January-March 2001

SPACE india

INDIAN SPACE RESEARCH ORGANISATION

The Indian Space Programme

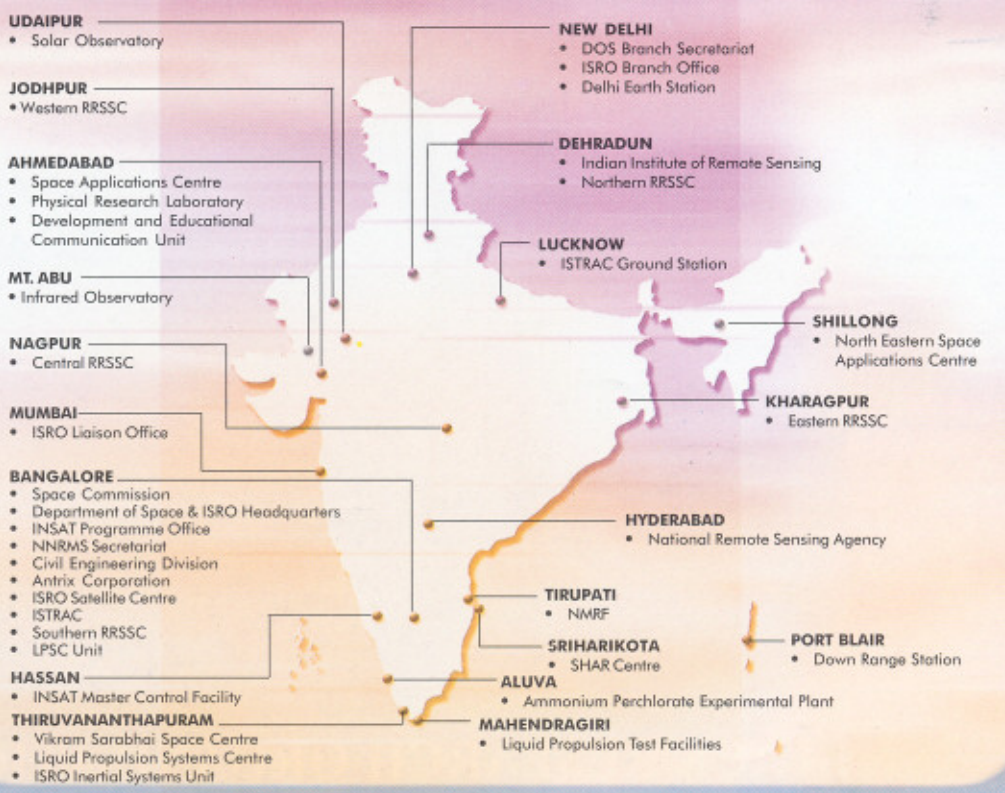
The setting up of the Thumba Equatorial Rocket Launching Station (TERLS) in 1963 marked the beginning of the Indian Space Programme. The Space Commission and the Department of Space (DOS) were established by the Government of India in 1972 to promote unified development and application of space science and technology for identified national objectives.

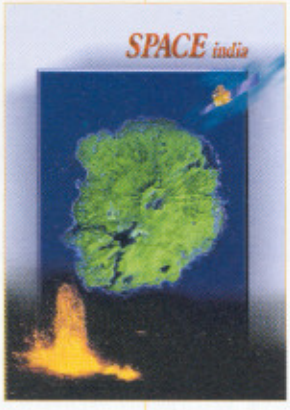
The Indian Space Programme is directed towards the goal of self reliant use of space technology for national development, its main thrusts being (a) satellite communications for various applications, (b) satellite remote sensing for resources survey and management, environmental monitoring and meteorological services and (c) development and operationalisation of indigenous satellite and launch vehicles for providing these space services.

The Indian Space Research Organisation (ISRO) is the research and development wing of DOS and is responsible for the execution of the national space programme. ISRO also provides support to universities and other academic institutions in the country for research and development projects relevant to the country's space programme.

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

SPACE CENTRES AND UNITS IN INDIA





Cover Page :

An IRS imagery showing Volcanic eruption of Mt. Oyama, Japan.

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Contents

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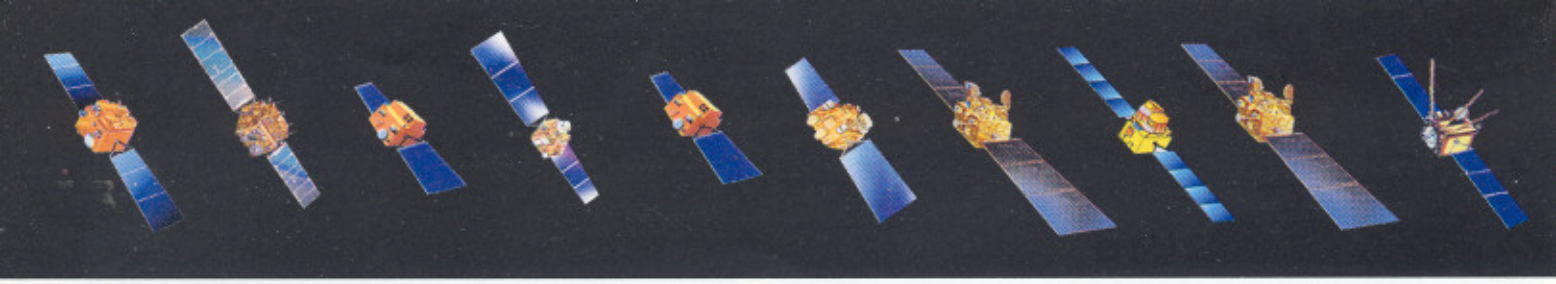
IRS International Ground Stations Operators Meet

