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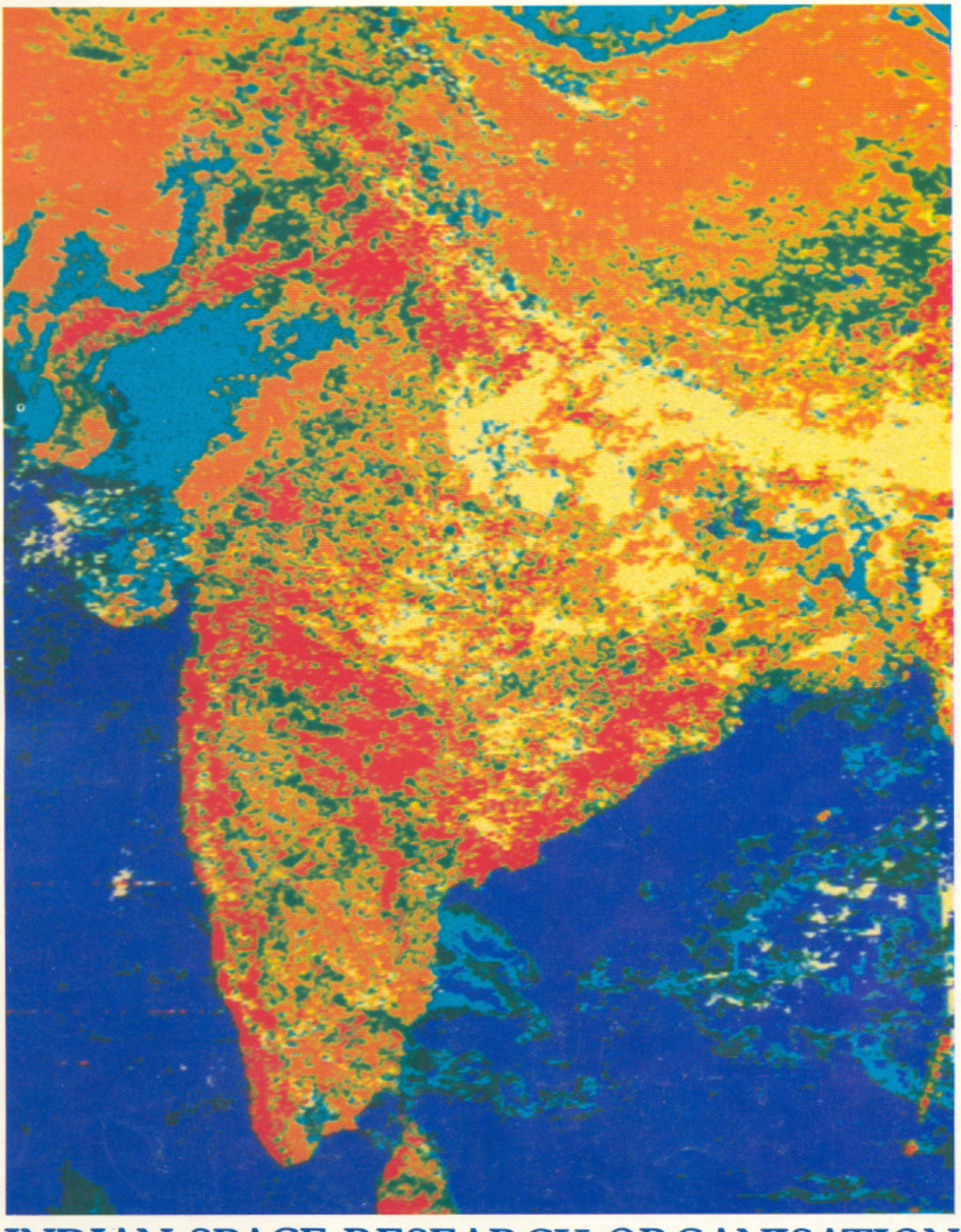
SPACE india



INDIAN SPACE RESEARCH ORGANISATION

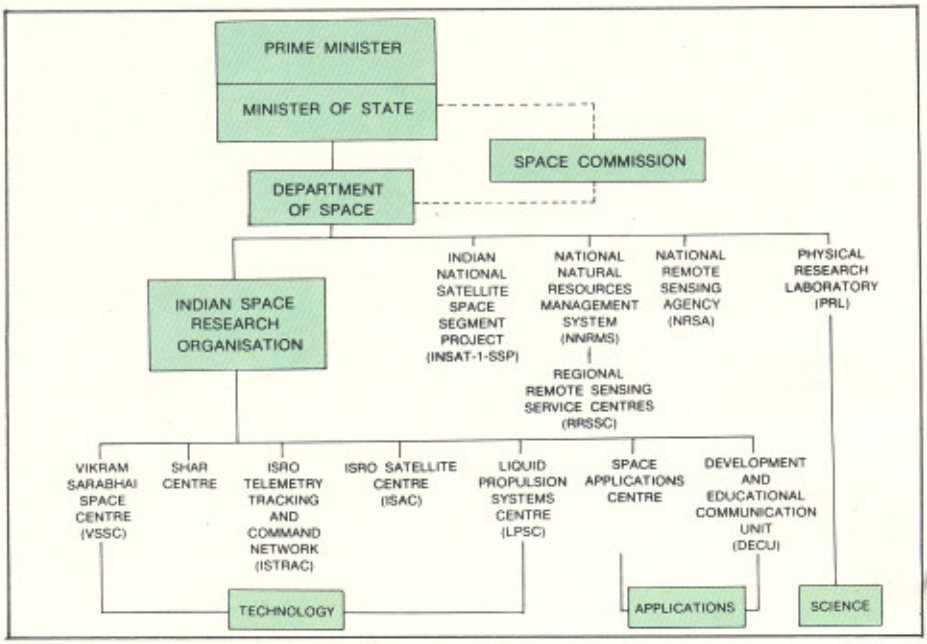
The Indian Space Programme

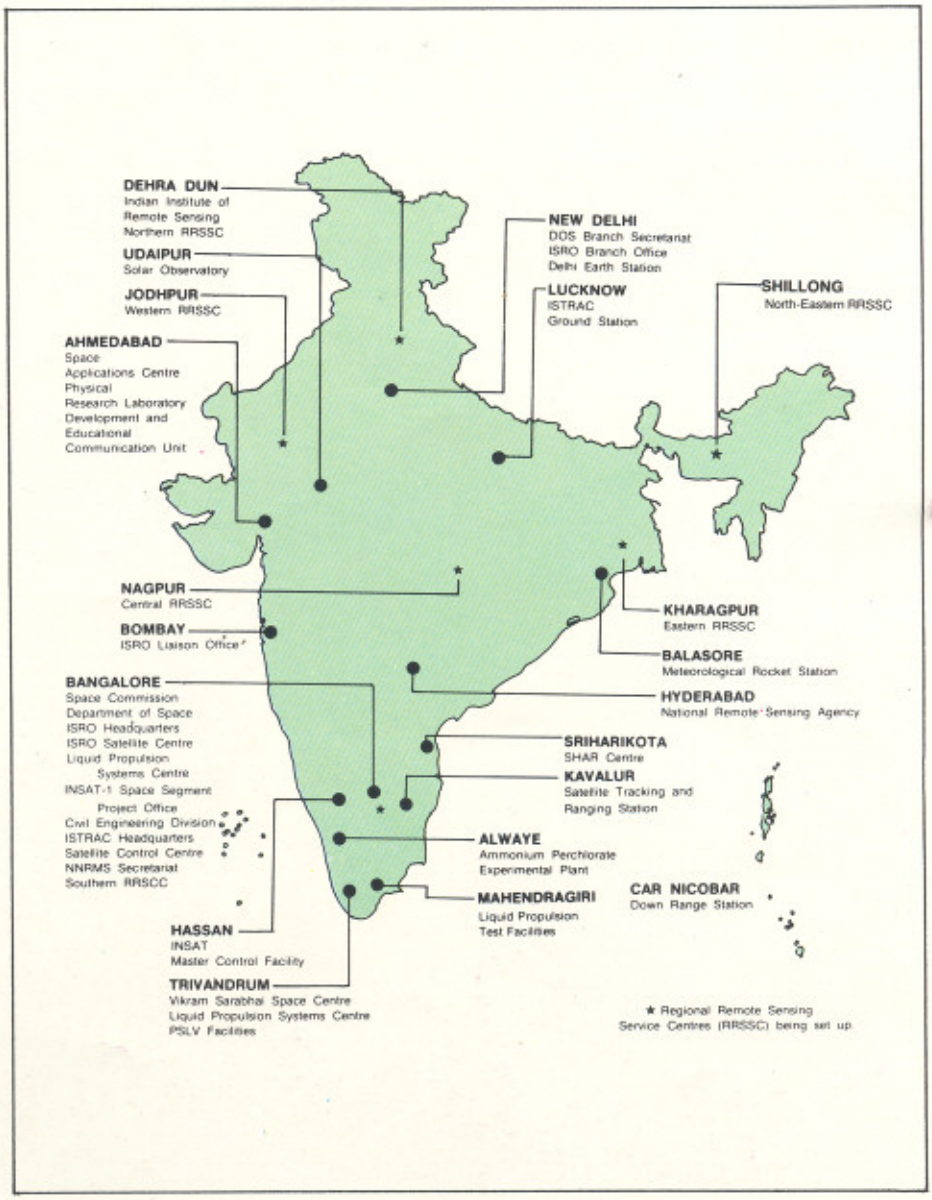
The setting up of the Thumba Equatorial Rocket Launching Station (TERLS) in 1963 marked the beginning of the Indian Space Programme. The Space Commission and the Department of Space (DOS) were established by the Government of India in 1972 to promote unified development and application of space science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





