CENTRE FOR SPACE SCIENCE AND TECHNOLOGY EDUCATION IN ASIA AND THE PACIFIC

(AFFILIATED TO THE UNITED NATIONS)

MEMOIRS

Twenty Seventh Post Graduate Course in Remote Sensing & Geographic Information System 2023 - 2024

Conducted at

Indian Institute of Remote Sensing (IIRS)

Indian Space Research Organisation

Dehradun, India

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CENTRE FOR SPACE SCIENCE AND TECHNOLOGY
EDUCATION IN ASIA AND THE PACIFIC (CSSTEAP)
(AFFILIATED TO THE UNITED NATIONS)

MEMOIRS

TWENTY SEVENTH POST GRADUATE COURSE IN REMOTE SENSING &
GEOGRAPHIC INFORMATION SYSTEM
SEPTEMBER 01, 2023 TO MAY 31, 2024

Conducted at

Indian Institute of Remote Sensing (IIRS)
Indian Space Research Organisation (ISRO)
Dehradun, India

Governing Board Members and Special Invitees during 28th Governing Board Meeting held on December 12, 2023

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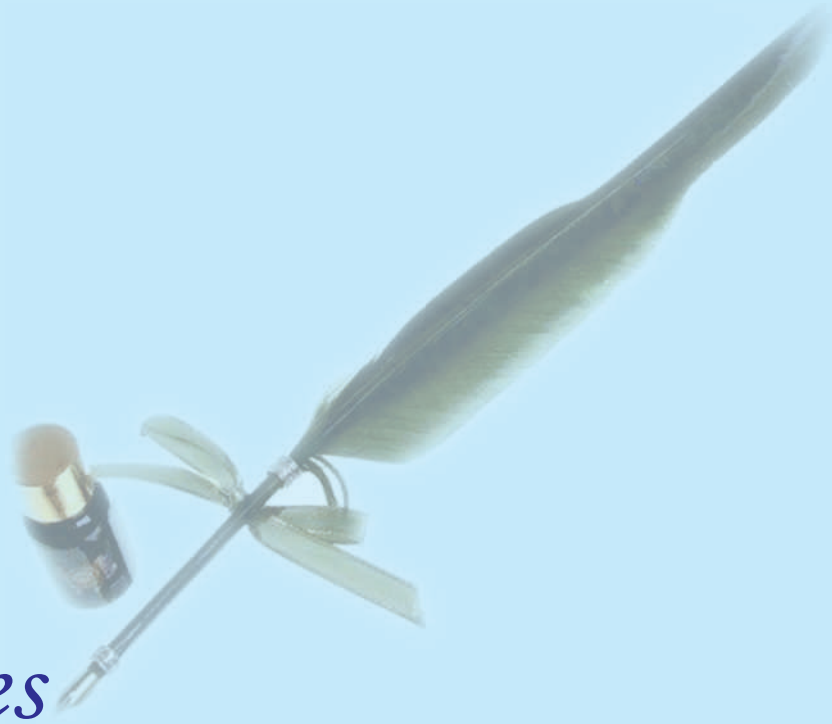

Messages

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Message

I am pleased to note that the 27th Post Graduate course in Remote Sensing and Geographic Information System (RS & GIS) of the UN Affiliated Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) is successfully concluding. This course has benefitted 18 participants from 10 different Asia Pacific countries. After the nine months of this course duration, they will be receiving their diploma certificate.

This CSSTEAP Post Graduate course is organised every year at Indian Institute of Remote Sensing (IIRS), Dehradun and attracts large number of professionals, educators and researchers of the region. Conducting such a course and sharing the expertise and knowledge helps to benefit professionals from many countries.

I hope that the participants will be able to utilize the knowledge and experience gained from this course in their home countries.

CSSTEAP and the host institution IIRS, deserves special commendation for the quality of the course designed and imparted by them. I once again congratulate all the participants of the 27th Post Graduate course in Remote Sensing & GIS and wish them the very best in their future endeavors.

सोमनाथ. एस / **SOMANATH. S**
Chairman, CSSTEAP Governing Board

Dated : May 13, 2024

United Nations
Office for Outer Space Affairs

16 May 2024

Message

It is with great pleasure that I extend my warmest congratulations to the graduates of the 27th RS&GIS Course, the 13th SATMET Course, and SAS Course. As you complete these rigorous programs at the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), you stand on the threshold of exciting opportunities to apply your newly acquired skills and knowledge in your respective countries.

The United Nations Office for Outer Space Affairs (UNOOSA) has always placed a strong emphasis on capacity building as a cornerstone of our mission. By fostering education and training in space science and technology, we aim to empower individuals and nations to harness the benefits of space for sustainable development. Fully in line with then vision of UNOOSA, the role of the Regional Centre for Space Science and Technology Education (CSSTEAP) is pivotal in this endeavour, particularly within the Asia-Pacific region. Through its comprehensive programs, CSSTEAP not only imparts technical knowledge but also nurtures a spirit of innovation and collaboration among its participants.

The impact of your work as graduates of these esteemed courses cannot be overstated. You are now equipped to drive advancements in remote sensing, satellite meteorology, and satellite communications. Your expertise will enable your countries to develop and enhance applications of space technologies, addressing critical issues such as disaster management, climate monitoring, and sustainable development. Your contributions will undoubtedly play a significant role in improving the quality of life and economic prosperity in your regions.

We are deeply grateful to the Indian Space Research Organisation (ISRO) and its esteemed Chairman for their unwavering support and partnership. ISRO's commitment to advancing space science and technology education is exemplified by its active involvement in CSSTEAP's initiatives. This collaboration has been instrumental in providing world-class training and fostering a global community
of space professionals dedicated to leveraging space technology for the betterment of humanit

D. Elhadani

Driss EL HADANI
Senior Adviser
United Nations Office for Outer Space Affairs

United Nations Nations Unies

Economic and Social Commision for Asia and the Pacific

Message

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) warmly congratulates all participants for completing the Twenty-seventh Post-Graduate Course on Remote Sensing and Geographic Information System.

Our region is emerging as a hub for digitally driven innovation and transformation. In ESCAP's recently launched report titled "Seizing the opportunity: Digital Innovation for a sustainable future", we urge countries to foster an enabling environment and build capacities to fully harness the power of these digital innovations to support the collective effort needed in accelerating progress towards the Sustainable Development Goals. Making geospatial data increasingly accessible, available, affordable, and actionable to support sustainable development is an integral part of this effort. It also supports the implementation of the Asia-Pacific Plan of Action on Space Applications for Sustainable Development (2018-2030) which is the regional blueprint in leveraging digital innovations in space applications.

ESCAP appreciates the initiatives of Centre for Space Science and Technology Education (CSSTEAP) in this regard. I am confident that this post-graduate course, as well as the friendships and networks, that you forged while completing your training course at the beautiful campus in Dehradun, has put you in a stronger position to support your countries in fully reaping the socioeconomic benefits that emerging technologies and geospatial tools, technologies and applications bring to attain sustainable development for all.

In closing, I would like to extend my sincerest gratitude to the CSSTEAP and the Government of India for their contributions to accelerating the implementation of the regional Space Plan of Action, particularly in upgrading skills and capacity building of professionals working in the geospatial sector and beyond, We will continue to sponsor young professional officials from developing countries in Asia and the Pacific to participate in the course study and short-term training to enhance their capabilities in the innovative use of space technologies for achieving the Sustainable Development Goals.

T. Wan Bonapace.

Tiziana Bonapace
Director, ICT and Disaster Risk Reduction
United Nations Economic and Social Commission for Asia and the Pacific

MONGOLIAN ACADEMY OF SCIENCES

Message

Dear Colleagues at CSSTEAP

Congratulations to all the graduates who have successfully completed the 27th PG Course On Remote Sensing and GIS with a total of 18 participants from 10 countries, the 13th PG Course In Satellite Meteorology and Global Climate with a total of 7 participants from 4 countries, and the PG Course in Space and Atmospheric Science (SAS-13) with a total of 11 participants from 4 countries.

This achievement is a testament to your hard work, dedication, and commitment to advancing your knowledge and skills in these specialized fields. Your contributions will undoubtedly have a positive impact on research, innovation, and problem-solving in the areas of remote sensing, GIS, meteorology, global climate, space, and atmospheric science.

Since its foundation in 1995, the Center for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) has been provided the best contribution to build human capacity in the space science related GIS/ remote sensing, GNSS, Communication satellite and its technology development within their associated countries.

I hope that this post-graduate courses have provided the necessary knowledge and skills for the graduates and helped them to achieve their future careers and goals.
I would like to send my regards to the graduates that programs encouraged their research capability to utilize the experiences and knowledge's in developing their networks and contributes to the sustainable development efforts of their countries and wishing all success.

I extend my sincere gratitude to the Director of CSSTEAP to successfully organized those courses and training programs.

Sincerely yours,

B. Avid
Secretary General,
Mongolian academy of Sciences

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डॉ. प्रकाश चौहान / Dr. Prakash Chauhan
उत्कृष्ट वैज्ञानिक & निदेशक
Outstanding Scientist & Director

Message

I am delighted to note that CSSTEAP has successfully organized three 9 months courses starting from September 01, 2023, to May 31, 2024. I congratulate the CSSTEAP Faculty and the organizers IIRS Dehradun, SAC Ahmedabad for training 36 participants from over 10 countries spreading the technology prowess of ISRO in the areas of RS&GIS, SATMET, and SAS in the Asia & the Pacific region. I am happy to be associated with the conduct of these CSSTEAP courses and witnessing the growth of CSSTEAP activities. My best wishes and appreciation to the participants from countries across the Asia & Pacific region. I am hopeful that CSSTEAP courses will make a greater impact and outreach in the days ahead.

May 16, 2024

Dr. Prakash Chauhan

भौतिक अनुसंधान प्रयोगशाला
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जे. सी. बोस नेशनल फेलो / **J. C. Bose National Fellow**
विशिष्ट प्राध्यापक / **Distinguished Professor**
निदेशक/Director

20 मई, 2024

Message

It is a great pleasure to know that the 27th PG Course on Remote Sensing (RS) and Geographic Information System (GIS) being conducted from September 1, 2023, at IIRS, Dehradun with 18 participants from 10 countries, will be concluding on May 31, 2024.

Remote Sensing & Geographical Information System are invaluable tools in natural resource management, infrastructure development, environmental protection and disaster management. I hope that the participants will be able to apply the knowledge and experience gained from this course in the socio-economic development of their home countries.

I thank the faculty and staff of IIRS and CSSTEAP for successfully conducting this course and extend my very best wishes to all the participants in their future endeavours.

अनिल भारद्वाज

प्रो. अनिल भारद्वाज
Prof. Anil Bhardwaj
निदेशक / Director

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CSSTEAP: A Brief

Centre for Space Science and Technology Education in Asia and the Pacific

Dr. Raghavendra Pratap Singh
Director, IIRS

Centre for Space Science & Technology Education in Asia and the Pacific (CSSTEAP) headquarter is located in the campus of Indian Institute of Remote Sensing (IIRS), Dehradun, India. It is one of the first Centre established in Asian region among the six regional centres for space science and technology established in developing countries under the auspices of the United Nations, through its Office for Outer Space Affairs (UN-OOSA). The other five centers established are in Africa (Morocco, Nigeria), Latin America and the Caribbean (with offices in Brazil and Mexico), Jordan for the West Asia region and China (Asia). In its resolution 45/72 of 11 December, 1990, the United Nations General Assembly (UN-GA) endorsed the recommendation of the Committee on the Peaceful Uses of Outer Space (COPUOS) to establish Regional Centres for Space Science and Technology in developing countries under the auspices of the United Nations, through its Office for Outer Space Affairs (UN-OOSA).

CSSTEAP has been promoting social and economic development through the use of space science, technology and its applications since its establishment on November 1, 1995. The Centre has agreement with the Government of India by which it has been accorded specific privileges and international status to the Centre, similar to the privileges enjoyed by UN specialized agencies. Under the agreement the Centre also has access to facilities, infrastructure and expertise of DOS/ISRO institutions, including Indian Institute of Remote Sensing (IIRS), Dehradun, Space Applications Centre (SAC), Ahmedabad, Physical Research Laboratory (PRL), Ahmedabad, UR Rao Satellite Centre (URSC), Bengaluru and National Remote Sensing Centre (NRSC), Hyderabad.

The Centre has a Governing Board consisting of signatories from 18 countries from Asia Pacific region and two observers, (UN-OOSA & ITC, The Netherlands). The Centre has formal UN affiliation with UN-OOSA for extending support in terms of expert advice, technical assistance, relevant documentation and future directions. The technical activities of the Centre are guided by an Advisory Committee (AC) consisting of subject experts that critically reviews the curricula, technical facilities, expertise in terms of faculty, etc. Funding grants for international travel of participants, subject experts, tuition fees and scholarships of participants and the management of the Centre are mainly provided by Department of Space on behalf of Host country. UN-OOSA and UN-ESCAP in Bangkok, Thailand also provides funding for travel of the few selected participants., The educational programmes of the Centre are oriented towards the dissemination of knowledge

in relevant aspects of space science and technology.

Dr. S. Somnath, Chairman, ISRO/Secretary, Department of Space and Chairman CSSTEAP Governing Board chairing the 27th GB Meeting

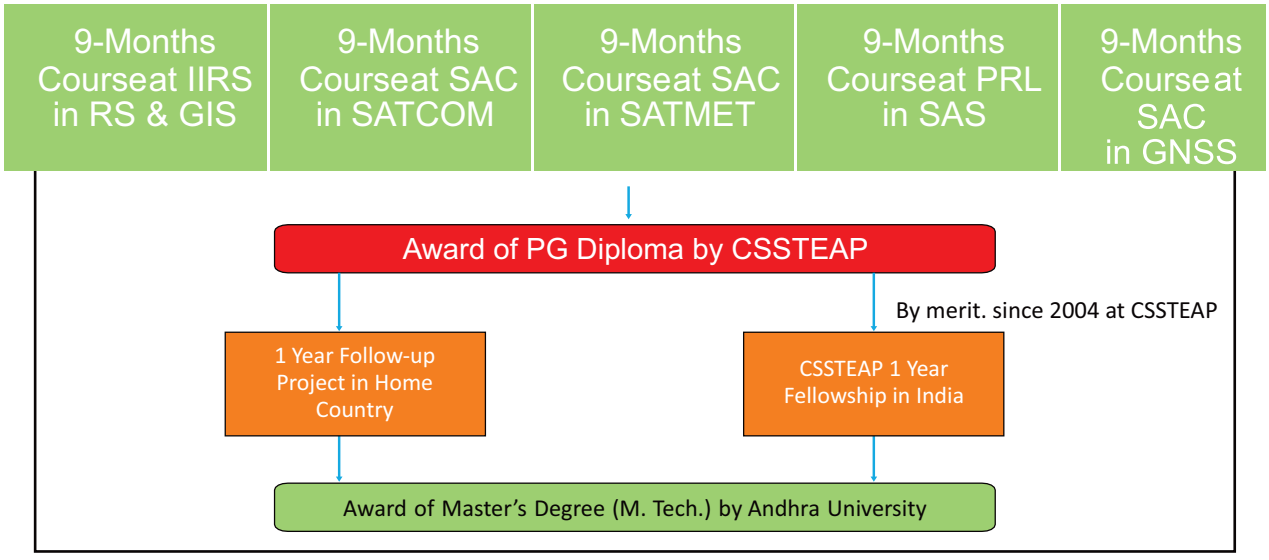
The Centre offers nine-months post-graduate (PG) level training in five areas of specialization namely:

a) Remote Sensing and Geographic Information Systems (RS & GIS),

b) Satellite Communication (SATCOM),

c) Satellite Meteorology and Global Climate (SATMET)

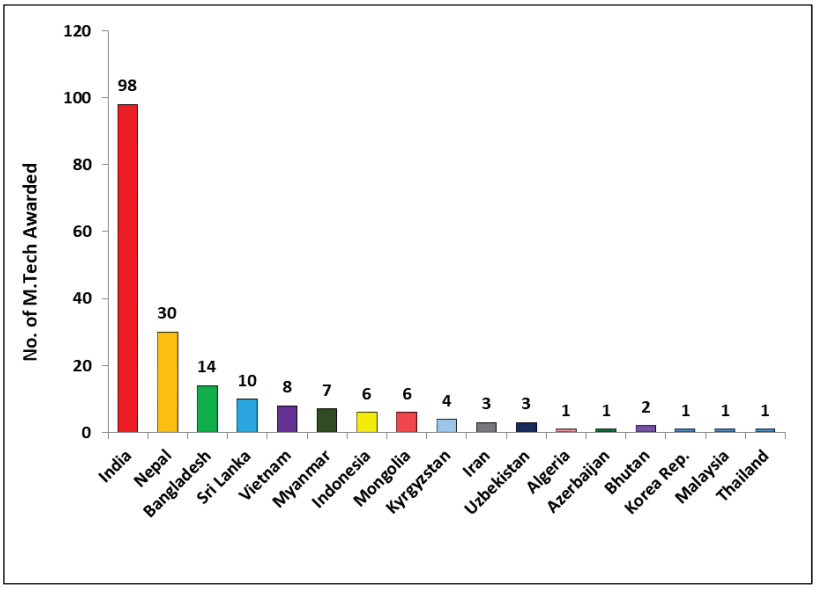
d) Space and Atmospheric Science (SAS), and
e) Global Navigation Satellite Systems (GNSS).