The International Ground Station (IGS) operators, who receive data from the Indian Remote Sensing satellite (IRS), met at Panaji, Goa, during January 29-30, 2001 to discuss and exchange views on the various aspects of data reception, ground station operations and application of data from IRS satellites. The agenda for the meeting, jointly organised by the Antrix Corporation, India and Space Imaging, USA, included presentations by ground station operators and IRS data users as well as discussions on the future plans of ISRO for continuation of remote sensing systems and the marketing plans for the data. Dr K Kasturirangan, Chairman, ISRO, who is also the Chairman of Antrix Corporation, the commercial agency, which has signed an agreement with the Space Imaging, USA, for reception and marketing of IRS data worldwide, delivered the keynote address. Mr. John R Copple CEO, Space Imaging, gave the opening remarks followed by a presentation "Space Imaging: year 2000 in review". Mr N Sampath, Executive Director, Antrix Corporation welcomed the delegates to the two-day meet.

Dr. K. Kasturirangan, Chairman, Antrix Corporation, inaugurating the meet by lighting the lamp. On his right is Mr. John Copple, CEO, Space Imaging, USA.

Space enterprise, which evolved from its modest steps of exploration and proof-of-concepts earth oriented applications, has now become a serious business endeavour. Ever since the launch of the earliest satellites and astronauts taking pictures of the earth from space, nearly four decades ago, those images have inspired excitement, introspection, awe, culminating into, among other things, commerce and business. Space has manifested itself as a vast command area and, if judiciously marketed, can touch every individual through its immense capability of information gathering and information delivery. Even as government support continues to promote space endeavours across nations, there is an increasing investment and influential role of the private sector in shaping the way space can impact humanity.

Remote Sensing is one of the major elements of the growing space enterprises and has immense potential to alter the way governments and industries operate the business of information. Compared to the overall space revenues of about US $ 120 billion, remote sensing accruable revenues are presently at the levels of



US $ 10 billion, which though appear modest, have the potential for higher acceleration and growth. Remote sensing will become the one-stop source of information particularly spatial information, thus enabling not only development oriented activities but also business, geographical information system (GIS), quality research and info-savvy communities. One survey puts the space based imaging growth at 28.6 percent per annum from 1997 through 2004. It is expected that internationally, there would be a mix of government and commercial satellites vying to provide information services to a wide variety of users. Remote sensing satellites are also becoming smaller, efficient and less costly. While highlighting these aspects in his keynote address, Dr Kasturirangan predicted that five to six commercial systems will orbit the earth in the near future generating massive, seamless archives of high-resolution panchromatic and multi-spectral images, almost reducing the need for aerial surveys for photography and mapping. Providing spatial resolutions in centimetre level and covering narrower and more spectral bands, the trend will be to image the earth in its entirety and organize image infrastructures. "The race will be to imaginatively capture the market with the fullest archive of the globe and cater to any imaging demand of users" Dr Kasturirangan said and added that the ground systems would undergo a revolutionary change in reaching the "terra-volumes" of data to the users; the buzzword will be "image access on-line" with full encapsulation of e-image business. Efficient systems at multi-mission data reception and archiving will provide across-the board archives of multiple satellite missions forcing satellite operators to share ground infrastructure and optimising their operations. Proliferation of a number of low-cost, personalized, smart image reception systems as well as establishment of image portals – one-stop shops or warehouses – of remote sensing images is also expected. With increasing realization that the information market will be more relevant than the imagery market itself, the emphasis will be on value-addition, Dr Kasturirangan said. The information so created will support planning and development activities especially in the management of natural resources, disaster management, watershed management/ development, resources monitoring, landuse planning, water resources development and agricultural development.

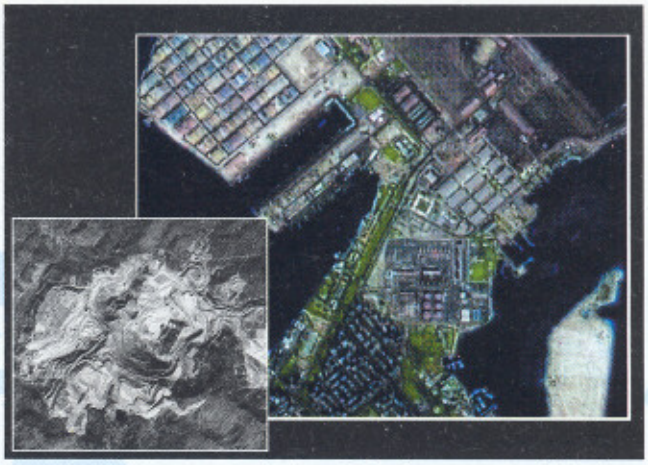
On the commercial aspects, Dr Kasturirangan said that the costs of images would dictate the commercial growth of remote sensing. With a variety of remote sensing satellites providing data in several spectral and spatial resolutions, faster revisit capabilities and easier accessibility would play an important role for the growth of remote sensing market. While the present annual remote sensing data sales is about US $ 170 million with value-added products forming another US $ 700 million and GIS services accounting for a further US $ 1 billion, the market is expected to reach a total of US $ 12 billion by 2003, he predicted.