FRONT COVER
Normalised vegetation index map of India

EDITORS
J. Raja
S.K. Dutta

EDITORIAL ADVICE
Y. S. Rajan
Manoranjan Rao

Contents

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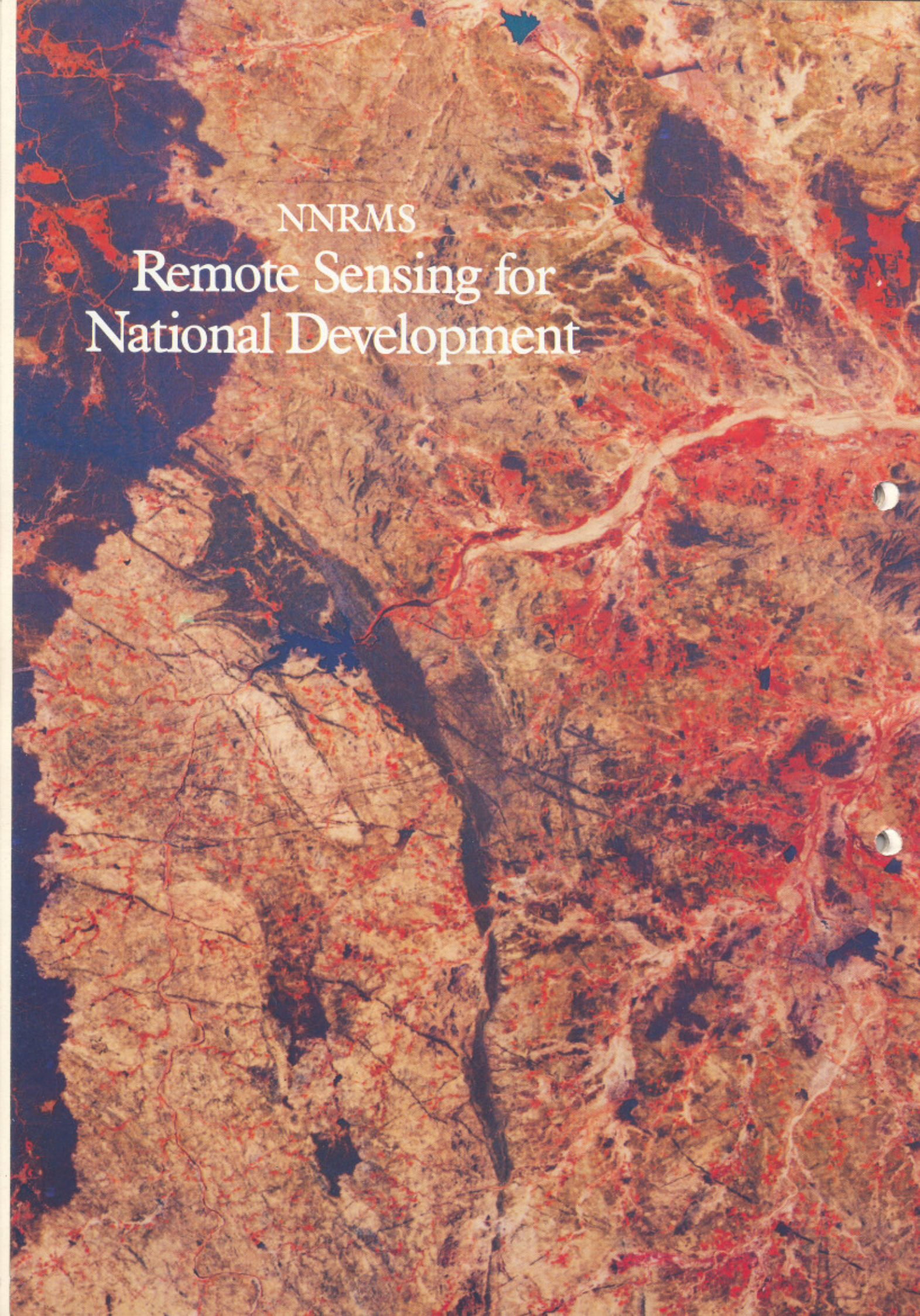


NNRMS

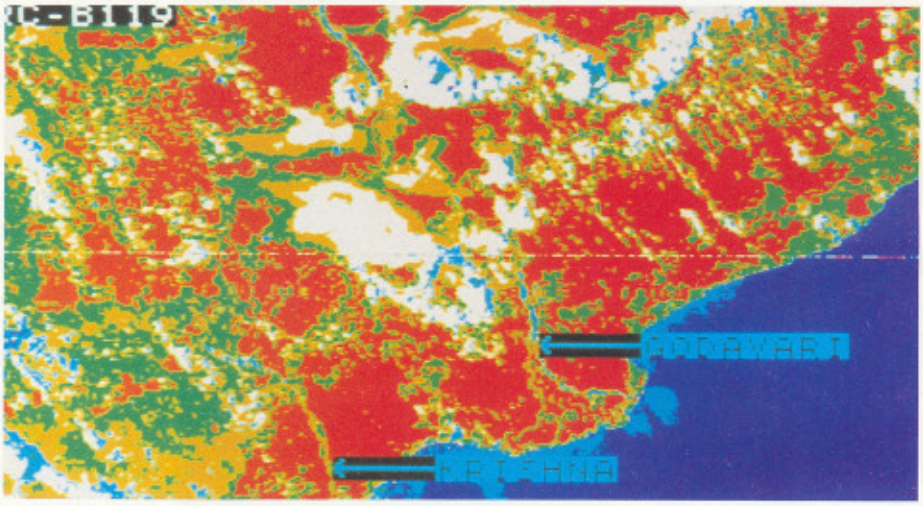
Remote Sensing for National Development

A comprehensive approach to the management of the natural resources of the country is imperative to meet the needs of national development. Surveying as well as monitoring resources is essential for the planning and management of the national natural resources. Remote sensing through air borne and satellite based sensors, integrated with traditional techniques, is emerging as an efficient and cost effective tool for this national development effort.

Remotely sensed data has vital relevance to major sectors of economy such as agriculture, forestry, urban development, geology, ecology, etc. Through this technology one could ensure optimal use of land, water, mineral resources and the like. This calls for a multi-disciplinary approach with active interaction by the users at all levels.

Even before the advent of the use of satellite imageries remote sensing techniques were extensively used in India for geological exploration and survey. Earliest such survey was conducted in 1920 with the help of aerial photographs. Satellite based remote sensing techniques are, however, unique in some respects. They are fast, they provide a synoptic view of large areas and they are capable of repetitively covering the same area every few days. To exploit fully these

Background: March 1985 Landsat Thematic Mapper (TM) image of Ananthapur area in Andhra Pradesh. Such False Colour Composite images can be used to study and evaluate geological, agricultural, hydrological and soil features of the area.



Normalised vegetation index map of Krishna and Godhavari delta region. This September 1987 image from NOAA satellite is used for studies relating to crop monitoring, vegetation, deforestation etc.,

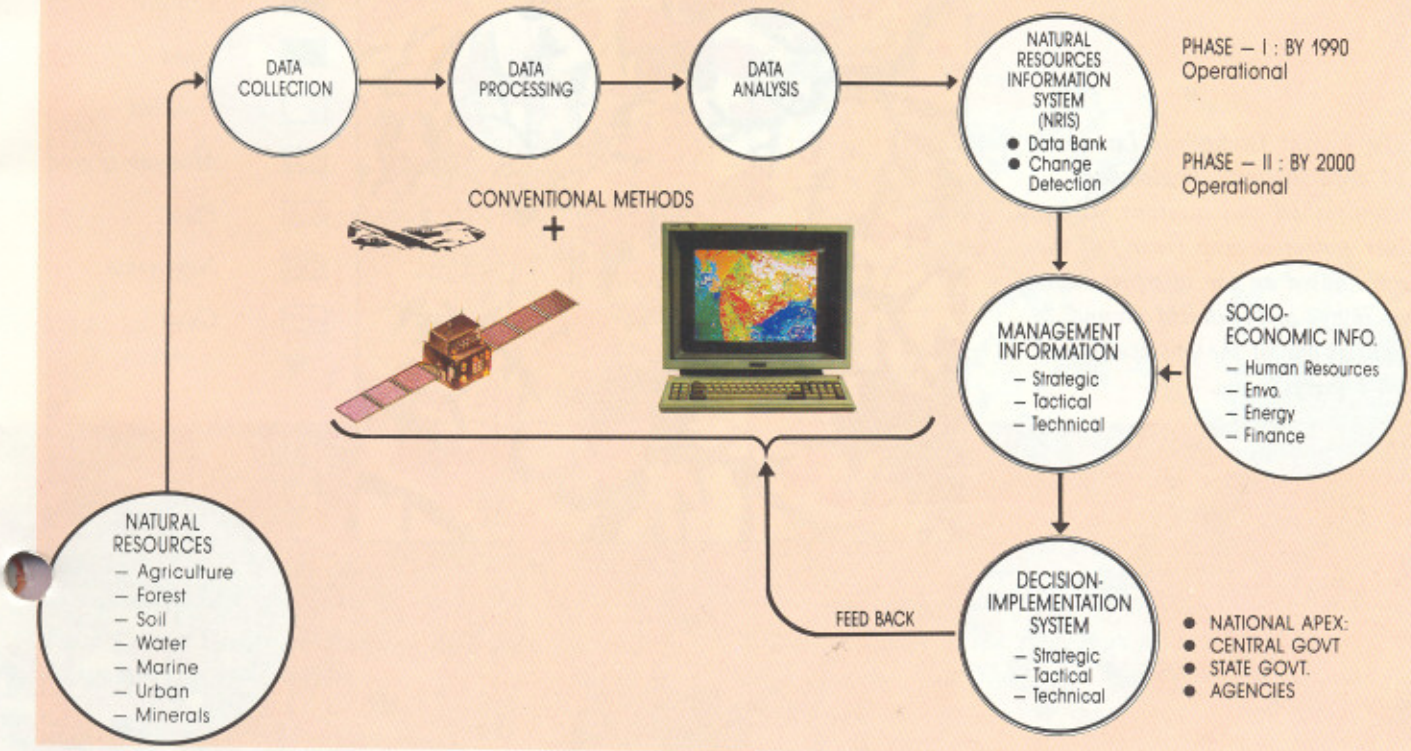
new techniques, a National Natural Resources Management System (NNRMS) is being established in the country with a number of interactive systems at regional and state levels.

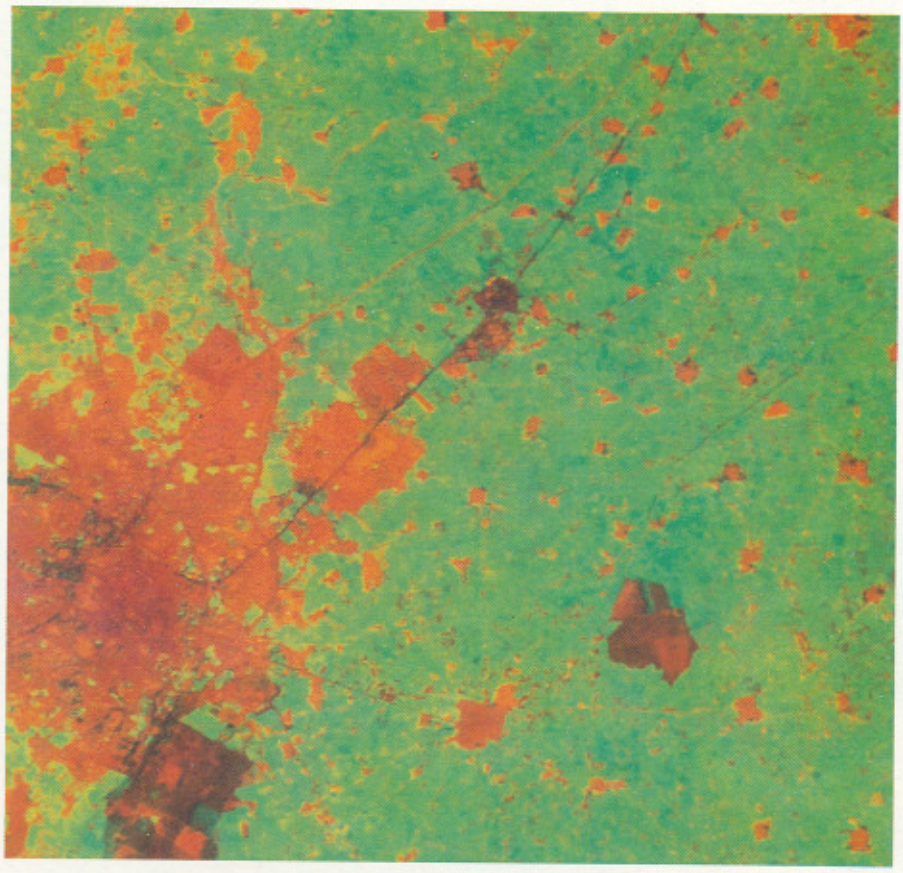
Some of the main features of this system are continuous reception of data from various earth resources satellites, conversion of this data into readily usable data-products and dissemination of data to a wide cross section of users at all levels and integration of the data derived through various other conventional systems. Evolution of the NNRMS may be traced to the early 1980s when a series of end-to-end experiments was conducted in a number of disciplines. Many user organisations and State Governments participated in these experiments initiated by ISRO. The experiments basically aimed at the integration of the conventional survey methods with the modern remote sensing techniques. During May 1983 a national seminar was conducted at Hyderabad where the results of these experiments were presented. A number of other applications studies conducted by various users was also discussed at this seminar. Nearly 500 research scientists, managers and administrators belonging to a large cross section of user organisations participated in this seminar. At the end of this seminar a 16 point resolution was adopted which formed the basis for the NNRMS. The Government decided on its establishment in 1985 and the Department of Space was named the nodal agency. Conceived as a hybrid information system NNRMS integrates modern remote sensing techniques with the conventional ground survey methods. It has three major components: application projects, infrastructure development including training and a Natural Resources Information system (NRI).

