अक्तूबर 2004 - जून 2005
October 2004 - June 2005

अन्तरिक्ष भारत SPACE india

भारतीय अन्तरिक्ष अनुसंधान संगठन
इसरो isro INDIAN SPACE RESEARCH ORGANISATION

Launching two Indian Satellites at a time – the larger CARTOSAT-1 (top) with the piggyback satellite HAMSAT (in the middle) mounted on PSLV-C6 fourth stage

अन्तरिक्ष भारत

अक्तूबर 2004 - जून 2005

SPACE india

October 2004 - June 2005

Cover Page: PSLV-C6 lift-off

Editors

S Krishnamurthy
V Sundararamaiah
Rajeev Lochan

Editorial Assistance

B R Guruprasad

CONTENTS

*'**SPACE india**' is published by the Indian Space Research Organisation for limited circulation. Articles appearing in SPACE india may be reproduced, accompanied by the credit line "Reprinted from SPACE india" along with the date of issue.*

Editorial / Circulation Office
Publications & Public Relations Unit, ISRO Headquarters, Antariksh Bhavan, New BEL Road, Bangalore - 560 094, India. www.isro.gov.in Printed at Mapco Offset Printers, Bangalore-560033.

PSLV Launches CARTOSAT-1 and HAMSAT

In its ninth flight conducted on May 5, 2005, ISRO's Polar Satellite Launch Vehicle, PSLV-C6, launched India's remote sensing satellite, the 1,560 kg CARTOSAT-1, along with a 42.5 kg piggyback satellite, HAMSAT, into a polar Sun Synchronous Orbit (SSO) of 632 km apogee and 621 km perigee. For the first time, the state-of-the-art Second Launch Pad (SLP) at Satish Dhawan Space Centre (SDSC) SHAR was used for a launch. President of India, Dr A P J Abdul Kalam, who had dedicated SLP to the nation the previous evening, witnessed the successful launch from the Mission Control Centre.

PSLV, initially designed to place 1,000 kg class Indian Remote Sensing (IRS) satellites into 900 km polar SSOs, has been upgraded to the present capability of 1,600 kg into 618 km polar SSO. The improvements over successive flights have been achieved through increased propellant loading in the stage motors, employing composite material for the satellite mounting structure and changing the sequence of firing of the strap-on motors.

One of the strap-on motors being integrated with PSLV-C6 first stage

At the end of final count down, the 44.4 metre tall, 295 tonne PSLV-C6 lifted off from SDSC SHAR, Sriharikota at 10:15 am IST with the ignition of the core first stage and four of the six strap-on motors. The remaining two strap-on motors were ignited at 25 seconds after lift-off. The important flight events included the separation of the ground-lit strap-on motors, separation of air-lit strap-on motors and the first stage, ignition of the second stage, separation of the payload fairing after the vehicle had cleared the dense atmosphere, second stage separation, third stage ignition, third stage separation, fourth stage ignition and fourth stage cut-off.

After these events, CARTOSAT-1 was successfully separated from the fourth stage 1078 seconds after lift-off. Forty seconds later, HAMSAT was also separated from the fourth stage equipment bay.

Both the satellites were placed in a polar SSO at an altitude of 632 x 621 km with an inclination of 97.8 deg with respect to the equator. The solar panels of CARTOSAT-1 were deployed soon after its injection into orbit.

In its present configuration, the 44.4 metre tall, 295 tonne PSLV has four stages using solid and liquid propulsion systems alternately. The first stage carries 138 tonne of Hydroxyl Terminated Poly Butadiene (HTPB) based solid propellant. The booster develops a maximum thrust of about 4,762 kN. Six strap-on motors, each carrying nine tonne of solid propellant and producing 645 kN thrust surround the first stage. The second stage employs indigenously built Vikas engine and carries 41.5 tonne of liquid propellant — UH25 as fuel and Nitrogen tetroxide (N_2O_4) as oxidiser. It generates a maximum thrust of about 800 kN. The third stage uses 7.6 tonne of HTPB-based solid propellant and produces a maximum thrust of

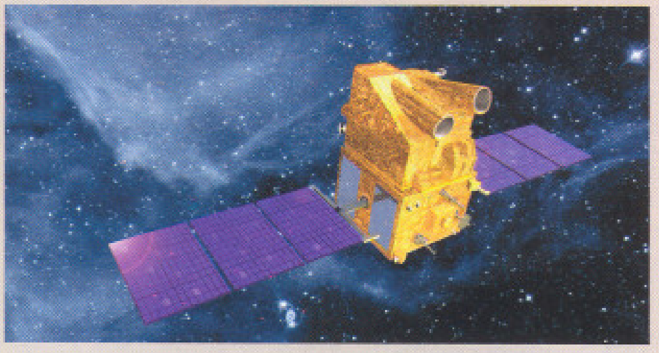
246 kN. The fourth and the terminal stage of PSLV has a twin engine configuration using liquid propellant. With a propellant loading of 2.5 tonne (Mono-methyl hydrazine and Mixed Oxides of Nitrogen), each of these engines generate a maximum thrust of 7.3 kN. The 3.2 m diameter metallic bulbous payload fairing of PSLV protects the spacecraft during the atmospheric regime of the flight.

With eight consecutively successful flights so far, PSLV has proved itself as a reliable workhorse. It has demonstrated multiple satellite launch capability having launched four small satellites for international customers besides nine Indian satellites. PSLV was used to launch ISRO's exclusive meteorological satellite, KALPANA-1, into a Geosynchronous Transfer Orbit in September 2002. The vehicle will be used to launch a spacecraft for India's first mission to Moon, Chandrayaan-1.

CARTOSAT-1

CARTOSAT-1, weighing 1560 kg at lift-off, is the eleventh satellite in the Indian Remote Sensing satellite series. It is intended for cartographic applications.

PSLV-C6 lifts-off from the Second Launch Pad



CARTOSAT-1 in orbit – an artist's view

CARTOSAT-1 carries two panchromatic cameras that take black-and-white stereoscopic pictures in the visible region of the electromagnetic spectrum. The imageries have a spatial resolution of 2.5 metre. The cameras cover a swath of 30 km and they are mounted in such a way that near simultaneous imaging of the same area from two different angles is possible. This facilitates in generating three-dimensional maps. The cameras are steerable across the direction of satellite's movement to facilitate the imaging of an area more frequently.

CARTOSAT-1 also carries a Solid State Recorder with a capacity of 120 Giga Bits to store the images taken by its cameras. These images can later be transmitted when the satellite comes within the visibility of a ground station.

CARTOSAT-1 will give further fillip to remote sensing services by providing imagery with improved spatial resolution. The unique high-resolution along-track stereo imaging capability, carried out for the first time anywhere in the world, will enable generation of the Digital Elevation Models and other value added products. The data from CARTOSAT-1 is expected to provide enhanced inputs for large scale mapping applications and stimulate newer applications in the urban and rural development, land and water resources management, disaster assessment, relief planning and management, environment impact assessment and various other GIS applications. The data can be used for updating topographic maps, besides generation of large-scale topographic maps.