Structure of PG diploma educational programmes at CSSTEAP

The Centre has arrangements with Indian Institute of Remote Sensing (IIRS), Dehradun for RS & GIS course; with Space Applications Centre (SAC), Ahmedabad for Satellite Communication (SATCOM), Satellite Meteorology and Global Climate (SATMET) and Global Navigation Satellite System (GNSS) for conducting these PG courses. The successful completion of the 9-month PG-Phase of the programme leads to the award of a Post Graduate diploma by the Centre. For the participants who successfully finish their PG course and are interested in continuing for a Master of Technology (MTech.) degree, the Centre offers the opportunity to do so, in collaboration with Andhra University (AU) in Visakhapatnam, India. To this end, the student has to complete a 1-year research project in an application of space science or technology. In most cases the 1-year project is carried out at the home institution of the student concerned. Since 2004 onwards every year selected meritorious PG participants in RS & GIS are being given fellowships to complete their MTech thesis work at CSSTEAP. This gives an opportunity to the scholar to apply their knowledge and training received to deal with a 'real life' problem, where inputs from space technology can be used.

Till date 196 participants from 17 countries have been awarded M. Tech. Degree in the 5 disciplines (85 participants in RS & GIS; 55 in SATCOM; 23 in SATMET; 27 participants in SAS and 06 in GNSS). The Centre has taken initiative to facilitate its alumni to do higher studies leading to Ph.D degree and M. Sc. and Centre provides support in terms of expert faculty to guide the student for analyses and logistics (accommodation, research lab, library access, etc.).



Status of M. Tech. degree awarded

Besides the PG level courses, the centre also conducts regular on campus short courses of 1-4 weeks duration on Satellite Navigation & Positioning with Space Applications Centre (SAC), Ahmedabad, on data acquisition and data processing with National Remote Sensing Centre (NRSC), Hyderabad, Small Satellite Missions with UR Rao Satellite Centre (URSC) Bengaluru and Indian Institute of Remote Sensing (IIRS) Dehradun, on special customized themes and on disaster risk reduction with Indian Institute of Remote Sensing (IIRS), Dehradun and UN agencies like UNSPIDER and UNESCAP. In addition, many customized online courses addressing the current trends in technology and applications are also offered.

RS&GIS (theme based)	Satellite Navigation & Positioning Data Acquisition & Processing	Small Satellite Missions	Special on Demand Courses
IIRS, Dehradun	SAC, Ahmedabad NRSC, Hyderabad	IIRS, Dehradun/ URSC, Bengaluru	IIRS, Dehradun with UNSPIDER, UNESCAP

1 week to 4 weeks' duration

For middle level managers & professionals having 5-10 years' experience in relevant field

Short-term training programmes at CSSTEAP

The educational programmes are conducted in English and for participants who need help to improve their English language skills, facilities are made available upon their arrival in campus. The courses are taught in smart classroom environments with the use of modern teaching methods and tools, and also include multimedia tutorials for self-study. Practical are given in the laboratories and skill development environments of the DOS institutions. In each of the host institutions, most of the faculty are drawn from the host institutions (about 80% of the teaching time). Whenever desirable or needed, faculty is drawn from other DOS/ISRO institutions, or professional, scientific or academic institutions in India (~10%) or from institutions or organizations outside India, from the Asia-Pacific Region as well as globally (~ 5%). In order to provide wider exposure to the participants in their respective fields, the Centre provides opportunities for technical visits to scientific institutions, laboratories and national symposia in India.

27th RS&GIS course participants with Scientific Secretary, ISRO

Valedictory session for participants of 26th RS&GIS Course

Achievements

CSSTEAP has been actively conducting Post Graduate and Short Courses in various disciplines for the last 28 years. Till date the Centre has conducted 70 PG courses 27 in RS & GIS, 13 in SATCOM, 13 in SATMET, 13 in SAS and 04 in GNSS. The Centre has also conducted several short courses and workshops in past 28 years. These programmes have benefitted around 3689 participants from a total of 38 countries in the Asia-Pacific region. In addition to this, 74 participants from 26 countries outside Asia-Pacific regions have also been benefitted. PG Courses have benefitted 1129 participants while Short Courses have benefitted 2560 participants. During year 2023, the center has conducted 03 post graduate diploma courses, 09 online short courses, 04 offline short courses.

Online Courses Conducted 2023

- Online Short Training course on "Planetary Science "during May 15 -19, 2023. (46 *Participants from 7 countries)*
- Online Short Training course on "Solar Physics "during May 22-26, 2023. (73 *Participants from 11 countries)*
- Online Short Training Course on "Use of Space Technology for Weather and Climate Studies" during May 22 to June 02, 2023. (*34 participants from 11 countries*).
- Online short course on "Open-Source GIS Technology and Geoweb Services" during September 04-15, 2023. (*32 participants from 05 countries*).
- Online Short Training Course on "GNSS: Advanced Technologies and Applications" during November 28 to December 08, 2023. (*37 participants from 09 countries*).
- Online Short Training course on "Fuzzy Machine Learning and Deep Learning for Remote Sensing Data Classification "during December 18-29, 2023. (*23 participants from 07 countries)*
- Online short course on "SAR Data Processing and its Applications" during December 04-08, 2023. (*25 participants from 07 countries*)
- Online short course on "Space Law and Policy" during December 04-08, 2023. (*57*

participants from 10 countries)

- Online Short Training course on "Overview of WebGIS "during December 18 -29, 2023. (*16 Participants from 04 countries)*

Offline Short Courses Conducted 2023

- Short Training course on "Geospatial Application in Disaster Risk Reduction for Environmental Disaster (Forest Fire, Heat Wave and Atmospheric Pollution)" during July 17 – 28, 2023. (*25 Participants from 13 countries)*
- Short Training course on "Remote Sensing Data Acquisition" during August 21- September 01, 2023. (*14 Participants from 07 countries)*
- Short Training course on "Remote Sensing Data Processing" during October 09-20, 2023. (*16 Participants from 07 countries)*
- Short Training course on "Small Satellite Mission" during December 04-15, 2023. (*20 Participants from 10 countries)*

About Host Institute: Indian Institute of Remote Sensing (IIRS)

The Indian Institute of Remote Sensing (IIRS), a Unit of Indian Space Research Organization (ISRO), Govt. of India is one of central educational institutions of excellence in India dedicated for the capacity building in the field of Remote Sensing (RS), Geographical Information System (GIS) and their applications. Formerly, known as Indian Photo-interpretation Institute (IPI), the Institute was founded on 21st April 1966 under the aegis of Survey of India (SOI). It was established with the collaboration of the Government of the Netherlands on the pattern of Faculty of Geo-Information science and Earth Observation (ITC) of the University of Twente, formerly known as International Institute for Aerospace Survey and Earth Sciences, The Netherlands. The original idea of setting the Institute came from India's first Prime Minister, Pandit Jawaharlal Nehru, during his first visit to The Netherlands in 1957. The Institute's building at Kalidas Road, Dehradun was inaugurated on May 27, 1972. Since its founding, the Institute has been playing a key role in capacity building in remote sensing and geoinformatics technology and their applications for the benefit of the user community from India and abroad. Keeping pace with the technological advances, the institute has enhanced its capability with time, to fulfil the increased responsibility and demand from Indian and International community.

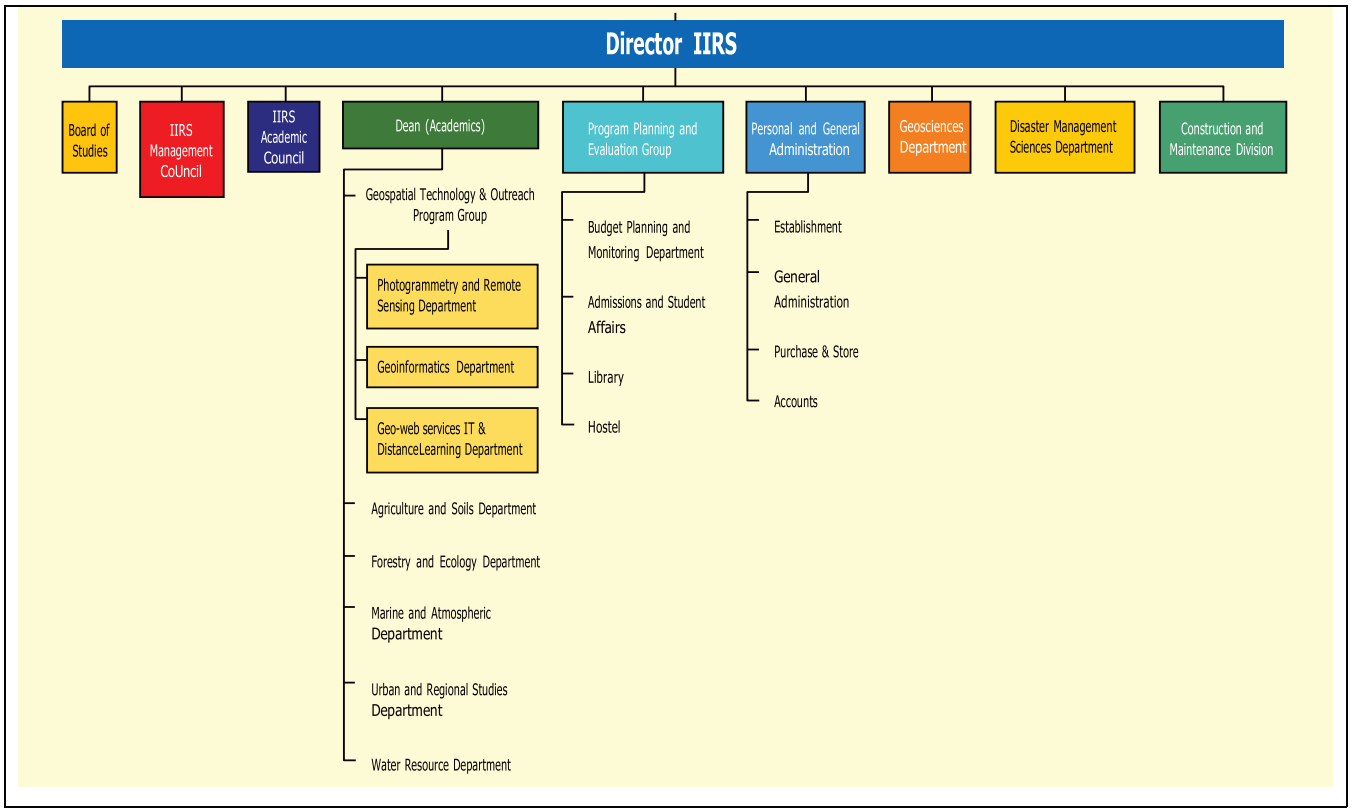
IIRS is playing a key role since five decades of its establishment in the country and Asian region in capacity building of various target groups, ranging from fresh graduates, engineers and postgraduate students to policy makers. The institute also hosts and conducts the training and educational programmes on RS & GIS offered by the Centre for Space Science & Technology Education in Asia and the Pacific (CSSTEAP), affiliated to the United Nations. The institute is playing a major role in capacity building activities which can be primarily grouped into Training & Education, Research and Outreach. To widen its outreach, IIRS has started live and interactive distance learning programme (DLP) in 2007. Further, graduate and postgraduate students from universities spread across the country have also benefitted through EDUSAT-based distance learning programmes being offered by the Institute till date. Today, more than 3198 institutions/ organizations are networked with IIRS.

Today, it has programmes for all level of users, i.e. mid-career professionals, researchers, academia, fresh graduates and policy makers. The sustained efforts by its dedicated faculty and management have made the institute remain in the forefront throughout its journey of about five

decades from a photo-interpretation institute to an institute of an international stature in the field of remote sensing and geo-information science. The institute has a strong, multi-disciplinary and solution-oriented research agenda that focuses on developing improved methods/ techniques for processing, visualization and dissemination of EO data & Geo-information for various societal applications and better understanding of Earth's system processes. Currently, microwave, hyperspectral and high-resolution EO data processing and their applications are some of the prime research areas. State-of-the-art laboratory and field-based instrumentation and observatories network help meeting the research goals and objectives. Various state-of the-art laboratories, field-based instrumentations and observatories networks help meeting the research goals and objectives. IIRS houses prominent facilities like atmospheric CO2 measurement network, observatory for aerosol climatology, carbon flux towers for measuring energy, water vapour and CO2 exchanges, field observatory for soil erosion and runoff assessment, laser- profiling, AWS, field observatory for hydrological modelling, besides full-fledged DIP and GIS labs etc.

The Organizational Structure

Considering the imminent need towards focused efforts in Training and Education for efficient utilization of the ISRO's forthcoming advanced Earth Observation Systems, IIRS has been given the status of a Unit of ISRO with effect from 30th April 2011. It is headed by the Director who reports to Chairman, ISRO/Secretary, Department of Space. The overall activities of the institute are guided by Management Council, while the academic programmes are guided by a Management Council and Board of Studies. Dean (Academics) is responsible for implementation of academic programmes. A highly motivated and dedicated team of about 64 multidisciplinary scientists and engineers contribute towards realizing the institutes objectives.



Capacity Building Programmes of the Institute

The training and capacity building programmes of the Institute are designed to meet the requirements of various target/user groups, i.e., for professionals at working, middle and supervisory levels, fresh graduates, researchers, academia and decision-makers. The duration of courses ranges from one-week to two-years. The programmes are meticulously designed by the domain experts and are then approved by the Board of Studies (BoS) and Academic Council (AC) consisting of eminent subject experts. A team of 64 dedicated scientists at IIRS contribute to delivering the course contents. Guest faculties from reputed organizations/ institutes in the country and abroad are regularly invited to share their knowledge and experience with the course participants. The training and education programmes conducted by the Institute include:

1. Post-graduate Diploma (PGD) in Remote Sensing and GIS in nine disciplines,
2. M.Tech. (RS & GIS) in nine disciplines conducted in collaboration with Andhra University, Visakhapatnam, and
3. M.Sc. and PG Diploma (PGD) in in Geoinformatics conducted in collaboration with the Faculty of Geo- Information Science & Earth Observation (ITC) of the University of Twente (UT), The Netherlands.