Over the years a number of application studies have been made using the data received from the Landsat series of satellites at the Shadnagar station of the National Remote Sensing Agency (NRSA). More important among them are a nation wide forest cover mapping, waste land mapping and ground water potential mapping in the drought prone districts.

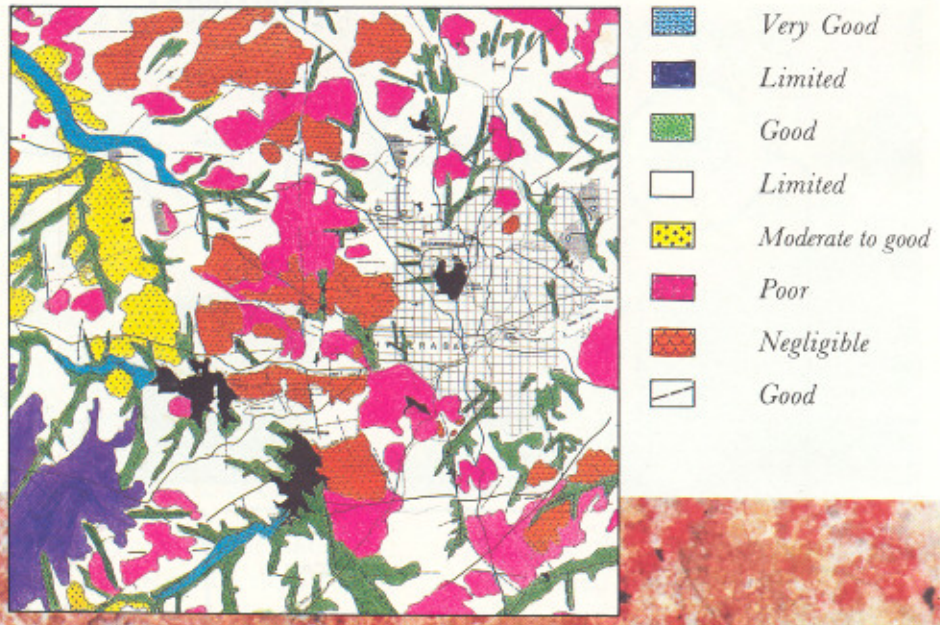
Processed composite of greenness index, surface brightness index and reflectance. This Landsat MSS image of the Srinagar area is suitable for forest type classification.

NATIONAL NATURAL RESOURCES MANAGEMENT SYSTEM (NNRMS)



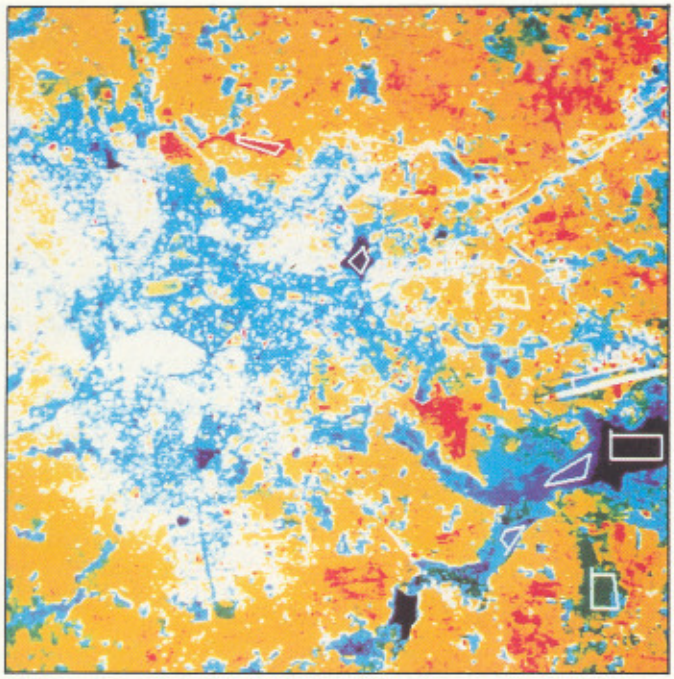


Colour hybrid composite of the February 1987 Landsat TM data used for settlement analysis in the Patiala region.



False Colour Composite Landsat TM data showing Hyderabad, Secunderabad and environs. Ground water potential map (inset) of the region based on the interpretation of this image with limited ground checks is one of the applications of such images.

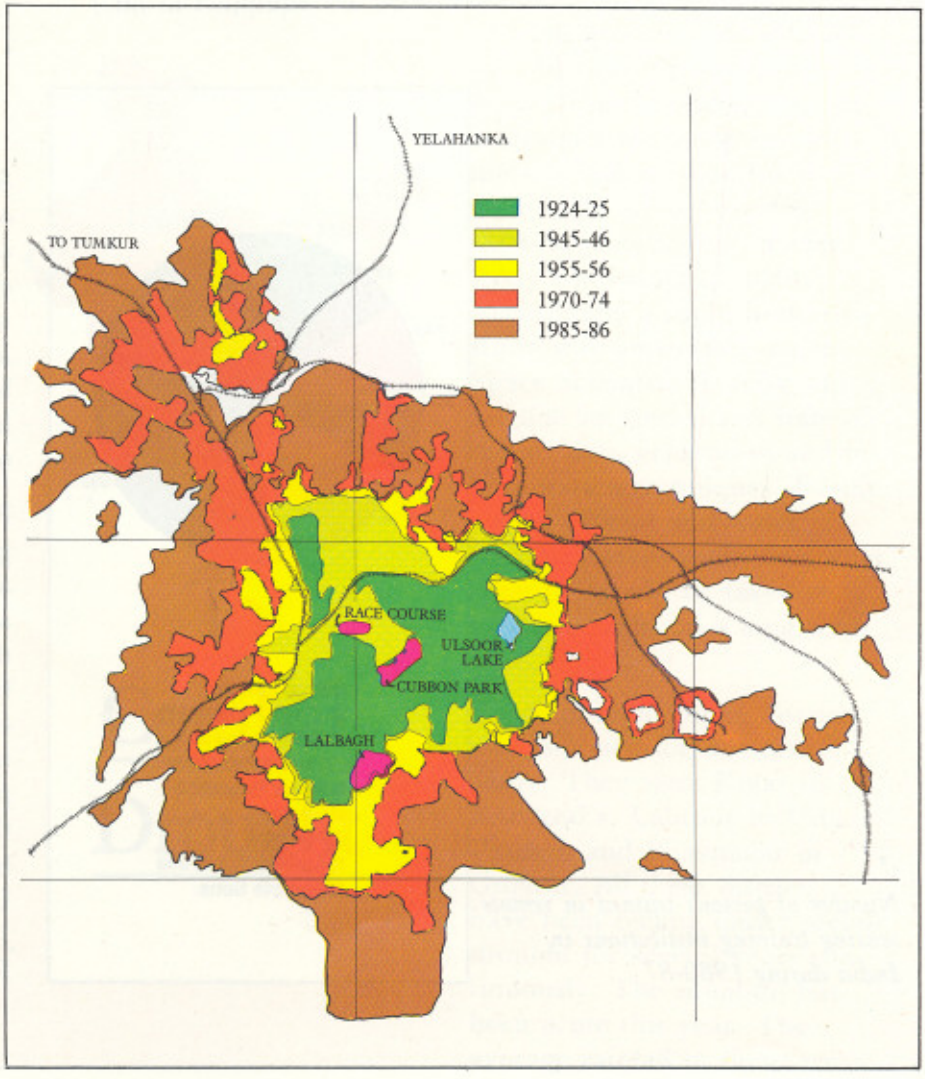
False Colour Composite Landsat TM data showing Bangalore city and environs.



Classified image of the Bangalore data highlighting built-up area (light blue), wet land (blue), arable land (yellow) etc.

The studies have revealed the exciting potential of application of remote sensing techniques to critical areas of national development. For example, the forest cover maps bring out the statistics on dense and open forests along with their spatial distribution; the waste land maps provide the necessary data base to initiate appropriate measures for reclamation and profitable use of the waste land; the success rate of wells dug using ground water potential maps in conjunction with the conventional data is reported to be as high as 80 to 90%; using computer classification of the crop acreage it has been possible to identify the wheat and rice areas clearly; land use and land cover mapping have been extremely useful for various urban development and resettlement applications. The results of such application studies have been so striking that these have lead to a national Science & Technology Project towards operationalisation of the NNRMS.

Urban sprawl map of Bangalore.



Training and Education

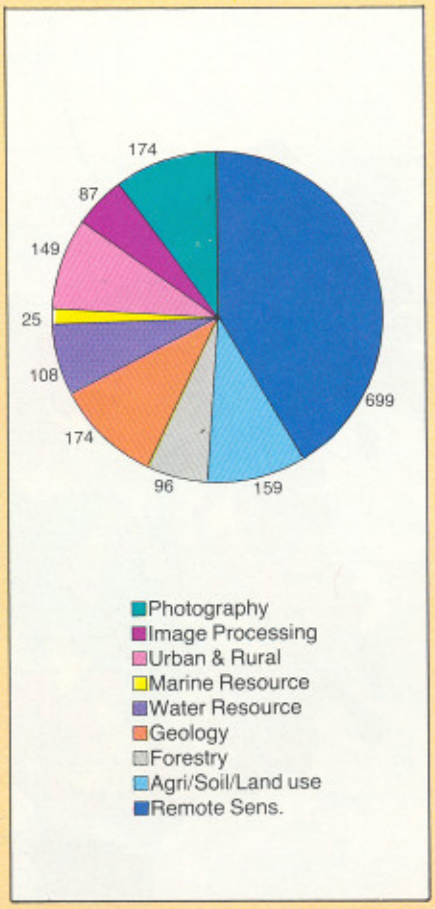
Effective utilisation of the remote sensing technology depends, to a very large extent, on the availabiJity of suitably trained manpower. A concerted programme of training and education has been established in the country under the overall framework of the NNRMS.