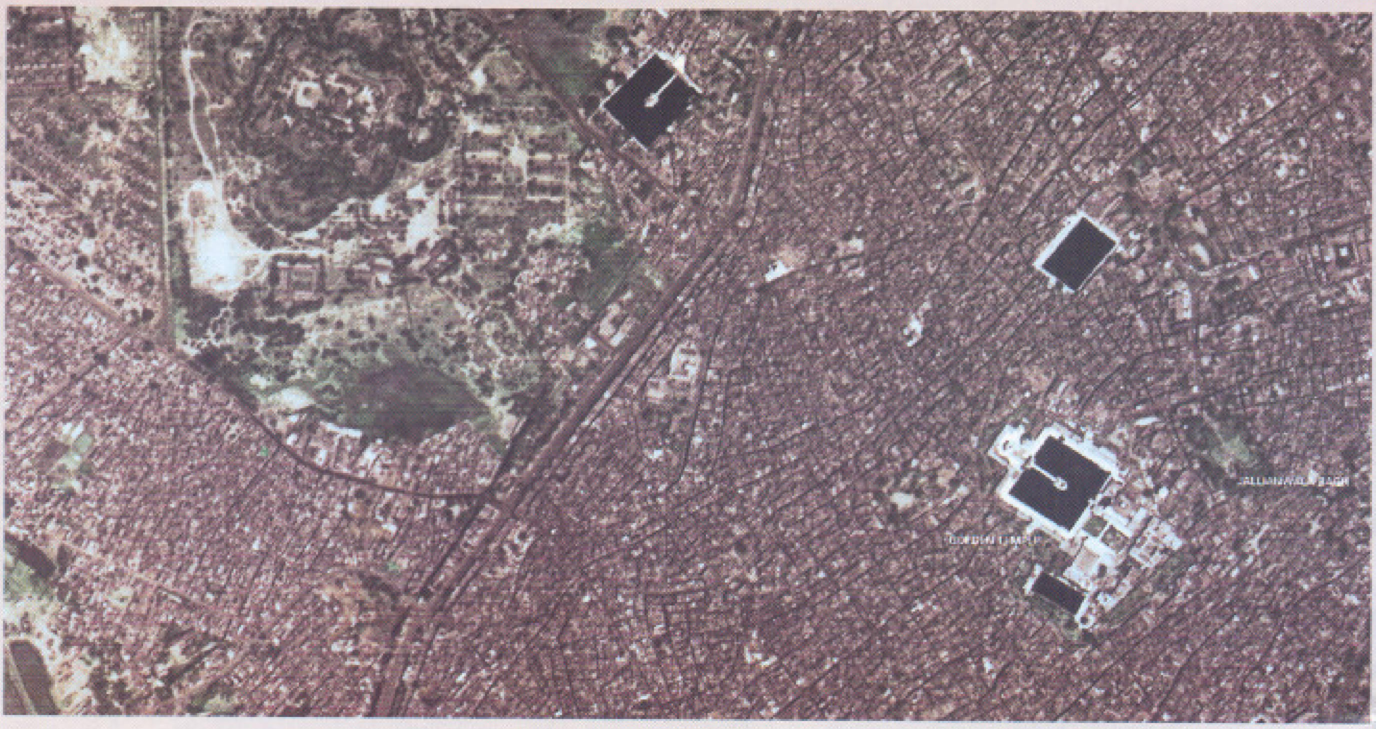


Image of Amritsar acquired from CARTOSAT-1

Salient Features of CARTOSAT-1

Orbit	:	Circular Polar Sun Synchronous
Orbit height	:	621 km
Orbit inclination	:	98.87 deg
Orbit period	:	97 min
Number of Orbits per day	:	14
Local Time of Equator Crossing	:	10.30 AM
Repetivity	:	126 days
Revisit	:	5 days
Lift-off Mass	:	1560 kg
Attitude and Orbit Control	:	3-axis stabilised using Reaction Wheels, Magnetic Torquers and Hydrazine Thrusters
Electrical Power	:	1100 W using 5 sq m Solar Array, Two 24 Ah Ni-Cd batteries
Mission life	:	5 years
Payloads	:	Two PAN Cameras one fore-mounted with a tilt of +26 deg and the other aft-mounted with a tilt of -5 deg from the yaw axis

Camera Specifications

Instantaneous Geometric Field of View (IGFOV)	:	< 2.5 m
Swath	:	30 km
Spectral band	:	0.50-0.85 micron
Data rate	:	105 Mbps for each camera
Solid State Recorder	:	120 GB capacity for image data storage

Indian Remote Sensing Satellite System

India has established the National Natural Resources Management System (NNRMS) for which the Department of Space (DOS) is the nodal agency. NNRMS is an integrated resource management system aimed at optimal utilisation of the country's natural resources by a proper and systematic inventory of resource availability using remote sensing data in conjunction with conventional techniques. The major elements of NNRMS encompass conceptualisation and implementation of space segments with the necessary ground-based data reception, processing and interpretation systems and integrating the satellite-based remotely sensed data with conventional data for resource management applications.

The Indian Remote Sensing (IRS) satellites form an important element of the NNRMS for providing continuous remote sensing data services for the management of natural resources of the country. A series of IRS satellites have been launched by India starting with IRS-1A in March 1988. There are six remote sensing satellites in service at present — IRS-1C, IRS-P3, IRS-1D, OCEANSAT-1, TES and RESOURCESAT-1 — making IRS system the largest civilian remote sensing satellite constellation in the world. CARTOSAT-1 is the latest satellite under the IRS programme.

CARTOSAT-1 will be followed by CARTOSAT-2, which will have a spatial resolution of about one metre. A Radar Imaging Satellite (RISAT), carrying a C-band Synthetic Aperture Radar with a spatial resolution of 3 to 50 m and a swath of 10 km to 240 km is under development. With all weather remote sensing capability, RISAT will enhance remote sensing applications in the areas of agriculture and disaster management. RISAT is slated for launch by 2006.

The National Remote Sensing Agency, under DOS receives, processes and distributes the data from IRS satellites to various users. The imagery from IRS satellites are disseminated worldwide on a commercial basis through Antrix Corporation of DOS.

HAMSAT

HAMSAT is a microsatellite for providing satellite based Amateur Radio services to national as well as international community of Amateur Radio Operators (HAMs). Launched as an auxiliary satellite along with CARTOSAT-1, the 42.5 kg HAMSAT meets the long felt need of the Amateur Radio Operators in the South Asian region who possess the required equipment and operate in the UHF/VHF band based Satellite Radio Communication. One of the transponders of HAMSAT has been developed indigenously involving Indian Amateurs, with the expertise of ISRO and the experience of AMSAT-INDIA. The second transponder has been developed by a Dutch Amateur Radio Operator and Graduate Engineering student at Higher Technical Institute, Venlo, The Netherlands.

HAMSAT is ISRO's contribution to the international community of Amateur Radio Operators. This effort is also meant to bring ISRO's satellite services within the reach of the common man and popularise space technology among the masses. This satellite will play a valuable role by providing a low cost readily accessible means of communication during emergencies and calamities like flood, earthquakes, etc. Besides, it will stimulate technical interest and awareness among the younger generation by providing them with an opportunity to develop their technological projects including offering a platform for testing new technologies. Some of the new technologies being incorporated in HAMSAT include Integrated Processor based Electronic Bus Management Unit, Lithium Ion Battery and Gallium Arsenide based solar panels.

HAMSAT

Salient Features

Physical	:	630 mm x 630 mm x 550 mm Cuboid
Mass	:	42.5 kg
Orbit	:	621 km Polar Sun Synchronous
Structure	:	Aluminium Honeycomb Structure
Power	:	Body mounted Gallium Arsenide Solar Panels, Lithium Ion Battery
Stabilisation	:	4±0.5 RPM spin stabilised
Antennas	:	UHF turnstile, VHF turnstile
Transponder Uplink	:	435.25 MHz
Transponder Downlink	:	145.9 MHz

With the switching on of the UHF/VHF (Mode-B) transponder on board HAMSAT on May 6, 2005, HAMs worldwide have witnessed hectic activities. HAMs have been sending their feedback on the performance of the satellite. E-mails have been received from HAMs in India, Canada, USA, Malaysia, Australia, Germany, Brazil, UK, Italy and Spain, confirming excellent quality of transmission by HAMSAT, both in terms of power and clarity. A few HAMs have even sent actual audio recordings of conversation carried out via HAMSAT.

Indian Remote Sensing Satellites

Sl. No.	Satellite	Launch Date	Launch Vehicle	Remarks
1.	Bhaskara-1	Jun 7, 1979	Intercosmos (USSR)	Experimental
2.	Bhaskara-2	Nov 20, 1981	Intercosmos (USSR)	Experimental
3.	IRS-1A	Mar 17, 1988	Vostok (USSR)	Mission completed
4.	IRS-1B	Aug 29, 1991	Vostok (USSR)	Mission completed
5.	IRS-1E	Sep 20, 1993	PSLV-D1	Could not be placed in orbit
6.	IRS-P2	Oct 15, 1994	PSLV-D2	Mission completed
7.	IRS-1C	Dec 28, 1995	Molniya (Russia)	In service
8.	IRS-P3	Mar 21, 1996	PSLV-D3	In service
9.	IRS-1D	Sep 29, 1997	PSLV-C1	In service
10.	OCEANSAT-1	May 26, 1999	PSLV-C2	In service
11.	TES	Oct 22, 2001	PSLV-C3	In service
12.	RESOURCESAT-1	Oct 17, 2003	PSLV-C5	In service
13.	CARTOSAT-1	May 5, 2005	PSLV-C6	In service

Second Launch Pad (SLP)

SLP, built at SDSC SHAR at Sriharikota is configured as a universal launch pad capable of accommodating all launch vehicles of ISRO including the advanced launch vehicles to be built in the next decade and beyond. It uses integrate-transfer-and-launch concept. The launch vehicle is integrated inside a permanent building called Vehicle Assembly Building. After checkout, it is transported on rails to the launch pad using a Mobile Launch Pedestal. The vehicle is then interfaced with the launch pedestal and fuel-filling and checkout operations carried out. The launch takes place after the final countdown. SLP helps to increase the launch frequency by reducing the turn-around time between the integration of the fully assembled vehicles.

SLP was built by involving Indian industry on a turnkey basis including design and engineering, procurement of systems and sub-systems, fabrication, erection and commissioning of facilities including civil works.

Panoramic view of Second Launch Pad showing the Umbilical Tower (left) with lightning protection towers and Vehicle Assembly Building (right)

SLP consists of the following major elements:

Vehicle Assembly Building (VAB): It is in this building that the vehicle integration is carried out on a Mobile Launch Pedestal (MLP) and then the vehicle transferred to Umbilical Tower for launch after carrying out the total checkout of the integrated vehicle. The 82 m tall VAB houses 200 tonne, 30 tonne and 10 tonne capacity cranes for lifting vehicle stages. It has 20 horizontal sliding doors of varying sizes with the largest being 13 x 20 m. Six 14 x 6 m foldable and vertically repositionable platforms at different levels help

His Excellency, the President (fourth from right) with Mr G Madhavan Nair, Chairman, ISRO (to his right), Mrs Nedurumalli Rajyalakshmi, Hon'ble Minister for School Education, Andhra Pradesh (extreme right), Mrs Panabaka Lakshmi, Hon'ble Union Minister of State for Health and Family Welfare (second from right), Mr Sushilkumar Shinde, Hon'ble Governor of Andhra Pradesh and senior ISRO scientists at the dedication of the Second Launch Pad

vehicle integration and servicing. VAB is equipped with an elevator also.

Mobile Launch Pedestal (MLP): The 19.5 x 19.5 m MLP with bogie system is used to transfer the integrated vehicle from VAB to the launch pad located at a distance of 1 km. With a height 8.6 m, MLP weighs about 700 tonne and caters for both PSLV and GSLV requirements. It has a removable bogie system at the bottom, which has a hydraulic system.