It is to be noted that Indian remote sensing satellites (IRS) constellation, consisting of IRS-1C, IRS-ID and the recent OCEANSAT-1, provides an immense imaging capability to the global community and the IRS images have made considerable inroads into the global market through the 10 international ground stations that receive IRS images world-over. IRS images, through the marketing efforts of Antrix and Space Imaging, have opened up new application areas. In India, specially under the programme of National Natural Resources Management System (NNRMS), various national development issues like groundwater targeting, crop production estimation, forest monitoring, city

planning, etc, have been addressed using the IRS data and there is a user base of 700-800 in the country. The institutional framework of NNRMS and the 23 State Remote Sensing Centres, address the government needs of spatial information and remote sensing images. It has also enabled 100-150 private agencies to provide remote sensing services. Awareness and education has also been addressed with the results that about 15,000 persons have been trained in remote sensing areas in the country. In his keynote address Dr Kasturirangan offered to share India's experience with other countries in this regard.

The future plans of ISRO to launch a series of satellites — RESOURCESAT, which will provide multi-resolution imaging capability 60 metre at 800 km swath, 23 metre four band imaging and 5 metre spot imaging; CARTOSAT-1 and CARTOSAT-2 which will provide 2.5 metre images and 1 metre resolution; and Megha Tropiques which is a joint venture with CNES, France, for climate and weather modelling — give sufficient assurance to IRS data users. Dr Kasturirangan expressed his satisfaction with the partnership between Antrix Corporation and Space Imaging and said that Antrix, with Space Imaging, has made the brand-name for IRS and made forays into image markets in North and South America, Europe, Asia, Australia through the network of ground stations.

Mr John R Copple, CEO of Space Imaging, USA, reviewing the performance of Space Imaging for the year 2000, said that ISRO's vision to plan and build so many remote sensing satellites has not been challenged by any other country so far and India is still the leader in this field. "The wonderful thing about IRS programme is that they are open to all our inputs in any manner which makes our life easy" he said and revealed that people will soon be able to access 5 metre resolution IRS data from their home in USA and prototypes for the same are ready. He said that he was looking forward to the launch of CARTOSAT by India.



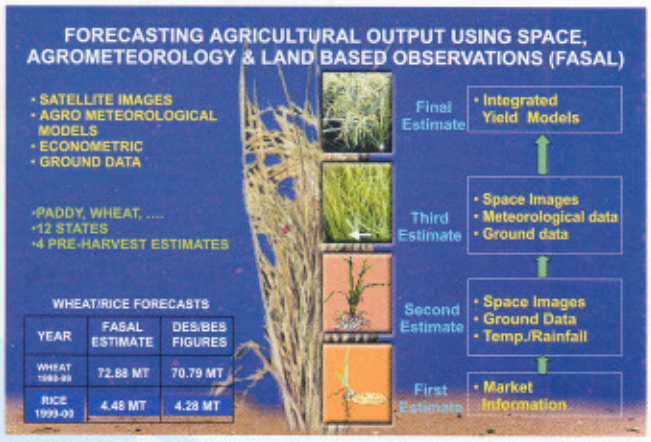
A typical 5 metre resolution IRS imagery used for base mapping and urban planning

There were presentations by Space Imaging on the various projects that are being undertaken using data from IRS. The examples included applications in environment, telecommunication network planning, business geographic like analysis for stores locations, transportation, agriculture, counter narcotic, etc. Use of IRS panchromatic data to develop accurate telephone network model in Colorado and IRS LISS-III data for providing route information to Tibet River expedition were of interest.

Dr Rupert Haydn, Managing Director of GAF, Germany, briefing on the use of IRS data, stated that his company has already implemented a tool to inform users automatically about the availability of new scenes acquired over predefined areas. The customers receive quick look data by e-mail within 3 to 6 hours after the satellite passes over the region. He said that IRS imageries have proved its utility in operational conditions, especially, for crop monitoring, flood and snow melt monitoring. A series of 3D-flythroughs,

Fly-through products developed by Euromap using IRS data.

A 3D imagery



Concept of FASAL

based on 25 metre resolution LISS-III and 5 metre resolution PAN camera data, has been developed and this software, with multi-resolution capability, runs on PCs and offer free navigation in real time. These products have also been produced for dedicated tourism applications.

Mr Zhang Jianguo, Director Asst, China Remote Sensing Satellite ground station of the Chinese Academy of Sciences, who also participated in the meet, presented on the remote sensing efforts in his country and said that there are about 600 users including the Ministries, State Administration, National Industry Companies who use remote sensing data in China. The remote sensing applications cover wide fields of application like forestry, agriculture, education and science, irrigation works, geology, defence, land use, urban planning, etc.