The institute also conducts various other courses, namely i) Certificate programmes (including NNRMS-ISRO sponsored programme for University faculty), ii) Awareness programmes, and iii) Special on-demand/tailor- made courses. The Institute has so far trained 14,640 professionals including 1544 from abroad representing 114 countries from the Asia, Africa and South America.

Under the Outreach Programmes, the Institute conducts several courses for working professionals, researchers and students through state-of-the-art studio and e-learning concept. Currently, around 3198 institutions and organizations spread across India are networked with IIRS. More than 5.73 lakh participants have benefitted so far from IIRS Outreach Programmes. To ignite the imagination and spread awareness on space technology among the school teachers and students, IIRS also conducts special programs through Distance Learning Programs as well as in campus mode. IIRS also has initiated massive open online courses (MOOC) on various aspects to widen its outreach capabilities and involving larger section of society to get benefitted.

The capacity building programmes conducted by IIRS are listed in the following Table.

S.No.	Programme	Duration	No. of Seats
1.	**MTech. in Remote Sensing & GIS (Affiliated with Andhra University)** Specializations in - Agriculture & Soils; Forest Resources & Ecosystem Analysis; Geosciences; Natural Hazards and Disaster Risk Management, Urban & Regional Studies;Marine & Atmospheric Sciences; Satellite Image Analysis & Photogrammetry; Water Resources; Geoinformatics	24 months	60
2.	**M.Sc. in Geo-Information Science & Earth Observation (Affiliated with ITC, University of Twente, The Netherlands)**Specialization in - Geoinformatics	22 months	10
3.	**Post-Graduate Diploma in Remote Sensing and GIS** 9 Specializations - Agriculture & Soils; Forest Resources & Ecosystem Analysis; Geosciences; Natural Hazards and Disaster Risk Management; Urban & Regional Studies;Marine and Atmospheric Sciences; Satellite Image Analysis & Photogrammetry; Water Resources and Spatial Data Science.	12 months	30

4.	**Post-Graduate Diploma in Geo-Information Science & Earth Observation (Affiliated with ITC, University of Twente, The Netherlands)** Specialization in - Geoinformatics	12 months	10
5.	**Certificate Course in Remote Sensing** Remote Sensing and Image Analysis (for Indian User participants)	8 weeks	20
6.	**International Programme - Certificate Course in Remote Sensing, Geoinformatics(Sponsored by ITEC, Govt. of India) &** Remote Sensing with special emphasis on Digital Image Processing; Geoinformatics	8 weeks	40
7.	**NNRMS- ISRO-Sponsored Certificate Course for University Faculty** 10 Specializations - GIS Technology and Advances; RS & GIS Applications in Water Resources; RS & GIS Applications in Forest Resources & Ecosystem Analysis; RS & GIS Applications in Urban & Regional Planning; Satellite Image Analysis & Photogrammetry; RS&GIS Applications in Geosciences; RS & GIS Applications in Agriculture & Soils; RS&GIS Applications in Coastal & Ocean Sciences; Geocomputation & visualization in Web Platforms;Natural Hazards and Disaster Risk Management	8 weeks	64
8.	**Awareness Programme** a) Remote Sensing - An Overview for Decision Makers b) Usefulness of Remote Sensing & GIS for Environmental Study for Class X-XII students	4 days 1 week	15 50
9.	**Special Courses** a) Remote Sensing & GIS Application in Hydrological Modelling b) Ground-based Subsurface Imaging for Enhanced Earth Observation Applications inGeosciences c) Big Geodata Processing d) Microwave Remote Sensing Applications in Agriculture	2 weeks 1 week 4 weeks 2 weeks	20 20 10 20
10.	**Tailor-Made On-Demand Courses**	1 to 8 weeks	Variable

The Institute has trained 13324 professionals (till April 2022), including 1347 professionals from abroad representing over 97 countries mainly from the Asia, Africa and South America. Further, over 1.2 lakh students/ researchers/ faculty from more than 1050 universities/ institutes spread across the country have also benefited through satellite-based distance learning programmes being offered by the Institute since 2007.

IIRS Outreach Programme- EDUSAT and e-learning

Distance Learning Program (DLP) offered by Indian Institute of Remote Sensing (IIRS), Indian Space Research Organization (ISRO), is an initiative for training students and professionals from academia and user departments in the field of geospatial technology & Earth Observation. IIRS DLP started in the year 2007 with 312 participants from twelve universities in India. Till December 2023, IIRS has successfully conducted 130 outreach programmes through live and interactive

classroom mode (also known as EDUSAT programme) benefitted more than 5.73 lakh participants from 3198 network Institutions distributed across the country. During last fourteen years, IIRS has successfully established a network of academic and professional Institutions in the country under this programme. The content of IIRS Distance Learning Program (DLP) focuses on teaching Basics topics along with technological advancement in the field of Remote Sensing, GIS, GNSS and its applications. The online sessions delivered under this programme are interactive and majority of such sessions/lectures of these courses are delivered by Subject Matter Experts (SME) from IIRS and also guest faculty from other ISRO centers. All the courses of IIRS DLP are made available through in-house developed Electronic Collaborative Learning and Knowledge Sharing System (E-CLASS) platform which enables various innovative learning tools to the participants such as attend the live sessions, post queries, download study material, attend offline sessions, appear for online examinations and download course certificate etc.

To enhance the outreach of geo-spatial science and technology, IIRS has also developed e-learning contents and Learning Management Systems (LMS) for different certificate courses in Remote Sensing and geo-spatial technology and its applications (http://elearning.iirs.gov.in). The e-learning courses are self-paced and learner centric courses. The syllabus of the courses is as per latest developments and trends in geo-spatial science and technologies with specific focus on Indian case studies for geo-spatial applications.

To cater the online training requirements of International users, IIRS is conducting International Distance learning programme under “ISRO-IIRS Space Application Training (ISAT)” programme since 2020. A dedicated portal, Learning Management System (LMS) and E-CLASS International platform was developed and deployed for International users in the month of October 2020. A dedicated portal, Learning Management System (LMS) and E-CLASS International platform was developed and deployed for International users. A total of three courses were conducted through MOOC for International participants.

Participants with Dr. Shirish Ravan (former Head UNSPIDER, Beijing Office)

Course Report

27th Post Graduate Course on Remote Sensing & Geographic Information System (RS & GIS)

The 27th Post Graduate Course on Remote Sensing & Geographic Information System (RS & GIS) formally started on September 1, 2023. This batch had eighteen participants from ten countries of Asia-Pacific Region. Three participants each from Sri Lanka, Bangladesh and Mongolia, two participants each from Myanmar and India and one participant each from Indonesia, Lao PDR, Mexico, Nepal and Vietnam. These participants were from various backgrounds including Meteorology, Geology, Hydrology, GIS, Disaster Management, Civil Engineering, Telecommunication, Agricultural Sciences, Forestry, Survey, Information Technology and Defence working in various capacities in their respective organizations. The course was inaugurated in the presence of former Director CSSTEAP Dr. Prakash Chauhan, Director CSSTEAP and IIRS, Dr. Raghavendra Pratap Singh, Dean Academics Dr. Pramod Kumar, Dr. Arijit Roy Program Coordinator along with the Group Heads, Heads, Course Director, Course Coordinator, faculty members and course participants.

The course started with an induction programme giving an overview of the course, briefing about the CSSTEAP campus and various other facilities. Induction and orientation program was followed with commencement of Semester-I consisting of principles of remote sensing, photogrammetry, image interpretation and analysis, Geoinformatics, natural resource & environmental management. The Semester-I laid emphasis on building the fundamentals. During Semester-II the course participants had to study two compulsory subjects which included advanced remote sensing and Geoinformatics focusing on topics like hyperspectral & microwave remote sensing principles and processing techniques, spatial database design, storage and retrieval, basics of programming language and data structures, Web GIS and open platforms for geoprocessing, AI/ML and Spatial Sampling and Variogram Modeling.

List of Participants

SNo.	Name	Elective - I	Elective-II	Country	Photograph
1.	Mr. Md. Abu Jafar	Advances in Image Analysis & Geoinformatics	Natural hazards and Disaster Risk Management	Bangladesh 	
2.	Mr. Md. Manik Ali	Forest Resource & Ecosystem Analysis	Satellite Hydrology & Water Resource Management	Bangladesh 	
3.	Mr. Rintu Roy	Advances in Image Analysis & Geoinformatics	Geological Remote Sensing	Bangladesh 	
4.	Cdr Kapil Dev Singh	Advances in Image Analysis & Geoinformatics	Natural hazards and Disaster Risk Management	India 	
5.	Ms. Reena Viveka Chintala	Advances in Image Analysis & Geoinformatics	Natural hazards and Disaster Risk Management	India 	
6.	Ms. Erni Saurmalinda Butar Butar	Agricultural & Soil Resource Management	Satellite Hydrology & Water Resource Management	Indonesia 	

SNo.	Name	Elective - I	Elective-II	Country	Photograph
7.	Ms. Jedtavong Thepvongsa	Advances in Image Analysis & Geoinformatics	Natural hazards and Disaster Risk Management	Lao PDR 	
8.	Dr. Ana Beatriz Contreras Ruiz Esparza	Advances in Image Analysis & Geoinformatics	Satellite Hydrology & Water Resource Management	Mexico 	
9.	Ms. Altanzaya Tumen	Advances in Image Analysis & Geo Informatics	Natural hazards and Disaster Risk Management	Mongolia 	
10.	Mr. Byambasuren Nasantogtokh	Advances in Image Analysis & Geo Informatics	Natural hazards and Disaster Risk Management	Mongolia 	
11.	Ms. Gandoljin Nergui	Advances in Image Analysis and Geo Informatics	Natural Hazards and Disaster Risk Management	Mongolia 	
12.	Ms. Myo Thandar Win	Advances in Image Analysis & Geoinformatics	Geological Remote Sensing	Myanmar 	

SNo.	Name	Elective - I	Elective-II	Country	Photograph
13.	Mr. Phyo Kyaw Kyaw	Advances in Image Analysis & Geoinformatics	Natural Hazards and Disaster Risk Reduction	Myanmar 	
14.	Ms. Neeru Thapa	Forest Resource & Ecosystem Analysis	Natural Hazards and Disaster Risk Management	Nepal 	
15.	Mrs. Gayani Prasadani Wickramasekara	Agricultural & Soil Resource Management	Satellite Hydrology & Water Resource Management	Sri Lanka 	
16.	Mr. Perera Guruge Amila Iroshana	Advances in Image Analysis & Geoinformatics	Natural Hazards and Disaster Risk Management	Sri Lanka 	
17.	Mrs. Kolonne Appuhamilage Nimmi Nushari Kolonne	Advances in Image Analysis & Geoinformatics	Natural Hazards and Disaster Risk Management	Sri Lanka 	
18.	Lt. Tieu Hoang Manh	Advances in Image Analysis & Geoinformatics	Satellite Hydrology & Water Resource Management	Vietnam 	

In this Semester apart from two compulsory subjects the participants also had to opt for two elective papers based on his/her academic qualification, professional experience and requirement of his/her parent organization. The thematic optional streams offered in Elective-I were (i) Agricultural & Soil Resource Management (ii) Forest Resource & Ecosystem Analysis, (iii) Urban & Regional Studies, (iv) Advances in Image Analysis & Geoinformatics whereas for Elective-II it was (v) Satellite Hydrology & Water Resource Management (vi) Geological Remote Sensing, (vii) Marine and Atmospheric Remote Sensing and (viii) Natural hazards and Disaster Risk Management. In the present batch for Elective-I, 14 participants opted for Advances in Image Analysis & Geoinformatics, 02 for Agricultural & Soil Resource Management and 02 for Forest Resource & Ecosystem Analysis whereas in Elective-II, 11 participants opted for Natural hazards and Disaster Risk Management, 02 participants opted for Geological Remote Sensing and 05 for Satellite Hydrology & Water Resource Management. The participants were assessed through internal assessment followed by semester end assessment and practical examinations.

RS & GIS course participants at classroom and lab

The core components of course syllabus were covered by the faculty of IIRS and additional lectures by guest faculty on specialized topics were also arranged for the academic benefit of the course participants. The participants had several field excursions for ground truth collection and for interpretation and analysis of remote sensing satellite data. The participants were assessed through internal assessment followed by semester end assessment and practical examinations.

RS & GIS course participants visiting IRI, Bhadrabad and Asan Barrage, Poanta Area

RS&GIS Syllabus Overview

Semester-I (Module-1): Compulsory

Remote Sensing - I : • Physics of Remote Sensing • Spectral Signature, In-situ measurements and Visual image interpretation • Platforms & Sensors • Remote Sensing Data Errors, Data Products and their sources • Principles of Thermal Remote Sensing

Image Interpretation and Analysis: • Statistics for Image Processing • Image Pre-processing • Image Enhancement • Image Transforms & Fusion • Image Classification

Photogrammetry: • Aerial Photography • Stereo Photographs & its Geometry • Stereo Photogrammetry • Digital Photogrammetry • Satellite Photogrammetry

Geoinformatics-I: • Overview of GIS, Geodesy • Data models, and Data Quality • Spatial Data Analysis • GNSS and Its Applications • SDI and Recent trends in GIS

Natural Resource & Environmental Management (NREM): • NREM-1 • NREM-2 • NREM-3 • NREM-4 • NREM-5

Study Tour

Field Visits

Semester End Examination

Semester-II (Module-2): 2 Compulsory & 2 Elective Paper

Remote Sensing- II: • Hyperspectral Remote Sensing • Hyperspectral Data Classification and Application • Microwave Remote Sensing • SAR Data Processing • Change Detection

Geoinformatics-II: • Spatial Database Design, Storage and Retrieval • Basics of Programming Language and Data structures • Web GIS and open platforms for geoprocessing • Overview of ML • Spatial Sampling and Variogram Modeling

Elective-I: • Agricultural & Soil Resource Management • Forest Resource & Ecosystem Analysis • Urban & Regional Studies • Advances in Image Analysis & Geoinformatics

Elective-II: • Satellite Hydrology & Water Resource Management • Geological Remote Sensing • Marine and Atomospheric Remote Sensing - Natural Hazards and Disaster Risk Management

Study Tour

Field Visits

Semester End Examination

Semester-II Module-3

Pilot Project Study & Seminar Presentation

Pilot Project

Participants worked on a pilot project work approved by a panel of committee during the pilot project synopsis presentation under the supervision of their supervisors. The topics varied from land use land cover change, grazing capacity estimation, object identification using deep learning, road network and congestion analysis, land deformation, modeling of flood hazard, glaciers and glacial lakes, forest fire, soil erosion, irrigation water requirement, rainfall variability, heat wave distribution and ship detection.

