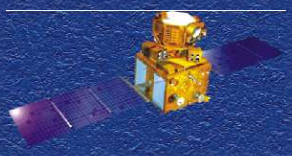
CONTACT



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Indian Institute of Remote Sensing
(National Remote Sensing Agency)

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...on mission for transferring technology through training and education

From the editors desk

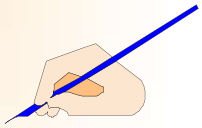
Dear Alumni

We are here again with a new issue of 'CONTACT' to keep you in touch with activities of IIRS and developments in the areas and applications of Remote Sensing and GIS.

You will find the course calendar of the training programmes to be conducted in IIRS for the year 2006 . Please bring it to notice of all who are interested to pursue their activities in relation to remote Sensing and GIS . These training programme will be beneficial in their career in this relevant field .

Also we would like you to Contribute news, small articles, and information of interest to remote sensing community. Do take out time to pen down and mail us. Any change in address may please be communicated to us so that you continue to receive our newsletter.

Editor



Inside this issue

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Special Compulsory Refresher Course for IFS Officers on Application of Remote Sensing and GIS in Forestry, 20-24 June, 2005.

The second compulsory refresher course was aimed at giving exposure to senior forest officers in day-to-day decision making and practical applications of geospatial technology in forest management. Sixteen senior IPS officers from state forest departments participated in the training course sponsored by Ministry of Environment and Forests, Government of India. The course was specially-designed to meet the need of the senior forest managers to help them in their day-to-day activities in forest management. Lectures on fundamentals of remote sensing and GIS, visual and digital image interpretations, forest stock mapping, forest fire risk assessment, growing stock estimation, wildlife habitat evaluation and biodiversity characterization at landscape level were arranged. Practical demonstrations, case study presentations and field excursion were also organised to appraise them of importance of geospatial technique in forestry. The participants were of the view that the state forest departments should adopt remote sensing and GIS techniques more to enhance decision making process at apex level.

RISAT-JEP-MICROWAVE TRAINING PROGRAMME IIRS (27.06.05 TO 08.07.05)

Microwave remote sensing in earth observation related to various applications has been established as an important tool to complement and supplement information presently being acquired from a host of optical remote sensing satellites. In order to strengthen the application potential of remote sensing technology in India, Department of Space has planned for radar sensor in future Earth Observation satellite, RISAT. In order to explore the application potentials, develop relevant methodology and processing techniques, it is required to train a large number of professionals to derive maximum benefits in terms of radar data processing and applications of microwave remote sensing data when available from Indian satellite. Therefore, under the JEP-Microwave programme, a specilaised training programmes was organized for scientists of DOS and collaborating agencies for the utilization of SAR data during 27th June to 8th July, 2005 at IIRS. The course was of two weeks duration, the first week was a Common Module devoted to '**Introduction to Radar Remote Sensing and Applications',** the second week was an Elective Module with specialization in (1) **Geology and Terrain Analysis; (2) Agriculture, Forestry, Soil and land use; and (3) Hydrology and Oceanography.**

In total, 18 participants from various user departments and DOS Centres (with experience in Optical Remote Sensing), and other interested faculty members of IIRS attended the course. The theory lectures were delivered by IIRS faculty and guest faculty from NRSA, SAC, IIT Bombay and other organisations. The theory classes were adequately supported by practical

exercises using various types of radar data (Radarsat, Envisat, ERS etc.). Numerous case examples were demonstrated highlighting the application potential of radar data using software such as ERDAS imagine, SARDA, Geomatica, SARSCAPE and DORIS. At the end, all course participants were provided with a CD containing all course material, practical demonstrations and presentation material. Very positive feed back was expressed during the valedictory function and it was declared that more such courses would be organized in future.

Special training course on Remote Sensing and Image Analysis for ARC officers

IIRS Conducted a Special training course on Remote Sensing and Image Analysis for the officers of Aviation Research Centre, New Delhi. The course of six weeks duration commenced on 4th July 2005. A total of 12 officers of the joined the course .Based on the request from user department the course curriculum included basic concepts of remote sensing, photogrammetry, image interpretation, fundamentals of GPS, digital and satellite photogrammetry, thermal & microwave remote sensing, cartography and map projections, digital image processing hyper spectral remote sensing, and LIDAR. These topics are covered in theory lecture classes and all the lectures are followed up by practical demonstrations & field visits. New exercises which were introduced in this course are browsing satellite data from NRSA web site , Interpretation of features from ETM data and generation of temperature map from Thermal band of ETM, Interpretation and mapping from oblique aerial photo on demand from user agency. A guest lecture on " Stereo satellite data processing with special emphasis on CARTOSAT" delivered by Dr. P.K. Srivastava, Group Director, SIPG, SAC, Ahmedabad was also organized for the benefits of the course participants. The participants also attended the guest lecture on Locust information system by Dr. J.R. Sharma Head RRSSC-Jodhpur. A small project work was carried out in the last two weeks in two groups. As an effort of combining training and recreation, the participants were also taken to Mussoorie, Haridwar and Rishikesh areas for short field visits.