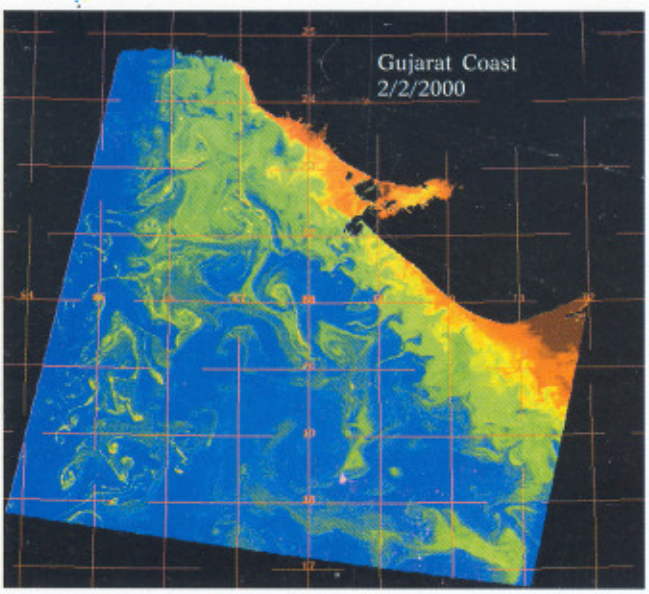
Mr Tatsuyuki Hanada of the Earth Observation Centre in National Space Development Agency of Japan highlighted IRS data reception and processing in Japan. He said that IRS-1C data has been acquired over 600 times and IRS-1D for about 725 times between 1998-2000 and over 353 users and researchers have been provided these data. Some of the significant uses of IRS data have been in the monitoring of the volcanoes in Hokkaido on March 31, 2000 and Mt Oyama in Miyake Island, which erupted on July 8, 2000. Mr Sanondh Brahmaphalin, GISTDA, Thailand presented on the formation of Geo-Informatics and Space Technology Development Agency, Thailand and the role of IRS data in this organisation.

Dr D P Rao, Director, National Remote Sensing Agency, Hyderabad gave details of the use of IRS satellites in the national developmental tasks. He briefed on the institutionalisation of National Natural Resources Management System, applications of remote sensing by the various Ministries of the Government, specifically highlighting the pilot project on Forecasting Agricultural Output using Space, Agro-Meteorology and Land Based Observations

Effects of atmospheric correction of IRS-P4 OCM data in band 3 and band 5

(FASAL), agricultural drought assessment, wasteland mapping, ground water prospecting, urban sprawl mapping, inventory and mapping of rural roads, aquaculture development, mapping soil affected areas, bio-diversity characterisation and coral reef mapping.

Dr R R Navalgund, Deputy Director of Space Applications Centre of ISRO, explained the applications of IRS-P4 (OCEANSAT), especially,

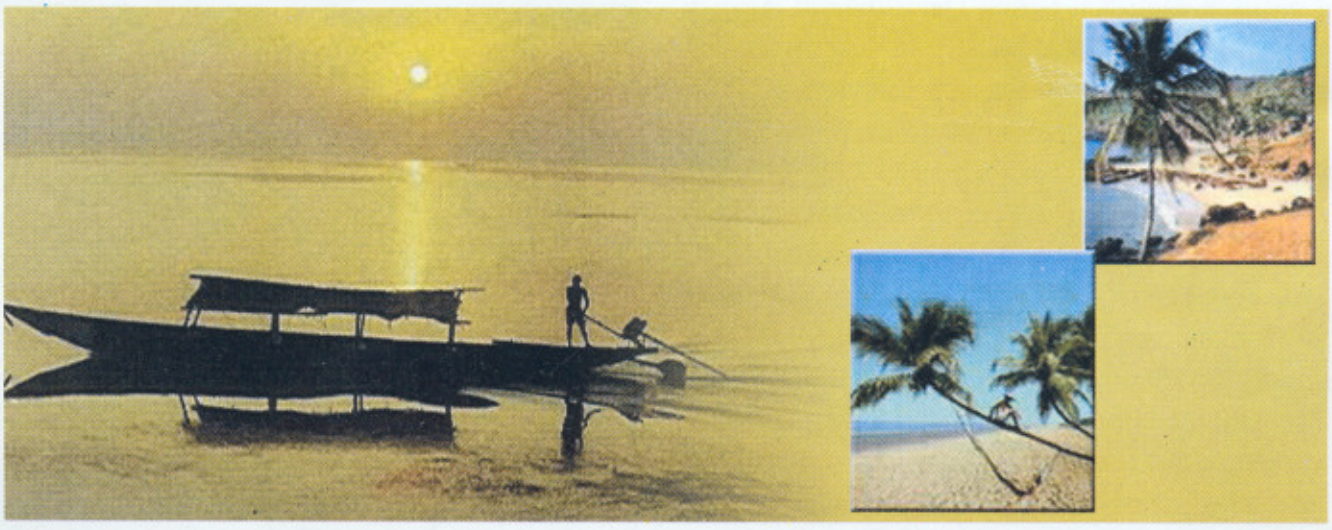


IRS-P4 OCM image shows distribution of algal bloom in open ocean waters of Arabian sea. High pigment patches are present in bottom left corner of image

the parameters that can be retrieved from the ocean colour monitor and its potential applications for fishing zone forecast, primary productivity, coastal processes and algal bloom detection. He also covered the application of Multifrequency Microwave Radiometer for measuring sea surface winds, sea surface temperature, ocean circulation, wave height, soil moisture, predicting on set of monsoon and for Antarctic sea ice estimation. Mrs Sarita Das, Member-Secretary of the National Capital Region Planning Board highlighted the application of IRS data and GIS for development of national capital region especially in the area of land use and land cover, information for land use plans, transportation plan and settlement system planning, protection of natural resources like water, forests, agriculture land, open spaces. Dr S K Sharma, Member, Central Ground Water Board, Government of India, highlighted how IRS data has been used for deriving vital inputs of relevance to land and water resources, targeting underground aquifers, identification of water logging and soil salinity in canal command areas, mapping of urban sprawl and ground water vulnerable area, identification of water stress zones and site demarcation for conservation of rain water and recharge of underground aquifers. He said that the space imageries are regularly used now for generation of detailed hydro-geo-morphological maps.