Umbilical Tower (UT): The 70 m tall, 10 x 10 m UT weighs about 980 tonne. The fully integrated vehicle on MLP, on its arrival on rail track, is interfaced with the UT with electrical, pneumatic and fluid filling lines. The final operations like fuel filling, gas charging and the vehicle checkout are carried out on UT. It has three platforms, which can be swung and also moved vertically to different levels. UT has an elevator and a 10 tonne tower crane at the top of the tower. It has a cryo arm for cryogenic fuel filling operations and monitoring till the last minute of launch operations.

Jet Deflector: The jet deflector system is used to move the hot gases, ejected from the launcher during lift-off, away from the launch pad so as to reduce the thermal and acoustic loads on the vehicle. The design and construction of jet deflector was one of the major engineering challenges. It has diaphragm wall construction with piles driven 45 m below ground, constructed for the first time on the east coast of India.

Lightning Protection Towers: In order to protect the launch vehicle from severe lightning when the vehicle is exposed for longer duration, lightning protection towers are erected around UT. There are four lightening protection towers of 120 m height around UT, which are interconnected through cables.

Propellant Storage and Servicing Facilities: Propellant storage and servicing facilities cater to storage of about 1000 tonne of earth storable propellants (UDMH and N_2O_4), cryogenic propellants (liquid Oxygen and liquid Hydrogen), water, etc. A large gas storage and supply system to supply the required quantity of Helium for on-board systems and Nitrogen system for meeting the purging requirements is part of this facility. A water tank of 5 lakh litre capacity is also included.

Utilities: These include instrumentation and control systems, compressed air and fire fighting system, overhead tank, water treatment plant, electrical substation, air conditioning plant and safety systesm.

Track for Movement of MLP: MLP with the integrated vehicle moves on a twin double rail track with a span of 14 m and a length of 1 km.

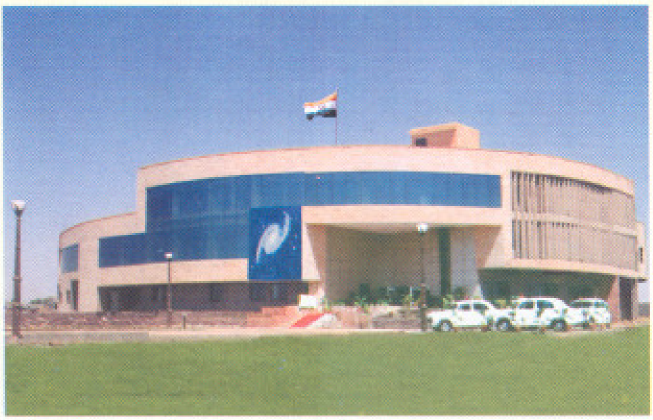
PSLV-C6 at the Umbilical Tower

Master Control Facility at Bhopal Inaugurated

A new Master Control Facility (MCF) has been set up at Bhopal for monitoring and control of geosynchronous satellites. On April 11, 2005, Mr G Madhavan Nair, Chairman, ISRO, inaugurated the new facility at Bhopal, the capital of Madhya Pradesh. Mr Vijay Singh, Chief Secretary, Government of Madhya Pradesh, presided over the inaugural function.

INSAT is one of the largest domestic communication satellite systems in the Asia Pacific region comprising eight satellites — INSAT-2E, INSAT-3A, INSAT-3B, INSAT-3C, INSAT-3E, GSAT-2, KALPANA-1 and EDUSAT. The system has 150 communication transponders operating in different frequency bands, namely, C-band, Extended C-band and Ku-band. Besides, INSAT system also incorporates a Very High Resolution Radiometer on three of these satellites (KALPANA-1, INSAT-2E and INSAT-3A) and an additional Charge Coupled Device camera on INSAT-2E and INSAT-3A for obtaining meteorological images for weather monitoring and forecast.

All the satellites in INSAT system are being monitored and controlled from the primary control centre, at Hassan in Karnataka (MCF-Hassan), which was established during 1980-81. MCF-Hassan has the overall radio visibility coverage from Persian Gulf in the west to Australia in the East (of about 150 degrees of the Geo-arc). The geographical advantage, together with a low radio noise environment, made MCF-Hassan ideal for controlling the geostationary satellites positioned over Asia-Pacific region.



MCF-Bhopal

MCF-Bhopal will help MCF-Hassan to support the operational requirements of an increasing number of satellites in INSAT system. MCF-Bhopal offers the same radio visibility coverage advantage as MCF-Hassan. MCF-Bhopal consists of a Satellite Control Centre, a Satellite Control Earth Station and Power Complex. Special operations like station-keeping, management of eclipse operations and payload operations to suit the requirements of INSAT users will also be carried out from the new facility. It is initially configured to monitor and control two geostationary satellites, but the number of satellites controlled is expected to grow to six in the next few years. The location of MCF-Bhopal will enable in-orbit testing of satellites, especially for their spot beam coverage.

Simultaneous satellite ranging from MCF-Bhopal and MCF-Hassan, which are separated by a distance of 1000 km, will also improve the ranging accuracy from the present 5 km to about 150 m. This increased accuracy improves satellite orbit determination and thus will help in co-locating three or more satellites at the same orbital slot.

With ISRO planning to launch more satellites into geostationary orbit in the coming years, MCF-Hassan, along with the new MCF-Bhopal, will play an important role in INSAT system.

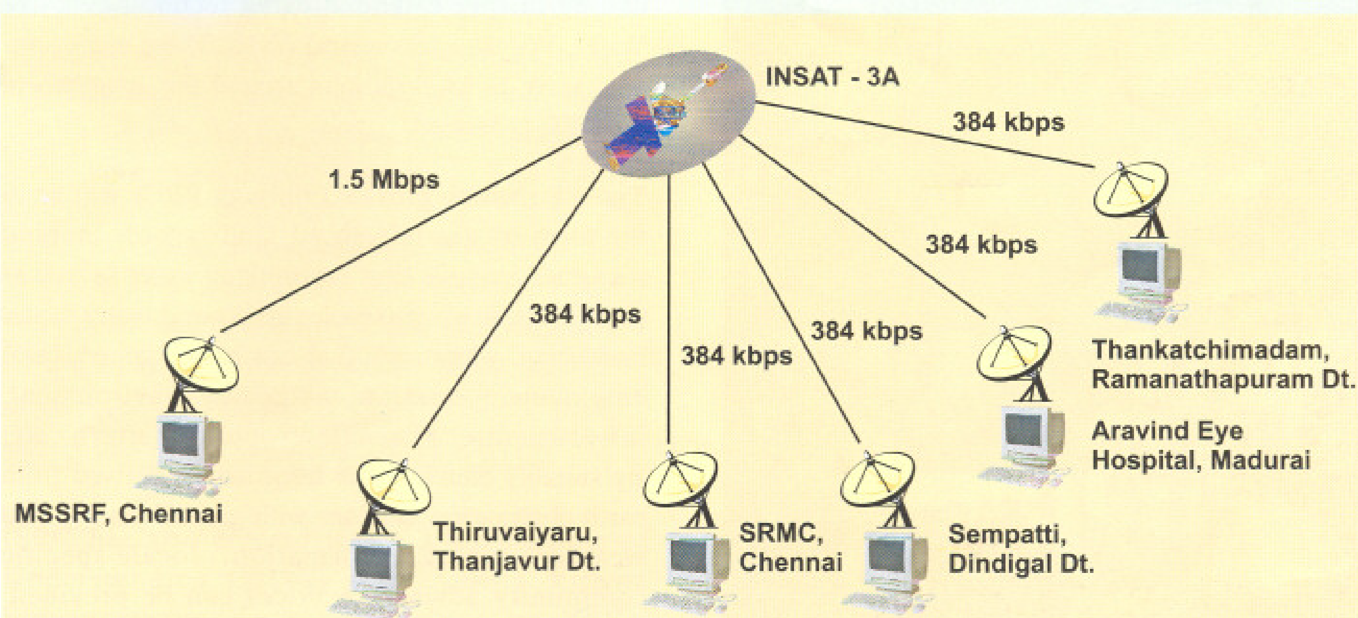
Prime Minister Inaugurates Village Resource Centres (VRC)

The Prime Minister, Dr Manmohan Singh inaugurated the first cluster of Village Resource Centres (VRC) in Tamilnadu on October 18, 2004. ISRO has established these satellite based VRCs jointly with the M S Swaminathan Research Foundation (MSSRF), Chennai.

One of the VRCs in Tamilnadu

Prime Minister, Dr Manmohan Singh with Mr G Madhavan Nair, Chairman, ISRO (left) while inaugurating the VRCs from Delhi

Inaugurating the conference from Delhi, the Prime Minister recalled the visionary leadership provided by Pandit Jawaharlal Nehru, in laying emphasis on the development of science and technology and establishment of institutions of excellence in science and technology since independence. He said that among the various institutions created since independence, no department or institution has brought greater laurels and credit to India than the



ISRO – MSSRF VRC Network concept

Indian Space Programme. He commended ISRO for its commitment to excellence and making the space programme socially relevant.

"India lives in villages and therefore, unless we take the benefits of modern science and technology to our villages, we cannot get rid of the mass poverty which has affected millions and millions of our people for centuries. The space applications in the last two to three decades have made it possible to address the problems of low productivity of our agriculture, inefficient use of our land and water resources as well as bring the benefits of modern medicine, modern educational technologies to the remotest parts of the country." He said and added that he is convinced that in the years to come, VRC can help in a vigorous national effort to improve agricultural productivity, improve agricultural yields, launch a new programme for the control of pest and diseases and, at the same time, ensure through distance education not only to modernise our school system of education but also make a more frontal attack on adult illiteracy.