Minakshi Kumar

Special Training Programme for Young Researchers

A special two-weeks training programme on "Research Techniques for Advanced Remote Sensing and GIS Applications" was organised for Young Researchers (JRFs) of National Remote Sensing Agency (NRSA) during August 16-26, 2005 at the Indian Institute of Remote Sensing (IIRS). The programme was first of its kind and specially designed for the budding researchers with an aim to provide insights into the latest techniques and developments in the fields of Remote Sensing (RS) and GIS. A total of 18 JRFs (14 from NRSA, Hyderabad and 4 from IIRS, Dehra Dun) of multi-disciplinary background attended this programme.

The topics covered various analytical, statistical, modelling and instrumentation techniques used in natural resources survey and management. The programme was designed in such a way that each day had a focus on a specific theme, such as (i) Basics and Future of RS & GIS Technologies, (ii) Sensors, Radiometry and Atmospheric Corrections, (iii) Statistical Techniques, (iv) Advanced Image Processing, (v) Ground Data Collection and Instrumentation, (vi)

Digital Photogrammetry, SAR Interferometry and LIDAR for Terrain Mapping, (vii) Maps & GIS, (viii) Modelling using RS data, and (ix) Thematic applications.

In order to cover the above multi-disciplinary and specialised topics, both the in-house and invited faculties have contributed. The invited faculties were from different Centres of the Dept. of Space (Advanced Data Processing and Research Institute, Secunderabad; ISRO Headquarters, Bangalore; National Remote Sensing Agency, Hyderabad; Regional Remote Sensing Service Centre, Dehra Dun; Space Applications Centre, Ahmedabad), Anna University, Chennai, Indian Agricultural Research Institute, New Delhi, Indian Agricultural Statistics Research Institute, New Delhi, Indian Institite of Technology, Kanpur, National Institute of Hydrology, Roorkee and Survey of India, Dehra Dun. An excellent reference material was brought out through the sincere effort of both the in-house and invited faculties, which were provided to the participants in hard- and soft-forms. It is hoped that the course will throw up newer research ideas, in terms of techniques and applications, into the minds of the budding researchers.

S.K. Srivastav

Asian Program for Regional Capacity Enhancement for Landslide Impact Mitigation (RECLAIM)

Asian Disaster Preparedness Centre (ADPC), Bangkok in collaboration with Norwegian Geotechnical Institute (NGI), Oslo has launched a collaborative programme titled "**Asian Program for Regional Capacity Enhancement for Landslide Impact Mitigation (RECLAIM)**" to address the need for building capacity in the selected countries in Asia namely, Bhutan, India, Indonesia, Nepal, Sri Lanka, and Thailand. The goal of the RECLAIM project is to reduce the landslide disaster vulnerability of human settlements, infrastructure, and critical facilities in the targeted countries of Bhutan, India, Indonesia, Nepal, Sri Lanka, and Thailand. From India, IIRS is the nodal participating agency along with CBRI.

More specifically, the project's objectives are: 1) to provide target countries with a cadre of specialists and decision makers with up-to-date knowledge of landslide disaster mitigation practices and to integrate this knowledge in routine development work initiated by national and local governments; 2) to increase collaboration between Norwegian and Asian institutions in jointly developing cost effective methodologies for landslide risk mitigation and training at national level for enhancement of capacity of national partners, which will result in more joint programs and opportunities for sharing of experience and learning applications in the subject area

As a part of the project, Asian Disaster Preparedness Centre (ADPC), Bangkok in collaboration with Norwegian Geotechnical Institute (NGI), Oslo organised International Seminar on Landslides Risk Management, Colombo, 6 June 2005 and Regional Training for Landslide Risk Mitigation, Bandarawela, 8-12 June 2005.

IIRS actively participated in the International Seminar, attended by over 100 participants from Sri Lanka, Norway, Indonesia, Thailand, Bhutan, Nepal and India and made a presentation on "Landslide Hazard and Risk Assessment in India- IIRS experience" highlighting the methodology and parameters that can be extracted from satellite data products and different modeling techniques for hazard and risk assessment using Indian case examples from Garhwal Himalaya. The efforts made by NRSA for preparation of Atlas on Landslide Hazard Zonation was also emphasised. Important papers presented by other participants include: Role of Geotechnical Engineering, Global Perspective of Landslides, Early warning and community based approach for preparedness followed by a group discussion on challenges and recommendations to overcome landslide risk.

In the regional training programme, attended by 30 participants from Sri Lanka, Norway, Indonesia, Thailand, Bhutan, Nepal

and India, presentation was made on "Assessment of Precipitation Control on Triggering of Debris Slide/ Flow in Garhwal Himalaya, India" by P.K. Champati ray, Vinaya Taneja, and R.C. Lakhera. The paper emphasized on establishing precipitation threshold for debris slide initiation based on ground as well as satellite based precipitation estimation. During discussion a paper was also distributed on "Spatial models for landslide hazard assessment using Geographic Information System and remote sensing techniques" by P.K.Champati ray and R.C. Lakhera.