The project topics undertaken by the participants were:

- Analysis of Long Term Rainfall Variability and Trends using Satellite and in-situ Gauge data over Barishal Division, Bangladesh.
- Assessment of flood hazard in Lower Teesta basin using remote sensing and geospatial techniques.
- Monitoring and Analysis of Ground Subsidence of Dhaka City and its Surrounding Area, Bangladesh Based on Multi-Temporal PS-InSAR Methodology.
- Ship Detection using space-borne Synthetic Aperture Radar Dataset.
- GIS based road transportation network analysis for emergency flood situations in parts of Godavari Basin - Andhra Pradesh, India
- Flood Vulnerability Assessment using GEE and Geospatial Technique, Study of case Demak Regency, Central Java Province, Republic of Indonesia.
- Land use/land cover and Land surface temperature analysis over Sikhottabong District, in Vientiane Capital, Laos, Using multitemporal satellite Data.
- Detection of land subsidence associated with microseisms and the Mixcoac-Plateros Fissure in Mexico City using SAR Interferometry.
- Analysis of traffic congestion using network analysis of satellite imagery in Ulaanbaatar, Mongolia.
- Change in grazing capacity between dry (2020) and non-dry (2021) years and its relation to soil parameters, in Khuvsgul province, Mongolia.
- Glacier Dynamics Study using Remote Sensing, Tavan Bogd mountain, Mongolia.
- Mapping and Characterization of Landslide in Parts of South-Eastern Myanmar.
- Spatio-temporal Distribution of Heat Waves in Myanmar using Ground Observation & EO Data.
- Forest Fire Risk Mapping in Nepal Through a Multi-Model Approach.
- Estimation of Crop Water requirement using Geospatial Technology in Muruthawela Scheme, Hambantota District,Sri Lanka.
- Assessment of Land Use Land Cover Changes and Prediction of Future scenario using satellite images: Case study of Tellippalai DS Area in Sri Lanka.
- Identification of the impact of the Mattala airport and marine port construction on land use changes in Hambantota DS area and Lunugamwehera DS area in Sri Lanka.
- Comparative analysis of high-resolution multispectral data for object detection using a Deep Learning Model.

Educational Tour:

As part of the course curricula the participants were taken for a study tour to Hyderabad and Ahmedabad during November 19 - 26, 2023. During first lap of the visit, the participants traveled to Hyderabad and visited National Remote Sensing Centre (NRSC) where the participants had an opportunity to see Integrated Multimission Ground Segment for Earth Observation Satellites (IMGEOS) facility and also witnessed real time acquisition of EO data at Shadnagar, Hyderabad. The participants were also shown the State-of-art CalVal (Calibration/Validation) site at Shadnagar campus of NRSC. The participants were also demonstrated on the virtual reality facility and National Database for Emergency Management (NDEM) facility at NRSC, Shadnagar Campus. They also got a chance to do live Video Conferencing with the Scientists at Antarctica. The participants during their travel also had an opportunity to visit cultural & natural landscape in Hyderabad and have an understanding of Indian culture, heritage and traditions.

RS and GIS participants at National Remote Sensing Centre (NRSC), Shadnagar

During the second leg of visit the course participants were taken to Ahmedabad and visited the Vikram Sarabhai Space Exhibition (VSSE), Physical Research Laboratory (PRL) and Space Application Centre (SAC) where they had an opportunity to get insight of Meteorological and Oceanographic Satellite Data Archival Centre (MOSDAC), SEDA (Sensor Development Area), Microwave Remote Sensing Area and PLASIV Lab.

RS and GIS participants visit to SAC and Vikram Sarabhai Space Exhibition (VSSE), Ahmedabad

As part of their programme, the students visited some laboratories at PRL (Main Campus) on 23 November, 2023. At the Aerosol Characterization Laboratory in the Space and Atmospheric Science Division, they were quite interested in knowing what aerosols are and their impact on climate. The different kinds of aerosols and their role in radiative transfer and climate were discussed. The various instruments and techniques deployed to measure aerosol characteristics were demonstrated and explained by Prof. S. Ramachandran, in addition to global model simulations of aerosols and their impact on climate. Questions were asked on global warming and climate change, and the role aerosols play in climate and climate change. At the Geosciences Division, the students were briefed about the activities of the Division by Prof. S. Kumar and Prof. A D. Shukla. After initial interaction, the students were taken to the following 3 laboratories: (a) IWIN Laboratory (water analysis using Isotopic Ratio Mass Spectrometer), (b) GEOSIL Laboratory (Geosciences Stable Isotope Laboratory: Isotopes of C, N, O and S in all types of geological samples), and (c) Thermal Ionization Mass Spectrometer (TIMS) which is used for analysing long-lived radioactive isotopes of Sr, Nd, Pb etc.

RS and GIS participants at PRL (Main Campus), Ahmedabad

The participants also had an opportunity to interact with the Director SAC, Shri Nilesh Desai on the history of ISRO, concept of Satellite Missions, recent and future ISRO Missions including Chandrayaan 1&2, Aditya L1, Gaganyaan and NISAR Missions

interaction of RS and GIS participants along with SATCOM Participants with SAC Director, Ahmedabad

Conferences:

The participants got an opportunity to participate in the 6th world congress on disaster management (WCDM) which was held at Dehradun from November 28 to December 01, 2023. In this conference participants got an opportunity to present their papers and attend lectures of various renowned speakers from various fields. The participants learned about the developments in Disaster Management for Prevention, Mitigation, Preparedness and Response in case of damage and destruction caused by natural and man-made disasters, through sustained and collective efforts of all Government agencies, Non-Governmental Organizations and People's participation. In this congress the participants also had an opportunity to witness various cultural activities showcasing heritage of Uttarakhand and exhibitions organized by different departments contributing in Disaster Management through their technologies and expertise in respective domains.

RS & GIS course participants at 6th world congress on disaster management, Dehradun

Participants also participated in IIRS Academic Meet (IAM) titled "Remote Sensing of Earth and Beyond @2047" held at IIRS, Campus between March 18-19, 2024. During the IAM participants got an opportunity to hear eminent speakers related to space science and interact with them. Participants had one to one discussion with Scientific Secretary, ISRO Sh. Shantanu Bhatawdekar and Dr Shirish Ravan, former Head UN-SPIDER.

RS&GIS course participants at IAM-2024 held at IIRS, Dehradun

Interaction with Distinguished Speakers

In addition to the above, the participants also had an opportunity to attend guest lectures and interact with several renowned academicians and researchers during the course.

List of talks delivered by distinguished Speakers and Guest Lecturers to CSSTEAP participants

Speaker Name	Lecture Title	Photo
Shri M. Sankaran Scientist of Indian Space Research Orgnisation(ISRO) Director of U R Rao Satellite Centre (URSC), Banglore, India.	Overview on concept of Satellite Missions and recent and future ISRO Missions.	
Ms.Kareff Rafisura Economic Affairs Officer, Space Applications Section ICT and Disaster Risk Reduction Division of ESCAP.	Geospatial Innovations for Sustainable Development in Asia and Pacific a focus on End-User Engagement.	
Dr.C.B.S. Dutt Former, Deputy Director, NRSA and Programme Director, IGBP, ISRO-HQ	Space Applications for Climate Change-Physical Basis	
Dr.V.K. Dadhwal Indira Gandhi Chair Professor of Environmental Sciences, NIAS, Bengaluru. Former Dean, IIRS. Former Director, NRSC. Former Director, IIST.	Understanding Terrestrial Carbon Cycle of India Using Earth Observation Data	
Sh.Bikram Singh Director, Meteorological Centre, IMD Dehradun.	Weather Monitoring and Early Warning System	
Dr. Shirish Ravan Founder, EarthSight Foundation & DevTA (Development Technologies Accelerator)	Utilisation of Space Technology in Disaster and Risk Management	
Mr. Patanjali Kumar Chodavarapu (Senior Geophysicist), Indian National Tsunami Early Warning Centre (ITEWC), Applied Research and Research to Operations (AOR),Indian National Centre for Ocean Information Services.	Overview of Space Technology for Tsunami Hazard and Early Warning Systems	
Dr.Susmita Ghosh Computer Science and Engineering Department Jadavpur University Kolkata, India.	Advance application of Artificial Intelligence and Machine Learning	
Dr AS Arya Group Director, Planetary Sciences and Geosciences Group Space Applications Centre, ISRO, Ahmedabad	Indian Planetary Science Missions - Retrospect and Prospect	

Campus Life

Participants were provided with accommodation in international hostel having kitchenettes and wifi access in their rooms. For recreation participants had indoor sporting facilities like gymnasium, TT table and snooker board apart from outdoor sporting. During their stay at campus and educational tour participants got to learn, understand and celebrate Indian traditions, customs and dishes. Participants participated in various activities like the sports week, cultural fest, indian festivals, sightseeing and visits to places of cultural, historical and heritage importance.

RS & GIS Participants at Library and International Hostel

Dr. Sanjeev K Singh
Course Coordinator, RS&GIS
sksingh@iirs.gov.in

Mr. C.M. Bhatt
Course Director, RS&GIS
cmbhatt@iirs.gov.in

List of Faculty

Name	Topics	Photograph
Dr. R.P. Singh	• EO data applications for natural resources management	
Dr. Pramod Kumar	• Urban resource planning, urban land use planning • Urban area analysis	
Mrs. Shefali Agrawal	• Remote Sensing • Principles and applications of hyperspectral RS • Image Analysis • UAV RS • Satellite Photogrammetry	
Dr. R.S Chatterjee	• SAR interferometry and its applications • Ground water geology	
Dr. Debashish Mitra	• Coastal Zone Management • Coastal geology and geomorphology • Coastal hazards and its mitigation • Coastal processes and modelling • Climate change impact on coastal zone • Land ocean Interaction	
Dr. Suresh Kumar	• Soil Resource Mapping, • Land Evaluation • Watershed Management • DTA for watershed delineation soil taxonomy	
Dr. N.R Patel	• Integrating RS and crop grwoth model for crop condition assessment • Crop condition, assessment and Crop yield modelling • Hyperspectral RS applications • Agromet parameters retrieval • Hyperspectral RS application	
Dr. Anil Kumar	• Image Classification • Temporal Data, Fuzzy Classifier and Deep learning models	
Dr. Hari Shanker Srivastav	• LULC analysis, Microwave RS in agriculture • Soil moisture estimation	

Name	Topics	Photograph
Mrs. Minakshi Kumar	• Digital Image Analysis • Image Preprocessing and Enhancement techniques • Texture analysis • Image segmentation • Object Based Image Analysis	
Dr. Arijit Roy	• Sampling techniques in forest inventory • Predictive modeling • Decision support systems • Climate change impacts on forests and biodiversity • Forest fire monitoring and early warning	
Dr. Sandeep Maithani	• Urban planning, Machine learning & CA in urban growth modelling • Urban hazard & risk assessment • Urban land surface temperature studies	
Dr. Harish Karnatak	• Bhuvan overview, Geodata abstraction library, Iterations, functions & recursion • WebGIS services, Open source GIS	
Dr. Hitendra Padalia	• Role of EO data in sustainable forest management • Role of RS and GIS in Forestry and Ecology	
Dr. Praveen K. Thakur	• Quantification of hydrological elements: Precipitation, WL/River Flow • Snow and glacier mapping and melt modelling • Flood and GLOF modelling; Flood early warning system	
Dr. Yogesh Kant	• EO systems for climate change studies • RS application for air quality monitoring • Satellite based aerosol studies	
Dr. Vandita Srivastava	• Geoinformatics • Image processing and Analysis • Information Extraction • Geoinformation Management	
Mr. Chandra Mohan Bhatt	• Disaster Risk Reduction & Management: Concepts & Overview • Earth Observation for Disaster Risk Reduction • Application of EO Data for Sustainable Development Goals (SDGs) • Flood hazard, risk & vulnerability	

Name	Topics	Photograph
Dr. (Mrs.) Poonam S. Tiwari	• Digital and close range photogrammetry • Lidar Remote Sensing • Image Processing, Machine Learning, Deep Learning • Geospatial technologies for Archeological studies	
Dr. Ashutosh Bhardwaj	• Stereo photographs and its geometry • Stereo photogrammetry • Introduction to digital surface generation • Advances techniques in SAR interferometry	
Dr. (Mrs.) Hina Pande	• Lidar Remote Sensing & Application • Photogrammetry & Application • Image processing application in automated feature extraction • Heritage documentation with geospatial methods	
Dr. Kshama Gupta	• Image Interpretation of Urban Areas • 3D Modeling Techniques for urban Surface profiling • DEM/DSM Generation for Urban Areas, Modeling and Visualization • Geospatial Technologies for Urban Heritage and Conservation • Urban Open Spaces and Green Spaces, Blue-green infrastructure • Urban Climate : Factors Affecting Urban Climate, Impact of Urban Surfaces, Diseases and Human Health • Urban Climate modeling, Urban canopy parameters, Heat wave	
Dr. (Mrs) Dipanwita Haldar	• Land use / Land cover (LULC) Analysis • Crop Inventory and mapping/discrimination • Optical and Microwave Remote Sensing • Physico-chemical factors of soil and pedogenic factors	
Mr. Kapil Oberai	• GIS data creation, optimization, Conceptual models of non-spatial information, relation algebra • Spatial databases, SQL spatial querying, Python imaging, connectivity, location based services & KML	
Dr. Subtrata Nandy	• High resolution remote sensing for vegetation mapping • Growing stock, biomass estimation using optical data • LiDAR applications is forest inventory • Multi-criteria decision making for ecological applications • Wildlife habitat suitability analysis and protected areas	
Dr. Vaibhav Garg	• Hydrological modeling using GWS portal inputs • Water body and water quality mapping • Reservoir sedimentation • Urban hydrology: storm drainage networks	
Dr. (Mrs.) Shuchita Srivastava	• Retrieval of temperature, trace gases & ozone • Gaseous air pollutants - chemistry, transport & monitoring • Green house gases & their implication	

Name	Topics	Photograph
Dr. Shovan Lal Chattoraj	• Spectroscopy of rocks and minerals • RS applications in Engineering Geology and Landslides	
Mr. Dharmendra Kumar	• Database and webserver handling for Geo Applications • Cyber security Analysis of Network systems • Aerial data Analysis.	
Mr. Ashutosh K Jha	• Agent based modelling, database connectivity, spatial variation models, dependence measures, Geo-visualization, LULU Modeling HPC computation	
Dr. Charu Singh	• Rainfall retrieval, monsoon studies, Extreme events • Tropical dynamics ENSO etc • Regional & Climate Modeling, Climate dynamics	
Dr. Shashi Kumar	• Principles of thermal and microwave remote sensing • Polarimetric SAR Remote Sensing • SAR interferometry	
Dr. Manu Mehta	• Physics of remote sensing • Spectral signature, In-situ measurements and visual image interpretation • Radiometric and atmospheric corrections for Remote Sensing data	
Mr. Ravi Bhandari	• Programming for geospatial applications	
Mr. Prasun Kumar Gupta	• h/w, s/w requirements for GIS, database design using UML, attribute & positional uncertainty, basic programing concepts, web programing	
Mr. Vinay Kumar	• Hyperspectral Remote Sensing and data processing • Platforms & sensors, Resolution • Satellite mission & their characteristics	

Name	Topics	Photograph
Mr. Ashish Joshi	• Principles of Microwave Remote Sensing • SAR Interferometry • Terrain Analysis. • Statistics for Image Processing	
Dr. Ashutosh Srivastava	• GNSS and its applications	
Dr. Kamal Pandey	• Strings, tuples, dictionaries, GDAL, open source GIS s/w, server side scripting, web mapping using open layers	
Mr. Hari Shankar	• Network analysis, spatial data quality • Spatial variation models & dependence measures • SAR interferometry for land deformation	
Dr. Arpit Chouksey	• Quantification of hydrological elements: interception and Soil Moisture • Water Balance studies • Integrated watershed management • Waterlogging and Soil Salinity • Trend analysis of hydro-meteorological data	
Dr. Pratima Pandey	• Glaciology, climate change impact on cryorphve • Landform dynamics • Permafrost	
Mrs. Richa Upadhyay	• Spectroscopy of minerals, hyperspectral RS mineral exploration • RS for geology, DIP	
Ms. Pooja Jindal	• Meteorological satellites & sensors • Atmospheric sounding • Retrieval of winds • Fog detection using satellite data	
Dr. Asfa Siddiqui	• Basics of Urban and Regional planning • Urban land Use/Land Cover • Renewable/Non-renewable Energy Sources: Solar potential estimation • Hyperspectral RS for urban areas • Thermal RS for Urban Areas • Ambient Air Quality Assessment for Urban Area	