VRC concept was evolved by ISRO by integrating its capabilities in satellite-based communications and of earth observation. ISRO-MSSRF VRCs aim to provide a variety of services emanating from the space systems and other information technology tools to address the needs of rural communities. VRC is a totally interactive VSAT (Very Small Aperture Terminal) based network.

The central node at MSSRF - Chennai

VRC capabilities

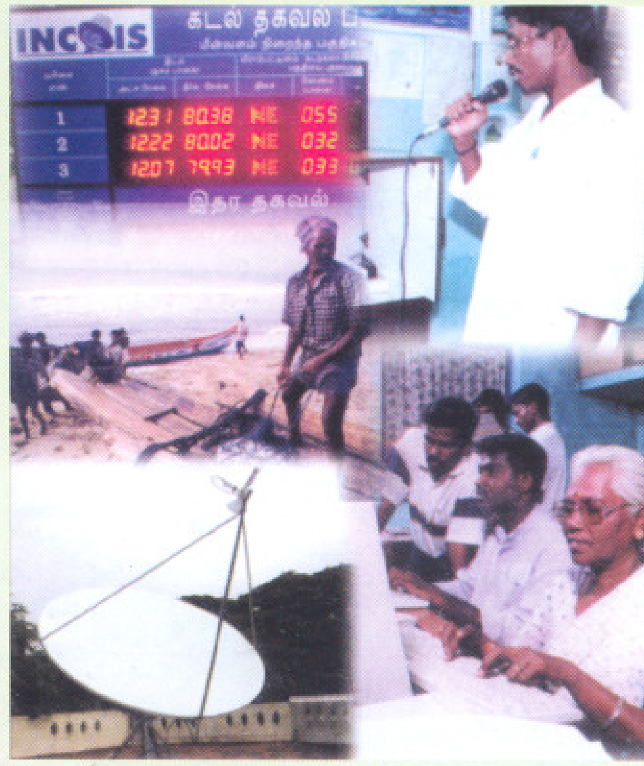
To start with, ISRO-MSSRF network consists of four nodes located at Thiruvaiyaru, Thankatchimadam, Sempatti and Chennai. The central node is located at MSSRF office in Chennai. The network uses one of the Extended C-band transponders of ISRO's satellite INSAT-3A. Users located at one node of this network can interact with others located at another node through video and audio links. Each of the four nodes can be further extended using technologies like Wi-Fi, Wireless and optical fibres. These extensions may serve as local clusters around the areas where the VRC is located.

The information provided through VRCs will be in the form of geo-referenced land records, natural resources, suitable sites for drinking water as well as sites for recharging to replenish ground water, water harvesting, wastelands that can be reclaimed, rural employment creation, watershed, environment, infrastructure, alternate cropping pattern, etc. By suitably blending the information derived from earth observation satellites with ground derived and weather related information, locale-specific community advisory services can be provided. Community based vulnerability and risk related information, timely early warning and dissemination severe weather related information could lead to a reliable disaster management support at the village level.

By providing tele-education, VRCs act as virtual community centric learning centers and by providing connectivity to specialty hospitals, VRCs can bring the services of expert doctors closer to the villages.

With access to spatial information on land use/land cover, soil and ground water prospects, VRCs can enable the farmers to get support in making query-based decisions. Besides, VRCs will enable online interaction between the local farmers and agricultural scientists. Fishermen can obtain information on sea state and wave heights. Information on governmental schemes, location and farming systems, specific action plans based on weather, community specific advice on soil and water conservation will also be provided by VRCs.

Thus, ISRO-MSSRF VRC can empower the village community with information and services.



VRCs – informative and interactive

By suitably blending the information derived from earth observation satellites with ground derived and weather related information, locale-specific community advisory services can be provided. Community based vulnerability and risk related information, timely early warning and dissemination of severe weather related information could lead to a reliable disaster management support at the village level.

By providing tele-education, VRCs act as virtual community centric learning centers and by providing connectivity to specialty hospitals, VRCs can bring the services of expert doctors closer to the villages.

ISRO has also entered into a Memorandum of Understanding (MOU) with Amrita Vishwa Vidyapeetham, Kochi, for setting up VRCs. As a follow up to this MOU, several prominent IT industries are associating with Amrita Vishwa Vidyapeetham by providing ground infrastructure and other IT based systems for the VRCs. To start with, 25 VRCs will be set up across the country. Later, these nodes could be extended further.

Consultative Committee on Regional Space Application Programme Meets at Bangalore

The tenth session of the Intergovernmental Consultative Committee (ICC) on the Regional Space Applications Programme (RESAP) for Sustainable Development was held at Bangalore during October 21-22, 2004. The meeting was organised by the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP) and hosted by ISRO.

At the inaugural function: (from left) Xung Zeng Pei, Chief of International Commission for Space Technology Division, UN–ESCAP, Ms Okaido Keiko, Deputy Executive Secretary, UN–ESCAP, Mr T N Chaturvedi, Hon'ble Governor of Karnataka and Mr G Madhavan Nair, Chairman, ISRO

ESCAP members and associate members — Bangladesh, China, Fiji, India, Indonesia, Islamic Republic of Iran, Japan, Malaysia, Mongolia, Philippines, Republic of Korea, Russian Federation, Thailand, United States of America, and Vietnam – attended the Bangalore ICC. The discussion was centered around evolving the role of RESAP within the framework of the Millennium Development Goals, the World Summit of the Information Society and the World Summit on Sustainable Development. The topics included:

- Public-private partnership for operational space information and communication services and applications
- Community information centers using satellite communications
- Regional cooperative mechanisms in disaster management using satellite-based information and communication technologies

The delegates agreed to work within the framework

A section of the delegates

of regional cooperation to pursue the agenda and further strengthen RESAP mechanisms in the long-term interest of developing the region.

Inaugurating the Bangalore ICC session, Mr T N Chaturvedi, Governor of Karnataka said that Asia and the Pacific have established themselves as a global economy but the benefits are yet to reach a majority of the population in the region. ESCAP should respond to the dynamic needs of the countries in this region in the emerging globalisation scenario and related social issues.

Mr G Madhavan Nair, Chairman, ISRO, in his address, highlighted the achievements under Indian space programme including the launches of RESOURCESAT-1 and EDUSAT and the application of space technology in several fields like communication, broadcasting, meteorology and resources survey. He highlighted the recent initiatives of ISRO in space applications like telemedicine, tele-education and Village Resource Centres to benefit the grassroots level society. He urged ICC to deliberate on how space technology could be utilised to eradicate poverty and illiteracy as well as for disaster warning and disaster mitigation. He emphasised the need to reduce the cost of space systems and setting up organisational mechanisms to make the benefits of such systems available to the society. Chairman, ISRO further announced that India is committed to share its experiences and resources in the collective effort to give RESAP a new direction.

Ms Okaido Keiko, Deputy Executive Secretary, UN-ESCAP, in her address, said that globalisation is shaping the economic and social scenario in ESCAP region and RESAP has been initiated to exploit space technology to manage this globalisation scenario and bridge the digital divide.

Under RESAP, UN-ESCAP promotes regional cooperation and facilitates equitable sharing of the benefits of space technology primarily to support poverty alleviation, food security and disaster management. ESCAP derives the necessary mandate for carrying out these activities through Ministerial Conferences. The first Ministerial Conference on Space Applications for Sustainable Development was held at Beijing, China in 1994 and it provided the necessary framework under RESAP for regional cooperation. The second Ministerial Conference, held at New Delhi in 1999 identified specific common projects in prioritised areas. India, by virtue of its leadership in space technology and applications, plays a key role in driving the RESAP activities.

The Bangalore session of ICC was significant in the backdrop of many UN Summits and rapid advances that are taking place in space technology and applications.

ISRO and CNES Sign MOU on Megha-Tropiques Mission

ISRO and the French national space agency (CNES), have decided to go ahead with the development and implementation of the joint atmospheric satellite mission, Megha-Tropiques. A Memorandum of Understanding (MOU) to this effect was signed by Mr G Madhavan Nair, Chairman, ISRO and Mr Yannick d'Escatha, President, CNES, on November 12, 2004 at Antariksh Bhavan, the Headquarters of ISRO in Bangalore. MOU outlines the arrangements for the development of the satellite, its launch, its operations in orbit and utilisation of the scientific data acquired from the satellite.

Mr G Madhavan Nair, Chairman, ISRO (left) and Mr Yannick d'Escatha, President, CNES, signing the Megha-Tropiques MOU at Bangalore

Megha-Tropiques (Megha meaning cloud in Sanskrit and Tropiques meaning tropics in French) is meant for investigating the contribution of water cycle in the tropical atmosphere to climate dynamics. The satellite will carry three scientific instruments:

- A Multi-frequency Microwave Scanning Radiometer (MADRAS) to be developed jointly by ISRO and CNES for providing information on rain above the oceans, integrated water vapour content in the atmosphere, liquid water in the clouds and convective rain over land and sea;
- A Multi-channel Microwave Instrument (SAPHIR) to be developed by CNES for providing vertical humidity profile in the atmosphere;
- A Multi-channel Instrument (SCARAB), also to be developed by CNES, for providing data on the earth's radiation budget.

ISRO has agreed to build the Megha-Tropiques spacecraft, using the Indian Remote Sensing (IRS) satellite bus. ISRO has also agreed to launch the satellite using its Polar Satellite Launch Vehicle, into an 867 km high orbit at an inclination of 20 degrees with respect to the equatorial plane. In this orbit, the satellite will be able to collect scientific data covering the tropical regions. ISRO will control the satellite in orbit and also receive, process and distribute the scientific data.