Important papers presented by other participants include: Land use planning for landslide risk reduction, Landslide studies in Bhutan, Landslide risk management in the context of preparedness and response, Mainstreaming risk management practices, Use of GPS, Debris flow modeling, Landslide hazard zonation in Sri Lanka, Thailand and India. Additionally during discussion best practices and problems associated with landslides (e.g., Nepal) were also brought to notice of participants for comments and suggestions on remedial measures.

The most important aspect of the training was filed visit to important landslide sites in the central Upland areas of Sri Lanka. While traveling from Colombo to Bandarawela, Watawala landslide site was visited where a massive landslide had severely damaged the railway track causing a train accident resulting in 70 deaths. Preventive measures were assessed and lessons were learnt on setting up of piezometers, horizontal and inclined drainage network and automated bore wells for extraction of water above a limit in order to lower the water table and keep it below the slide surface. Other preventive measures such as constant monitoring of water table, drainage diversion, landscaping for removal of over burden were also analysed. Other important landslides at Naketiya (199 Km on Collombo-Ratnapura-Wellawaya-Batticaloa road), Beragala (2 km on Beragala-Haliela road) and Kahagalle landslide near Bandarawela were visited and remedial measures were analysed and further improvements were discussed during group discussion.

During the training a visit was also organized to Institute of Surveying and Mapping, Diyatalawa, Sri Lanka where after paying a short visit to museum on survey instruments, an exercise was carried out on use of differential GPS.

In order to generate awareness on preventive measures, it was decided to organize awareness workshop in India, Nepal and Indonesia for which brief outline was presented by ADPC and it was also agreed to partially finance such programmes from RECLAIM fund.

Further course of action and organization of next training workshop was decided to be held in Bhutan with emphasis on early warning and other topics such as seismicity induced landslides was included for discussion in the next meet.

At the end realizing the interest of the participants on using latest satellite data products, a brief presentation was made on the possible use of Cartosat-1 data products (Stereo PAN and DEM) for landslide mapping and parameter extraction for hazard and risk mitigation.

On return journey from Bandarawela to Colombo via Kandy, we came across important earth and rock fill dam sites and at Kandy we visited a Buddhist shrine and passed through University of Peradeniya before reaching Colombo for departure on 13.6.05.

Thus the tour provided ample opportunity to interact with participants from various countries to learn about landslides in different geological set up and overall it was a good learning experience on landslide hazard mitigation and role of preventive measures using structural and non-structural measures.

(P.K. Champati Ray)

Contact

Decision Tree Approach for improving the Classification of RS data

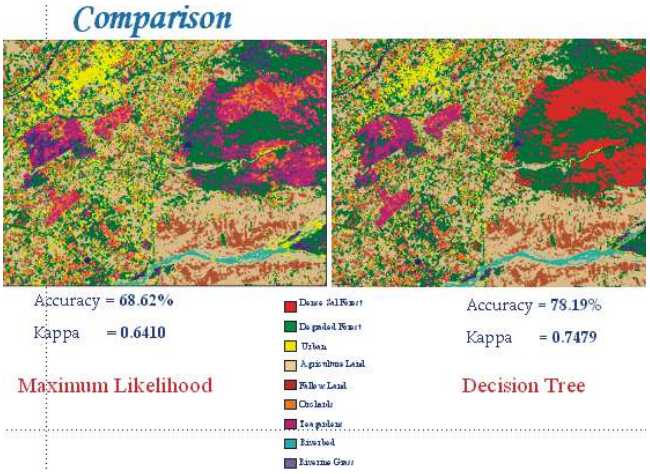

Image classification is one of important tasks in remote sensing image interpretation; in which the image pixels are classified to various predefined land use/land cover classes based on the spectral reflectance values at different bands. In reality there is lot of spectral confusion among the classes and results in inaccurate classified images. It is very difficult to classify such classes correctly using traditional parametric classifier like Maximum Likelihood Classifier. The other drawback of these traditional parametric classifiers is that they require training data to be normally distributed. Due to this fact it becomes difficult to add ancillary layers into classification procedures to improve accuracy of the classification. To remove such spectral confusion we require extra spectral and spatial knowledge. The main objective of this research is, from where and how we can get knowledge automatically? This research explores a non-parametric decision tree classifier to extract knowledge from the spatial data in the form of classification rules. The results of this research show that the knowledge extracted from decision tree can remove the problem of spectral confusion to some extent. The result of the classified image using the extracted knowledge was compared with the result of the maximum likelihood classification. It was found that the overall accuracy of the classification was improved by approximately 10 percent after using the extracted knowledge in the classification of satellite images.

Amit Bharti and Sameer Saran

Terrain and Aquifer Characterisation for Ground Water Potential Evaluation in Bata Watershed (H.P.) using Remote Sensing and GIS Techniques

The study has been undertaken in the Bata watershed falling in Sirmaur District of Himachal Pradesh (H.P.) state with a primary aim to evaluate the groundwater potential. In order to achieve this goal, RS and GIS tools in conjunction with conventional methods have been used to: (i) characterise the terrain based on different groundwater controlling/indicative parameters like lithology, structure, geomorphology, slope, drainage texture and land cover, (ii) characterize the nature, extension and performance (including water quality) of the aquifers, (iii) prepare the groundwater prospects map by integrating different controlling/indicative terrain and aquifer parameters in GIS, and (iv) to estimate/quantify the groundwater resource based on GEC (1997) guidelines for futuristic planning.