Dr V Jayaraman, Director, Earth Observation Systems, ISRO presented on the future scenario of Indian earth observations programme while Mr S Kalyanaraman, Programme Director, ISRO Satellite Centre, gave the present status of IRS mission.

The meet at Goa, the first such international ground stations operator's meet, was very fruitful and it allowed IRS ground station operators and the data users to exchange views that are expected to help in fine tuning the satellite remote sensing systems and ground station equipment, besides exploring new areas of data utilisation. The meet also gave the delegates an opportunity to enjoy the beautiful and idyllic Goa, the land of dance, fun and frolic.



Indian Students Selected for Mars Mission

Planetary Society, USA, has selected five Indian students as 'Student Navigators' for participation in an exploratory mission to the red planet Mars organised. Of these, three are in the primary team and two in the backup team. The students are

Primary Team

11 year old Avinash Chandrashekar, Padma Sheshadri Bala Bhavan, Chennai.

13 year old Bhushan Prakash Mahadik, Fr.Angel Multipurpose School, Mumbai.

16 year old Shaleen Rajendra Hartalka, St. Paul's Sr.Secondary School, Udaipur.

Back Up Team

11 year old Harikrishnan Ramani, Padma Sheshadri Bala Bhavan, Chennai.

12 year old Kamalayazini S P, Vivekanandha Higher Secondary School, Pondicherry.

The above are among the 12 students selected from all over the world. The other students are: Daniel Jan Hermanowicz, Poland, Kevin Hou, USA, Kimberly DeRose, USA, Jacqueline Cherie Hayes, Australia, Paul Nicholas Bonata, Australia, Kevin Kuns, USA, Esteban Gomez Pineda, Venezuela. Apart from the five Indian students selected for primary and back up teams, Srikanth Sridharan of National Public School, Bangalore and Sastry Laksmi Narayan Vadlamani of Nagasena Vidyalaya, Bangalore, have got honourable mention for outstanding journals.

The National Aeronautics and Space Administration (NASA), USA, is launching a probe 'MARS SURVEYOR 2002' for exploration of the planet Mars. The mission will offer opportunities to the students all over the globe to participate in this exploratory mission. Both Primary Student Team and the Student Back Up Team will receive nine months of intensive training via the Internet and in a simulated Mars base. The student navigator will participate in the operation of the Rover and the Lander Robotic Arm on Mars. Working with them will be Student Scientists who will define experiments to be carried out on Mars. During mission operations, the Student Navigator will take shifts, living and working in the simulated Mars base, and student Navigator back up team will serve as media representatives keeping the major networks and the newspapers as well as the local media groups informed about the daily activities and progress of Red Rover Goes to Mars. This unprecedented opportunity has come to the bright, dedicated students who can understand rover mechanics and command sequencing as well as the Martian environment and make new friends around the world.

Primary Team

Avinash Chandrashekar

Bhushan Prakash Mahadik

Shaleen Rajendra Hartalka

The students from India were recommended by ISRO, which is the national coordinator, after going through a rigorous selection process including a questionnaire round, journal writing contest on rover operations and its behaviour on simulated Mars base, rover parts assembly, group discussions

and interviews. ISRO had forwarded the names of twelve students to the Planetary Society. Of these, five students were selected from among the 51 entries from all over the world. An international panel of judges telephonically interviewed five of the students and all the five were selected.

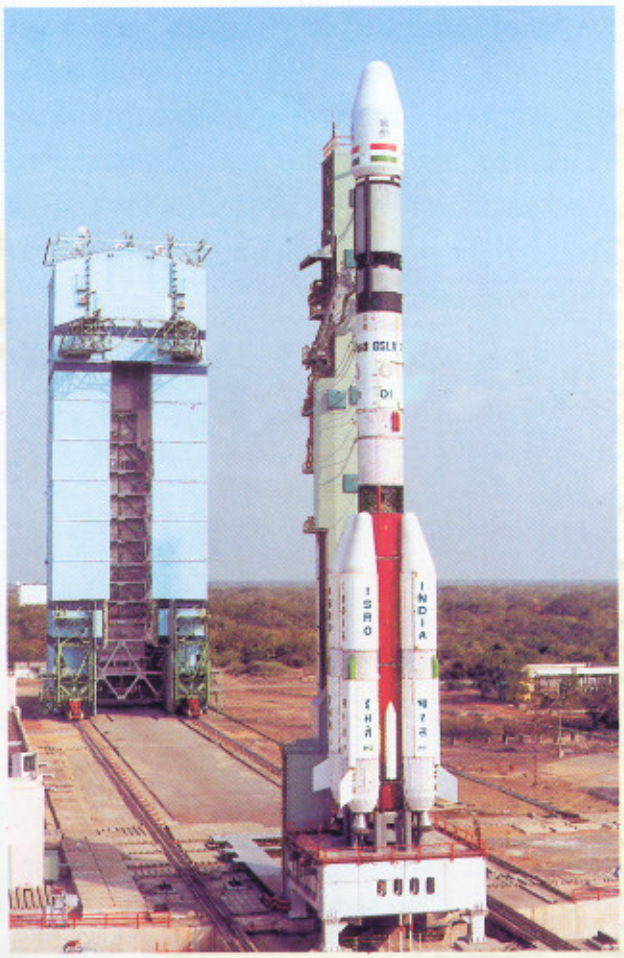
It may be recalled that three Indian students, namely, Vikas Sarangadhara of Bangalore, Tanmay Sanjay Khirwadkar of Nagpur and Shaleen Rajendra Hartalka of Udaipur were selected as Student Scientists in September 1999 (Space India July-September 2000). Shaleen Rajendra Hartalka is one among the two students who has been selected both as Student Scientist and Student Navigator.