On signing MOU, Mr Madhavan Nair said that Megha-Tropiques is an important mission that will provide vital atmospheric data over the tropical region for monsoon variability studies. Mr Yannick d'Escatha said that MOU on Megha-Tropiques demonstrates the importance CNES attaches to the stewardship of our planet and once again confirms the utility of space assets in improving our understanding of the underlying mechanisms. "Megha-Tropiques is a fine and promising mission made possible by our successful long-term partnership with ISRO" he added.

Megha -Tropiques, with its unique combination of scientific payloads and its special orbit, is expected to provide valuable data for climate research. Besides Indian and French scientists, international teams of scientists working on global climate related studies have evinced keen interest in the mission.

ISRO and CNES had signed a Statement of Intent in November 1999 for undertaking the Megha-Tropiques mission. Joint feasibility studies were undertaken to arrive at a baseline configuration of the satellite, the instruments to be flown, the orbit and the possible launchers. In May 2001, the two agencies signed the first MOU to jointly carry out the detailed design of the Megha-Tropiques mission. The present MOU enables the development and implementation of the mission.

The launch of Megha-Tropiques is planned by 2008-2009.

International Conference on Moon Held at Udaipur

The Sixth International Conference on the Exploration and Utilisation of the Moon (ICEUM6) was held at the picturesque and historical city of Udaipur during November 22-26, 2004. ICEUM6 was hosted by the Physical Research Laboratory, Ahmedabad and sponsored by ISRO, the International Lunar Exploration Working Group, the European Space Agency (ESA) and Optech Inc.

President of India, His Excellency, Dr A P J Abdul Kalam (second from left) with Mr G Madhavan Nair, Chairman, ISRO (left) and other delegates

ICEUM6 was significant in the context of India's scientific mission to moon, Chandrayaan-1, which is planned by 2007 as well as a number of missions to moon being planned during the current decade. Already SMART-1 lunar probe of ESA is in lunar orbit. LUNAR-A and SELENE by Japan, Chang'E by China and the Lunar Reconnaissance Orbiter and Moonrise by USA are planned during the next few years. A continuous presence of a variety of space probes is expected on or around the moon till the end of this decade offers excellent opportunities for international collaboration.

ICEUM6 was a week long gathering of space agency representatives, scientists and engineers, astronomers, entrepreneurs, educators, professionals and enthusiasts seeking to develop global and inter-global understandings, strategies, initiatives and enterprises leading to a permanent human presence on the moon.

No wonder that the conference received an overwhelming response with the participation of more than 150 delegates representing 15 countries, including Australia, Canada, China, Germany, France, The Netherlands, UK and USA. The conference programme included reviews as well as invited talks. A posters session was also organised.

The President of India, Dr A P J Abdul Kalam, himself a space technologist, addressed the group with an insightful vision and made recommendations for international activities pertaining to exploration of the moon for the benefit of humankind.

The first International Lunar conference under the aegis of International Lunar Exploration Working Group was held in Beatenberg (Switzerland 1994) followed by Kyoto (Japan-1996), Moscow (Russia - 1998), Noordwijk (The Netherlands-2000) and Hawaii (USA – 2002).

The ICEUM6 included programme for young lunar explorers; science of, from and on the moon; robotics, engineering, space flight dynamics, navigation and control; programmes of future lunar exploration and the development of lunar bases; lunar exploration programmes of international space agencies; first results from ESA's SMART-1 mission; Chandrayaan-1, Chang'E missions; status of Lunar-A and SELENE Missions; future missions to moon and the next generation science and technology missions to moon. In addition, round table discussions were held on science questions and priorities, international collaboration and moon-mars roadmap as well as technology and resources utilisation.

The Udaipur declaration made at the end of ICEUM6 acknowledged that fundamental science questions about the moon remain to be addressed, not only to understand the early history of the earth/ moon system and its current environment, but also to acquire knowledge for the next steps of exploration and human utilisation. Of prime importance is the formation and evolution of terrestrial planets, including the origin of the moon. Central to this is the impact history including the absolute timing of early events such as the giant basins. A major unknown is also the internal structure of the moon, both its geophysical and compositional properties. The moon is a natural laboratory for studying interaction with the space environment, together with the products resulting in the polar deposits.

Recognising that the lunar exploration programme must later include advanced orbital instruments as well as in-situ analyses from several surface stations and targeted sample return, ICEUM6 urged broad and open discussion and coordination for selections of landing sites to optimise the science return and benefit for exploration.

The declaration further said, "We believe that exploration and utilisation of the Moon will bring global benefits to humankind as well as serve national needs, and we recommend an international plan for implementation. The participants endorse the ILEWG stepwise approach, starting with joint science analysis from ongoing precursor missions (SMART-1, Lunar-A, SELENE, Chang'E, Chandrayaan-1, Lunar Reconnaissance Orbiter, Moonrise), continuing with lunar landers cooperating into an international lunar robotic village before 2014, evolving technologies for man-tended missions and preparing the ground for an effective, affordable human lunar exploration and permanent presence by 2024. We encourage space agencies to coordinate and integrate their plans in a robust international Moon-Mars roadmap in coordination with the ILEWG roadmap, where the partners can identify their contribution for an effective implementation using their skills."

To move forward with mission implementation, ICEUM6 urged space agencies to study and coordinate international lunar infrastructure and assets such as telecommunication, navigation, logistics and lunar internet, which are necessary for an effective lunar exploration. The conference specifically recommended coordination of international efforts for the establishment of "standards" to facilitate lunar exploitation and settlement – e.g., use of the metric system, well-characterised lunar soil stimulants, common data formats and instrument interfaces, frequency and power. It urged for the establishment of a standard lunar geodetic network and also recommended that the "Moon Treaty" be revisited, refined and revised as necessary in the light of the present-day impetus for expeditions, both robotic and human, to the moon by several nations.

A section of the delegates in the moon conference

ICEUM6 believes that missions to moon have an enormous potential to inspire both children as well as their parents because the moon is visible to all and is within our reach to visit. The Udaipur conference encouraged young scientists of different fields and nations to join this activity and work together in realising lunar exploration goals.

The next International Conference on Exploration and Utilisation of the Moon is planned in Canada during September 2005 which will be followed by the conference in China during July 2006.

Indian Ocean Tsunami — Space Resources for Relief

While today's space based systems cannot predict an earthquake and its after effects – Tsunami – remote sensing and communication satellites provide the means for assessing the extent of damage and enable the relief operators to use this data for planning the mitigation measures as well as facilitate the establishment of an emergency communication system. In the aftermath of the tsunami that hit India on December 26, 2004, ISRO put into operation all its resources towards disaster mitigation.

A flyaway VSAT (Very Small Aperture Terminal), 10 INMARSAT telephones and four Mobile Satellite Service (MSS) phones were airlifted to Port Blair for augmenting the telecommunications links. VSAT based video conferencing facilities were set-up to connect seven taluk headquarters to the Secretariat. A&N Administration used VSATs at Diglipur, Mayabandar, Rangat, Port Blair, Hut Bay, Car Nicobar, Camorta and Cambel Bay for relief and rehabilitation. Regular video-conferencing facility was established between these locations and the mainland via INSAT-3E. Satellite based telephone connectivity, as well as ISDN connectivity for video-conferencing were enabled at the above locations through the Telephone Exchange at ISRO's Space Application Centre, Ahmedabad.

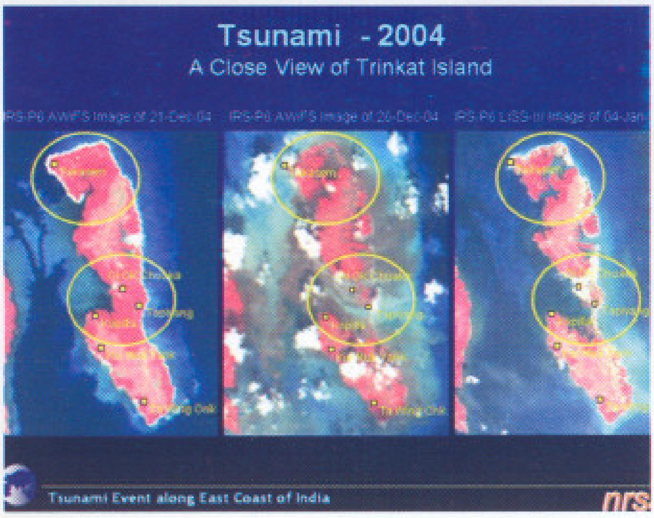
Transponder capacity on INSAT-3E was earmarked for supporting large capacity telephone links from A&N islands to Kolkata, which was connected to Delhi. Telephone links from one place in Andaman and Nicobar islands to any other place through transportable VSATs were arranged.

Telemedicine facilities were in operation at two hospitals at Port Blair (GB Pant Hospital and INS Dhanvantari Hospital), and Indira Gandhi Hospital at Car Nicobar to enable the local Doctors to communicate with specialty hospitals like Apollo Hospital at Chennai and Amrita Institute of Medical Sciences at Cochin, which are in ISRO Telemedicine network.

Data from Indian Remote Sensing satellites (IRS-1C, IRS-1D, OCEANSAT-1 and RESOURCESAT-1) over affected areas were used for analysis and damage assessment and the information was provided to Crisis Management Group of the Ministry of Home Affairs and State agencies. Satellite data for Car Nicobar, Chennai and Kakinada (AP), Tamil Nadu coast (especially Nagapattinam) and Kerala were acquired.