The synopticity, multispectral nature and high spatial resolution of PAN-sharpened LISS-III image of IRS-1D and Resourcesat-1 helped a great deal in terrain characterisation, i.e. in mapping the geomorphology, lithology, structures and land cover of the area. Geologically, the area comprises of the rocks of Subathu (Eocene), Lower and Upper Siwaliks (Middle Miocene to Early Pleistocene) formations, and younger sediments (Late Pleistocene to Holocene), Doon gravels and alluvium. The main boundary thrust (MBT), Markanda thrust and Yamuna tear fault are the important geological structures/ discontinuities. A number of other lineaments have also been mapped. Active flood plains, channel/braid bars, river terraces (T_1, T_2 and T_3), lower and upper piedmont, and residual, structural and denudational hills are the geomorphic units/landforms mapped in this area. The piedmont zone, especially lower piedmont, forms the main aquifer in the area.

The ground surveys and the existing data provided the information about the depth to water table, nature, thickness, yield of aquifers and quality of the groundwater. Based on the study of sub-surface lithologs, it is found that groundwater occurs multi-tier aquifer system under unconfined and semi-confined to confined conditions. Well data have been analysed to prepare water table maps of unconfined and semi-confined to confined aquifers. The depth to water table in phreatic/unconfined aquifers ranges from 3m to 42m from ground level during pre-monsoon period, and 1m to 35m from ground level during post-monsoon period. The water table fluctuation varies from 0.5m to 12m. The groundwater movement is primarily from west to east/southeast, i.e. towards Yamuna river. The discharge of tube wells tapping multiple aquifers varies from less than 500 lpm to more than 2500 lpm with drawdown ranging from 2 m to 60 m. The pH, TDS (total dissolved solids) and chloride (Cl) contents in the groundwater indicate that overall the groundwater quality is potable, barring some isolated places, where pH and Cl are beyond permissible limits.

The terrain and aquifer parameters have been integrated using the weighted index overlay method in GIS domain to delineate the groundwater prospective zones. The groundwater prospects are mapped in five categories: excellent, good, moderate, low and runoff zone. Excellent and good groundwater prospects zones fall in the flood plain, younger, and older terraces, and lower piedmont; moderate to low prospects zones occur in the upper piedmont. The denudational, structural and residual hills mainly act as runoff zones, wherein the groundwater occurs in localised pockets, i.e. along narrow valleys, faults and fractures. The groundwater resource estimation carried out in the study area based on GEC-97 guidelines indicates that the net annual groundwater recharge and availability are about 14,200 ha.m and 13,700 ha.m, respectively.

Sanjiv Kishor (M.Tech. Student),
S.K. Srivastav and D.K. Jugran

IIRS Celebrates World Environment Day 5th June

Word Environment Day is celebrated to generate awareness and to recognize our responsibilities towards our environment among the citizens of all ages. United Nations Environment Programme has declared this year's theme as Green Cities and the slogan is: Plan for the Planet! Greening of 'Concrete Jungle' is extremely important to improve the quality of urban life. Several activities were organized with participation of staff and their children, trainees, researcher and all officers with zest for conservation of this panoramic nature and enlightening them with knowledge about various aspects. This year there was overwhelming response from children who actively participated in 'Sit and Draw' competition and tree plantation. The budding citizens of India made beautiful pictures on themes like 'Tiger and Man' and 'Tsunami'. Debate competition was organized for staff and trainees on 'Technology Drives Application', which saw active participation of faculty, researchers and trainees, particularly NNRMS course participants. To mark the campaign of 'Green Cities' for the year 2005, 50 saplings of edible fruit bearing trees were planted behind the auditorium. Enthusiastic participation from children, trainees, staff from

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IIRS/RRSSC-D/ CSSTEAP was a very pleasing moment to each one of us. Also, an open quiz competition to test our knowledge about our surroundings and general awareness about various activities for environment protection and conservation going on in India was most brain twisting. Prizes were distributed to all the winners of various events.

Dr. Sarnam Singh

The development of a methodology for seismic hazard assessment and microzonation for Dehradun city, India

