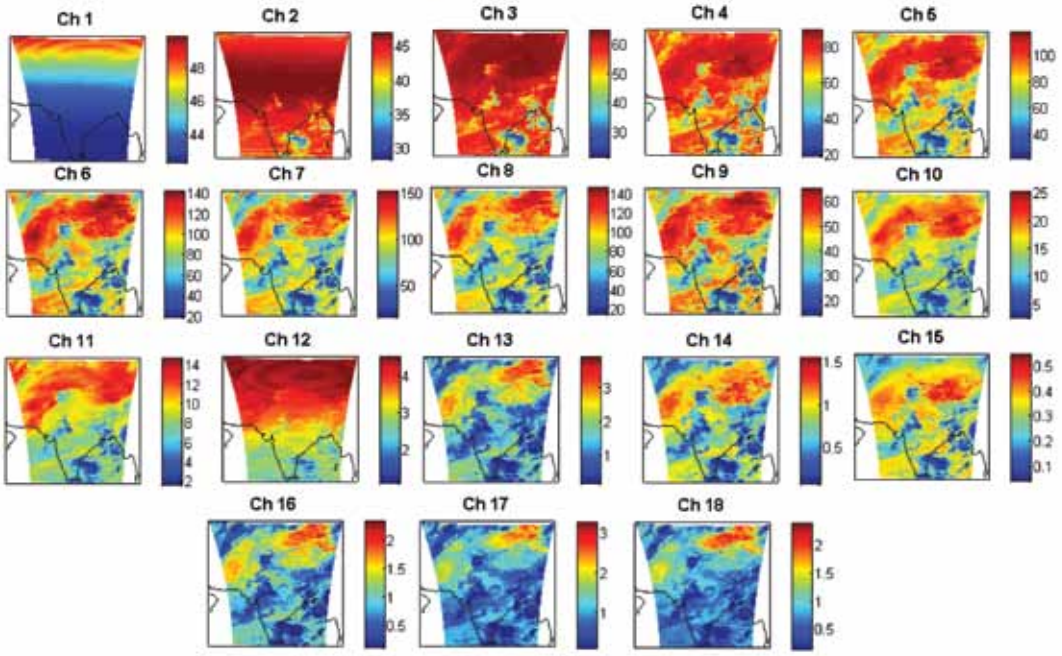


IMSRA (Rainfall)



WV Wind

INSAT-3D Sounder Radiances (mW/m^2/sr/cm^{-1})
10 August 2013 0331UTC



GSLV-D5 / GSAT-14 Mission

The launch of GSLV-D5 (with Indian Cryogenic Stage), scheduled for 1650 hrs on August 19, 2013, had to be called off due to a leak observed in the UH25 Fuel system of the Liquid Second Stage, during the pre-launch pressurisation phase on the vehicle just two hours before the scheduled lift-off. At the time of calling off the Countdown, the GSLV Vehicle was loaded with 210 tons of liquid and cryogenic propellants. About 750 kg of UH25 Fuel had leaked out, leading to contamination of the area around the launch pad. It took 6 days of round-the-clock operations before the contamination could be reduced to the safe level to enable movement of the GSLV-D5 back to the Vehicle Assembly Building. The GSLV-D5 Launch Vehicle has been safely moved back to the Vehicle Assembly Building on the early morning of August 26, 2013. The Vehicle has been de-stacked.

Chairman, ISRO constituted a High Level Task Team on August 20, 2013, chaired by Shri K. Narayana, (former Director of Satish Dhawan Space Centre) to identify the cause of the leak and to work out an action plan for quick restoration of the Mission, taking into account the safety, reliability and life of the Liquid Second Stage and the four Liquid Strap-on stages, which were wetted with liquid propellants. The leak is suspected to be in the lower portion of the propellant tank or the fluid lines between the tank and fuel filling system of the Second stage. Detailed investigation of the leak is underway.

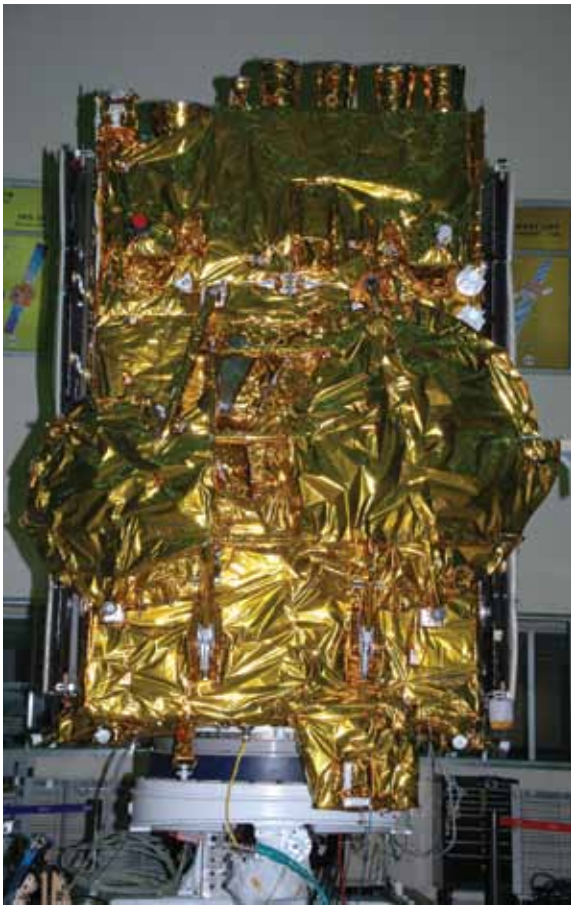
The following action plan is put in place:

- A new Liquid Second Stage (GS-2) is being assembled to replace the leaked-stage. All the four Liquid Strap-on Stages are being replaced with new ones. The First Stage (Solid) and core base shroud are being inspected and the elements that are affected will be replaced. The Satellite Assembly, Avionics Equipment Bay and the Cryogenic Stage will be preserved, following prescribed practices.
- Based on current availability of hardware and components, the GSLV Vehicle assembly and checkout is expected to be completed at the Vehicle Assembly Building by the first week of December 2013 and the launch could take place by December 2013.

India's Advanced Communication Satellite GSAT-7 Launched Successfully

India's advanced multi-band communication satellite, GSAT-7, was successfully launched at 0200 hrs IST on August 30, 2013 by the Ariane-5 launch vehicle of Arianespace from Kourou, French Guiana. Ariane-5 precisely placed GSAT-7 into the intended Geosynchronous Transfer Orbit (GTO) after a flight of 34 minutes 25 seconds duration.

As planned, ISRO's Master Control Facility (MCF) at Hassan in Karnataka started acquiring the signals five minutes prior to the separation of GSAT-7 from Ariane-5 launch vehicle. The solar panels of the satellite have been deployed and they are generating power. Initial checks have indicated normal health of the satellite.



GSAT-7 at ISRO Satellite Center

The satellite has been successfully placed in GTO with an altitude of about 36,000 km above Earth's surface on September 3, 2013 morning, after three orbit-raising manoeuvres commanded from MCF, Hassan. Later in the day, the communication antennae of GSAT-7, including the UHF Helix antenna, were deployed successfully. Following this, GSAT-7 was put in its final orbital configuration, stabilised on its three-axis by the momentum wheels.

All the 11 communication transponders operating in UHF, S, C and Ku-bands of GSAT-7 have been successfully switched on and their performance is found to be normal. GSAT-7 is now positioned at its designated orbital slot of 74 deg East longitude in the geostationary orbit and In Orbit Testing (IOT) of the 11 transponders is in progress.

List of Foreign Satellites launched by India's Polar Satellite Launch Vehicle

Sl. No.	Satellite	Country	Launch Vehicle	Launch Date	Weight (Kg)
1	KITSAT – 3	KOREA	PSLV–C2	26.5.1999	110
2	DLR-TUBSAT	GERMANY			45
3	BIRD	GERMANY	PSLV–C3	22.10.2001	92
4	PROBA	BELGIUM			94
5	PEHUENSAT – 1	ARGENTINA	PSLV–C7	10.1.2007	6
6	LAPAN-TUBSAT	INDONESIA			56
7	AGILE	ITALY	PSLV–C8	23.4.2007	350
8	TECSAR	ISRAEL	PSLV–C10	21.1.2008	300
9	CUTE 1.7	JAPAN	PSLV–C9	28.4.2008	5
10	SEEDS	JAPAN			3
11	CAN X2	CANADA			7
12	AAUSAT -II	DENMARK			3
13	COMPASS-1	GERMANY			3
14	DELFI-C3	THE NETHERLANDS			6.5
15	NLS – 5	CANADA			16
16	RUBIN - 8	GERMANY			8
17	CUBESAT – 1	GERMANY	PSLV–C14	23.9.2009	1
18	CUBESAT – 2	GERMANY			1
19	RUBIN – 9.1	GERMANY			1
20	RUBIN – 9.2	GERMANY			1
21	CUBESAT – 3	TURKEY			1
22	CUBESAT – 4	SWITZERLAND			1
23	ALSAT-2A	ALGERIA	PSLV-C15	12.7.2010	116
24	NLS-6.1(AISSAT-1)	CANADA			6.5
25	NLS-6.2 (TISAT-1)	SWITZERLAND			1
26	X-SAT	SINGAPORE	PSLV-C16	20.4.2011	106
27	VESSELSAT-1	LUXEMBOURG	PSLV-C18	12.10.2011	28.7
28	SPOT 6	FRANCE	PSLV-C21	09.09.2012	712
29	PROITERES	JAPAN			15
30	SAPPHIRE	CANADA	PSLV–C20	25.02.2013	148
31	NEOSSAT	CANADA			74
32	NLS-8.1 (UNIBRITE)	AUSTRIA			14
33	NLS-8.2 (BRITE)	AUSTRIA			14
34	NLS-8.3 (AAUSAT-3)	DENMARK			3
35	STRaND-1	UK			6.5

Ready for the historic mission: PSLV-C21 at the First Launch Pad with the Second Launch Pad in the background

इसरो isro

Antariksh Bhavan, New BEL Road, Bengaluru - 560 231, India.
www.isro.gov.in