To obtain high resolution data under cloud/haze conditions, aerial survey using the aircraft of National Remote Sensing Agency was undertaken for the assessment of the extent of inundation, affected agriculture areas, damaged coastal vegetation, damage to coastal landforms, breaches, beach erosions, and damage to the clusters of habitations. The satellite imageries clearly indicated large-scale damage to the southern tip of Great Nicobar Island and the Indira Point. Trinkat Island of the Nancowri Group had been separated into two parts due to the water impoundment in the central part.

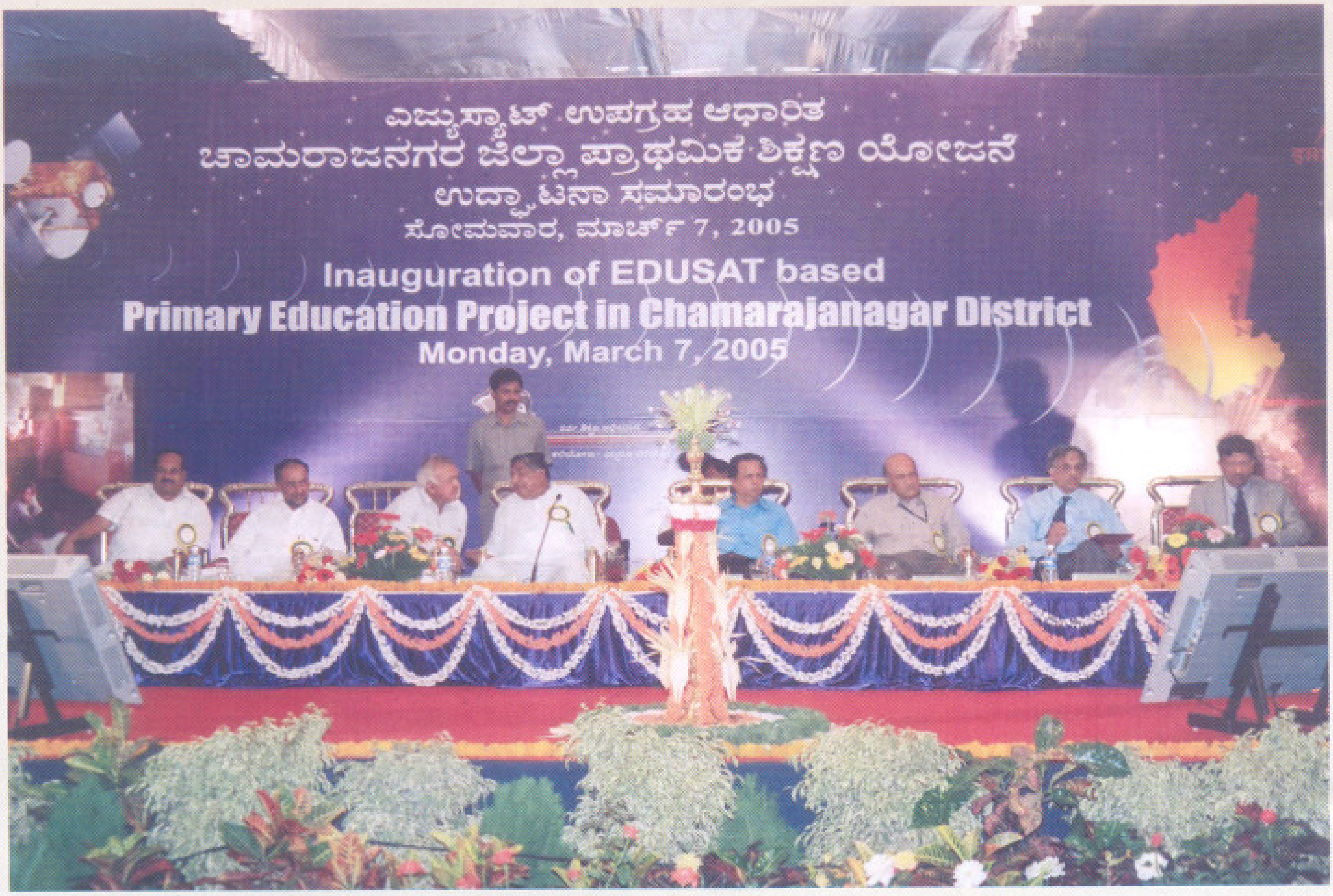
As a member of the International Charter on Disaster, ISRO activated the Charter on Dec 26, 2004 and the satellite data from foreign satellites such as SPOT, RADARSAT and ENVISAT over Port Blair, Car Nicobar, Cudallore and Nagapattinam were received.



IRS Imagery showing the damage inflicted on Trinkat island

EDUSAT Applications Take off

The utilisation of ISRO's first thematic satellite, EDUSAT, took off with the inauguration of EDUSAT based Primary Education Project in Chamarajanagar District of Karnataka on March 7, 2005. The Chief Minister of Karnataka, Mr Dharam Singh inaugurated the project at ISRO Telemetry, Tracking and Command Network, Bangalore.



From left: Mr M Shivanna, Hon'ble Member of Parliament, Mr H S Mahadeva Prasad, Hon'ble Minister for Food & Civil Supplies, Government of Karnataka, Mr R Ramalinga Reddy, Hon'ble Minister for Primary & Secondary Education, Government of Karnataka, Mr Dharam Singh, Hon'ble Chief Minister of Karnataka, Mr G Madhavan Nair, Chairman, ISRO, Mr Vijay Gore, Additional Chief Secretary, Government of Karnataka, Mr A Bhaskaranarayana, Director, SCP, ISRO and Mr S K Shivakumar, Director, ISTRAC at the inauguration

Under the project, taken up by ISRO under EDUSAT distance education programme jointly with the Karnataka State Government, 885 satellite receive terminals have been set up predominantly in tribal areas – Chamarajanagar (289), Gundlupet (203), Yelandur (69), Kollegal (114), Kannur (194) and H D Kote (14). This forms part of the Sarva Shiksha Abhiyan being implemented by the Department of State Educational Research and Training (DSERT). These Ku-band satellite receive terminals are intended for programmes that supplement curriculum based teaching in the schools and will be synchronised with the school time-table for covering the syllabus.

DSERT has already produced 100 programmes on identified topics, which are highly focused hot spots to improve the quality of education for the students in remote tribal areas. Another 100 programmes are under production. The programmes are produced in simple local language with a good content of high quality animation to make the students understand the basics in science, mathematics and languages. The local teacher at each location will also act as the facilitator in helping the children to understand the subjects and answer their questions.

Each of the 885 Direct Receive Satellite terminals consists of a 1.2 m diameter Ku-band dish antenna, a set-top box and a 29" colour TV monitor to receive the programme. Each of these terminals is also provided a battery pack, which is charged by a solar panel to provide uninterrupted power supply for reception at least for a period of 2 to 4 hours. The system is housed in a specially designed, aesthetically appealing cabinet. The local custodian can easily operate the system. To avoid misuse of the terminals,TV is tuned to receive only EDUSAT based programme. The complete terminal including the solar panel-battery power supply costs about one lakh rupees. While ISRO is funding the cost of these terminals, DSERT produces the contents and local people maintain the sets.

As the programme proceeds in Chamarajanagar district, periodic evaluation will be undertaken to optimise the content and delivery system to replicate the programme in other backward and remote places. The Karnataka Government is already proposing to add another 200 terminals in other parts of the State.

Apart from the Chamarajanagar Primary Education Project, Visvesvariah Technological University Network with 100 nodes has been transferred to EDUSAT.

EDUSAT, launched by Geosynchronous Satellite Launch Vehicle (GSLV-F01) on September 20, 2004, is India's first thematic satellite dedicated exclusively for educational services. Parked at 74 Deg East Longitude in the 36,000 km high geosynchronous orbit, the satellite is specially configured to relay through audio-visual medium, employing multi-media multi-centric system, to create interactive classrooms. EDUSAT has multiple regional beams covering different parts of India — five Ku-band transponders with spot beams covering northern, north-eastern, eastern, southern and western regions of the country, a Ku-band transponder with its footprint covering the Indian mainland region and six C-band transponders with their footprints covering the entire country.

The Hub for national beam has been established at Ahmedabad. The national beam is planned to be used for:

- Indira Gandhi National Open University —100 terminals across the country and another 20 terminals in the North East for teachers' training
- National Council for Educational Research and Training — 100 terminals for Secondary and Higher Secondary Education and Teachers' Training
- Indian Institutes of Technology at Kharagpur and Chennai — 70 and 5 Terminals respectively
- Institute of Electronics and Tele-communication Engineers — 18 for DST/National Council of Science Museums — 25
- Centre for Environmental Education — 5

Regional beams of EDUSAT are planned to be as follows:

- **Southern beam:** Anna University, Chennai (260 nodes), Annamalai University, Chennai (57 nodes), Gandhigram Rural Institute, Dindigal (90 nodes), Bharathidasan University, Tiruchirapalli (22 nodes), Sarva Shiksha Abhiyan, Tamilnadu (442 nodes)
- **Western beam:** Gujarat Government, Department of Education (148 nodes), Maharashtra Knowledge Corporation Ltd., (50 nodes), Department of Higher Education, MP (50 nodes), Tribal Development, MP (50 nodes), BITS, Pilani (20 nodes), Technical Education Board, Rajasthan (91 nodes) and Blind People's Association, Ahmedabad (25 nodes)
- **Northern beam:** State Institute of Educational Technology (67 nodes), Guru Nanak Dev University, Amritsar (40 nodes), Tapar Institute of Engineering and Technology, Patiala (10 nodes), Department of Training and Technical Education, New Delhi (40 nodes), UP Rajashri Tandon Open University, Allahabad (55 nodes)
- **Eastern beam:** West Bengal University of Technology, Kolkata (40 nodes), Vidyasagar University, Midnapore, West Bengal (10 nodes), Netaji Subhas Open University, Kolkata (90 Nodes), Jarkhand Education Project Council, Ranchi (192 nodes)
- **North-Eastern beam:** Assam Agricultural University, Jorhat (18 nodes), Arunachal University, Itanagar (13 nodes), Manipur University, Imphal (200 nodes), Nagaland University, Kohima (10 nodes), Sikkim Government Law College, Gangtok (20 nodes).