Backup Team

Harikrishnan Ramani

Kamalayazini S P

GSLV-D1 Launch Postponed



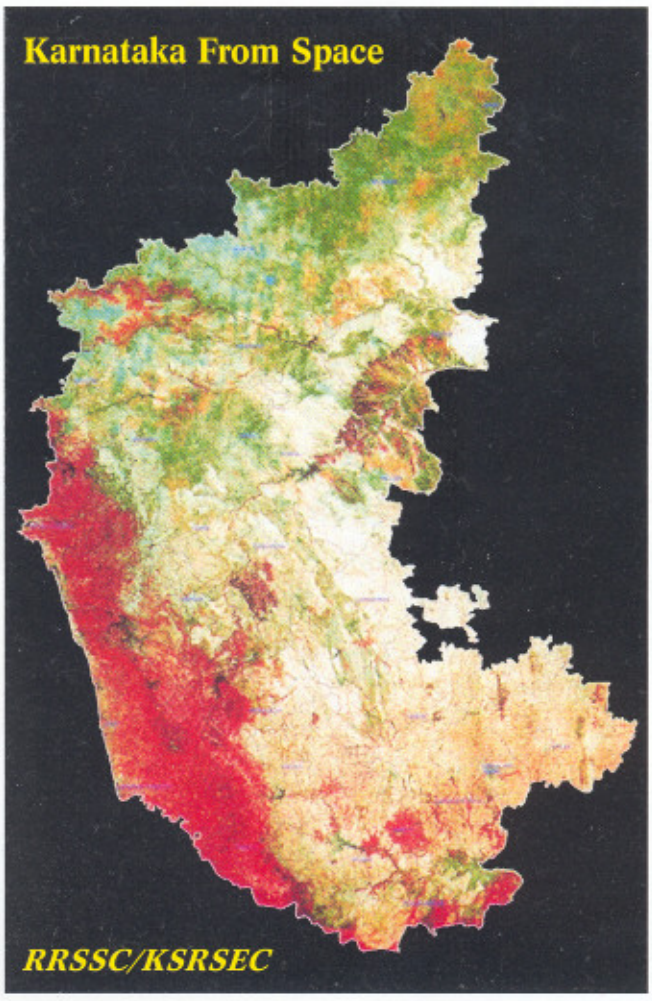
The launch of India's Geo-synchronous Satellite Launch Vehicle [GSLV-D1] which was scheduled at 3.47 pm on March 28, 2001 from SHAR Centre, Sriharikota, was aborted in the last moment. The countdown for the lift-off proceeded smoothly till one second before lift off when the automatic launch process system stopped the countdown after it detected that one of the liquid propulsion strap-on booster did not develop the required thrust.

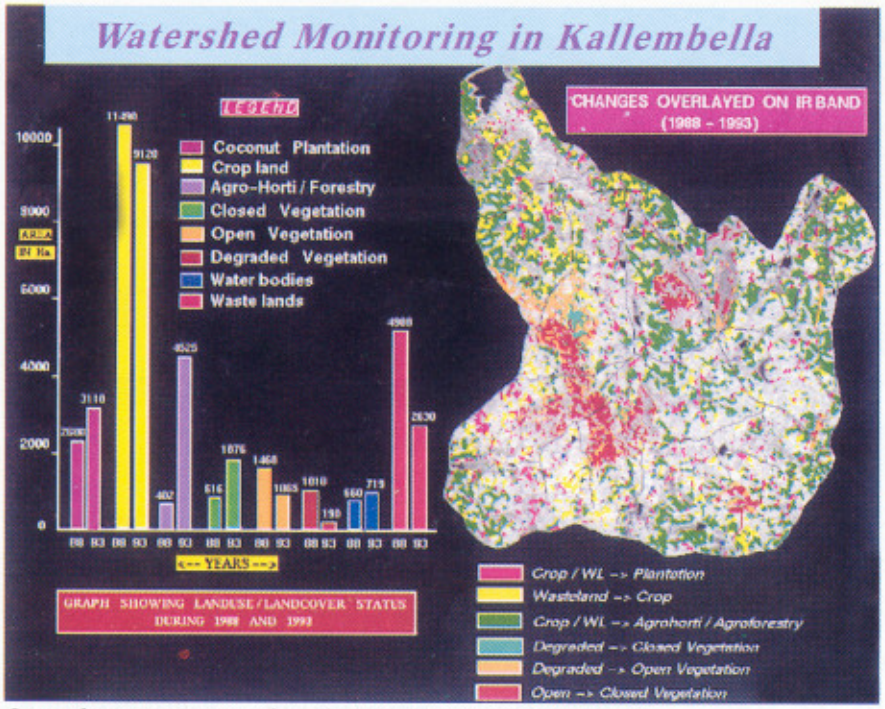
The launch will be rescheduled after investigating the reasons for the malfunctioning of one the strap-ons and effecting necessary modifications.

ISRO to Help Karnataka in the Use of Space Based Systems

ISRO signed a Memorandum of Understanding (MoU) with Government of Karnataka (GOK) in Bangalore on January 22, 2001, that will help in the use of space based systems for the development of the state. The MoU was signed in the presence of Chief Minister of Karnataka, Mr S M Krishna and Chairman of ISRO Dr K. Kasturirangan, by Mr Vivek Kulkarni, Secretary to the Government of Karnataka, on behalf of the Government of Karnataka and by Dr K N Shankara, Director, Satellite Communication Programme and Dr V Jayaraman, Director, Earth Observation System, on behalf of ISRO.