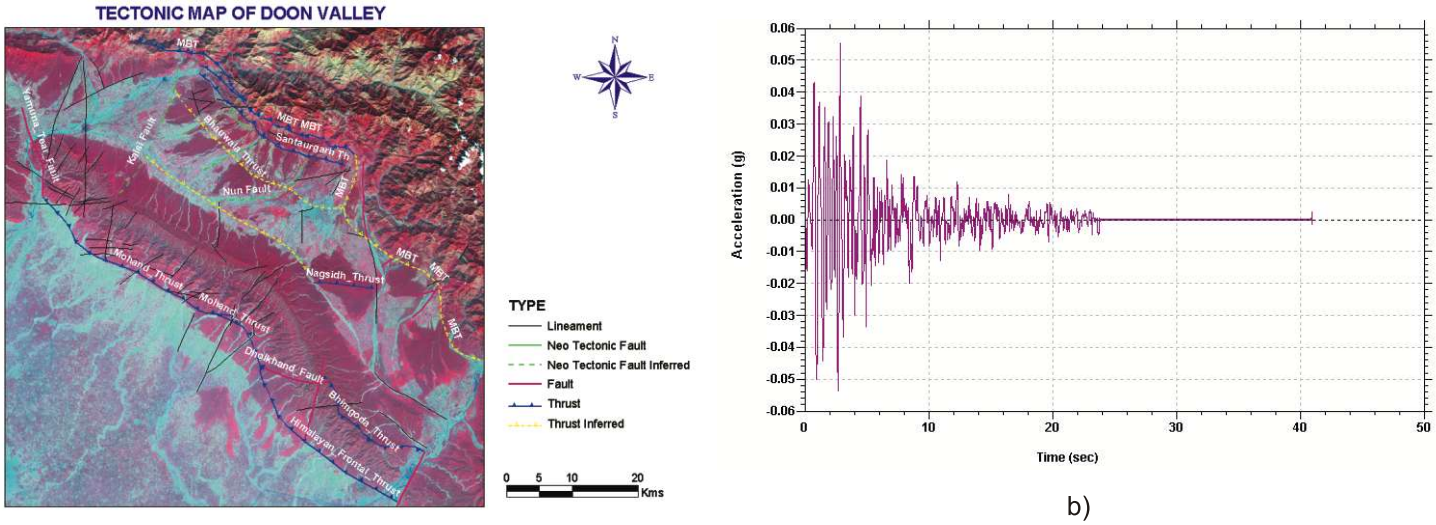

Figure 1. (a) Tectonic map of Doon valley (b) Chamoli earthquake data recorded at Tehri (c) Spectral acceleration map of Doon valley

Dehradun city, situated in Doon valley, bounded by two important faults i.e. Main Boundary Fault and Himalayan Frontal Thrust is one of the most seismically active zones of India. In the recent past it was affected by all major earthquakes of the region i.e. 1905 Kangra, 1991 Uttarkashi, 1999 Chamoli. Recently the city has gained further prominence due to being declared as the interim capital of the newly formed state of Uttaranchal and as result a large population is at a greater risk to seismic hazard. Realising this, IIRS in collaboration with Wadia Institute of Himalayan Geology and ITC, the Netherlands had initiated a study on development of a methodology for seismic hazard assessment and microzonation for Dehradun city.

Geology and geomorphology of the area was characterised in terms of rock types and geomorphological units. Seismo-tectonic lineaments have been identified and tectonic activity along major structural features have been studied using temporal data sets (30 years interval). It is a well known fact that in an earthquake, the damage at a site is greatly influenced by the response of the local geology and soil column. In seismic response analysis, the site response is calculated in the form of response spectra for a particular site. Various parameters that are needed for seismic response analysis are soil profile and its thickness, depth to bedrock, geotechnical properties of the soil and shear wave velocity. In the present study, shear wave velocity and soil thickness was obtained by using one of the most recent techniques: Multi channel Analysis of Surface Waves

(MASW) method. By using this technique, 31 sites have been covered in the study area to know the shear wave velocity variation and the material depth in the city for upper 30 m, which is considered as ideal for seismic response analysis world over. The calculated shear wave velocity of different sites is compared with tube well lithologs and local geology to know the different material types. SHAKE 2000 has been used for site response modelling using Chamoli and Uttarkashi earthquake data recorded at Tehri as input motion. On the basis of present analysis whole city has been classified in to different zones of shear wave velocity and spectral acceleration. The study shows shear wave velocity varying from 174m/s to 287 m/s in upper 30 m of the sub-surface profile. The maximum spectral acceleration was observed at 2-3 Hz frequency indicating damage to mostly 3-5 storied buildings. At 3 Hz frequency, high spectral acceleration in the south western part of the city indicates the role of thick layers soft sediments, which will also cause higher amplification of shear wave velocity.

P.K. Champati Ray and R.C. Lakhera

Professional Hazards

It was a quiet evening of 12th March, 2005. We had just finished our biodiversity field work and after taking bath were resting on the 20 feet tall watch tower at Burir Dabri khal, on the right bank of Raimangal river on Bangladesh border in Sunderban Tiger Reserve. The night in this part of country sets in a bit early. The moon had already appeared on the horizon from behind the clouds. The two boatmen were busy preparing dinner for three of us - me, Mr. Subrata Nandy and Mr. Manas Ranjan Debta, the team incharge of biodiversity characterization at landscape in West Bengal using remote sensing and GIS. The medium-sized boat (jetty) being used by us for field work belonged to Sunderban Biosphere Reserve. The Director of the Reserve had agreed to spare the same for entire duration of our 10-day field work. This was for the first time that we had entered Sunderban Tiger Reserve, famous for high density Royal Bengal Tigers. Down the memory lane, the Sunderban reminds us of poverty, fishing and depredation of boatmen and women venturing into the Reserve in search of livelihood. Sunderban depicts vividly the human struggle for survival and conservationists' goal for protection its flagship species, the Royal Bengal Tiger.