Thus, EDUSAT is expected to herald a new era in the educational sector by bridging the distances and allowing effective optimum sharing of scarce resources for teaching.

Mobile Ku-band terminal used during the inauguration

International Telemedicine Conference Held at Bangalore

An International Telemedicine Conference, INTELEMEDINDIA 2005, was held at Bangalore during March 17-19, 2005. Astronautical Society of India, supported mainly by the Indian Space Research Organisation (ISRO), organised the conference. Other Government of India Departments like Health and Family Welfare, Communications and IT, DRDO, Rural Development and Science and Technology also supported the conference.

At the inauguration, from left: Dr Devi Shetty, Managing Director, Narayana Hrudayalaya, Prof Yunkap Kwankam, WHO, Mr G Madhavan Nair, Chairman, ISRO, Mr T N Chaturvedi, Governor of Karnataka, Prof Rifat Latifi, University of Arizona, USA, Dr K N Shankara, Director, SAC, ISRO, Mr M N Sathyanarayan, Executive Director, Space Industry Development, ISRO, Mr B S Bedi, Senior Director, Dept of Information Techonology, Government of India

Mr T N Chaturvedi, Governor of Karnataka inaugurated the Conference on March 17, 2005. Presiding over the inauguration, Mr G Madhavan Nair, Chairman, ISRO, quoted ancient Indian texts to stress the importance of the physical body to achieve one's goals in life. He also highlighted the astonishing medical advances in ancient India for preventing and curing diseases and preserving health. Specifically, he highlighted the advances in the areas of Ayurvedic treatment. He recalled that the earliest recorded treatise on medicine Sushruta Samahita was compiled in 8th century B C. Sushruta is considered one of the earliest surgeons who used to perform successful skin grafting and plastic surgery.

Mr Madhavan Nair said that in consonance with pursuing the objective of taking the benefit of space technology to the rural and remote area population, ISRO had taken the initiative to establish a space-based telemedicine network in 2001. He added that the success achieved by India in telemedicine has drawn the attention of other countries and India's experience could be valuable for many developing countries that share similar problems in reaching the benefits of modern healthcare to the remote and rural areas.

Delivering the Keynote Address, Dr Devi Shetty, Managing Director, Narayana Hrudayalaya, Bangalore, highlighted as to how medical benefits could be extended to the poorer sections of the society at very nominal costs through cooperative schemes. Prof S Yunkap Kwankam of World Health Organisation (WHO), Geneva and Prof Rifat Latifi of the University of Arizona, USA were the Guests of Honour.

With 75 percent of the Indian population living in rural areas and more than 75 percent of the doctors practicing in urban areas, telemedicine, which is an emerging technology, appears to be the only way to bridge the rural-urban health divide. The same is true for many of the developing countries.

In pursuing its objectives of using space technology for societal benefits, ISRO initiated space-based telemedicine connecting Apollo Hospital, Chennai and a rural hospital at Argonda in Andhra Pradesh in November 2001. ISRO Telemedicine network has now expanded to 78 hospitals in remote rural areas including Jammu and Kashmir, Andaman and Nicobar and Lakshadweep islands, North Eastern Region and remote tribal areas in central and southern Indian States which are connected to 22 specialty hospitals in major cities. The experience so far is encouraging and there is demand for such facilities to be established on a larger scale.

Telemedicine system is user friendly and is like any other computerised electronic system. Telemedicine ground systems mainly consist of customised medical software integrated with computer hardware along with medical diagnostic instruments connected through the satellite based Very Small Aperture Terminal (VSAT) or terrestrial communication link. Normally, the medical records of the patients can be sent to specialist doctors either in advance or on real time basis. Specialist doctors will, in turn study, diagnose and advise the course of treatment through video-conferencing with the patients and the local doctors. A short duration training is sufficient for both specialty hospital doctors and rural doctors to handle the system. Hospital technicians can take care of operation and maintenance.

Besides ISRO, several agencies like the Departments of IT, Science and Technology, State Governments and private institutions like Apollo Hospital Enterprises, Amrita Institute of Medical Sciences, Kochi, Sanjay Gandhi Post Graduate Institute for Medical Sciences at Lucknow and Asia Heart Foundation at Kolkata, Shankara Nethralaya at Chennai, Sri Ramachandra Medical College, Chennai, Escorts Heart Institute and Research Centre, New Delhi and several others are also involved in telemedicine.

Several countries in South East Asian Region and Africa have evinced keen interest for the establishment of telemedicine technology for improved healthcare delivery systems. Also, significant technological developments have taken place worldwide in this field and there is a need to ensure that the benefits of telemedicine reach the rural and remote population. It is expected that in future, telemedicine could be used for tele-surgery, robotic surgery, virtual e-hospitals and medical universities including continuing medical education, tele-health monitoring of chronic patients, etc.

The main objective of the Bangalore conference was to create awareness on the technical, operational, social, ethical, financial and other related aspects of telemedicine. The conference provided a forum to discuss and arrive at appropriate recommendations for implementing telemedicine, particularly in developing countries, where the need is most felt.

In all, 36 invited lectures were delivered by national and international experts in the field of telemedicine and allied fields. Besides, 66 technical papers were presented in parallel sessions. A separate poster session was arranged, where about 40 papers were presented. The topics included Indian experience of telemedicine, interesting case studies like telemedicine in the American Prison System, Telemedicine's role of US Army Medical Centers, Telemedicine in Space Medicine, Remote Tele-health to Mobile Tele-health, Tele-trauma and Tele-presence resuscitation, Social issues in Telemedicine, cost effectiveness, policy, regulatory, licencing and standardisation issues, etc. The future of telemedicine including rationale of robotic surgery, Tele-health in the care of patients with chronic diseases, mobile tele-health, etc., were also covered.

About 550 delegates including 40 from abroad attended the conference. Speakers from several countries including US, France, Germany, Belgium, Australia, Sri Lanka and Asia Pacific countries like Malaysia, Korea and Taiwan presented papers. World Health Organisation and International Telecommunication Union were also represented in the conference. UN-ESCAP sponsored delegates from some of the developing countries in the region. Afghanistan and Bangladesh also sent delegates.

INTELEMEDINDIA 2005 was spread over three days with a regional workshop and the inauguration of the conference was on March 17, 2005 and the main conference on March 18th and 19th. The regional workshop was organised to create awareness and familiarise telemedicine techniques among the public, private and NGO healthcare providers, doctors, health administrators and others.

A corporate healthcare round table involving health care service providers, insurance companies, equipment manufacturers and business enterprises was organised to discuss on making telemedicine a viable business proposition so that the benefit can reach the rural and semi-urban population. A panel discussion was arranged for arriving at the recommendations based on the conference deliberations. The panelists included experts in the field, corporate, health, rural and planning sectors as well as NGOs. A Tele-demonstration from Europe was arranged during the conference. An exhibition depicting the latest in telemedicine hardware and services was also organised.

INTELEMEDINDIA 2005 provided valuable inputs regarding the steps to be initiated to introduce and expand telemedicine facilities catering to the needs of the society, especially to the rural and remote population and clinical, technical, operational, administrative expertise and facilities for effective functioning of the telemedicine system.

A view of the exhibition

Recommendations of INTELEMEDINDIA 2005

National Task Force

- It is recommended that a National Task Force for Telemedicine be constituted. This Task Force would define standards and structures of electronic medical records and patient data bases which could be accessed on a National Telemedicine Grid
- The Task Force would work towards definition of a National Telemedicine Grid and its standards and operational aspects. The Task Force should not merely be a recommending authority but should preferably have some say in the actual execution of decisions taken
- The Task Force should have members from Ministry of IT, Ministry of Health, C-DAC, DOT, ICMR, ISRO, NGOs, corporate hospitals and organisations that already have done considerable work in the field of telemedicine
- The task force or any other appropriate identified body could have association with International Telemedicine Society to look at the possibilities of a global exchange of information and views on all the aspects associated with Telemedicine

Policy

- There is need to define a policy framework to facilitate the introduction of Telemedicine and to give it a legitimate place in the Health plans, missions and infrastructure of the nation
- Given the national priorities, it is essential that Telemedicine and Information and Communication Technology (ICT) play an important role in the primary and public health system. All efforts will be made to explore and promote this priority

Interoperability

- Efforts have already been made to define standards for Telemedicine software. However, there is need to promote these standards and ensure their compliance
- Telemedicine software used in India should be globally compatible or at least scalable for global compatibility, so that telemedicine could be used in promoting medical tourism
- It is recommended that NASSCOM and C-DAC arrange workshops to develop interoperability of all software packages
- To enhance user friendliness, interaction between doctors and vendors will be encouraged by NASSCOM
- Efforts will be made by ISRO to convert the existing terminals to interoperable standards

Bandwidth

- Bandwidth is the most important component of the recurring costs. All Telecom agencies should be encouraged to provide bandwidth at a lower rate for Telemedicine purposes
- This should be applicable not only to space, but also, terrestrial links and mobile connection networks
- Telecom agencies should be appraised of the national needs