Training programmes in remote sensing range from appraisal courses of a few days' duration to 30 to 40 weeks' intensive courses. Many specialised institutions in the country are equipped to offer such courses. More important among them are:

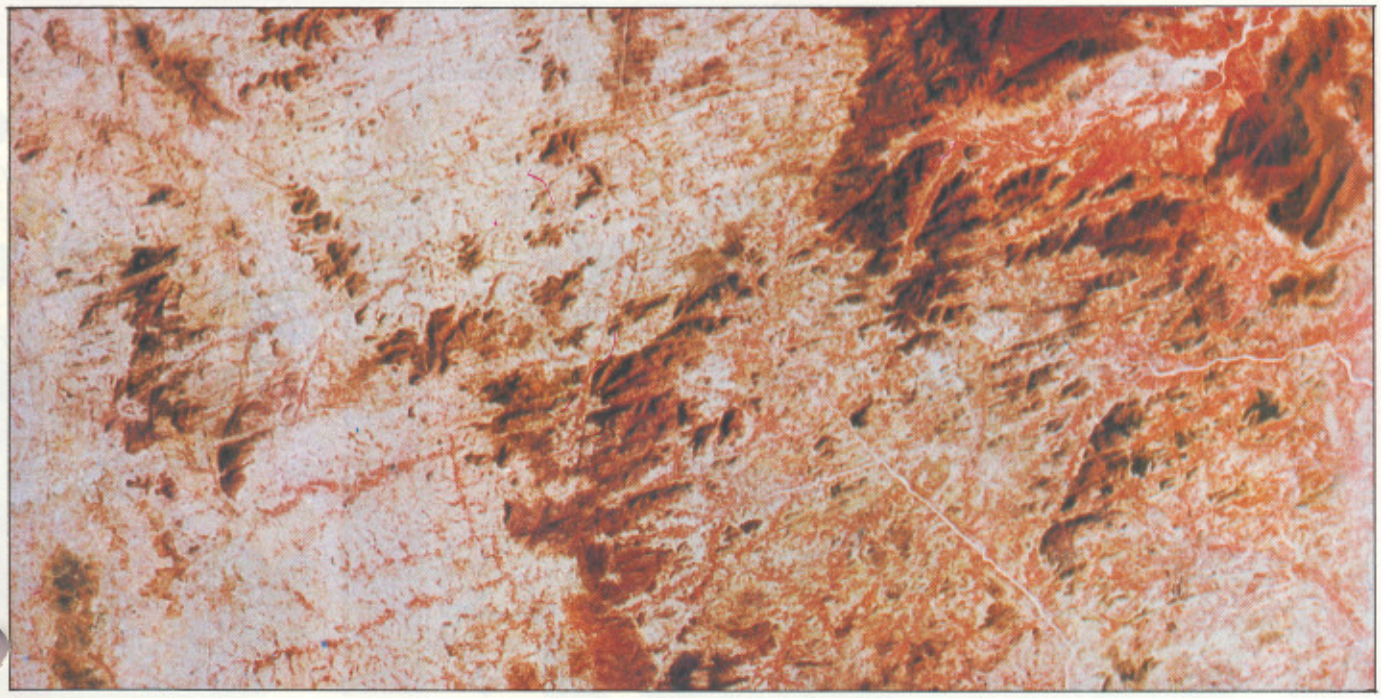
* Indian Institute of Remote Sensing, Dehradun
* National Remote Sensing Agency, Hyderabad
* Space Applications Centre, Ahmedabad
* Centre of Studies in Resources Fngg., Indian Institute of Technology, Bombay
* Institute of Remote Sensing, Anna University, Madras
* Geological Survey of India, Dehra Dun
* National Bureau of Soil Survey & Land Use Planning, Nagpur.

Some of these institutions also offer specialised training courses for specific applications on a need based request. As many as 2500 scientists belonging to various user agencies have been trained by these institutions since the beginning of the NNRMS programme.

Postgraduate educational programmes in remote sensing are also offered by several academic institutions around the country. A concise brochure giving details of such educational facilities and the training programmes has been published by ISRO. Copies of this publicaiton can be obtained by writing to the Manager, User Services, NNRMS, Janardhan Tower, Residency Road, Bangalore 560 025 □



Number of persons trained in remote sensing training institutions in India during 1980-87.

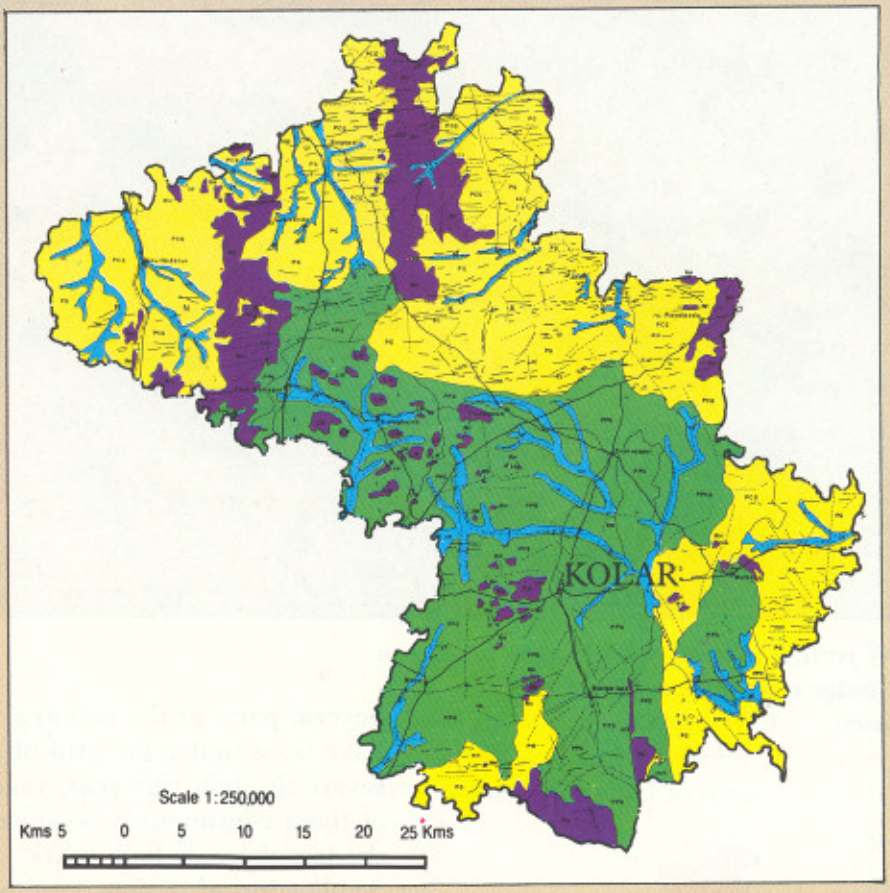


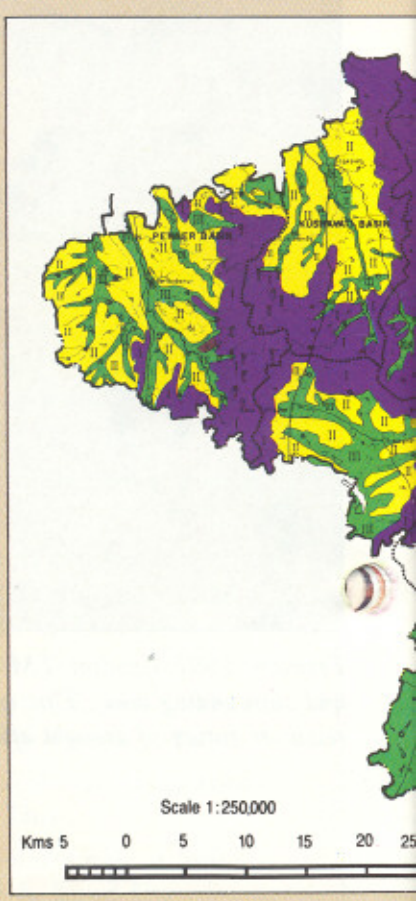
February 1987 Landsat TM data of parts of Kolar district (bottom left) and surrounding area. This type of image is used for land and water resources survey of drought affected areas.

To Combat Drought

Several parts of the country have been under the grip of a severe drought this year, many of them continuously so since the last three or four years. Application of remote sensing techniques for quick assessment of water resources in vulnerable areas provides exciting possibilities for effectively combating drought. Accordingly a rapid indicative study was undertaken by the Space Scientists recently, using satellite imageries and state-of-the-art data generation and interpretation techniques. Result : a set of land and water resources maps indicating what measures could be taken to tackle drought on a long term basis.

Three drought prone districts were selected for this case study. They were Kolar in Karnataka, Lalitpur in Uttar Pradesh and Bhavnagar in Gujarat. All these districts have been reeling under severe drought for several years continuously. The situation has been acute this year. The average rainfall in these areas