Name	Topics	Photograph
Mr. Pankaj R. Dhote	• Hydrograph analysis • Streamflow measurement • Watershed morphological analysis • Groundwater modelling • Basics of flood hydrology flood peak estimation and routing • Flood mapping, monitoring and modeling	
Dr. Suresh Kannuajiya	• Geodynamics and Seismicity of Himalaya • Active fault imaging in the Foothills of Himalaya • Basics of GNSS satellite and Advanced GPS data processing • Basics GRACE/GRACE-FO satellites and applications in hydrology and other applications • Geophysical Prospecting: • High-Resolution EO data study in the various geological applications	
Mr. Justin George	• Land degradation and watershed management • Fundamentals of soils & pedogenesis • Hyperspectral RS in degradation mapping / Soil spectral / Characteristics	
Dr. Sanjeev Kumar Singh	• Numerical modelling of tropical cyclone • Numerical Weather Prediction • Satellite data assimilation in NWP model	
Mr. Prabhakar Alok Verma	• Geoinformatics • Geostatistics	
Dr. Ishwari Datt Rai	• Phenology for vegetation differentiation • Biodiversity characterisation & conservation priontization • Forest ecosystem structural and functional analysis • Definitions and concepts of Landscape ecology • Forest ecosystem and climate linkages	
Dr. Taibanganba Watham	• Forest inventory concept & Scope • Statistical treatment of forestry inventory data • Wetland habitat monitoring and conservation planning • Forest fire risk zonation and danger rating • Forest productivity estimation and carbon flux monitoring • Fire ecology, Eo-based active fire detection and monitoring , burnt area mapping and recovery assessment	
Mr. Abhishek Danodia	• Agriculture Informatics, • Remote sensing for Agricultural Drought & Water management • Fundamentals & importance to agrometerology • ICT applications in agriculture, Basic of DBMS, SDSS	

Name	Topics	Photograph
Dr. Mamta Chauhan	• Planetary Geology	
Mr. Yateesh Ketholia	• Geomorphology & geomorphic processes • Hydrocarbon resources & mode of occurrences • Landslides & earthquakes	
Dr. Surendra Kumar Sharma	• Machine Learning for urban studies	
Mr. Ashish Bisht	• Cloud based computing platforms, Mobile and Web Applications	
Mrs. Jappji Mehar	• Lunar geology, Microwave remote sensing	
Dr. Sachiko Mohanty	• Internal wave dynamics, Numeric Ocean Modelling • Ocean circulation and upper oceanic processes • Ocean biogeochemistry.	

Pilot Projects of Students

Analysis of Traffic congestion in Ulaanbaatar City, Mongolia using CNN and agent based modeling

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Urban traffic congestion poses significant challenges to the sustainable development of cities worldwide, with no exception to Ulaanbaatar, Mongolia. Ulaanbaatar, the capital city of Mongolia, is a vibrant urban centre situated in the heart of the country. It covers an area of approximately 4,704 square kilometres (1,816 square miles) and is home to a population of around 1.6 million people, making it the largest city in Mongolia.

More than half of the population lives in Ulaanbaatar, the capital city of Mongolia (population 1,672,627 million), and in recent years, urbanization problems such as traffic jams, road traffic accidents, and air pollution have reached to a extreme level, affecting the lives of residents. The number of vehicles have been steadily increasing across the country by an average of 5% per year since 2015, with chronic traffic jams at every intersection. The study assessed comprehensive network analysis to understand the dynamics of traffic congestion in Ulaanbaatar.

The general road network of Ulaanbaatar city was built according to the plan that 349,000 people and 10,044 cars or only 2.9% of the population have cars. The maximum population capacity of the city was estimated at 400,000-500,000. To determine the direction of traffic and traffic jams, vehicles on the road were detected from satellite images using AI techniques and integrated to GIS based road network data and network analysis methods. The project assessed route analysis, i.e. finding optimal routes, routes from the accident to the nearest facility, and service points. GIS mapping techniques, and network modelling was further integrated to the Agent based models to we examined the complex interactions within the city's road network using dynamic modeling. The study concludes road congestion is due improper and incorrect use of roads, ineffective traffic control, inefficiency of the transportation system, and unawareness of road capacity.

Figure 1. Shows the on Road detected Cars.

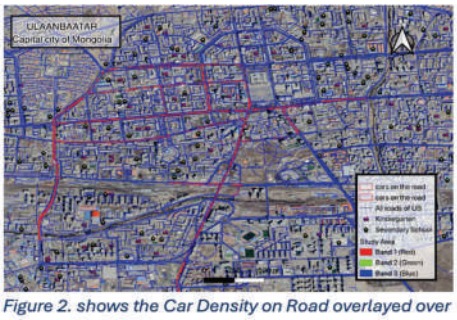

Figure 2. shows the Car Density on Road overlayed over the satellite RGB images.

Keywords. Network analysis, Traffic congestion, GIS, Modelling,

ABSTRACT

Assessment of Land Use Land Cover Changes and Prediction of Future scenario using satellite images: Case study of Tellippalai DS Area in Sri Lanka

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A B S T R A C T

The Tellippalai DS area in Sri Lanka has experienced rapid LULC changes in built-up, agricultural expansion, and environmental transformations over the past two decades. This has led to significant changes in land use and land cover patterns, highlighting the need for a comprehensive analysis of LULC changes to inform sustainable development strategies.

In this study, an attempt is made to observe the changes in the LULC features of the Tellippalai DS area In Sri Lanka. The comparison and analysis of land use/land cover based on Landsat satellite images in 2004, 2014 and 2024, determination of specific changes in Tellippalai DS area in 2004-2024 and monitoring of its growth were carried out. First, Landsat images are classified for LULC mapping over a 20-year period (2004 - 2024) to identify and classify different land use land cover within the study area. Then, using RS & GIS approach, change detection and spatial-temporal analysis is integrated to characterize the changes of LULC in the Tellippalai area. The results showed that Builtup area expansion maintained an even rate of increase (around 10% - 15%), while substantial amount of Vegetation decreased during the period (around 13% - 15%). The Cultivated area also increased around 6% to 8% percentage in this period and barren lands decreased. But there are almost no significant changes in the classes of Water and Airport.

Using RS technology and advanced geospatial analysis methods, this study aims to provide valuable insights into temporal LULC dynamics, facilitating informed decision-making and sustainable land management practices in the region.

The methodology involves the pre-processing of Landsat satellite imagery, land use and land cover classification, change detection analysis, and prediction of future LULC scenarios using predictive modeling techniques.

The future prediction model is expected to provide valuable insights into potential trajectories of change and land use scenarios for the year 2034.

The findings of this research are expected to contribute to a comprehensive understanding of temporal LULC dynamics in the Tellippalai DS area, enabling informed decision-making and sustainable land management strategies. By combining remote sensing technology with advanced geospatial analysis methods, the study aims to support effective planning and resource allocation for the conservation and development of the region.

Key words: LULC classification, LULC change assessment, Landsat, predictive modeling

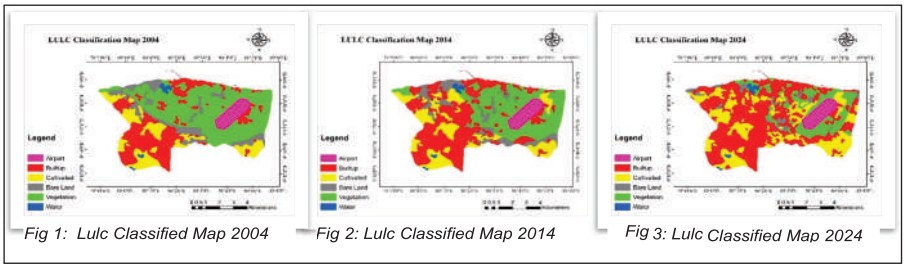

Fig 1: Lulc Classified Map 2004 *Fig 2: Lulc Classified Map 2014* *Fig 3: Lulc Classified Map 2024*

Detection and monitoring of the Plateros-Mixcoac fissure in Mexico City using SAR Interferometry

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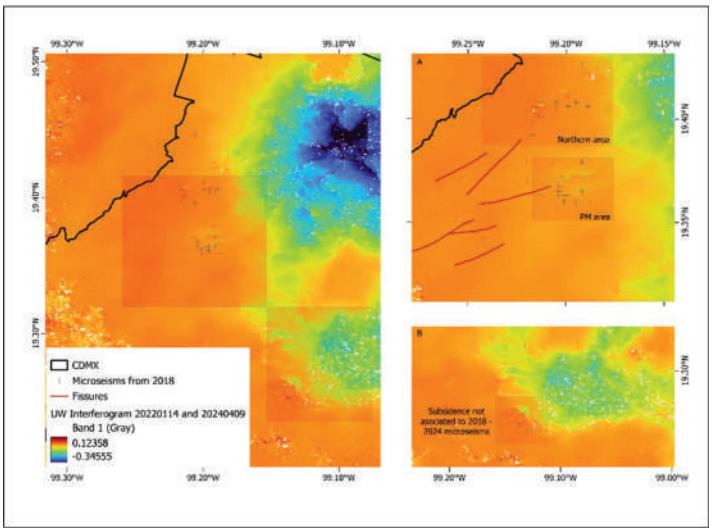
Over the past seven years, microseisms have been occurring in Mexico City (CDMX), and in December 2023 a 1 km fissure appeared in the middle of the Plateros-Mixcoac area (PM Fissue) and an Initial Synthetic Aperture Radar Interferometry (InSAR) analysis detected 7 cm subsidence at the fissure site. CDMX, was built on top of a lake and now extends to surrounding alluvial deposits and volcanic ranges. The area directly on top of the aquitard has been steadily sinking, due to water extraction. This study aims to understand the underlying mechanisms causing the PM fissure, estimate the vertical displacement and evaluate if other areas are being affected. Interferograms using Sentinel 1 images pre- and post-microseism clusters (2018-2024) aided the analysis. The epicentre locations defined the areas of interest for each date and results were interpreted using geomorphology maps and fault data. Our findings show that this phenomenon is not restricted only to the Plateros-Mixcoac region, as we identified two seismic hotspots, PM area and a Northern area. In the PM zone, two subsidence areas have developed (PM fissure and PM south) and both seem to be the continuation of existing faults. The area to the North is also near an existing fault with no evidence of subsidence yet (Fig. 1A). Additionally, an area in the south of CDMX exhibits recent displacement unrelated to seismic activity, warranting further investigation (Fig 1B). In conclusion, our study suggests that the areas suffering differential displacement and micro-seisms are at the edge of the aquitard where there is a steep gradient of groundwater depth and that the monitored area needs to be extended.



Keywords: : InSAR, Plateros-Mixcoac fissure, Differential subsidence, Aquitard, Water extraction

ABSTRACT

Flood Vulnerability Assessment using GEE and Geospatial Technique, Study of case Demak Regency, Central Java Province, Republic of Indonesia

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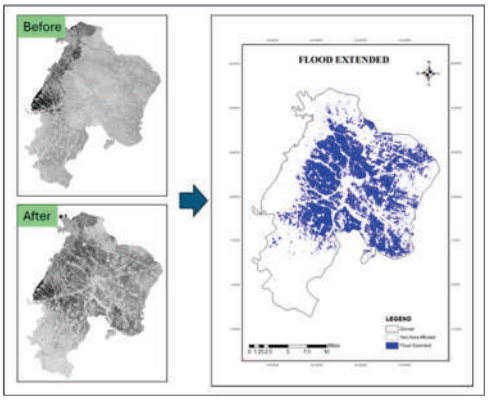
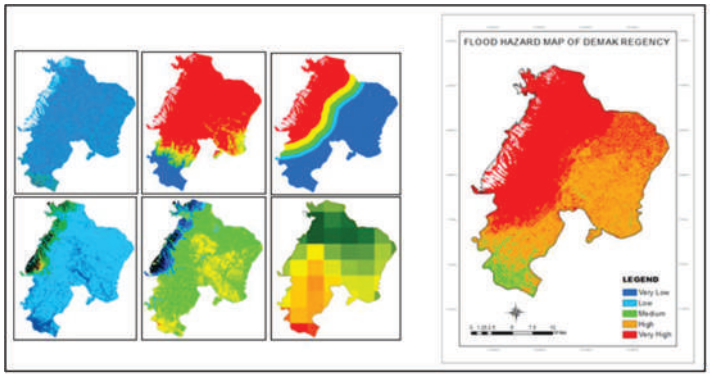
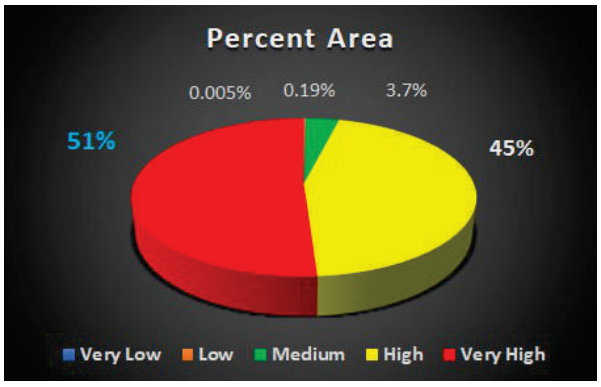
A B S T R A C T

Floods are the primary natural hazard in Indonesia, accounting for 43% of all recorded incidents, and are particularly prominent in the Demak Regency. Satellite observations, notably facilitated by platforms such as Google Earth Engine (GEE), are indispensable for flood studies, furnishing crucial spatial and temporal data. This study aims to develop flood inundation maps, assess damage to cropland, built-up areas, and population in affected zones, and conduct flood vulnerability mapping using remote sensing data. The collected and processed data employ an overlay technique for conducting multi-criteria analysis, incorporating factors like slope, elevation, TWI, rainfall, vegetation index, flood history map, distance from rivers, and TPI, within the Google Earth Engine (GEE) platform. Flood inundation maps were generated using SAR Sentinel 1 data in November 2017. The findings reveal that 278,115 hectares (27%) of the area were submerged by floods, with 26,018 hectares of it comprising agricultural land. Furthermore, 70 hectares of built-up areas were affected, and 205,045 people were exposed. According to the study's results about the flood vulnerability map, approximately 45% and 51% of the area are susceptible to high and very high flood risk zones, respectively. This emphasizes the necessity of implementing efficient, effective, and sustainable flood mitigation plans, thereby enabling the implementation of flood prediction, early warning, and management practices regularly to alleviate future incidents.







Keywords: GEE, Flood vulnerability, Overlay technique, Flood Inundation.