It was eighth day of our field work. The boatmen and local forest officers since beginning never agreed to our proposal to enter the mangrooves of the interiors of the Tiger Reserve for fear of depredation and hence, our field work was limited to areas, which are normally considered safe and are along creeks. That evening we were very much exhausted and felt tired. However, a nap was ruled out due to millions of mosquitoes hovering around us. We were also terribly hungry. To pass the time, we started cutting jokes, narrating experiences of individual lives, student days and got so much absorbed in talking that for a moment, we even forgot our otherwise hostile surroundings. By 1930 hours, we were through with our talks and I looked towards my left across the watch tower fence and surrounding open mangrove area. And behold, I spotted a Royal Bengal Tiger barely 5 metre away on the other side of wire fence. The Fence which was high and strong enough to keep the tiger away. Yet what chilled our spine was the fact that the entrance gate of the watch tower enclosure was open and it will not be difficult for the tiger to enter through gate to take on us. Although, we panicked but kept quiet for a while. Then we thought of deterring the beast away by focusing our two torch lights on him. This had desired impact. The tiger moved 20 metre away and sat staring at us for quite some time, perhaps still hopeful of reaching to its prey.

On our right, there was a fresh waterhole created by forest department for meeting drinking water needs of local area wild animals. There again, Subrata spotted another tiger almost spontaneously. This one too was a full grown animal, drinking water on the other side of the hold. It disappeared into mangroves after the fill. While we were discussing on our plans to reach back to boat, we noticed one of the boatman approaching us with a powerful torch light. We felt sigh of relief. He invited us for dinner. Since there was noise, and the animal left for dense jungle. We returned back to jetty. Once on the boat, we

instantaneously narrated our story to boatmen. Boatmen promptly advised us to leave the Tiger Reserve for safer destination. They, in turn, narrated several real life stories of man eaters sneaking into boats and huts in and along creeks, lifting people during night. We could notice a general sense of fear in their eyes and expression. We sailed for more than four hours to Sajnekhali to anchor our boat near Forest Range Office, and had our dinner at mid night.

S.P.S. Kushwaha, HFED, IIRS

CARTOSAT-1 and HAMSAT in placed orbit by PSLV-C6

ISRO (Indian Space Research organisation) has successfully placed two satellites named CARTOSAT-1 and HAMSAT in the earth's orbit. 18 minutes after the PSLV-C6 lifted off in the space from the Sriharikota launch pad in South India India's remote sensing satellite CARTOSAT-1 was successfully placed in the orbit on 5th May 2005. A few moments later, it completed its mission by placing the HAMSAT in orbit.

CARTOSAT-1 satellite has a life of around 5 years and would be mainly used for cartographic applications. While, HAMSAT with a life of two years is a micro satellite designed for providing satellite-based Amateur Radio Services to the national as well as the international community of Amateur Radio Operators (HAMs). It is expected to meet 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.

CARTOSAT-1 or IRS P5 (Indian Remote Sensing Satellite) is a state-of-the-art remote sensing satellite built by ISRO which is mainly intended for cartographic applications. It is the eleventh satellite to be built in the Indian Remote Sensing (IRS) satellite series.

CARTOSAT-1 carries two state-of-the-art Panchromatic (PAN) cameras that take black and white stereoscopic pictures of the earth in the visible region of the electromagnetic spectrum. The swath covered by these high resolution PAN cameras is 30 km and their spatial resolution is 2.5 metres. The cameras are mounted on the satellite in such a way that near simultaneous imaging of the same area from two different angles is possible. This facilitates the generation of accurate three-dimensional maps. The cameras are steerable across the direction of the satellite's movement to facilitate the imaging of an area more frequently. The images taken by CARTOSAT-1 cameras are compressed, encrypted, formatted and transmitted to the ground stations. The cameras operate in the 500 - 750 nm wavelength and are tilted +26 deg and -5 along the track. The images are reconstructed from the data received at the ground stations

CARTOSAT SPECIFICATIONS	
Orbit	618 km high, circular Polar Sun synchronous
Orbit Inclination	98.87 deg
Orbital 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
Payload	PAN Fore +26 DegPAN Aft -5 Deg
Instantaneous Geometric Field of View (IGFOV)	< 2.5 m
Swath	30 Km
Spectral Band	0.50-0.85 Micron

(Source : ISRO)

Compiled by Minakshi Kumar

Contact

Calendar of Training Courses at Indian Institute of Remote Sensing, Dehra Dun for the year 2006