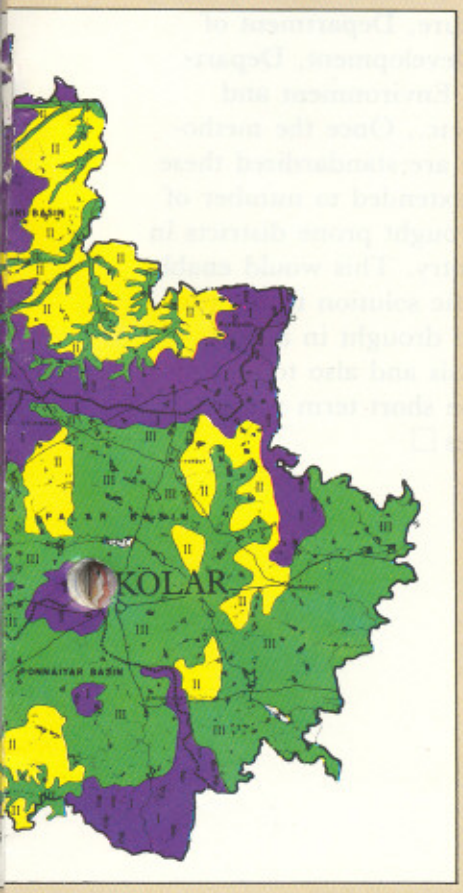


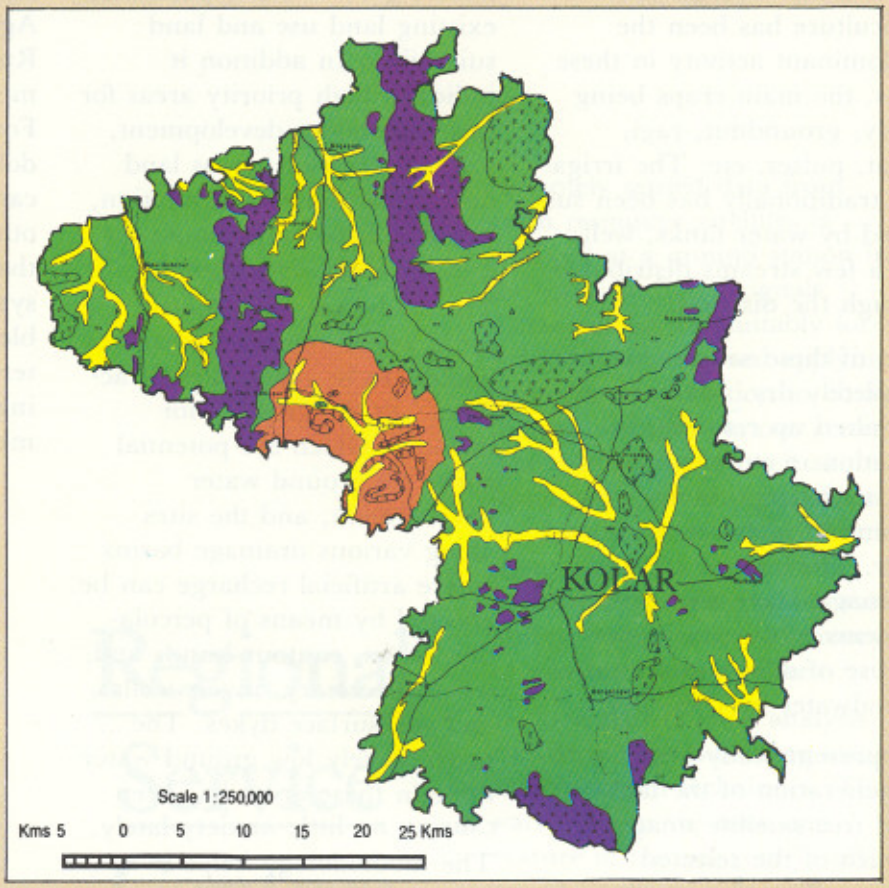
Land form/ Structure	Lithology	Ground water potential
Valleyfill	Colluvium/Alluvium	Good-Very Good
Fracture/ Fault Zone	Granite, Gneisses, Schists	Moderate-Good
Pediplain	Granites, Gneisses Schists, Laterite,	Moderate-Good
Pediment	Granites, Gneisses, Schists	Poor-Moderate
Residual Hill/Mesa	Crystalline/Metamorphic rocks and Laterite	Poor

Area for recharge
Area for recharge system
Area for recharge sites
Site for recharge system (surface dyke)
Recharge site (percolatio

Ground water potential map of Kolar district in Karnataka.

Potential sites for artificial ground





	Land System	Erosion	Ground water potential	Recommended landuse
	Hills	Moderate to severe	Poor	Afforestation
	Undulating plains	Slight to severe	Moderate to good	Fuel/fodder/grass & cash crop (locally)
	Valley flats	Nil	Good to very good	Food & Commercial crops
	Lateritic plains & Hills	Slight to severe	Moderate to good	Horticultural & Afforestation

development.
sites.
no further ground water development.
(percolation tank, invert well & sub-

tank & invert well).

water recharge.

Integrated land and water resources map of the district.

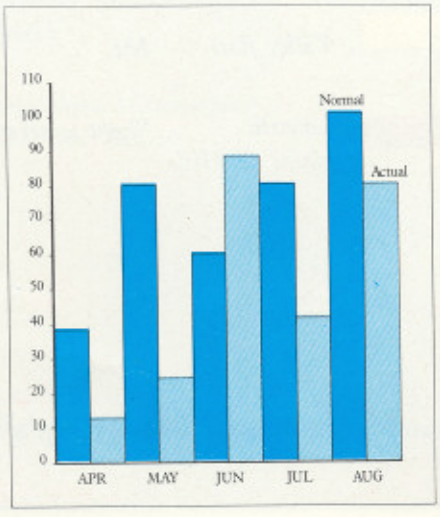
does not exceed 1000 mm even under normal conditions. Agriculture has been the predominant activity in these areas, the main crops being paddy, groundnut, ragi, wheat, pulses, etc. The irrigation traditionally has been sustained by water tanks, wells and a few streams distributed through the districts.

Most of these sources are now completely dry. Many have also silted up resulting in reduction in storage capacity and, more importantly, preventing recharge of ground water. The coastal areas of Bhavnagar have also developed problems of salinity ingress because of over withdrawal of groundwater by pumping.

The present study began with the generation of the latest cloud free satellite imageries for each of the selected districts. Transferring these on to a base map a series of thematic maps were produced.

One was a surface water body map showing dry tanks and tanks with reduced water spread area. A second was a map of the ground water potential, showing favourable areas for immediate extraction of drinking water. A third was a map showing potential sites for artificial recharge systems. by using a number of ground information as well.
A fourth was a soil map indicating the nature and erosion status of soils. There was in addition a land use map showing existing land distribution, including different categories of waste lands.

In the next step, overlaying one thematic map over another, a final "integrated land and water resources map" was prepared. This map provides readily assimilable information on soil, erosion status, ground water potential, existing land use and land suitability. In addition it indicates high priority areas for fuel and fodder development, soil conservation, grass land development and afforestation, along with potential zones for ground water development.
The study has also identified areas where remedial measures could to be taken: the "fractures" in the ground, for instance, which are potential zones for ground water development; and the sites along various drainage basins where artificial recharge can be effected by means of percolation tanks, contour bunds and, where necessary, invert wells and sub-surface dykes. The progressively low ground water table in these areas has been causing no little anxiety lately.
The methodology helps in identifying the sites where ground water recharging can be undertaken to utmost advantage. The study concludes with a set of recommendations which could help in combating drought. The Department of Space is therefore planning to conduct a number of field checks and refine the methodology alongwith the scientists and officials of the respective state Governments and other user agencies like the Ministry of Agriculture, Department of Rural Development, Department of Environment and Forests etc., Once the methodologies are standardised these can be extended to number of other drought prone districts in the country. This would enable systematic solution to the problems of drought in a long term basis and also to providing some short term remedial measures □



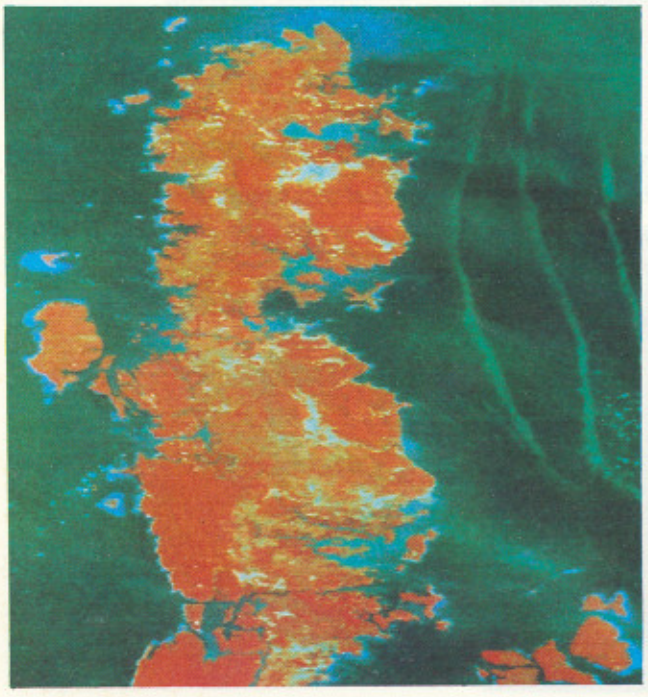
Normal and actual rainfall over the Kolar district during 1987.

Regional Service Centres

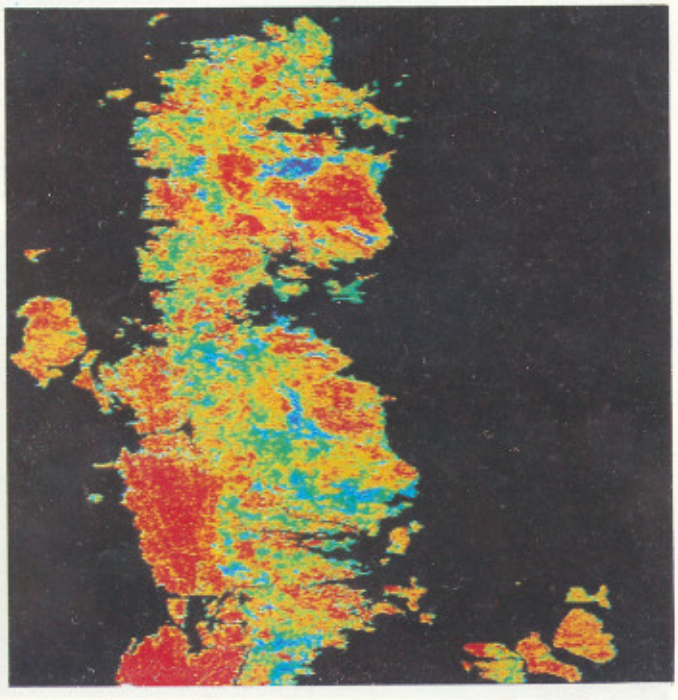
Remotely sensed data from earth resources satellites is received at a ground station in the form of digital signals. These signals are suitably formatted and processed applying appropriate correction to obtain imageries of the various scenes. These imageries as well as the formatted data in digital form are used for extracting information on specific application areas: crop growth, water availability, forest cover, inventory of resources and the like.

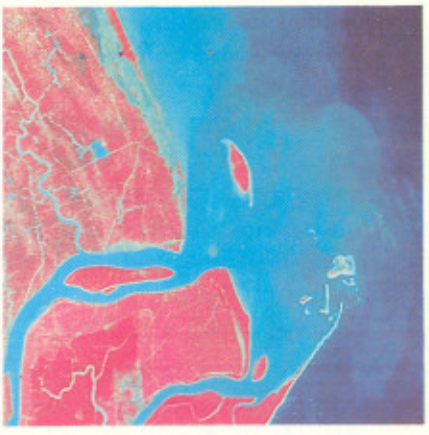
A good part of such analysis can be carried out using visual interpretation techniques. The variations in the tone and texture of the imagery in different bands give an indication of the properties of the terrain. Often, however, the variations in the reflectance between two

False Colour Composite of the March 1986 Landsat MSS image showing the Andaman islands.



Processed image of the islands showing the biomass index. This image is derived from a combination of the visible and IR band data.





False Colour Composite image of the Orissa coast including the Mahanadi delta.

Supervised classification of the Landsat TM data shows the geomorphic features.

areas and the corresponding variations in the imagery are very subtle. These may be discernible only after considerable enhancement of the contrast, without losing the original data quality. In such cases specialised analysis techniques are required. The large volume of data obtained from the satellite and the quick turn-around times expected of the analysis point to the application of computerised statistical techniques.