According to the MoU, ISRO will help Karnataka to plan and establish a satellite based communication network for education; health, e-governance and use of space based remote sensing data for monitoring and managing natural resources. ISRO will explore the possibilities of establishing a satellite based communication network in Karnataka using the INSAT system for promoting distance education and development. It may be noted that ISRO has reserved transponders capacity on INSAT, for training and developmental communication and Karnataka is already using this facility extensively for programmes like Panchayat Raj workers training. ISRO will also extend support for the use of remote sensing data for various natural resources monitoring and development. The present MoU will formalise and further promote the use of space systems, especially in the areas of interactive training programmes, information Networking, e-governance, tele-medicine, resources information system (NRIS), watershed development, school education, Internet and setting up virtual





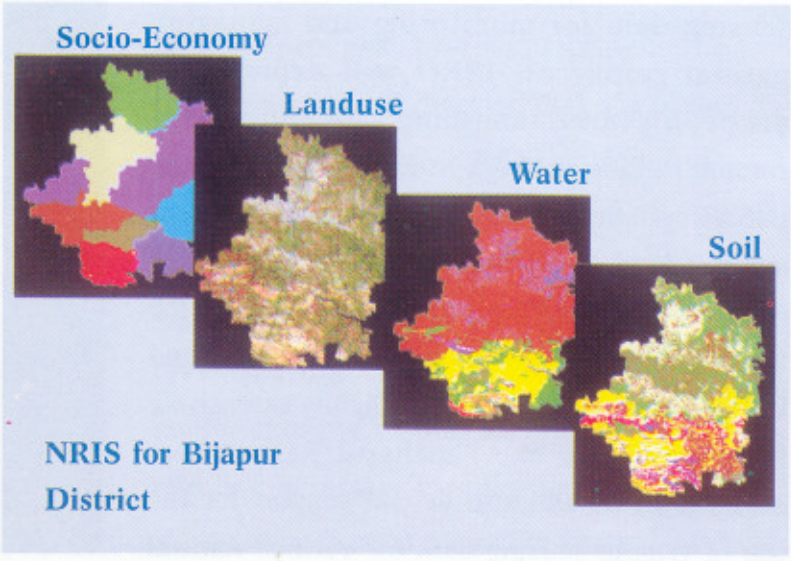
Several remote sensing based projects have been taken up by ISRO for Karnataka like Watershed monitoring and generation of Natural Resources Information System for Bijapur.

universities and development of information technology activities in the State.

The Karnataka Government is also proposing to establish a State National Resources Management Information System (SNRMIS) on the lines of National Natural Resources Management System (NNRMS) of the Department of Space. The Karnataka Natural Resources Management System will be a part of the State Remote Sensing Application Centre (SRSAC).

Speaking on the occasion, Chief Minister of Karnataka, Mr S M Krishna said that ISRO is one of those rare government organisations, which has succeeded in carrying the benefits of science and technology to the common man. Apart from excelling in frontier activities like making state-of-the-art satellites and rocket systems, ISRO has devoted equal attention to how its knowledge can be harnessed to benefit the poor, the disadvantaged and the uneducated in this country. He emphasised that Karnataka has committed itself to e-governance, and therefore the development of an information networking systems for e-governance will be in the fitness of things. "With technical assistance from ISRO, a comprehensive satellite network will be established which will be used for providing training to government functionaries such as Anganawadi workers, Gramasevaks, panchayat secretaries, members of Grampanchayats, teachers, para-medical workers and all other village functionaries who are located at village level and therefore are difficult to reach geographically" he said.

Karnataka has also been in the forefront of watershed development movement and it has been successful in planning watersheds in a comprehensive way and harnessing the benefits in a scientific manner. With ISRO's help, the state proposes to delineate and optimally exploit the watershed resources of the state in a holistic manner.



SATCOM Users Meet

ISRO organised a SATCOM Users Meet on February 23, 2001 in Bangalore, to help in its planning of INSAT series of satellites. With the liberalisation of economy in the last few years, the SATCOM users who were hitherto mainly in the government sectors have now shifted to private sectors. Hence the feedback from the SATCOM users on their plans for the next few years, will greatly help in designing the INSAT-4 series of satellites to make it tuned to the user needs. The participants included the present users of INSAT system as well as the potential users, both government departments and private entrepreneurs.

The meet assumes significance in the light of the national telecom policy of 1994, which opened up value-added services to private sector. It may be noted that there are several private satellite TV channels that are broadcast over India and the cable TV network has come to stay. Besides, there has been an exponential growth of VSAT services, which has led to a sharp increase in the demand for satellite capacities. The national telecom policy of 1999, further opened up the services like Internet and Ku-band for private telecommunication service providers. ISP gateways are allowed through the foreign satellites. Broadcasting uplinks from Indian soil to foreign satellites have also been allowed. In this context of growing competition and higher demand for satellite capacities, ISRO has to plan its space systems so that dependence on foreign satellites can be reduced.