Sl. No	Course Code	Course Name	Entrance Requirements	No. of Seats	Starting Date	Passing Out date dd.mm.yy	Govt. dd.mm.yy	Course Fee Sponsored	Foreign Trainees Open Candidates US $
REMOTE SENSING & GIS MAPPING AND MONITORING OF NATURAL RESOURCES									
1.	C-PR	Basic Photogrammetry & Remote Sensing	Science/Engineering Graduate school level with mathematics up to higher secondary & 2 years experience (in service)	5	6.3.2006	30.6.2006	Nil	24,000	2400
2.	D-AS	Agriculture & Soils	M.Sc in Agriculture/ Soil Sciences/ Geography /B.Sc Agriculture (4 years)	6	6.3.2006	29.12.2006	Nil	60,000	6,000.
3.	D-FE	Forestry & Ecology	M. Sc in Forestry/ Environmental Science/Ecology/ Botany/Wildlife/Geography / B.Sc. Forestry (4 years)	6	6.3.2006	29.12.2006	Nil	60,000	6,000
4.	D-GG	Geosciences	M.Sc./M. Tech. in Geology/ Geography	6	6.3.2006	29.12.2006	Nil	60,000	6,000
5.	D-MS	Marine Sciences	Post Graduate in Marine Sciences/Earth Sciences / any Natural Science	6	6.3.2006	29.12.2006	Nil	60,000	6,000
6.	D-UR	Human Settlement Analysis	Post Graduate in Town & Country Planning / M.Sc. in Geography Civil Engg. or Architecture Graduates / B Planning	6	6.3.2006	29.12.2006	Nil	60,000	6,000
7.	D-WR	Water Resources	B.E. / M.E. in Hydrology / Civil Engineering /Agricultural Engineering/ M.Sc. in Geology. Graduate Engrs with 2 yrs experience (in service).	6	6.3.2006	29.12.2006	Nil	60,000	6,000
8.	D-DP	Digital Photogrammetry	M.Sc./M.Tech. Physics, Maths, App. Maths, Statistics, Geophysics, Meteorology, Oceanography, Gelogy, Geography or any Natural/Environmental Sc. or BE/B.Tech. Working Govt servants with Graduation in Science with 2 yrs experience	6	6.3.2006	29.12.2006	Nil	60,000	6,000
9.	+M -RG	M.Tech. in RS & GIS in all the disciplines of the above Post Graduate Diploma Courses	M.Sc./M.E. in Natural Sciences- Geography / B.E. (Civil) /B.Tech/ B.Arch. (Planning) /M.Planning / B Planning in First Class or Master in Computer Applications (with Science at Graduate level) + B.Sc. (4 years)	10	6.3.2006	29.02.2008	Nil	1,44, 000+ 3,8000 (Andhra Univ. Regn. Fee)	14,400 + 75 (Andhra Univ. Regn. Fee)
GEOINFORMATICS : TECHNOLOGY AND APPLICATION									
10.	C-GG	GIS in Geosciences	M.Sc. in Geology/ Geography with Remote Sensing experience	3	3.7.2006	27.10.2006	Nil	24000	2400
11.	C-GL	Land Information System	Post Graduate in Town & Country Planning/ M.Sc. in Geography with RS experience / B.E./ B.Arch. / B. Planning	3	3.7.2006	27.10.2006	Nil	24000	2400
12.	C-GA	GIS in Soils & Landuse Planning	M.Sc. in Agriculture or equivalent with Remote Sensing experience	3	3.7.2006	27.10.2006	Nil	24000	2400
13.	C-GW	GIS in Water Resources Management	B.E./M.E. in Hydrology/ Civil Engineering/ Agricultural engineering/ M.Sc. in Earth Sciences with Remote Sensing experience	3	3.7.2006	27.10.2006	Nil	24000	2400
14.	C-GC	GIS in Coastal Zone Management	M.Sc. in Marine Sciences/ Earth Science / any Natural Science with Remote Sensing Experience	3	3.7.2006	27.10.2006	Nil	24000	2400
15.	C-GF	GIS in Forest Management	M.Sc. in Forestry / Wildlife / Environmental Science / Botany / Ecology with Remote Sensing Experience	3	3.7.2006	27.10.2006	Nil	24000	2400
16.	D-GI Joint IIRS-ITC Diploma	Post Graduate Diploma in Geoinformatics	M.Sc./M.Tech. in Remote Sensing, Physics, Maths, Applied Maths., Statistics, Geology, Geophysics, Geography with Maths.upto graduation level or graduate in Civil engg / Planning / Arch.. or working professionals with Maths upto graduation level and minimum experience of 2 yrs in the field of photogrammetry.	10	3.7.2006	27.04.2007	Nil	80,000 (Rs. 65,000 payable to IIRS + Rs. 15000 payable to ITC	8000
17.	*M-GI Joint IIRS-ITC Program	M. Sc. in Geoinformatics	M.Sc. in Physics/ Computer Science (or applications)/ Maths/ Natural Sciences, Geology, Urban & Regional Planning / B.Arch. / B.E./B.Tech (Civil / Electronics/ Computers) + B.Sc. (4 years) in First Class	10	17.7.2006	29.12.2007	Nil	1,20,000 payable to IIRS + Euro 1250 payable to ITC +2,00,000 towards living allowance & visit to ITC	12,000
PROGRAMMES IN GEOINFORMATIC APPLICATIONS IN GEO-HAZARDS									
18.	C-GH	Certificate course on "Geo-Hazards" 3 Optional streams : Hydrometeorological/ Geological/ Environmental	P.G. In Natural Sciences, Earth Science, Urban & Regional Planning/M.E./B.E./ B.Arch & Planning or Post Graduate in Science	10	3.7.2006	27.10.2006	Nil	24,000	2400
19.	D-GH Joint IIRS-ITC	PG Diploma in "Geo-Hazards" 3 Optional streams : Hydrometeorological/ Geological/ Environmental	P.G. in Natural Sciences, Earth Science, Urban & Regional Planning /M.E. / B.E /B.Arch/ B.Planning/ M. Planning	10	3.7.2006	27.4.2007	Nil	80,000 (Rs. 65,000 payable to IIRS + Rs. 15000 payable to ITC	8000
20.	*M-GH Joint IIRS-ITC	M. Sc. in Geo-Hazards	P.G. in Natural Sciences, Earth Science, Urban & Regional Planning /M.E. / B.E /B.Arch/ B.Planning/ M. Planning	10	3.7.2006	29.12.2007	Nil	1,20,000 payable to IIRS + Euro 1250 payable to ITC +2,00,000 towardsliving allowance & visit to ITC	12,000