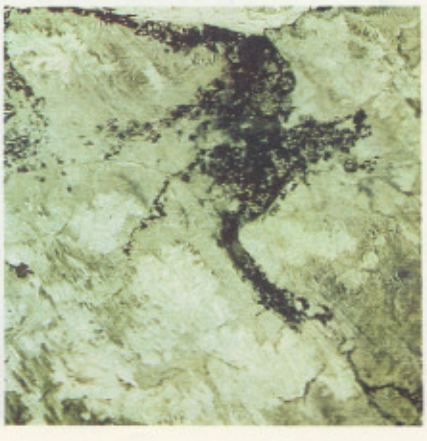
Regional Remote Sensing Service Centres (RRSSC) provide such facilities to user organisations. Under the NNRMS programme a chain of regional service Centres around the country has been planned. Funded by a number of Central government Departments and agencies, six RRSSCs are being set up by the Department of Space.

The funding agencies are the Department of Science and Technology, Indian Council of Agricultural Research, Department of Mines and the Geological Survey of India. Several State Government and Central Government agencies have joined this effort and are setting up 'associate centres' with active support from the RRSSC Central Management Office.

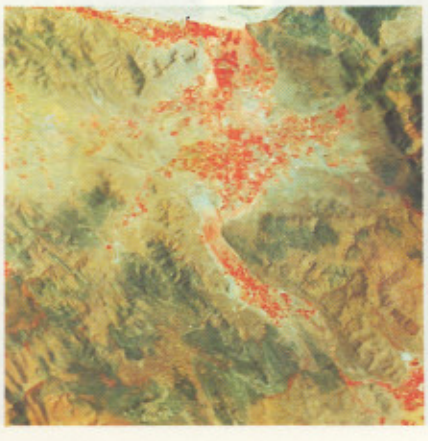
The basic features of an RRSSC are: an interactive image analysis system configured around a super-mini computer, a visual interpretation facility with optical projectors, mirror stereoscopes and light tables; a photo processing laboratory; and selected ground truth equipment. The image processing functions that can be carried out are:

* preprocessing and rectification
* contrast enhancement
* band ratioing
* principal component transformation
* edge enhancement/extraction
* directional filtering
* combination of enhancements

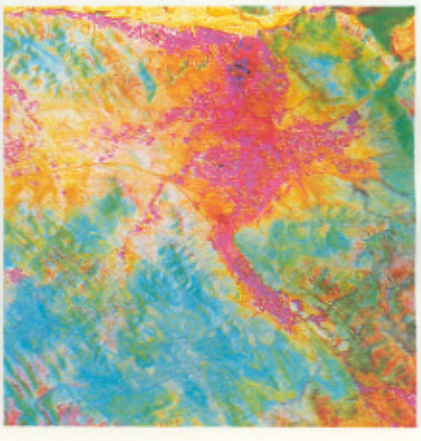
False Colour Composite Landsat TM image of the Vontimetta region of Cuddapah district.

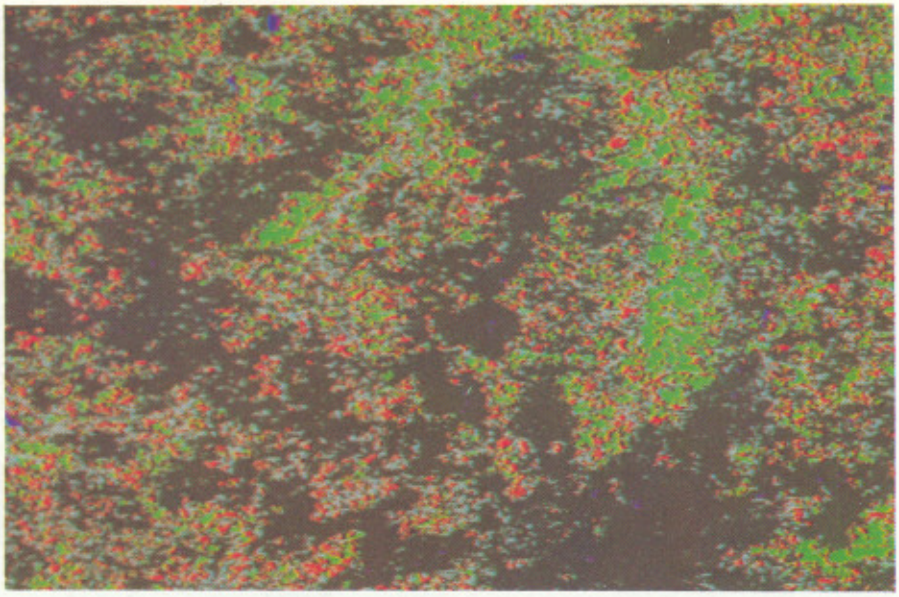


Principal component transformation of the TM bands show the lithology of the area prominently.

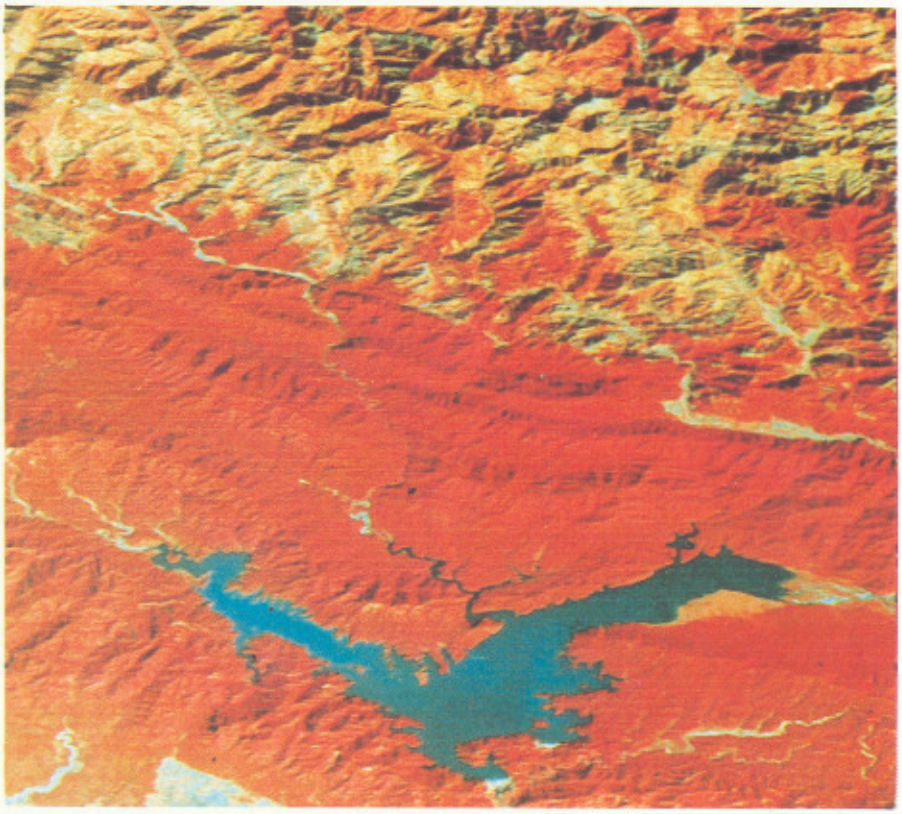


False Colour Composite of three principal component transformation data brings out the geological features.





January 1987 Landsat MSS image of Indore and surroundings. Such a classified image aids study of moisture stress properties.



False Colour Composite Landsat MSS of November 1985 showing the Ramganga lake, and the environs.

Classified image of the lake shows different levels of turbidity. (Pink, blue, red, yellow and green colours reveal high to low turbidity in that order).

Two Service Centres Commissioned

The first RRSSC to become operational is the southern Centre at Bangalore. Located at Banashankari, Bangalore this Centre was inaugurated by Prof. U.R. Rao, Chairman, Space Commission, on August 20, 1987. The Bangalore RRSSC is fully funded by the Geological Survey of India. It would cater to the needs of users in Karnataka, Andhra Pradesh, Tamil Nadu, Kerala and Pondicherry regions.

Mr. K.R. Narayanan, Minister of State for Science & Technology inaugurated the second RRSSC at Dehra Dun on November 4, 1987. This northern Centre is located at the Indian Institute of Remote Sensing (IIRS). Other regional Centres are expected to be commissioned in early 1988, so that all the Centres will be ready to process data received from the Indian Remote Sensing Satellite, IRS-1A□

Mr. Y.S. Rajan, Scientific Secretary ISRO and Director, Earth observation Programmes speaking during the inauguration of the Dehra Dun Centre. Seated from left to right are Mr. K.R. Narayanan, Minister of State for S&T, Prof. U.R. Rao, Chairman, Space Commission and Prof. B.L. Deekshitalu, Director, National Remote Sensing Agency. Earlier in Bangalore (right) after the inauguration of the Southern Centre Mr. K. Radhakrishnan, Project Director, RRSSC gave a delectable Kathakali performance.

* supervised and unsupervised classification.

These processing techniques improve discrimination of terrain features, identification of specific resource targets, recognition of changes taking place since previous survey etc.

The regional Centres also have plans for conducting short-term training courses in digital image analysis for personnel from the user organizations□

A view of the RRSSC at Jodhpur which will be commissioned shortly.

Indian Institute of Remote Sensing

The Indian Institute of Remote Sensing (IIRS) located at 4, Kalidas Road, Dehra Dun is the premier institute in the country imparting training in the field of remote sensing and photo interpretation. The Institute was established in 1966 under the aegis of the Survey of India and was initially known as the Indian Photo Interpretation Institute (IPI). It was the pioneering vision of late Prime Minister Jawaharlal Nehru which saw setting up of IPI. Even before the dawn of the space age he was convinced of the necessity to adopt modern techniques for planning, development and exploitation of the natural resources. Initially the main objective of IPI was to provide trained manpower for the use and interpretation of aerial photographs.

In the formative years IPI drew significant support in the form of faculty and equipment from the International Institute for Aerial Surveys and Earth Sciences, Netherlands, widely known as International Training Centre (ITC).

In 1976 the institute was merged with the newly formed National Remote Sensing Agency (NRSA). Later in 1983 the training courses were revised and updated keeping in view the advances made in the satellite remote sensing, digital processing and computer aided techniques. This led to the renaming of the institute as Indian Institute of Remote Sensing (IIRS).

IIRS imparts training in the following areas:

- Agriculture and soils
- Coastal and Marine resources
- Forestry and Ecology
- Geosciences
- Human Settlement Analysis
- Water Resources
- Photogrammetry and Remote Sensing
- Photo processing

The training is organised in three levels to meet the requirement of various target groups.

* A 10 month post graduate diploma course for working scientists and engineers. This diploma course is structured in 3 modules of 3 months, 4 months and 3 months duration respectively. The first module covers the basics of remote sensing and photogrammetry; the second module covers a chosen area of training; the last module is devoted to the project work using remote sensing data and techniques specifically tailored to the candidate's choice of topic and the geographic location.
* Short duration courses varying from 2 to 8 weeks in fundamentals and basics of remote sensing and its applications to various disciplines for the middle level supervisory personnel and resource managers.
* A one week appraisal and overview course for senior professionals and decision makers to make them aware of the potentials and limitations of the technology.