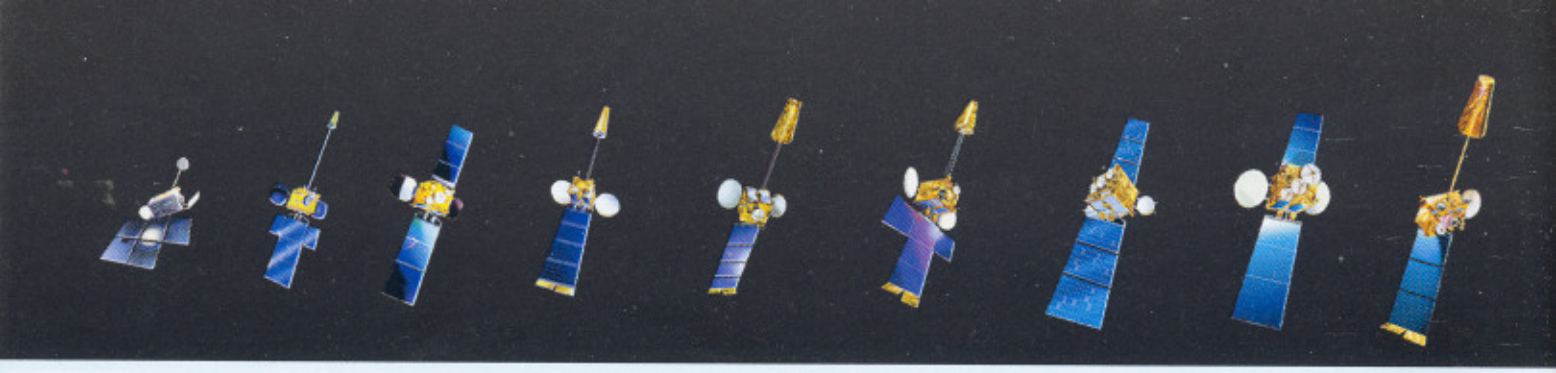
At present, INSAT system has about 80 transponders from its constellation of four

Present INSAT services

- All SATCOM links of DOT
- TV Broadcasting for DD
- All Radio Networking channels of All India Radio
- Data Relay Transponder for Meteorological & real-time Hydro Meteorological Data collection from river basin
- Meteorological services such as earth imaging, meteorological data dissemination, cyclone warning dissemination system
- Satellite Mobile Services: Satellite Telephony & Reporting Services
- Satellite Aided Search & Rescue System

INSAT System Utilisation

DOT Earth Stations	650
No of VSATs	12,000
No of TV Channels	25
No of Terrestrial Xmitters linked to INSAT	1063
No of RN Channels	38
No of AIR Transmitters linked to INSAT	200
No of Cyclone Warning Dissemination System Receivers	250
No of DCPs	200
No of Meteorological Data Dissemination terminals	100
No of VHRR Images per day	10 to 11



Orbital Slots occupied by INSATs

Orbital Slot	Satellite
93.5 deg E	INSAT-2B & 2C
83 deg E	INSAT-3B & INSAT-2E
74 deg E	INSAT-2A
55 deg E	INSAT-2DT
48 deg E	GSAT-2 (Planned)

satellites — INSAT-2C, INSAT-2DT, INSAT-2E and INSAT-3B — besides a few leased transponders. With the planned launch of INSAT-3A, INSAT-3C, INSAT-3D and INSAT-3E, this capacity will be increased to about 120 transponders by 2002 middle. Dr K Kasturirangan, Chairman, ISRO, who inaugurated the meet, stated that ISRO was very much aware of the difficulties presently faced by the users because of shortage of capacity. In planning the INSAT-4 system ISRO will address these factors and provide sufficient on-orbit spare capacity and ready-to-launch ground spare. He desired that the SATCOM users in the country will become active partners in the INSAT system.

Prominent among the SATCOM users, who projected their requirement and provided inputs included the Bharat Sanchar Nigam Limited, Doordarshan, All India Radio, India Meteorological Department, Snow & Avalanche Study Establishment, VSAT Operators including HCL COMNET, HECL, COMSAT MAX, Bharati BT, STPI, BSE, NSE and Essel Shyam and TV Broadcasters including Eenadu, Vijaya, Discovery Channel and Orbital Comm. ISRO's Development and Educational Communication Unit made presentations on the use of INSAT for development communication.

The SATCOM users meet provided a useful platform for exchanging views between spacecraft designers and the end users.

Transponder Availability with INSAT series of Satellites (July 2001 – July 2002 time-frame)

	C-band	Ext-C band	Ku-band	S-band
INSAT-2E	8	-	-	-
INSAT-3B	-	12	3	1 MSS
INSAT-3C	24	6	-	2 BSS + 1 MSS
INSAT-3A	12	6	6	-
INSAT-3E	24	12	-	-
Total	68	36	9	2 BSS + 2 MSS

INSAT-2C and 2DT are approaching End of Life

Stop Press

GSLV Launched Successfully

The first developmental test flight of India's Geosynchronous Satellite Launch Vehicle, GSLV, was successfully carried out on April 18, 2001 from SHAR Centre, Sriharikota, about 100 km north of Chennai, marking a major milestone in the Indian space programme. The 401 tonne, 49m tall GSLV, carrying an experimental, 1,540 kg, satellite, GSAT-1, lifted off from Sriharikota at 3-43 pm IST. Seventeen minutes after lift off, GSAT-1 was successfully placed in an orbit of 181 km perigee and an apogee 32,051 km with the orbit inclination of 19.2 degree.

IRS Images of Kumbhmela site

AS SEEN ON, 21-APR –2000

AS SEEN ON, 15-JAN –2001

The imagery processed from data of Panchromatic camera on board Indian Remote Sensing Satellite, shows the development that took place at the Maha kumbhmela site near Allahabad between April 26, 2000 & January 15, 2001.