Glacier Dynamics Study using remote sensing, Tavan Bogd mountain, Mongolia

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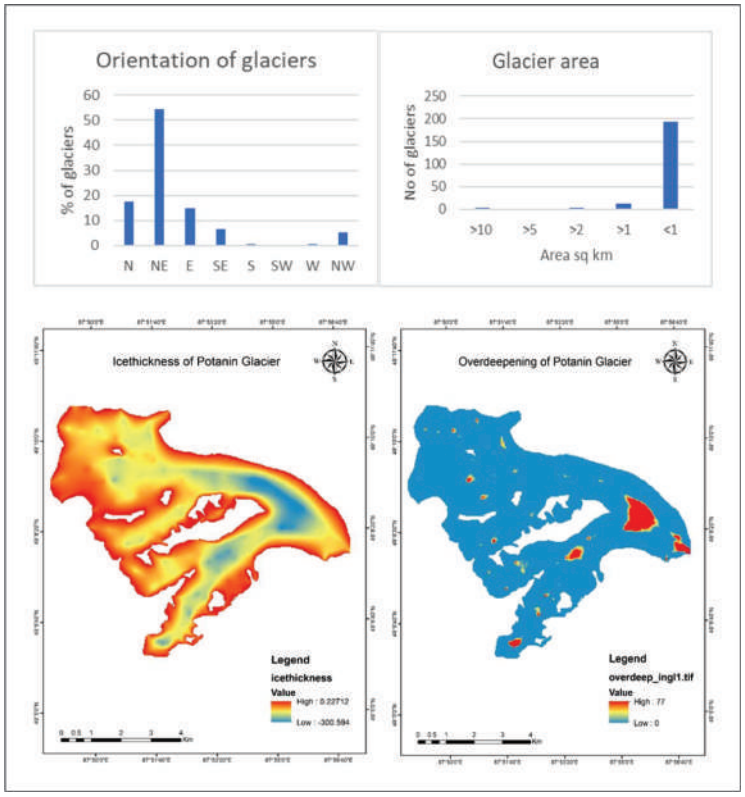
The Tavan Bogd mountains are located in the center of the Altai mountain system, in the countries of China, Mongolia, and Russia. Mongolia is considered as a country with little water resources. Due to global warming both the permafrost and the glaciers in Mongolia are melting and will continue to do so in the future. The study area is Tavan bogd mountain in Mongolia. The objectives are to determine the area of change and Ice thickness of the glacier.

The inventory of the glacier has been carried out and a total of 214 glaciers were mapped using Landsat OLI satellite data of the year 2023 and manual digitization through visual interpretation methods. The aspect analysis showed that about 55% of the glaciers in the region are oriented towards the northeast. The change in the glacier area for the last two decades between 2023 and 2010 was carried out and it was found that there was 3% loss in total glacier area from 2010 and 2023 as revealed from satellite images.

In conclusionThe loss in the glacier area for the past two decades i.e. between 2010 and 2023 was also carried out to understand the impact of global warming on the glaciers in this region. The thickness and future depression locations were also studied for two glaciers using the Glabtop model. The thickness of the glacier was found to be varied between 0.22 to 300 m. About five major future depression locations were identified through the model where the future lake can be formed. Remote sensing is found to be an efficient tool for study of glaciers.



Key Words: DEM, GlabTop Model, Ice thickness Glacier inventory, Glacier area

Estimation of Crop Water Requirement Using Geospatial Technology in Muruthawela Scheme, Hambantota District, Sri Lanka

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ABSTRACT

Nearly 72% of paddy production, the staple food in Sri Lanka, is grown during the wet season in dry areas where water resources are already limited. A good water management practice is required to successfully cultivate two seasons in a year. Evapotranspiration estimation is crucial in cropping fields as it determines crop water requirements, aids in water balance, irrigation scheduling, water management, water budgeting and as an important factor of hydrological cycle.

The objectives of this research are, to do the parametrization of crop coefficient using satellite data and calculate the crop evapotranspiration/ crop water requirement using Geospatial Technology. Satellite imagery, including Optical and Synthetic Aperture Radar (SAR), offers synoptic coverage at fixed time intervals, making it a valuable data source.

The outputs were generated for geometrically and atmospherically corrected images from Sentinel -2 and SAR images from Sentinel-1 from April 2023 to August 2023, each capturing different stages of the **Yala** season in Hambantota District, Sri Lanka. Parametrization of various pre-requisite parameters were done and various remote sensing derived products were developed using Sentinel 1 and Sentinel-2 data i.e. Normalised Difference Vegetation Index (NDVI), Normalized Backscatter intensity (σ^0), crop coefficient (Kc) and model evaporative fraction. The Sentinel-2 based vegetation indices that are best suited for paddy monitoring were identified with less cloud cover, and the most robust Sentinel-2 models for Kc estimation achieved R^2 = 0.96. The most robust Sentinel-1 models were obtained by applying an innovative local incidence angle normalization method with R^2 = 0.88. Finally daily evapotranspiration maps are generated using crop coefficient and MODIS Potential Evapotranspiration (PET) data for each image. The mean crop water requirement of the study area is 540 mm/season in 2023 Yala season.

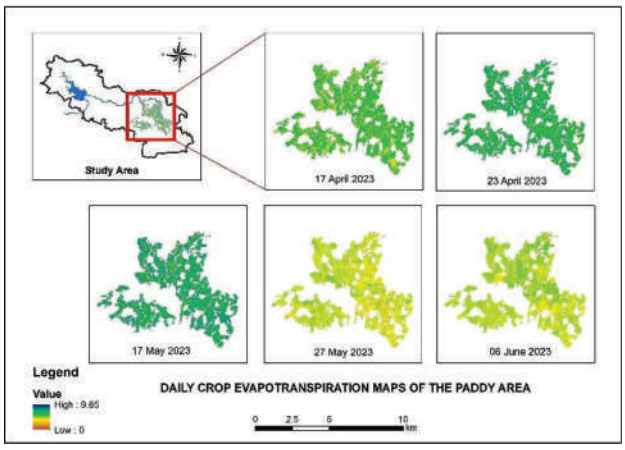

Fig1: Daily crop evapotranspiration map of the study area

Key Words: Crop Water Requirement, Crop Coefficient, Evapotranspiration, SAR, PET, NDVI

Land use/land cover and Land surface temperature analysis over Sikhottabong District, in Vientiane Capital, Laos, Using multitemporal satellite Data.

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The pattern of land use/land cover (LULC) changes has a significant impact on rising land surface temperature. The growth of the urban area means a build-up increase, as well as a reduction of forest cover area, which is all relative to land surface temperature. This study aims to monitor the change in Land Use/Land Cover (LULC) and its correlation with Land Surface Temperature (LST) in Sikhottabong district which is one of nine districts in Vientiane's capital LAOS. The district has busiest airport and has seen many changes since the airport began its operation. The study was carried out using Landsat 5 TM imagery of 1992 and Landsat 8 OLI/TIRS imagery of 2023. Classification of the imagery to obtain LULC was performed in Googe Earth Engine (GEE) and post classification change detection of LULC was analyzed for the two time periods. The thermal band is utilized for LST estimation. LST, NDVI, NDBI, NDBSI, and NDWI indices were computed and statistically correlated. The result of the study area showed that built-up was the main cause of the rise which doubled from 7.27 Sq. Km to 21.92 Sq. Km amounting to increase by 9% as compared to 1992. However, while agricultural areas also expanded, by 24 %, most of the loss occurred in forest regions, upto 30 %. The correlation of LST with NDBI, and NDBSI is positive, and LST with NDWI is negative. It means that land surface temperature increases with rise in builtup areas and decreases with increase in water area.

Keywords: Change detection, LST, LULC, NDVI, NDBI, NDBSI, NDW.

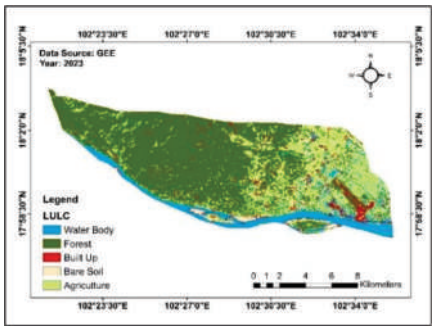

Fig.1: Land use/land cover Map of 1992

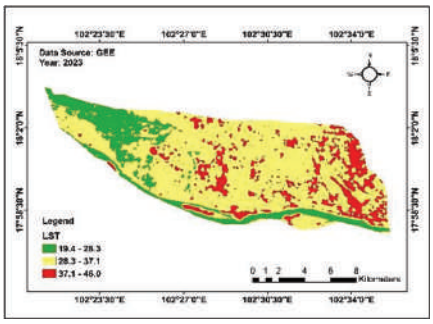

Fig.2: Land Surface Temperature of 2023

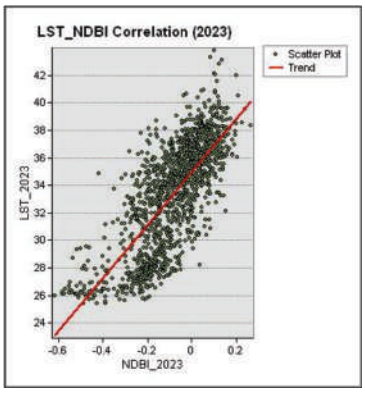

Fig.3: Correlation graph LST with NDBI of 2023

Ship Detection using Satellite Based Synthetic Aperture Radar Datasets

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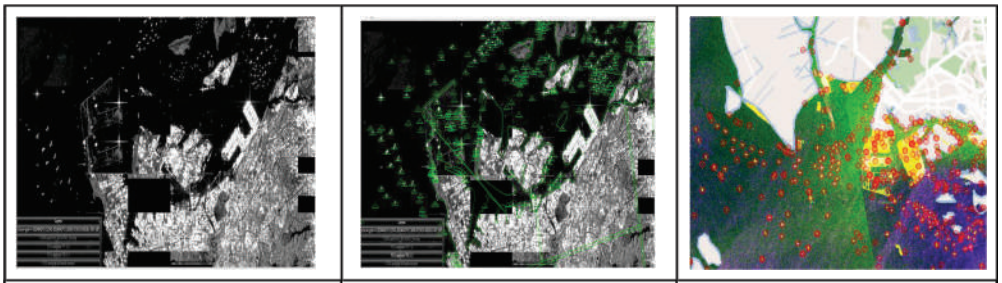
A B S T R A C T

Ship monitoring can be helpful in various applications, including illegal transitions, rescue operations, and territory regulation, among many others. Synthetic Aperture Radar (SAR) ability to penetrate clouds can be advantageous in tropical regions for monitoring sea objects. The SAR missions provide continuous all-weather, day-and-night imagery, making it ideal for precise cueing and locating ship activities at sea. Our study was done in the Malacca-Singapore Strait, an area of heavy cargo traffic. We explored the possibility of ship detection using Sentinel-1 fine dual-pol acquisitions over the region. The project includes a temporal analysis of traffic density in the Singapore Strait between Jan – Apr 2024. Also, it compares the detection results obtained by the Ocean Object Detection tool provided by SNAP and the Vessel Detection System (VDS) provided by the automatic ship detection tool, Search for Unidentified Maritime Objects (SUMO), an open-source tool designed for ship detection by JRC.
The ships were detected in the study area using two tools SNAP and SUMO. The SNAP object detection was utilized to undertake a temporal study of ship traffic and SUMO to determine the different polarization efficacy in detecting small targets vs large targets.
To achieve the task of "Maritime Surveillance" or simply marine object detection, we need a structured approach combined with a set of algorithms. Using vector mask/land mask and the CFAR (Constant False Alarm Rate) algorithm provided by SNAP (Sentinel Application Platform) software from ESA shows rapid



Sentinel 1 GRD image	Detected ships with VH polarisation using the SUMO tool	Detected ships with Ocean Object Detection tool in SNAP

detection of ships. SUMO is a pixel-based algorithm which employs a structured approach, including the use of land masks to reduce false alarms caused by the land by using buffered coastlines, local thresholding for background clutter, and target identification using clusters of pixels brighter than the threshold to detect and characterize marine objects. A reliability value is computed to eliminate azimuth ambiguities. Also, the detected targets' attributes are calculated to describe ships and their characteristics accurately.

Key Words. SAR, Sentinel-1, Ship Detection, Maritime Surveillance, SNAP, SUMO

Assessment of flood hazard in lower Teesta Basin using Remote Sensing and Geospatial techniques

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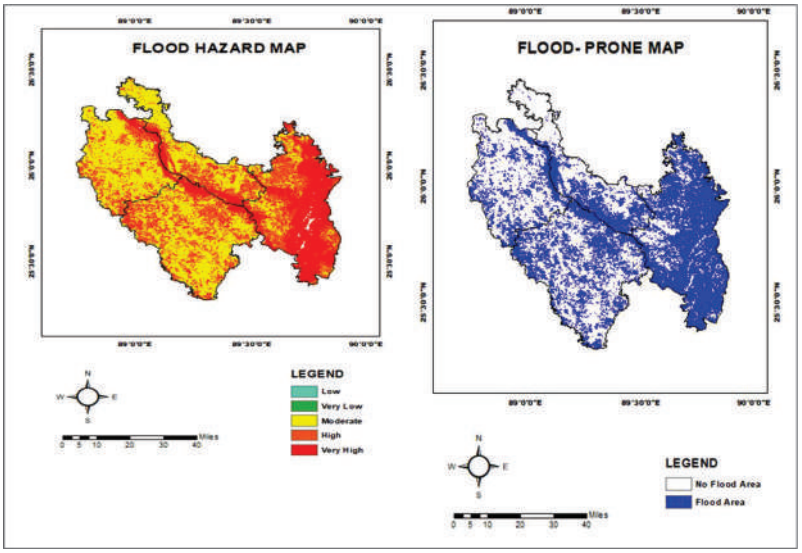
Disasters, whether they are natural or man-made are increasingly concerning globally, with floods standing out as among the most prevalent and devastating occurrences. There is a significant impact on human lives, property, and infrastructure in areas such as Bangladesh, where flooding occurs frequently and can be severe. Flood management and forecast efforts are made more difficult by the dynamic nature of flooding, which is amplified by variables such as urbanization and changes in landuse. The Teesta River basin encompasses the northern districts of Rangpur, Nilphamari, Lalmonirhat, and Kurigram in Bangladesh. Approximate the coordinates 25.7° N and 89.2° E in Rangpur district. This study focuses on mapping flood risk areas in the Lower Teesta River Basin, employing remote sensing and geospatial techniques by integrating various data sets, including slope, rainfall, flow density, soil type, and land cover, the research identifies vulnerable areas and assesses their environmental impact. Our results show the spatial distribution of flood hazard categories within the Lower Teesta River Basin. Additionally, the percentage of area covered for each category is presented with the findings. Extremely Low and Low flood hazard zones combined constitute a small percentage of the basin, which is around 0.015% of the total area. This indicates that these locations have the least likelihood of being affected by flooding. Medium flood hazard zones, on the other hand, encompass the biggest amount of the basin, accounting for around 40.53% of the total basin area, indicating that there is a moderate likelihood of flooding happening. Both high and very high flood hazard zones, which represent approximately 37.12% and 22.33% of the basin, respectively, indicate a substantial sensitivity to flooding. Very High flood hazard areas are the most likely to experience severe floods. This distribution highlights the diverse flood risk landscape across the basin, emphasizing the importance of targeted mitigation and adaptation strategies to enhance resilience and minimize the impacts of flood events in the region.



Keywords: Flood hazard map, Flood vulnerability, Teesta basin, Bangladesh

Analysis of Long-Term Rainfall Trends and Variability using Satellite and in-situ Gauge data, Over Barishal Division, Bangladesh

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A thorough analysis of long-term rainfall data is vital for understanding the frequency, intensity, and impacts of precipitation events which in turn can be helpful in effective water resource management, agriculture and disaster mitigation. Extensive research has been conducted on rainfall at national and regional levels using in-situ gauge data in Bangladesh. However, application of satellite data to assess the spatio-temporal variability of long term rainfall patterns has not much been explored. The present study aims to investigate long-term (1983 to 2022) trends and variability in rainfall using CHIRPS satellite data and data from four Bangladesh Meteorological Department climate stations, on annual and seasonal scales. Validation statistics such as RMSE-Observation standard deviation ratio (RSR), Nash-Sutcliffe Efficiency (NSE), and PBIAS has been applied to assess the accuracy of the CHIRPS satellite data and very good performance is observed for Barishal, Patuakhali, and Khepupara stations in terms of RSR, NSE, and PBIAS, with Bhola station showing good results. Trends and variability analysis of the observed and satellite based precipitation has been done using Mann-Kendall (MK), modified Mann-Kendall (MMK), Sen's slope estimator SSE, Innovative trend analysis (ITA), Coefficient of Variation (CV) and Standardized Precipitation Index (SPI). Analysis for annual rainfall trends revealed decreasing trends at Barishal, Bhola, and Patuakhali stations using MK, MMK, SSE, and ITA tests, with Bhola station exhibiting a significant decreasing trend at a 5% significant level in in situ data. Khepupara station showed an increasing trend based on in situ data, but a decreasing trend with satellite data. All stations displayed low variability (CV < 20%) in annual rainfall based on both data sets. Overall, satellite data performed well compared to in situ gauge data, suggesting the probability for satellite data to serve as a viable alternative to gauge data in future studies.