Besides, the Institute also offers short duration technology courses in photography; these are specifically designed for photo processing of aerial and satellite data.

On an average more than 150 candidates are trained at IIRS every year. The training programmes of IIRS are also offered to candidates from abroad, particularly from the developing countries. Of the 1894 persons so far trained at this institute 83 are from 25 countries of Asia and Africa□

Indian Institute of Remote Sensing at Dehra Dun.

IAF Congress

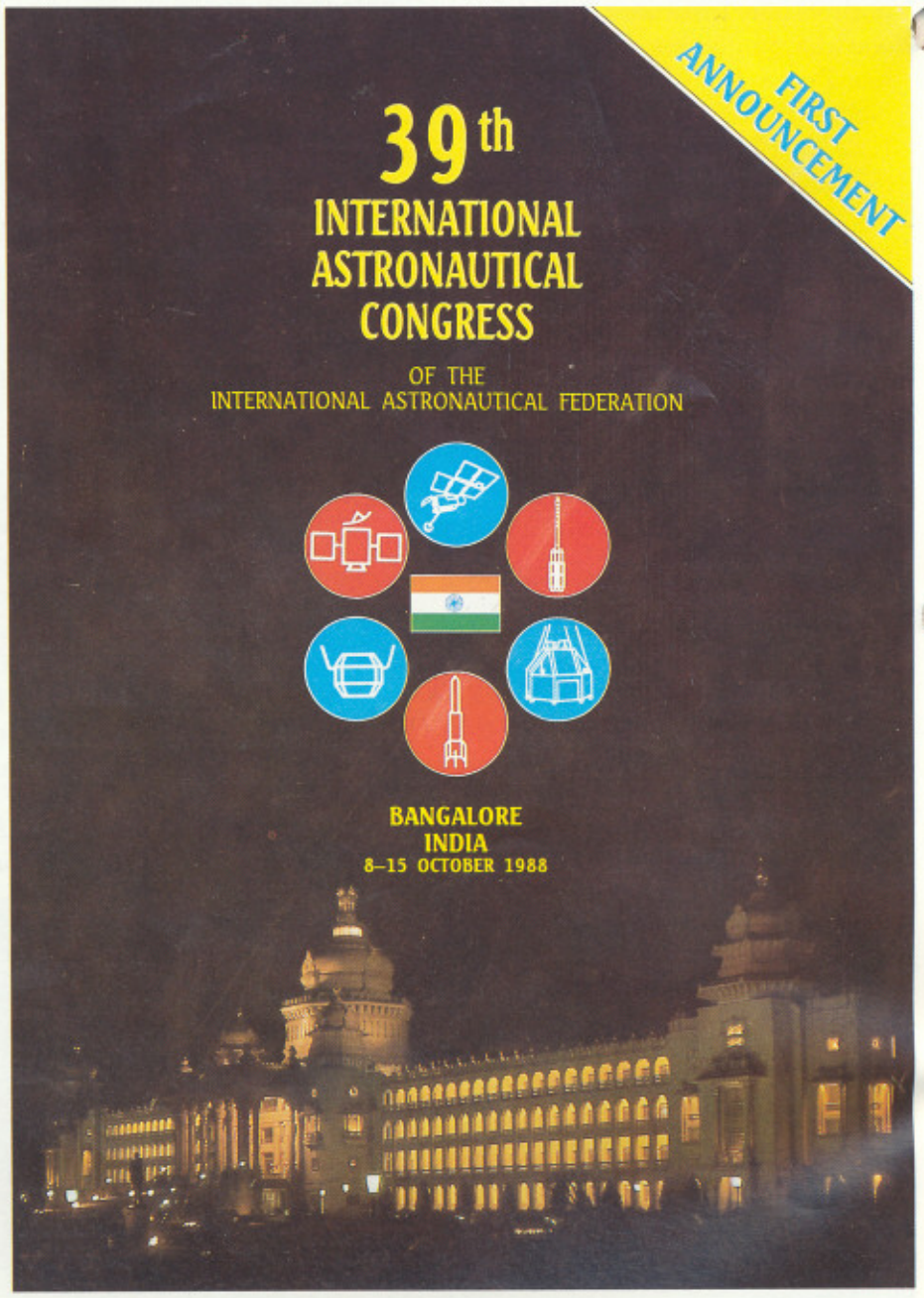
Brighton to Bangalore

The 38th International Astronautical Federation (IAF) Congress, the largest event of its kind on the annual space calendar, opened at Brighton, Sussex in the UK on October 10, 1987. During the week-long Congress some 600 technical papers were presented in addition to a series of current affairs meetings.

A novel feature of this year's Congress was a current event session on 'the use of space technology for the Benefit of Humankind with particular reference to the Developing Countries'. Initiated for the first time, this session was chaired by Prof. U.R.Rao, Chairman of the Indian Space Commission and also a Vice-President of IAF. The speakers of this session included representatives from Brazil, China, India and Kenya. The discussions underlined the need for close understanding between the scientific and engineering community of the developed world and practical problems of the developing world. The fact that space technology can solve some immediate and pressing problems clearly emerged. In a separate session on Disaster Management Prof. Rao, who has been elected Chairman of the IAF Committee for Liaison with International Organisations and Developing Nations (CLIODL), delivered a key note talk. In this talk he addressed short term and long term strategies, touching upon the potentials of combining space based remote sensing with conventional techniques to develop an integrated plan.

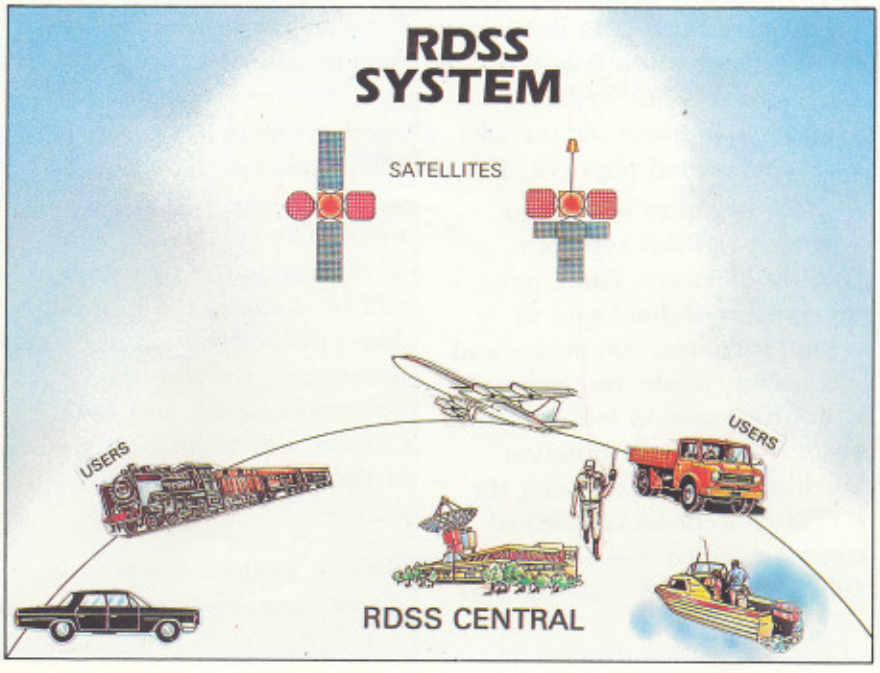
The Brighton Congress was also the venue where the first announcement of the 39th Congress of IAF was organised. The Astronautical Society of India (formerly Indian Rocket Society) will host the 39th meet in 1988 at Bangalore.

The IAF's special stress on developing countries has increased considerably over the years leading to a theme session at Bangalore on Space and Humanity. In addition, a special current event session addressing Space and Drought management will be organised during the 39th Congress□



Radio Determination Satellite Service

Imagine an agency operating a large fleet of vehicles — such as the Indian Railways or a national roadways corporation. If only it were possible to pin-point the exact location of all the vehicles by tracking their movement every moment Send messages instantly anywhere, any time of the day. The possibilities are staggering. The agency is in direct, continuous communication with field units or personnel. In case of an accident, precise coordinates of the location would be known and emergency assistance could be swift. Unprecedented control of fleet operations is possible. This is the kind of commnications service RDSS promises. Remote positioning and messaging. Instantaneous connection to one's vehicles, cargo and people. You know their position to within metres with accurate transfer of data within minutes using geostationary satellites.

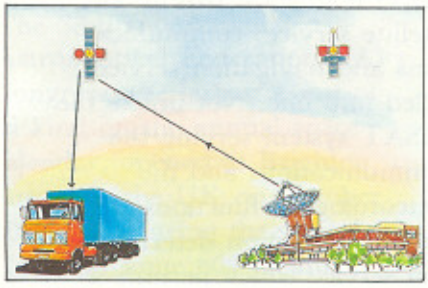


RDSS is infact a two-in-one satellite service: communications and navigation services rolled into one. Not unlike the INSAT system serving the communications and the meteorological functions. It is a kind of a position determination service which permits a user whether on land, sea or air—to identify the exact position, as also to send short messages to and from a central station.

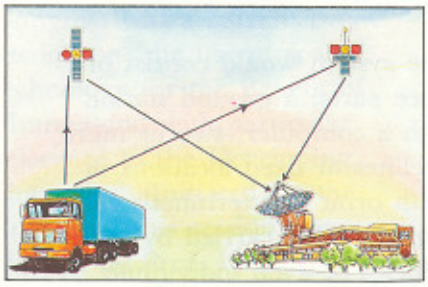
The system would consist of three parts: a ground station with a computer, two or more, satellites at fixed locations in earth orbit and terminals called transreceivers carried by mobile vehicles or even individuals. A minimal system would require two satellites: one to relay outbound messages from the ground station to the users and the inbound messages back to the ground station; and another relaying inbound messages from the users to the ground station. Inbound messages from atleast two different paths is required to fix the exact position, speed etc of the mobile units.

An important characteristic of the RDSS is that it can be highly flexible and cost-effective. Compared to the familiar, large earth station terminals the transceiver units of RDSS will be simple and low in cost. Pocket-book sized and powered by pen-torch cells, these receivers can even be used by a trekking enthusiast on her mountaineering expeditions. And at the central station one can have, at a glance, all the information one

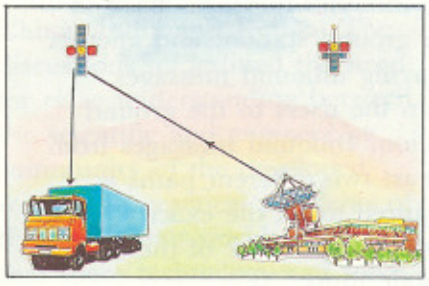
Positioning and Messaging



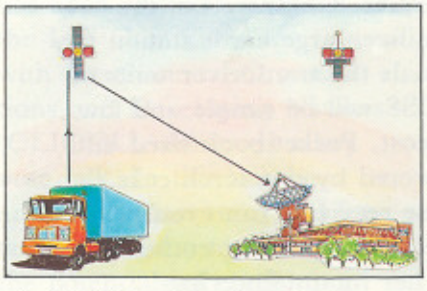
1. The Central Facility interrogates the mobiles.