Contact

REMOTE SENSING APPLICATIONS : Theme Specific Orientation Course									
21.	O-NRM	Orientation Course in any area of Natural Resource Management, Environmental Assessment and Disaster Management	Middle Level Managers involved in Natural Resource Management (minimum five years experience in service)	The theme based short courses of 2 weeks duration for a minimum of 5 to 10 participants may be organized on request basis as per the actual expenses					
AWARENESS COURSE/WORKSHOP / DECISION MAKERS COURSE									
22.	O-GH	Awareness course/ workshop on "Geo-Hazards"	Administrators/Decision Makers/Middle Level Managers with 5-10 years of professional experience	10	10.7.2006	14.7.2006	4000	4000	400
23.	O-DM	Overview for decision makers	Decision makers in organizations (with 10 years experience in service).	10	19.9.2006	22.9.2006	7,000@	7,000@	700@
INTERNATIONAL PROGRAMMES									
24.	S-RS	Short Course in Remote Sensing and Digital Image Processing (ITEC Sponsored)	Middle level officers	20	09.1.2006	03.3.2006	12,000	12,000	1200
25.	S-GI	Short Course on Geoinformatics	Middle level officers	20	17.7.2006	08.09.2006	12,000	12,000	1200
NNRMS - ISRO SPONSORED COURSES : FOR UNIVERSITY FACULTY ONLY									
26.	N-GI	GIS Technology and Applications	P.G. in Science/Engineering Graduate	8	15.5.2006	07.7.2006	Nil	12,000	1200
27.	N-WR	RS & GIS Applications to Water Resources	B.E. (Civil), Agricultural Engineering, masters in Hydrology/Hydrogeology with 2 years teaching experience	8	15.5.2006	07.7.2006	Nil	12,000	1200
28.	N-FE	RS & GIS in Forestry/ Botany/Ecology/Wildlife /Environmental Science	P.G. in Botany/Ecology/Forestry/ Environment/ Wildlife with 2 years teaching experience	8	15.5.2006	07.7.2006	Nil	12,000	1200
29.	N-UR	RS & GIS in Urban & Regional Planning	B.E.(Civil)/B. Arch./P.G. Planning / B Planning with 2 years teaching experience	8	15.5.2006	07.7.2006	Nil	12,000	1200
30.	N-PR	Cartography and Mapping	P.G. in Science/Geography with 2 years teaching experience	8	15.5.2006	07.7.2006	Nil	12,000	1200
31.	N-GG§	RS & GIS in Geosciences	P.G. in Science/Geography with 2 years teaching experience	8	15.5.2006	07.7.2006	Nil	12,000	1200
32.	N-GA§	RS & GIS in Soils and Land Use Planning	P.G. in Science/Geography with 2 years teaching experience	8	15.5.2006	07.7.2006	Nil	12,000	1200

* Proposed. Would be run if approved.

Due to poor response any programme may be dropped or may be rescheduled.

+ M. Tech. accredited by Andhra University. Last date of receipt of applications is 20.12.2005. M. Tech. is offered in six major disciplines Please log in : www.iirs-nrsa.gov.in for details and application form (Agriculture and Soils, Forestry and Ecology, Geomorphology and Geohydrology, Marine Sciences, Urban and Regional Planning and Water Resources).

@ Includes boarding and lodging.

NOTE: - If the date of commencement falls on holiday, course will start from next working day.

Sponsoring organizations are required to meet all expenses viz., traveling allowance, daily allowance, contingent expenses, medical expenses etc., for their candidates EXCEPT course fee. However Sl. Nos. 18, 22 & 23 are paid courses for all.

Govt. organizations include Central / State Government bodies / Autonomous Institutions and Universities and can sponsor only permanent staff.

Private & Self sponsored candidates have to pay full course fee.

Security deposit (i) @ Rs. 2000/- in respect of Certificate Courses (ii) @ Rs. 4000/- in respect of PG Diploma Courses and (iii) @ Rs. 6000/- in respect of M.Sc./M.Tech. for Self Financed candidates, have to deposited/remitted one month prior to the commencement of the course; failing which seats would be offered to waitlisted candidates..

Boarding and lodging charges at IIRS Hostel comes to Rs. 2000 p.m. (approx.). Local candidates will be considered for hostel accommodation, only if available.

For further details, please contact:

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