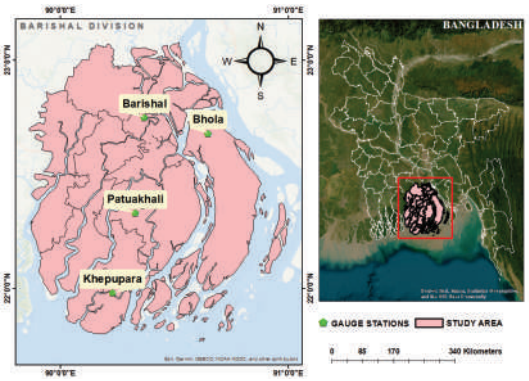

Fig. 1- Study Area

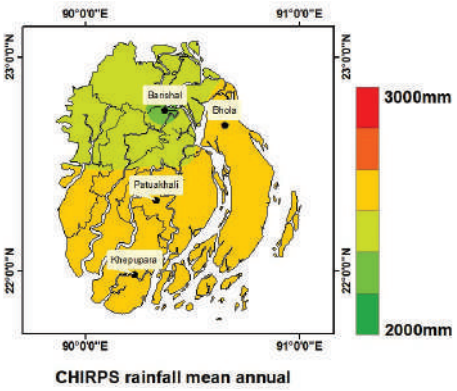

Fig. 2- Satellite (CHIRPS) based annual rainfall

Keywords: CHIRPS, satellite, rainfall, gauge, statistical

Mapping and Characterization of Landslide in Parts of South-Eastern Myanmar

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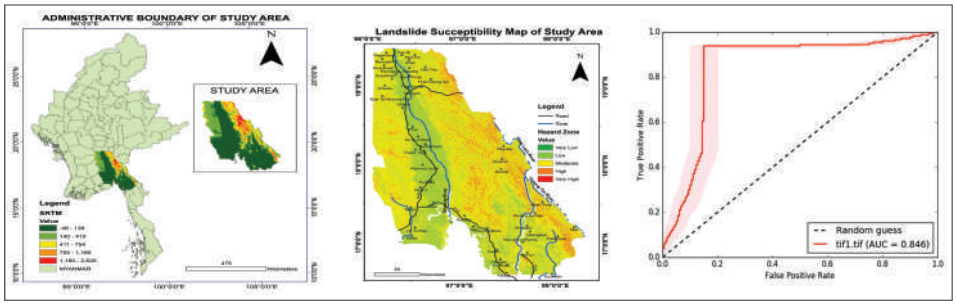
Landslide is the most important geomorphic process in humid mountains; it can also be the most dangerous. Landslides are one of the major environmental hazards in the mountainous regions. In this study, landslide hazard zonation of Southeastern Myanmar. Landslides mostly occur in the heavy rainy season. In this paper, ArcGIS has been applied to landslide-susceptibility analysis and mapping. The models (scripts), available for direct downloading as an ArcGIS tool, allow landslide susceptibility to be computed in a given region, providing a landslide-susceptibility map, with the GIS. The susceptibility model leads the user first through a Digital Elevation Model (DEM), depicting the morphological and morphometric features of the study area, and, useful as a source of landslide-determinant factors, such as slope elevation, slope angle and slope aspect. In addition, another determinant factor is the lithological unit, independent of the DEM. Once the determinant landslide factors are reclassified and in a vectorial format, all the combinations between the classes of these factors are determined using the geoprocessing abilities of ArcGIS. In the resulting landslide-susceptibility map a progressive zonation of areas or slopes increasingly prone to landslides is performed. A model for the validation of the resulting landslide-susceptibility map is also presented, based on the determination of the degree of fit, which is calculated from the cross tabulation between a set of landslides (not included in the susceptibility analysis) and the corresponding susceptibility map. The present study is conducted by using Analytical Hierarchy Process (AHP) and Geographic Information System (GIS) tools. The susceptibility map was prepared with the integration of 13 raster maps. The major physical and ecological factors that are considered in landslide hazard mapping are; Slope, Aspect, Curvature, NDVI, NDWI, LULC, SPI, TWI, Drainage line density, Lineaments, Lithology and Geomorphology existing landslides. Pairwise comparison matrix and standard matrix are utilized to obtain the weightage values to the different factors. Several landslide hazard zones are delineated as high, medium, low and very low by an unequal interval classification method in GIS. According to the result of the susceptibility map, three towns are standing at moderate class and these towns are safe from landslides. Near Hpa-an town and near the Thailand border which have many very high landslide areas. So that place should not be an urban area.



Keywords: Landslide, GIS, AHP, Slope, Aspect, Curvature, NDVI, NDWI, LULC, SPI, TWI, Drainage Line Density Lineaments, Lithology and Geomorphology

Assessing forest fire risk through multi-model approach in Nepal

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ABSTRACT

Globally increasing incidents of forest fires are challenging the sustainability of forest and Nepal is no exception. Forest fire is one of the most dominant disasters in the country where forest area accounts for 44.74% of total land. In recent years, the frequency and intensity of fires have accelerated because of factors like climate change, population growth along the wildfire urban interface. This study applied an Analytical Hierarchy Process (AHP) and MaxEnt Entropy approaches to assess the temporal and spatial distribution of forest fires and generated spatial outputs that show where forest fires area likely to pose risks throughout the country. Ten specific physiographic layers were selected for the study. These include: vegetation type map, Normalized Difference Vegetation Index (NDVI), Normalized Difference Moisture Index (NDMI), Land Surface Temperature (LST), Rainfall, slope, aspect, elevation, distance from the settlement and distance from the road. The weight for each layer was calculated based on AHP method and forest fire risk map was generated. To analyze the temporal and spatial distribution of fire, data from 2001 to 2023 years was downloaded from Fire Information for Resource Management System (FIRMS), Moderate Resolution Imaging Spectroradiometer (MODIS). Total fire incidences count was 42937 at 50 % confidence over a period of 2001 to 2023. Majority of fire events (42903 i.e., 86.85%) happened from February to May and highest fire incidences in April.

In Nepal, mid -western region has maximum fire counts and eastern region the lowest. The fire risk map based on AHP has close alignment with actual fire points obtained from MODIS. MaxEnt model-based forest fire risk map is grounded on fire count location data and 10 input layers. The final output obtained from MaxEnt model was validated with the Receiver operating characteristic (ROC) curve, the AUC (area under the receiver operating characteristic curve) of value 0.83 which confirms the accuracy of the fire risk map. Final map using AHP and MaxEnt model was divided into the following five risk zones: very low, low, moderate, high, and very high. For AHP area covered by risk zones are 7% very high followed by 26% high, 37% moderate, 20% low and 10% very low. Similarly, for MaxEnt model area covered are 14% very high followed by 26% high, 19 % moderate, 27% low and 14% very low.

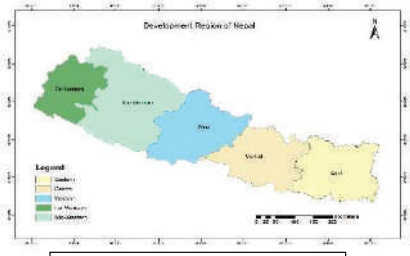

Fig 1. Study area

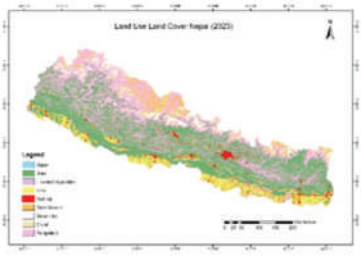

Fig 2. LULC Map

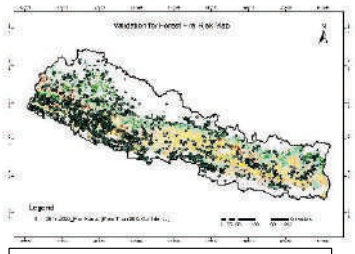

Fig 3. Forest fire distribution

Keywords: Forest fire, LST, NDMI, NDVI

Identification of the impact of the Mattala Air Port and Marine Port construction on land use in Hambantota DS area and Lunugamwehera DS area in Sri Lanka

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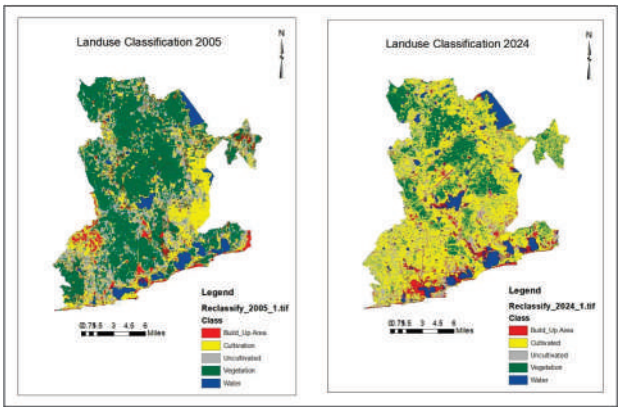
The construction of transportation infrastructure such as Airports and Marine Ports are often viewed as a catalyst for economic development, promising increased connectivity, trade opportunities and job creation. In Sri Lanka the Mattala Marine Port was inaugurated in 2010 and Mattala Airport was inaugurated in 2013. Exploring the land use change triggered by these two Ports is important to understand the socio economy of the region. This study investigates the impact of the Mattala airport and marine port construction on land use changes in the Hambantota DS area and Lunugamwehera DS area in Sri Lanka using a combination of remote sensing analysis and GIS techniques. The analysis of land use and land cover is based on Landsat 7 & Landsat 8 satellite images for 2005, 2015 and 2024. The temporal images were pre processed and prepared for classification and analysis. The satellite images were classified. The comparison and analysis of land use/land cover based on Landsat satellite images in 2005, 2015 and 2024, to bring out specific changes in the area during 2005-2024 and monitoring of the changes. First, Landsat images are classified for LULC mapping over a 20-year period (2005 - 2024) to identify and classify different land use land cover within the study area. Then, using RS & GIS approach, change detection and spatial-temporal analysis is integrated to characterize the changes of LULC in the Hambantota and Lunugamwehera DS area. The results showed that Built-up area expansion maintained an even rate of increase around 14%, while substantial amount of Vegetation decreased during the period around 54.96%. The Cultivated area also increased in this period and uncultivated lands decreased. It is concluded that land use patterns before and after the construction of these infrastructure projects. These land use changes have important socio-economic and environmental implications for the local communities, ecosystems and regional development. This study contributes to a better understanding of the complex relationship between infrastructure development and land use dynamics and provides insights for sustainable development planning in similar contexts.

Figure 1: Study Area

Figure 2: Land Use Classification 2005 and 2024



Keywords: land use mapping, change detection, remote sensing, sustainability.

Spatio-temporal Distribution of Heat Waves in Myanmar using Ground Observation & EO Data

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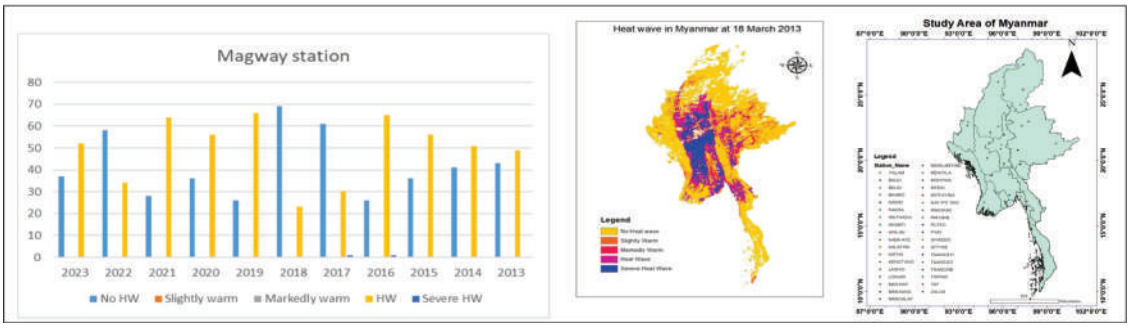
A heat wave is a period of abnormally hot weather generally lasting more than two days and with or without high humidity. They have potential to cover a large area, exposing a high number of people to hazardous heat. The World Meteorological Organization (WMO) defines a heat wave as a period during which the daily maximum temperature exceeds for more than five consecutive days the maximum normal temperature by 5 degrees Celsius, the normal period being defined as 1961–1990 With the increasing impacts of climate change, heatwaves are placing an enormous burden on health and social systems and threatening ecological diversity around the world. Heatwaves are increasing not only in frequency but also in severity and magnitude. They are causing the deaths of thousands of people. Object of the study are (1)To compute the Average Different between LST and air temperature a selected ground station, (2)Spatio – Temporal distribution pattern of Heat Wave in Myanmar using Ground observation data and EO data, (3)Spatio-temporal distribution pattern of Heat Wave in Myanmar by comparing of Ground observation data and EO data. In this study, we analyzed Spatio-temporal distribution of HWs in Myanmar by computing EO and ground observation data (36 stations). We used data by using MODIS LST data from data on Google Earth Engine (GEE) platform and ArcGIS to and analyzing the Spatio-temporal variations in HWs in Myanmar using EO data and ground observation data (36 stations) in Myanmar. To determine the HW we calculated the methodology of this study is Daily LST/Ground (Max Temperature) - Climatological mean. We selected two proxies to conditions for defining heat waves (1) based on Departure from Normal (2) based on Actual Maximum Temperature. The results show that heat waves occur over plain regions in the middle part of Myanmar. And more importantly,the Spatio-temporal distribution of HWs estimated in Myanmar using EO data is bigger than that estimated by the Spatio-temporal distribution of HWs in Myanmar using ground observation data analysis. Heatwave occurrence was extreme in 2019 and 2016 mostly in the middle of April and generally over plain regions of the middle part of Myanmar, with Magway station showing the highest occurrences. However, higher elevations also have Slightly Warm conditions and near the coasts, there are mostly no Heatwave occurrences.



Keywords: Heatwave, MODIS LST, Ground Observation data(Maximum Temperature, Google Earth Engine, ArcMap

GIS based road transportation network analysis for emergency flood situations in parts of Godavari Basin - Andhra Pradesh, India

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Andhra Pradesh is the major flood affected area in southern India. Godavari is one of the largest rivers receiving peak discharge with heavy to very heavy rainfall between June to September every year. Godavari river leads to river inundation and flooding in low lying areas which blocks the roads and transportation facilities. The objective of this study is to identify Optimum evacuation routes, closest facilities and service areas during emergency flood situations. The study area was the gateway of Konaseema with coordinates 16°29′N to 16°53′N and 81°50′E to 81°74′E. The study incorporates data extraction from the platform Google Earth Engine (GEE) for the flood extent by using Sentinel-1 (SAR) GRD product with VH polarization for the year 2022 from June to September month. Open Street Map (OSM) data is crucial to do analysis. The spatial analysis was done by editing roads by following connectivity rules and making the connections from point to point, point to line, line to line and line to point. For non- spatial analysis attribute data entry to above edited roads by giving the speed limits(km/hr.) from to end and end to from for both the ways, one-way restriction was needed to show the proper path and finally calculated the travel time (minutes) by using the formula [Time=(Distance/Speed) *0.06]. Network dataset was created, network analyst tool was activated for finding the best route, closest facility and service areas from the flood affected areas towards the facilities with distance, time impedance and directions from one location to another. Best route is the one which shows the easy way to reach the facility with safety measures considering the distance, travel time and road restrictions. Closest facility is the one which shows the nearest route to reach the facility within a short time from incidents towards the facilities. Service area is the one which represents the area that has the accessibility to facilities within that coverage area. Overall the integration of GEE, OSM and Network Analysis tools enables a comprehensive understanding of flood extent and facilitates the development of targeted emergency response plans tailored to the specific needs of the study area.