2. The reply from the mobile units enables identification and location.



3. The position and the message transmitted back to the mobile unit.



4. Mobile unit acknowledges message.

needs to track the whole fleet or a subset of a fleet. Using simple computer software, one can easily see which vehicle is loading, unloading or in distress.

Because of such capabilities RDSS will be of immense benefit to users such as land mobile, maritime, aviation and law enforcement agencies. The combination of position location and messaging capabilities can provide for:

* continuous updates or location and states
* centralised and dynamic operations control
* quick responses to emergency and rescue operations
* continuous monitoring of hazardous or high value material movement
* improved safety and traffic management.

Where there are other systems already in use to satisfy one or

New Life From Death

It happened on a clear and sunny day in San Diego, USA in 1978. Despite good weather conditions and advanced communication facilities, a small private plane collided with a commercial jet aircraft in mid air. Scores of passengers of the crowded jet liner were hurtled to death; among them was a friend of Dr. Gerard K. O'Neill. Himself a frequent air traveller and a renowned physicist, Dr. O'Neill began to work on a way to avoid this type of a tragedy in future. Combining the existing technologies of orbital satellites, computers and integrated circuits he came up with an answer in less than five years: Radio Determination Satellite Service. Patenting the RDSS concept he established a company called 'Geostar' in 1983. On a small scale Geostar has already demonstrated the usefulness of the concept. Were it not for the world wide dearth of launch capability it would have been operational by now. The Geostar concept is simple. Two (or more) satellites are posted in a geostationary orbit around the earth. They provide the datalink between a base station and its users. While the base station will have high speed computers to process and relay messages fast, the users will carry small transceiver units. The complex calculation to determine the user's position will be done on the ground. The satellites will act as mere messengers relaying the information back and forth. Geostar also facilitates exchange of short messages between vehicles.

Besides, Geostar Corporation atleast three other companies in

more of such needs, RDSS can operate in a supplementary or advisory mode. Inspite of constraints like no-voice communication and short messages (about 100 characters only) the RDSS is eminently suitable to low-density users□

the USA have offered RDSS services to users. The French 'Locstar' offers such a service in Western Europe. Infact with six satellites placed at 60-degree orbital spacing, RDSS can offer positioning, radio location, emergency location and two-way communications services for the entire globe excepting a small portion in the polar region□

RDSS User Symposium

Recognising the vast potential of the RDSS system, the Indian Space Research Organisation has completed a comprehensive feasibility study on introducing such a service in the country. This is in consonance with the main objective of ISRO, viz: utilisation of space technology for national development. Following such a study an RDSS user symposium was held at Bangalore during August 24-25, 1987. More than 75 delegates from the possible user sectors participated in this symposium. This included the Indian Railways, shipping, civil-aviation, road transport agencies and a number of industries.

Presentations were also made by the American 'Geostar' and the European 'Locstar' representatives towards evolving a global RDSS system. At the end of the deliberations the symposium adopted an eight point recommendation on the steps to be taken for evolving a cost-effective RDSS for the nation.

The inaugural address of the symposium was delivered by Prof. U.R. Rao, Chairman ISRO and Secretary, Department of Space Excerpts overleaf:

R & QA

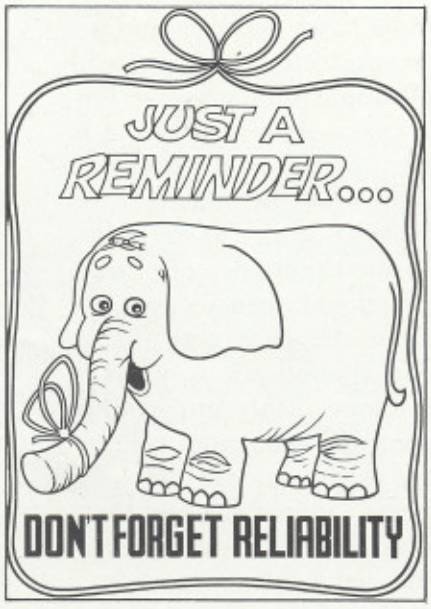
Learning from Experience

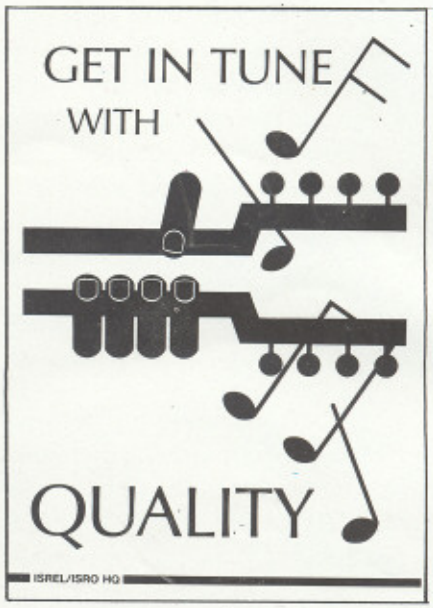
There is no substitute to experience in the business of Reliability & Quality Assurance. In an effort to pool together, the experience of R&QA personnel of ISRO, a Workshop was held during September 1-2, 1987 at SHAR Centre. After the opening remarks by Mr. M.R. Kurup, Director, SHAR, an inaugural address was delivered by Mr. R. Aravamudan, Director, ISRO Reliability (ISREL).

The Workshop was organised in four technical sessions followed by a Panel Discussion. The accumulated experience of ISRO in the field was culled and presented in the form of 15 technical papers. The panel discussions highlighted the following:

* effectiveness of Product Assurance Boards of ISRO Project
* the role of human factor in failures of space launchers
* reliability of mission critical ground support facilities
* new concepts and tools in reliability estimation techniques
* software quality assurance.

Director, ISREL in his concluding remarks pointed out the delicate balance that the R&QA person needs to maintain in the mission and schedule oriented environment of the organisation. He also stressed the need for devising ways and means to meet the growing responsibilities of the R&QA community in the context of operationalisation of ISRO missions□



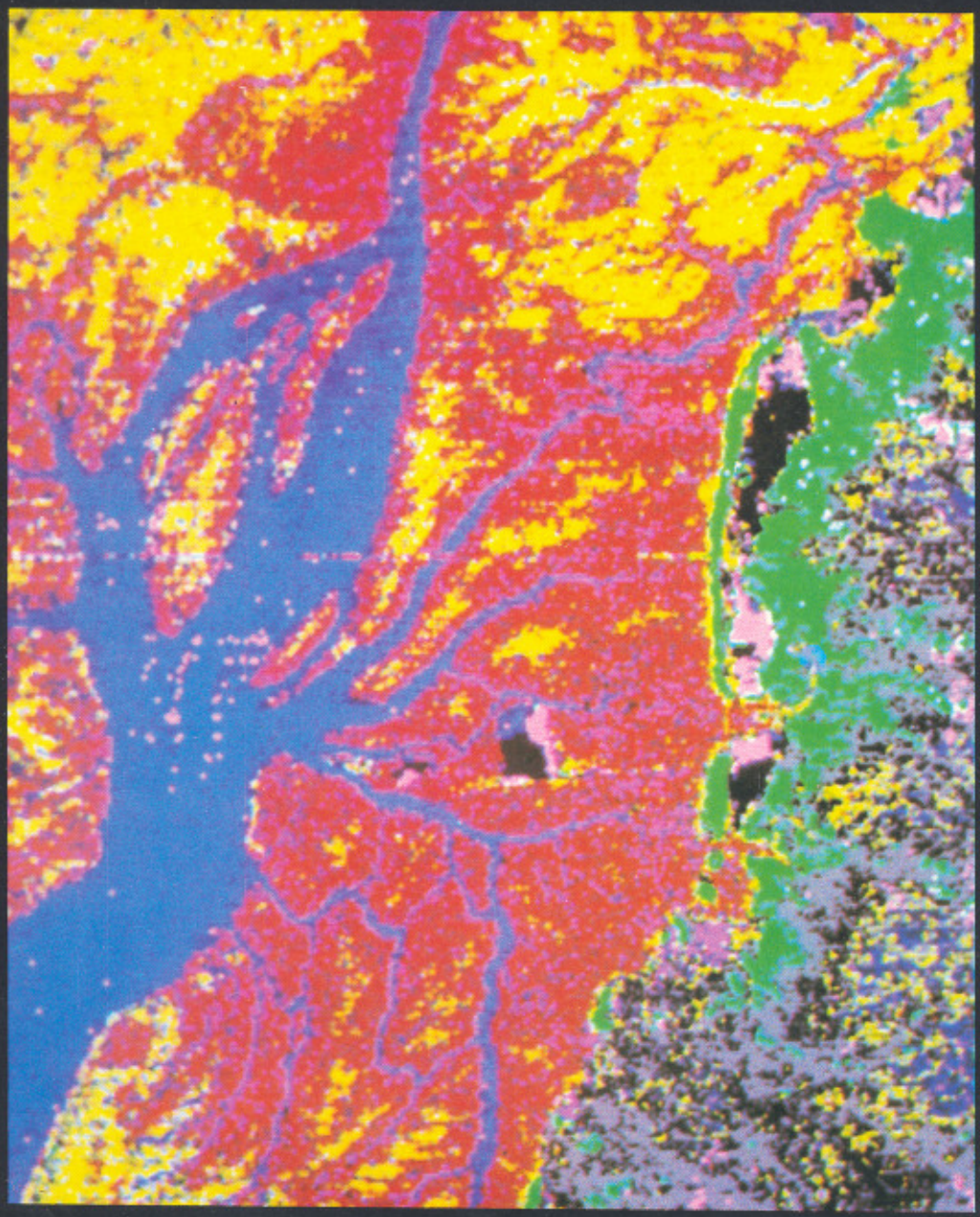


Introducing

ISROVISION

(WITH SACIMAGE AND VIBGYOR-2001)

A Powerful Low Cost
Digital Image Processing & Analysis System from India



Indian Space Research Organisation

ISRO's Space Application Centre at Ahmedabad has developed a digital image analysis system with comprehensive capabilities for image data handling, preprocessing, enhancement and formatting functions. Comprising a menu driven software library called 'Sacimage' and a high resolution image display processor 'Vibgyor-2001', ISRO VISION is a PC-AT based system. This stand alone, low-cost system has been licenced to capable Indian Industries. It can be used for processing data from remote sensing satellites such as Landsat, SPOT and the IRS as well as a variety of airborne sensors. For details of the system, write to Direcor, TT&IC, ISRO Hq., Cauvery Bhavan, K.G.Road, Bangalore 560 009 or Group Director, IPDPG, RSA, Space Applications Centre, Ahmedabad 380 053.

Digitally classified image of Mewat region. This type of classification of the Landsat MSS data has been used for the study of geomorphological features.