Cost Reduction

- The IT Ministry would come out with the appropriate policy guidelines and methodologies for providing Telemedicine software and hardware at subsidised rates

Awareness

- There is great and urgent need to create awareness about Telemedicine in the community of medical practices. To achieve this the following is recommended:
  - All Medical Associations and other regional bodies will be encouraged to hold seminars and workshops on Telemedicine
  - In the next two years ten such conferences/ workshops should be held in different parts of the country. These workshops would receive support from Ministry of Health/IT and ISRO
  - Articles would be published in all medical journals. All doctors presently using Telemedicine would be urged to write such articles
  - There are 100 locations in the country where Telemedicine has already been installed. Each of these institutions would organise a local workshop and share their experiences with the doctors/hospitals of the neighborhood
  - Telemedicine should be introduced as a topic in the curriculum of MBBS. This will increase the familiarity of the future generation of doctors with Telemedicine
  - Telemedicine (health informatics) should be introduced as a topic in the curriculum of engineering college students. This will enable future engineers / IT students to realise the importance of ICT in healthcare
  - A large number of states have Gramsat networks, which are being used for training of field staff. The training of health staff on the networks would cover Telemedicine aspects

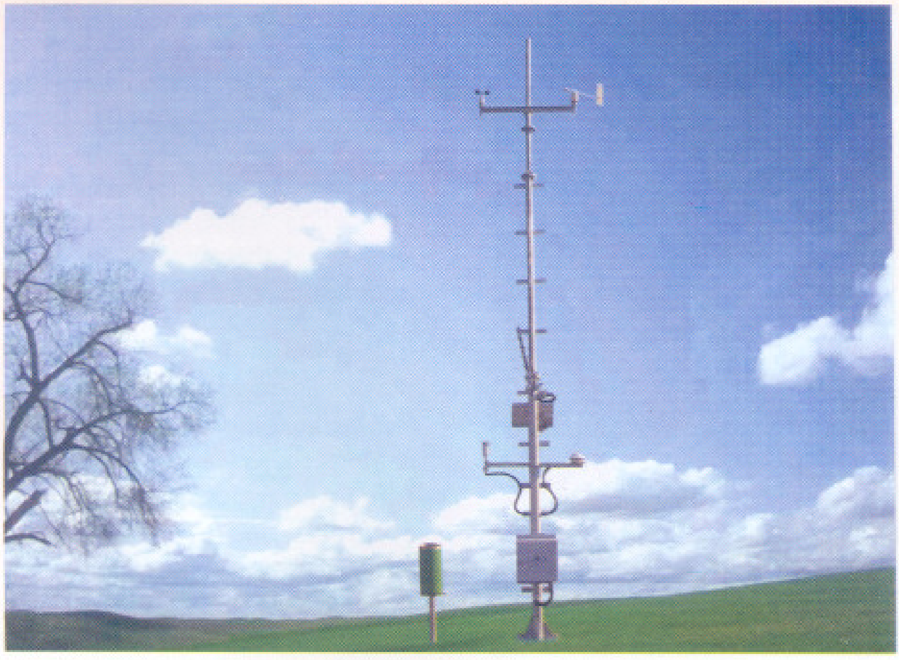
Agreement Signed for Production of Automatic Weather Stations

Antrix Corporation, the commercial arm of the Department of Space, signed an agreement on March 18, 2005 with a private company, M/s Astra Microwave Products Limited, Hyderabad, for production and supply of Automatic Weather Stations (AWS) to be deployed in various parts of the country. With data collection from local levels and remote and inaccessible areas through AWS, weather forecasts and services can be improved significantly.

ISRO's INSAT-3A and KALPANA-1 carry Data Relay Transponders, which can receive data from remote platforms deployed on ground and water bodies like rivers, sea, etc. Meteorological application of this satellite based data relay is one of the important applications.

Development of AWS was taken up by ISRO with the participation of Indian industry and the prototype has been successfully demonstrated. The low-cost AWS is compact, modular, rugged and capable of operating with minimum power from battery and solar panel for extended periods in the field conditions even in remote areas where power supply and communication are not available. AWS can continuously record weather data like temperature, atmospheric pressure, wind speed and direction, rainfall, relative humidity, solar radiation, etc. The data from a large number of AWS located across the country could be collected through the Data Relay Transponder on board the ISRO's INSATs. AWS features include easy programming of sensors, front panel display, archival of one-year data and communication options via INSAT, telephone, modem, cellular telephone, etc. A Global Positioning System receiver integrated with AWS provides accurate time for transmission of data. The weather information collected through AWS could also be disseminated through the Village Resources Centres, being set up by ISRO in cooperation with NGOs and other agencies.

As per this agreement, Astra Microwave Products Ltd will productionise and deploy AWS in the country based on the requirement of the user agencies.

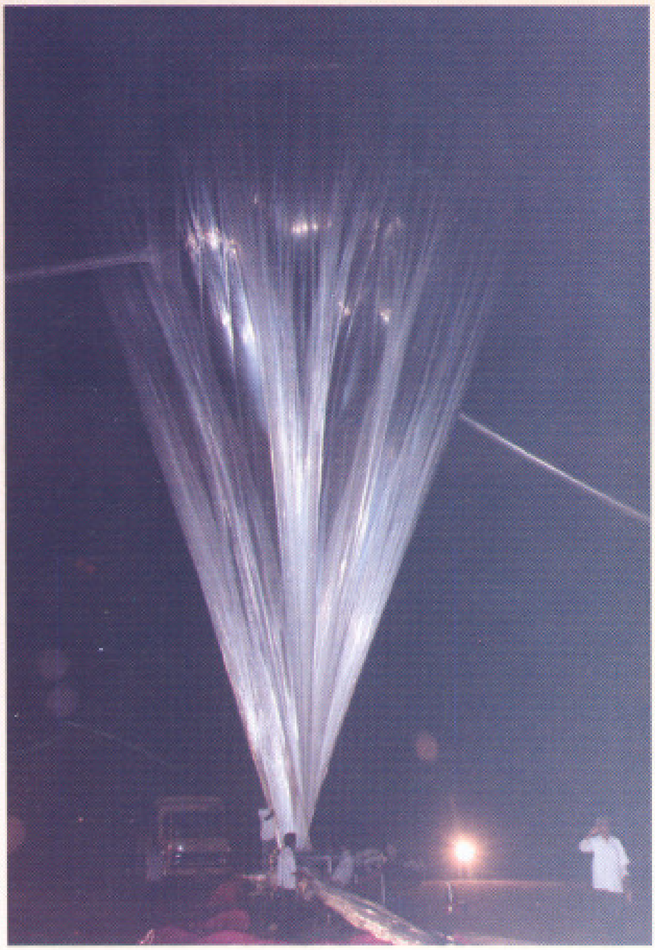


Automatic Weather Station

Search for "Origin of Life": ISRO-TIFR Balloon based Experiment

ISRO, jointly with Tata Institute of Fundamental Research, Hyderabad and Centre for Cellular and Molecular Biology (CCMB) conducted a balloon based experiment on April 20, 2005 to search for any micro-organisms that could be present in the stratosphere (20 km – 41 km altitudes). While the earthly organisms and other life systems live in the congenial terrestrial environment, the troposphere which is 20 km above the earth's surface experiences high doses of radiation due to ultraviolet rays and inhibits their sustenance in such hostile environment. Also, the atmospheric pressure being 10 times to 500 times lower in these regions, survival of any earthly micro-organisms is very difficult.

However, it is believed that during the origin of the universe, some of the life supporting systems could have originated from extra terrestrial source. These theories have so far been unfounded for want of proof to determine the availability of organisms above the tropospheric altitude.



Balloon carrying ISRO–TIFR experiment being readied for launch

ISRO's balloon experiment conducted from Hyderabad was to ascertain the possibilities of detecting any micro-organism, which can thrive under the extreme UV radiation. The experiment involved collection of air samples at various levels from 20 km to 41 km using a cryosampler developed by ISRO. The cryosampler is an electromechanical device to collect air samples under pre-evacuated condition. Opening and closing of valves to allow air samples inside the collection tubes are controlled remotely from ground. The sampling tubes had been prepared under sterile conditions to make sure that there was no terrestrial source of contamination. The high vacuum in the sampling tubes and super cooled liquid Neon provided extremely low temperatures of –270° C to enable collection of air samples in large quantity.

The 14 million cubic feet Hydrogen filled balloon carrying the 660 kg cryosampler collected air samples at 24 km, 27 km, 30 km, 35 km, 40 km and 41 km. After the air sample collection and sealing of the tubes, the cryosampler was separated from the main balloon bubble and allowed to descend near Gulbarga, 250 km west of Hyderabad. With the support of an Indian Air Force helicopter, the cryosampler was recovered within 3 hours.

CCMB Laboratory, Hyderabad and National Centre for Cell Science, Pune, are carrying out critical analysis of the air samples for the detection of any micro-organisms in the stratosphere.

If it is found that micro-organisms have existed in the hostile environment at stratospheric altitude, they will be independent of terrestrial origin. This, in turn, could perhaps lead to the hypothesis that "Origin of Life" was from an extra terrestrial source which eventually led to evolutionary mechanisms and established a complex system of living organisms in the earth's atmosphere. However, the hypothesis needs extended observations and continued scientific investigations.

Yakshagana – Folk art from Karnataka State arranged during INTELEMEDINDIA 2005

PSLV-C6 mounted on Mobile Launch Pedestal on its way to launch pad. The Vehicle Assembly Building is in the background