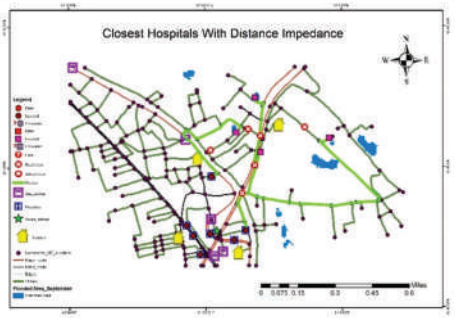
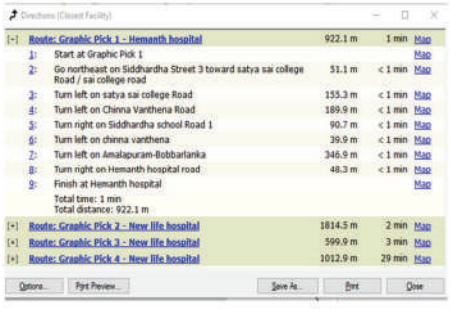


Figure 1: Closest Hospitals with Distance Impedance



[-]	Route: Graphic Pick 1 - Hemanth hospital	922.1 m	1 min
1:	Start at Graphic Pick 1		
2:	Go northeast on Siddhardha Street 3 toward satya sai college Road / sai college road	51.1 m	< 1 min
3:	Turn left on satya sai college Road	155.3 m	< 1 min
4:	Turn left on Chinna Varthena Road	189.9 m	< 1 min
5:	Turn right on Siddhardha school Road 1	90.7 m	< 1 min
6:	Turn left on chinna vanthena	39.9 m	< 1 min
7:	Turn left on Amalapuram-Bobbarlanka	346.9 m	< 1 min
8:	Turn right on Hemanth hospital road	48.3 m	< 1 min
9:	Finish at Hemanth hospital		
	Total time: 1 min Total distance: 922.1 m		
[+]	Route: Graphic Pick 2 - New life hospital	1814.5 m	2 min
[+]	Route: Graphic Pick 3 - New life hospital	599.9 m	3 min
[+]	Route: Graphic Pick 4 - New life hospital	1012.9 m	29 min

Figure 2: Directions to reach the Hospitals

Keywords: Flood Extent, GEE, OSM, ArcGIS, Network Dataset, Best Route Analysis, Closest Facility Analysis, Service Area Analysis.

Monitoring and Analysis of Ground Subsidence of Dhaka City and its Surrounding Area, Bangladesh Based on Multi-Temporal PS-INSAR Methodology.

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A B S T R A C T

Extensive groundwater extraction is a widespread practice in Dhaka city and is widely recognized to cause land subsidence. Sediment load and soil compaction due the long-term groundwater overexploitation leads to land deformations especially in areas with significant building loads. Over the past few decades, numerous high-rise buildings and industries have been developed in and around Dhaka city. This has significantly increased the demand for groundwater for both industrial and domestic use, resulting in a rapid depletion of groundwater levels. The analysis presented in this study focuses on land deformation obtained over the metropolitan area of Dhaka city and its environs by using advanced Differential Interferometric SAR (DInSAR) methodology. The study also utilizes the use of Persistent Scatterer Interferometric Synthetic Aperture Radar (PS-InSAR) and Small Baseline Subset (SBAS) interferometry, which represents advanced methods for the effective monitoring of ground deformation. This research leverages PS-InSAR time series by utilizing multiple SAR images (Sentinel-1) acquired over the same area during the period spanning from 2020 to 2023 in and around Dhaka city. The analysis of land subsidence and time series of deformation was conducted by reviewing 121 Sentinel-1 SAR images whereas SRTM (30m resolution) digital elevation model data served as the reference for adjusting the residual phase. The detected highest land deformations rate was spatially correlated with the recorded groundwater levels at nearby water observation wells. Distinct variations of the land subsidence are observed throughout the study regions. The highest rate of subsidence is experienced in reclaimed land, which is composed of loose sand, silt, and clay materials. Southern part of the city exhibits linear vertical rates exceeding 20 cm/yr, whereas other areas show rates ranging from 5 to 10 cm/yr. In 2023, the highest displacement recorded was 19 and 18 mm/year in the Mirpur, Dhanmondi, Uttara, Sutrapur and Nawabganj areas. The results have unveiled a significant amount of land deformations occurring in various geomorphic features primarily in natural levees, depressions, point bar and back swamps etc. These results provide useful insights in understanding the groundwater regime of the area and the relation of land surface deformation due to unplanned urbanization as well as unregulated groundwater overexploitation. Due to the dependable reliability of the PS and SBAS InSAR monitoring techniques, these results could offer crucial assistance in decision-making regarding geological disaster mitigation in Dhaka city and its vicinity for the sustainable governance of groundwater reservoirs.

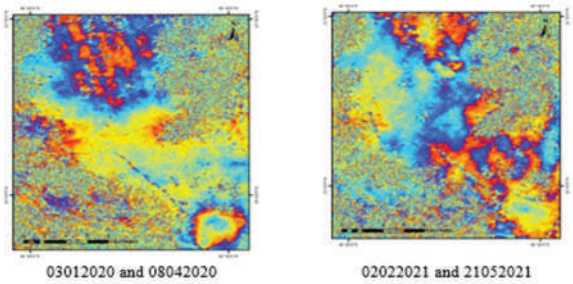

Figure :- Differential Interferogram for different time periods of the study area.

Keywords: Interferometric Synthetic Aperture Radar; DInSAR; Persistent Scatterers Interferometry (PSI); SBAS; Deformation; Groundwater; Time Series.

Comparative Analysis of Deep Learning Models for Object Extraction from High-Resolution Multispectral Images

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Associate Professor
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This study evaluates and compares advanced Convolutional Neural Network (CNN) architectures for automated detection and classification of natural and man-made features from high-resolution multispectral imagery. The research assesses the models' ability to exploit spectral and spatial information for accurately extracting target objects across various scenes, including urban, agricultural, and environmental landscapes, using imagery from Cong Liem, Vietnam. The aim is to analyze and compare the performance of DeepLab v3, U-Net, and ResNet-34 for object extraction. DeepLab v3 demonstrated the highest performance, excelling in segmenting and classifying objects such as buildings, roads, vegetation, water bodies, and fruits, due to its Atrous Spatial Pyramid Pooling and encoder-decoder architecture. U-Net achieved the second-best performance, particularly in segmenting complex objects like buildings and road networks, but struggled with small or occluded objects and diverse vegetation types. ResNet-34, known for its residual learning approach, showed robustness but faced challenges in localizing small or occluded objects. The study's findings provide insights into the strengths and weaknesses of each model and suggest avenues for improvement, such as integrating attention mechanisms and exploring advanced data augmentation techniques.

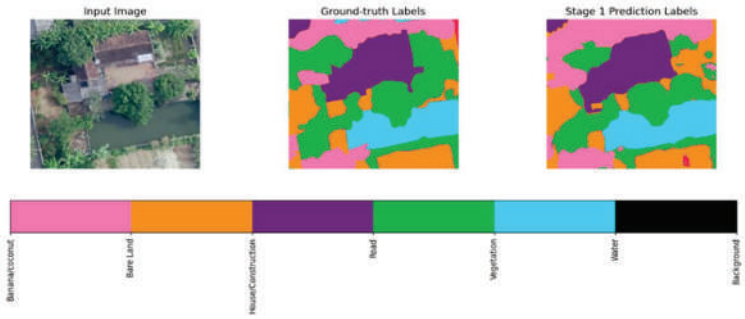

Figure: The image represents a typical result, in the image on the right it can be seen that the main features are segmented and delineated.

Overall, DeepLab v3 emerges as the top performer, followed by U-Net, in multispectral object extraction tasks, with potential for further enhancements through advanced techniques.

Keywords: Deep learning, Object extraction, Deeplab v3, U-net, ResNet-34, Comparative analysis of deep learning models, High-resolution image.

Change In Green Gover Between Dry (2017) And Non-dry (2021) Years And Its Correlation With Soil Parameters In Khuvsgul Province, Mongolia

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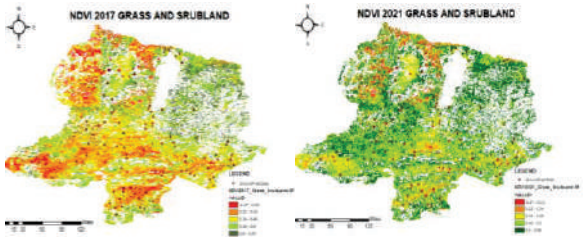
A B S T R A C T

Mongolia is a globally crucial region that has been suffering from land desertification owing to its arid,semi-arid and desert characteristics. The study was aimed to examine the dynamic relationship between green cover and soil parameters, and climatic variability in Khuvsgul Province. Mongolia has 75 million livestock, it's one of the principal economic activities. The Khuvsgul province, Mongolia, has diverse grassland ecosystems. However, these ecosystems are sensitive to environmental changes, particularly variations in climate and land use practices.

Khuvsgul experiences strong variations in weather, including dry and non-dry years. The study aims t]o assess the change in green cover between dry (2017) and non-dry (2021) years in the Khuvsgul province and investigate the correlation between soil parameters and green cover.



There was a clear change in green cover between 2017 & 2021 and a positive correlation between NDVI class and Humus percentage at 0-5 cm, only for Shrubland in 2021. The average soil density has a negative
effect on 2017 years for both shrubland and grassland, but only shrubland in 2021 for the first two depth classes 0-5 and 5 to 10 cm.

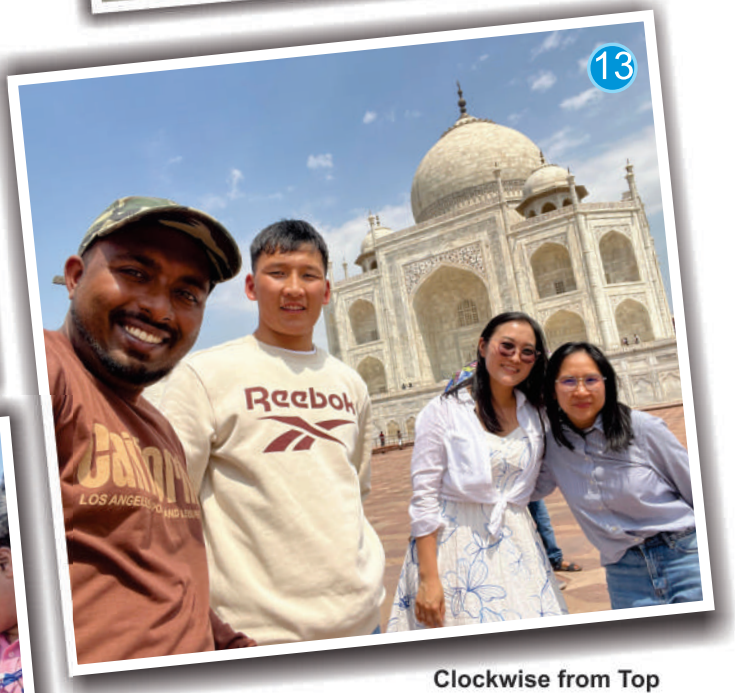
Humus and Avg density relation with NDVI classes for both years

Keywords: Mongolia, Green cover, Drought, Soil parameters, NDMI, NDSI, NDVI

Photo Gallery

1- Dehradun Navy Marathon
2- Carrom Tournament, 3- Snooker Masters
4- Where anticipation lingers and conversations spark
5- Flavours Mingle and Culinary adventure begins

6-Where Imagination Thrives and Knowledge unfolds
7-Fuelling up and forging connections
8- 27th RS&GIS Participants at CSSTEAP Secretariat Building
9-CSSTEAP Yamuna International Hostel
10- Hostel Arena Home Away from Home



Clockwise from Top

11- Holi Different Colours from Asia Pacific
12- India Gate, New Delhi
13- Immersed in Timeless Beauty of the Taj Mahal
14- Field Visit Poanta Area
15- Sacred grounds of Budha Temple, Bodh Gaya
16- Dhanaulti Blanketted in Serenity

Impressions of Participants

Unforgettable Journey: Mastering Geospatial Technologies

Gathered from distant corners of the Globe, we converged to embark on the prestigious 27th PG Diploma Course in Remote Sensing (RS) & Geographic Information Systems (GIS), orchestrated by CSSTEAP with the mission to empower aspiring scholars from the Asia-Pacific region in driving social and economic progress through the adept utilization of spatial data and geospatial information.
Eighteen participants, representing ten different countries across Asia-Pacific, immersed themselves in intensive training. Delving deep into the realms of RS & GIS, we explored a diverse spectrum of disciplines, including Advances in Image Analysis & Geoinformatics, Agricultural & Soil Resource Management, Forest Resource & Ecosystem Analysis, Natural Hazards and Disaster Risk Management, Geological Remote Sensing, and Satellite Hydrology & Water Resource Management.
Our academic journey commenced with the foundational phase, where we honed our skills in Remote Sensing. Progressing through rigorous training, we mastered Remote Sensing and geospatial techniques and data processing tools such as ArcGIS, QGIS, Google Earth Engine, SNAP, ENVI, Python, and GIS databases. From structured datasets to intricate image analysis techniques, we traversed the learning curve with determination and resolve. We were fortunate to learn from leading scientists who are actively engaged in cutting-edge research. Their insights, shared through published articles and papers, provided a solid foundation in core concepts, along with inspiring examples of real-world applications.

Amidst our academic pursuits, we found moments of respite and camaraderie. Engaging in sports like volleyball, badminton, and billiards, along with invigorating treks to sites of historical and cultural significance across India that enriched our experience. From the serene landscapes of Mussoorie and Dhanaulti to the spiritual hubs of Haridwar and Rishikesh, and the iconic landmarks of Agra, Delhi, and Bodh Gaya, our journey was interwoven with cultural exchange and mutual celebration.
As the seasons shifted, so did our experiences at IIRS, Dehradun. From the rains of monsoon to the crisp winters, blossoming springs, and balmy summers, each phase brought its own charm. Excursions to Hyderabad and Ahmedabad broadened our horizons, exposing us to the rich diversity of southern and western India.

Bonding over late-night study sessions and savouring diverse cuisines and cultural festivities, we forged enduring friendships. Midnight birthday celebrations added moments of joy to our collective journey.
Our chosen projects stand as testament to the depth of knowledge and confidence we have gained over nine transformative months, equipping us to tackle any challenge that comes our way.
In the realm of sports, our achievements were numerous, with victories in Badminton and Table Tennis showcasing our competitive spirit. Even in defeat, our resilience shone through as we engaged fervently in Volleyball and other games.
As farewells approach, nostalgia mingles with anticipation. We carry with us the wealth of knowledge and experiences garnered here, ready to disseminate and apply them in our respective homelands. Our heartfelt gratitude extends to CSSTEAP, IIRS-ISRO, and our endorsing departments and agencies, whose unwavering support facilitated our collective growth and enlightenment.

On behalf of the 27th RS & GIS Batch, I extend profound thanks. Jai Hind!

Commander Kapil Dev
Indian Navy

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